

# NOTICES

OF THE

AMERICAN MATHEMATICAL SOCIETY

1993 Annual AMS-IMS-MAA Survey  
(*First Report*) page 1164

Merida, Yucatan, Mexico Meeting page 1229



NOVEMBER 1993, VOLUME 40, NUMBER 9

Providence, Rhode Island, USA

ISSN 0002-9920

# Calendar of AMS Meetings and Conferences

This calendar lists all meetings and conferences approved prior to the date this issue went to press. The summer and annual meetings are joint meetings of the Mathematical Association of America and the American Mathematical Society. Abstracts of papers presented at a meeting of the Society are published in the journal *Abstracts of papers presented to the American Mathematical Society* in the issue corresponding to that of the *Notices* which contains the program of the meeting, insofar as is possible. Abstracts

should be submitted on special forms which are available in many departments of mathematics and from the headquarters office of the Society. Abstracts of papers to be presented at the meeting must be received at the headquarters of the Society in Providence, Rhode Island, on or before the deadline given below for the meeting. Note that the deadline for abstracts for consideration for presentation at special sessions is usually three weeks earlier than that specified below.

## Meetings

Meeting #	Date	Place	Abstract Deadline	Program Issue
888	† December 1–4, 1993 (Joint Meeting with the Sociedad Matematica Mexicana)	Merida, Yucatan, Mexico	Expired	November
889	* January 12–15, 1994 (100th Annual Meeting)	Cincinnati, Ohio	Expired	December
890	* March 18–19, 1994	Lexington, Kentucky	December 28	March
891	* March 25–26, 1994	Manhattan, Kansas	December 28	March
892	* April 8–10, 1994	Brooklyn, New York	January 28	April
893	June 16–18, 1994	Eugene, Oregon	April 4	May-June
894	August 15–17, 1994 (96th Summer Meeting)	Minneapolis, Minnesota	May 17	July-August
	October 28–29, 1994	Stillwater, Oklahoma	August 3	October
	November 11–13, 1994	Richmond, Virginia	August 3	October
	January 4–7, 1995 (101st Annual Meeting)	San Francisco, California	October 1	December
	March 4–5, 1995	Hartford, Connecticut		
	March 17–18, 1995	Orlando, Florida		
	March 24–25, 1995	Chicago, Illinois		
	November 3–4, 1995	Kent, Ohio		
	January 10–13, 1996 (102nd Annual Meeting)	Orlando, Florida		
	March 22–23, 1996	Iowa City, Iowa		
	April 19–21, 1996	Baton Rouge, Louisiana		
	January 8–11, 1997 (103rd Annual Meeting)	San Diego, California		

\* Please refer to page 1243 for listing of Special Sessions.

† Please refer to the Table of Contents for further information.

## Conferences

January 10–11, 1994: AMS Short Course on Complex Analytic Dynamics, Cincinnati, Ohio.

June 11–July 6, 1994: Joint Summer Research Conferences in the Mathematical Sciences, Mt. Holyoke College, South Hadley, Massachusetts

June 20–July 1, 1994: AMS-SIAM Summer Seminar in Applied Mathematics on Dynamical Systems and Probabilistic Methods for Nonlinear Waves, Mathematical Sciences Research Institute, Berkeley, California.

## Other Events Cosponsored by the Society

February 18–23, 1994: Section A (Mathematics) Sessions at the AAAS Annual Meeting, San Francisco, California.

## Deadlines

	January Issue	February Issue	March Issue	April Issue
Classified Ads*	December 8, 1993	January 5, 1994	January 26, 1994	February 22, 1994
News Items	December 1, 1993	December 23, 1993	January 17, 1994	February 13, 1994
Meeting Announcements**	December 2, 1993	December 30, 1993	January 20, 1994	February 17, 1994

\* Please contact AMS Advertising Department for an Advertising Rate Card for display advertising deadlines.

\*\* For material to appear in the Mathematical Sciences Meetings and Conferences section.

# NOTICES

OF THE

AMERICAN MATHEMATICAL SOCIETY

## ARTICLES

### 1158 Joint Mathematics Meetings in Heidelberg

A joint meeting of the AMS and the DMV (German Mathematical Society) took place in October in Heidelberg, Germany. Allyn Jackson describes some of the mathematical highlights of the meeting as well as some of the issues facing the German mathematical community.

### 1160 "New Order" for Federal Funding: *Committees on Science Policy and on Education Face Shifts in Public Support*

Faced with mounting public concern over the quality of education, the Society is trying to formulate a role for itself in mathematics education. At the same time, the scientific community is facing new pressures to justify federal research funding in terms of what that research contributes to the nation. Allyn Jackson reports on recent discussions of these issues in meetings of the Committees on Education and on Science Policy.

### 1164 1993 Annual AMS-IMS-MAA Survey (*First Report*)

The first report on the 1993 survey includes the 1993 survey of new doctorates, starting salaries of new doctorates, faculty salaries, and a list of names and thesis titles for members of the 1992–1993 Ph.D. class.

## FEATURE COLUMNS

### 1203 Computers and Mathematics *Keith Devlin*

Richard Pinch starts off this month's column with an article on the primality testing algorithms used by four popular computer algebra systems. This is followed by a plea from Greg Kuperberg of the University of Chicago that all mathematics departments adopt the electronic address `math.school.edu`. A review of *Harmonic Function Theory* comes next, followed by a few small items of general information.

### 1217 Inside the AMS

The "Rewards Committee" of the Joint Policy Board for Mathematics is preparing a report on the panorama of issues surrounding the question of what activities are recognized and rewarded in mathematics departments. Allyn Jackson describes some of the committee's findings. Also, a report of a Special Committee on Professional Ethics is included.

## DEPARTMENTS

1155 Letters to the Editor

1200 Forum

1220 News and Announcements

1225 Funding Information for the  
Mathematical Sciences

1226 1994 AMS Election

1229 Meetings and Conferences of  
the AMS

Merida, Yucatan, Mexico  
December 1–4, 1229

Cincinnati, OH  
January 12–15, 1242

Invited Addresses and Special  
Sessions, 1243

Joint Summer Research  
Conferences in the Mathematical  
Sciences, 1246

1251 Mathematical Sciences Meetings  
and Conferences

1260 New Publications Offered by the  
AMS

1265 Miscellaneous  
Personal Items, 1265  
Deaths, 1265

1266 AMS Reports and  
Communications  
Bylaws, 1266  
Recent Appointments, 1280  
Report of Council Meeting, 1281

1291 Classified Advertising

1315 Forms

# NOTICES

OF THE

AMERICAN MATHEMATICAL SOCIETY

## EDITORIAL COMMITTEE

Sheldon Axler  
Amassa C. Fauntleroy  
Robert M. Fossum (Chairman)  
Susan J. Friedlander (Forum Editor)  
Carolyn S. Gordon  
Carl R. Riehm  
L. Ridgway Scott (Letters Editor)

## MANAGING EDITOR

John S. Bradley

## ASSOCIATE EDITORS

Jeffrey C. Lagarias, *Special Articles*

## ASSOCIATE MANAGING EDITOR

Allyn Jackson

## SUBSCRIPTION INFORMATION

Subscription prices for Volume 40 (1993) are \$139 list; \$111 institutional member; \$83 individual member. (The subscription price for members is included in the annual dues.) A late charge of 10% of the subscription price will be imposed upon orders received from nonmembers after January 1 of the subscription year. Add for postage: Surface delivery outside the United States and India—\$15; to India—\$28; expedited delivery to destinations in North America—\$32; elsewhere—\$67. Subscriptions and orders for AMS publications should be addressed to the American Mathematical Society, P.O. Box 5904, Boston, MA 02206-5904. All orders must be prepaid.

## ADVERTISING

*Notices* publishes situations wanted and classified advertising, and display advertising for publishers and academic or scientific organizations.

© Copyright 1993 by the American Mathematical Society. All rights reserved.

Printed in the United States of America.

♻️ The paper used in this journal is acid-free and falls within the guidelines established to ensure permanence and durability.

♻️ Printed on recycled paper.

Most of this publication was typeset using the T<sub>E</sub>X typesetting system.

[*Notices of the American Mathematical Society* is published monthly except bimonthly in May, June, July, and August by the American Mathematical Society at 201 Charles Street, Providence, RI 02904-2213. Second class postage paid at Providence, RI and additional mailing offices. POSTMASTER: Send address change notices to *Notices of the American Mathematical Society*, Customer Service Department, American Mathematical Society, P. O. Box 6248, Providence, RI 02940-6248.] Publication here of the Society's street address, and the other information in brackets above, is a technical requirement of the U. S. Postal Service. All correspondence should be mailed to the Post Office Box, NOT the street address. Tel: 401-455-4000. e-mail: ams@math.ams.org.

## From the Executive Director . . .

### MATHEMATICAL REVIEWS

In 1938 the AMS decided to undertake the sponsorship of an abstracting journal in mathematics. In early 1939, with promised financial support from the Carnegie Corporation and the Rockefeller Foundation, the AMS Council recommended support for such a journal. The name *Mathematical Reviews* (*MR*) was chosen, and the first issue was published in January 1940 with reviews from July 1939.

The idea for a new abstracting journal in mathematics was prompted by the rising political tensions and unrest which were plaguing Europe at that time and which reached into the mathematical community. There was serious concern about intrusion of political considerations into the science of mathematics and in particular into the coverage and selection of competent reviewers for the primary abstracting journal then available. The Society articulated its approach to sponsoring *MR* this way: be as objective as possible, do what is considered best for mathematics as a whole, and "then proceed as cheerfully and as efficiently as we can." There is no doubt that service to mathematics guided the founding of *MR*. Today the guiding principle for *MR* is service to the worldwide mathematical community. Publication of *MR* is considered one of the most important services of the AMS.

While *MR* has changed in many ways in the last fifty years, the most obvious difference for the user may be the increase in the journal's size, representing the explosion in published mathematics. The first volume of *MR* in 1940 consisted of 400 pages with 2,120 reviews. The 1990 volume of *MR* had 11,344 pages (with sixteen issues and annual indexes) and nearly 51,000 reviews. However, there have also been dramatic changes in the production of *MR*, with the most significant being the computerization of production and the growing importance of electronic delivery of the information in the *Mathematical Reviews Database* (MRDB).

The development and maintenance of the MRDB is central to *MR*. The MRDB is an electronic file of tagged bibliographical information, mathematical classifications, and reviews and abstracts of pure and applied mathematical research literature. The *MR* paper journal, the MathSci Disc (compact disc), MathSci Tapes (computer tapes for site loads), and MathSci Online (computerized dial-in access to the vendors of the computer tapes) are derived from the MRDB for dissemination to the international mathematical community. The products derived from the MRDB provide various mechanisms for communicating information that mathematicians need.

To more accurately reflect the expense in developing and maintaining the MRDB and to provide wide access to this information, the AMS is introducing a plan that provides for a data access fee that recovers the costs of building and maintaining the MRDB and for a product delivery fee that reflects specific costs associated with each of the derived products. Once the data access fee has been paid by a site, the cost of a subscription to the printed *MR* reflects the cost of printing and distribution. This is a first step in plans for developing broader, less expensive access to the information in the MRDB. (A detailed explanation will appear in the December *Notices*.)

The AMS is exploring other ways to assure that mathematicians can gain access to the information in the MRDB with a maximum of ease and a minimum of expense. A recent survey collected information on why and in what form mathematicians use the information in the MRDB. Information from this survey will help guide improvements in the development and maintenance of the MRDB and suggest ways for broadening access to it.

There are complex issues surrounding the expense of developing and maintaining the MRDB and then providing information delivery at a reasonable cost. In addition there are concerns about how to provide this information to the large community of mathematicians in currency-weak countries where there are limited or nonexistent resources to pay for *MR* products. During 1994 the AMS will be considering various programs for which an important goal will be to aid mathematicians and institutions in these countries to gain wide access to *MR*. Already, the AMS aid program for mathematics in the former Soviet Union (fSU) has made it possible to continue delivery of *MR* to the fSU through assistance to libraries, including subscriptions to *MR*.

Considerable attention is being given to reducing the cost of MRDB products and making this information more broadly available. This is quite a challenge; however, prospects are encouraging that the AMS can provide access with much more ease and with less expense.

William Jaco

## Letters to the Editor

### Quadratic Reciprocity in Dickson's *History*

Everybody knows that Dickson's three-volume *History of the Theory of Numbers* covers all of number theory up to about 1918. Right? Wrong. Try looking up quadratic reciprocity. It is virtually absent: the subject indices for volumes I and II contain nothing; the ten references in the subject index of volume III (listed under "reciprocity") are all peripheral passages that occur in discussing other topics.

When I tell this to somebody I am usually greeted first with disbelief and then with astonishment. Just think—he omitted quadratic reciprocity, the crown jewel of elementary number theory!

There is an explanation: he farmed it out to a student. This should not come as a total surprise, for Chapter 6 of volume III on class numbers is acknowledged as the Ph.D. thesis of G. H. Cresse.

Here are some details. A University of Chicago Ph.D. degree was awarded to Albert Everett Cooper in June 1926. The thesis title was "A topical history of the theory of quadratic residues". (It is interesting to note that on page xx of the preface to volume II, Dickson says that he initially planned to use the words "topical history" himself but was talked out of it by a prominent historian.) On page 375 of volume 33 (1927) of the *Bulletin of the AMS*, Cooper's thesis is listed among the Ph.D.s awarded in 1926.

The thesis is sitting safely in the Chicago mathematics library, or at least it was when I checked about a year ago. It faithfully follows the style of the master. The text proper runs ninety-eight pages, and there are ten pages of auxiliary material. The first entry refers to Alsidschzi, about 970 A.D., and the last to Landau, 1918. The vita reveals that Cooper was born on January 26, 1893, and took three degrees at the University of Texas, winding up with an M.A. in 1924.

How did I learn about this? I have forgotten. Here's one fact: many years ago I sent a copy to Bill LeVeque at his request. How did he know? On June 30, 1993, Bill said he thought I had told him. My guess would have been that he told me. It looks like we'll never know.

At any rate I have decided (a) the world of mathematics might be interested, (b) a good procedure would be a letter to the *Notices* (if they accept it).

To conclude I note that the three reviews I located, in the *Bulletin*, the *Monthly*, and the *Jahrbuch über die Fortschritte der Mathematik* make no mention of the omission. For someone who would like to read any of the reviews (they are raves) I give the references.

*Bulletin*. I: 26 (1920), 125–132 (D. N. Lehmer). II and III: 30 (1924), 65–70 (Vandiver).

*Monthly*. I: 26 (1919), 396–403. II: 28 (1921), 72–78. III: 30 (1923), 259–262 (Carmichael).

*Jahrbuch*. I and II: 47 (1919–1920), 100–104. III: 49 (1923), 100–101 (Lichtenstein).

Irving Kaplansky  
Mathematical Sciences  
Research Institute  
(Received July 22, 1993)

### Yugoslav Mathematicians and the UN Sanctions

Mathematicians from Yugoslavia (Serbia and Montenegro) are confronted these days with a serious problem which in our opinion raises disturbing questions concerning the entire mathematical community. Some of the well-known publishers of mathematical journals (Elsevier, Pergamon Press) have decided to temporarily stop publishing papers of Yugoslav scientists due to the UN sanctions against Yugoslavia. We cite two letters as evidence, the first from one of Elsevier's publishing editors addressing the executive editors, and the second sent to a Belgrade mathematician who submitted his paper to an Elsevier journal. In the first letter the argument is "[In order] to conform with UN sanctions, we [Elsevier] must decline to publish papers from authors in Serbia and Montenegro". It contains general instructions,

including the phrases which should be used in communication with Yugoslav authors such as, "We shall be happy to retain his or her paper until sanctions are lifted." At the end of this letter there is a generous suggestion: "Authors of such papers may, of course, withdraw them should they wish to do so." The second letter is from an editorial office manager of *Theoretical Computer Science B*, published by Elsevier Science Publishers. Here is an excerpt:

Dear Dr. . . . ,

I am pleased to inform you about the acceptance of your manuscript. . . . Unfortunately, due to the UN embargo, we are not allowed to publish your paper. When the embargo is lifted, however, your paper will be published at the earliest possible occasion.

Thanking you for this contribution to our journal. . . .

These and other similar letters raise a number of questions. **On what bases are Yugoslav mathematicians (scientists) discriminated against?** The UN sanctions are based on the UN Security Council Resolution 757 (30 May 1992). Here is the relevant part:

*The Security Council . . . decides that all States shall*

(8b) *Take the necessary steps to prevent the participation in sporting events on their territory of persons or groups representing the Federal Republic of Yugoslavia (Serbia and Montenegro);*

### Letters to the Editor

Letters submitted for publication in the *Notices* are reviewed by the Editorial Committee.

The *Notices* does not ordinarily publish complaints about reviews of books or articles, although rebuttals and correspondence concerning reviews in *Bulletin of the American Mathematical Society* will be considered for publication.

Letters should be typed and in legible form or they will be returned to the sender, possibly resulting in a delay of publication. All published letters must include the name of the author. Letters which have been, or may be, published elsewhere will be considered, but the Managing Editor of the *Notices* should be informed of this fact when the letter is submitted.

The committee reserves the right to edit letters.

Letters should be mailed to the Editor of the *Notices*, American Mathematical Society, P. O. Box 6248, Providence, RI 02940, or sent by e-mail to [notices@math.ams.org](mailto:notices@math.ams.org), and will be acknowledged on receipt.

(8c) *Suspend scientific and technical cooperation and cultural exchanges and visits involving persons or groups officially sponsored by or representing the Federal Republic of Yugoslavia (Serbia and Montenegro); . . .*

How do local authorities in different countries interpret and enforce the resolution? We do not know any example of sanctions applied to individuals in sports, culture, and fine arts. The explanation given is that they represent themselves and not the Yugoslav government. So, the question above could be rephrased as follows: **Is the publishing of an individual scientist's paper an activity which should be seen as cooperation with the Yugoslav government?**

Among those affected by this policy are professionals, members of international mathematical societies. Is it not reasonable to expect that the largest societies like the American Mathematical Society should play a more active role in such global decisions affecting their members, or should it be left to publishers (editors, governments) to decide?

On behalf of Yugoslav mathematicians, we kindly ask our colleagues, the AMS, and the whole mathematical community to support our request for immediate and public withdrawal of such discriminating decisions.

Rade Živaljević  
Mathematical Institute  
Belgrade, Yugoslavia  
(Received April 6, 1993)

**P.S.** This letter was signed by 151 mathematicians and other scientists from Yugoslavia and abroad.

### Biting the Bullet

Solomon Garfunkel, Saunders Mac Lane (*Notices*, July/August 1993), and virtually everyone else will agree that it is highly desirable to increase the prestige of college teachers of mathematics. The question is how to achieve that. Dr. Garfunkel seems to have two suggestions. Stated baldly, they are: reduce the prestige of research and make the education of college teachers more like that of high school teachers. Each of these, I believe, is far more likely to reduce the prestige

of the college teacher than to raise it.

Meyer Jerison  
Purdue University  
(Received August 6, 1993)

**Response from Solomon Garfunkel:** Professor Jerison misses the point. My concerns are with the effectiveness of college teachers, not their prestige. However, I cannot but believe that if we improve undergraduate instruction we will also improve our professional lives and enhance our image to the general public.

### Ignoring the Lessons of History

Everyone seems to be aware of the horrible conditions faced by new Ph.D.s in mathematics who are trying to find a position. See the recent article in the July/August 1993 issue of the *Notices*.

About five years ago at a meeting of the American Mathematical Society, I attended a conference devoted to ways and means of increasing the number of graduate students in mathematics. The speakers presented charts and data showing that the number of graduate students was not as large as it should be, and there was much discussion about ways to increase this number. Since this was five years ago, some details are fuzzy in my mind, but I recall that during the meeting I tried to ask why we wanted to increase the number of Ph.D.s, and I pointed out that somewhat earlier students faced exactly the same horrible conditions in the job market that they do today. Those in charge of the meeting paid little attention to my remarks, but they were tolerant enough to permit this obstructionist to talk (but not for very long). We are now witnessing the tragic results of their efforts to produce still more Ph.D.s, but as usual the suffering is visited upon the innocent and not on the perpetrators of the crime. If a person loves mathematics and wishes to devote his life to that study, he or she should be encouraged to do so. But in my opinion it is just plain stupid to try to entice people into that study, and this was exactly the thrust of that gathering. One can argue that nobody could foresee the reduced teaching budgets throughout the nation, nor could they imagine the flood of well-qualified immigrants. However,

trying to lure an undecided student into a particular study was and is just plain wrong. Many students who devoted four or more years' training to do research in pure mathematics must now readjust to teaching arithmetic or basic algebra (assuming they can find such a job) or drop mathematics and retrain themselves for another type of work. This was exactly the situation about ten years ago, but our fearless leaders ignored the lessons of history.

A. W. Goodman  
The University of South Florida  
(Received August 6, 1993)

### Comments on the Situation in Russia

I am a mathematician and a recent emigrant from Russia. I would like to make some comments on the interesting articles on mathematics in the *fSU (Notices*, volume 40, number 2).

1). I share Professor Arnold's indignation with Victor Sadovnichy, the present rector of Moscow University, and his clique. I also share his indignation at anti-Semitism in Russia. However, Professor Arnold grossly misleads his readers when he claims that the present governments of Russia and other newly independent states are "Fascist" (p. 105). Sadovnichy is not (yet) the government. One might rather compare Yeltsin's ineffective government with the Weimar Republic, which could not solve Germany's problems in the 1920s. It is regretful also that no mathematicians from other than Russia of the newly independent states are mentioned in the *Notices*.

2). Professor MacPherson (p. 117) lists three reasons why mathematicians emigrate from Russia now: economic, academic, and political. There are at least two more. One is the feudal character of the Russian science. More than once my supervisor at Moscow University cornered me into doing some work which he pretended to have inspired. I tried to obtain another research position in Moscow and failed. It turned out to be easier to emigrate!

Second, the moral atmosphere in all the privileged strata of Russian society has become so poisoned, cynical hypocrisy is so overwhelming that this

alone may well move one to emigrate. I believe that the moral reason for emigration plays a major role. However, it is rarely mentioned. Perhaps this is exaggerated modesty. Or perhaps mathematicians are poor in expressing their feelings. Or perhaps my experience is somewhat different from that of my colleagues. My grandfather had been a well-known poet; and, when he died, I cared about his archive and used the liberalization of "perestroika" to publish some of his writings, which my grandfather could not have published in his lifetime. Several Russian writers and Communists, led by Andrei Dementev and Grigory Baklanov, got irritated.

(Perhaps also because my grandfather had been Jewish.) They arranged such a painful provocation against me and my family that I donated the archive to a safe place and left my native country to never return.

Andrei Toom  
Incarnate Word College  
Dallas, Texas  
(Received March 15, 1993)

**Editor's Note:** Professor Arnold disagrees with the interpretation that Professor Toom has given to his statement regarding fSU states and Fascism. He has provided the following response.

The editors appreciate this clarification, since either interpretation is possible.

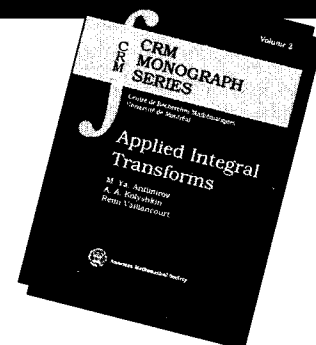
**Response from V. I. Arnold:** The letter by Professor Toom attributes to me the statement that Yeltsin or his government are Fascists. It is easy to see that this is not what was stated in the article that Toom quotes from (nor have I ever said or thought this). What *is* said in that article is that those governments which apply laws discriminating against "ethnically alien" people are Fascist—Yeltsin and his government have never accepted or applied such laws.

(Received July 16, 1993)

## CRM MONOGRAPH SERIES

# Applied Integral Transforms

M. Ya. Antimirov, A. A. Kolyshkin,  
and Rémi Vaillancourt  
*Volume 2*



This book does what few books on integral transforms do: it constructs the kernels of the integral transforms by solving the generalized Sturm–Liouville problems associated with the partial differential equations at hand. In the first part of the book, the authors construct the kernels and then use them to solve elementary problems of mathematical physics. This section, which proceeds mainly by examples and includes exercises, requires little mathematical background and provides an introduction to the subject of integral transforms.

In the second part of the book, the method of integral transforms is used to solve modern applied problems in convective stability, temperature fields in oil strata, and eddy current testing. The choice of topics reflects the authors' research experience and involvement in industrial applications. Because of the applications it discusses, the book will interest engineers (especially petroleum engineers) and physicists.

The CRM Monograph Series is jointly published by the American Mathematical Society and the Centre de Recherches Mathématiques.

1991 *Mathematics Subject Classification*: 35; 76, 80, 78, 44  
**ISBN 0-8218-6998-1**, 265 pages (hardcover), February 1993  
**Individual member \$40**, List price \$66, Institutional member \$53  
To order, please specify CRMM/2NA



All prices subject to change. Free shipment by surface: for air delivery, please add \$6.50 per title. *Prepayment required.* **Order from:** American Mathematical Society, P.O. Box 5904, Boston, MA 02206-5904, or call toll free 800-321-4AMS (321-4267) in the U.S. and Canada to charge with VISA or MasterCard. Residents of Canada, please include 7% GST.

# Joint Mathematics Meetings in Heidelberg

*Meetings Provide a Look at Some Interesting Mathematics*

*and at Issues Facing Mathematicians in Germany*

The AMS is very much an international organization, with nearly one-third of its membership residing outside of North America. To strengthen its international ties, the AMS has begun holding joint meetings with mathematical societies outside the U.S. The first one on the European continent was a joint meeting with the Deutsche Mathematiker Vereinigung (DMV, the German Mathematical Society) held at the University of Heidelberg on October 1–3. The meeting provided a venue for some high-quality mathematics and a look at issues facing the mathematical community in Germany.

Both the AMS and the DMV are over one hundred years old, and the University of Heidelberg is more than 600 years old. The opening ceremonies of the joint meeting looked back on these venerable traditions, with speeches by dignitaries from the university, the AMS, and the DMV. The audience, following the tradition in German universities, knocked on the tops of the wooden desks instead of clapping.

The meeting's highlights were invited addresses by Gerd Faltings of Princeton University, Günter Harder of the University of Bonn, Helmut Hofer of Eidgenössische Technische Hochschule in Zurich, Michael Hopkins of the Massachusetts Institute of Technology, Vaughan Jones of the University of California at Berkeley, and Robert Langlands of the Institute for Advanced Study. Langlands, the only one to speak German, talked not about the famed "Langlands program", but about a topic from physics. Harder, who will welcome Faltings next year as a colleague at the Max Planck Institute, spoke on the topological trace formula for Hecke operators. Jones presented the first plenary talk, which outlined some old and new ideas in the field of von Neumann algebras. He mentioned the connections of this field to other branches of mathematics and to physics, but he concentrated on the combinatorial structure emerging from the study of subfactors and von Neumann algebras themselves, which he described as strongly analogous to Galois theory.

Hopkins spoke about applications of algebraic geometry to homotopy theory. In the early 1970s Quillen discovered relations between the moduli space of formal group laws and homotopy theory. Over the last twenty years these have been used as a guiding principle by researchers in homotopy theory, leading them by analogy to assertions which they then proved by conventional topological methods. Now Hopkins and his collaborators have for the first time used the Quillen correspondence to prove a deep result about homotopy groups of spheres using algebraic geometry. No topological proof of this result, which is closely related to the Riemann-Roch theorem in algebraic geometry, is known.

Hofer described applications of pseudoholomorphic curves to three-dimensional contact geometry. He sketched a proof of the Weinstein conjecture for the three-sphere (and some other three-manifolds), which asserts that every Reeb vector field has a closed orbit. This is related to the Seifert conjecture, which says that every vector field on the three-sphere has a closed orbit (or a singular point). For the vector fields coming from contact structures this is now known to be true by Hofer's result. On the other hand,  $C^1$  and  $C^2$  counterexamples to the Seifert conjecture have been around for some time. Hofer also mentioned the recent rumor that an infinitely differentiable counterexample has been found.

One special session featured talks by Matthias Flach of the University of Heidelberg, Kenneth Ribet of the University of California at Berkeley, and Jacques Tilouine of the University of Paris XI at Orsay, who all described work supporting Andrew Wiles's proof of Fermat's Last Theorem. A special session on geometry and computer visualization covered all kinds of topics, from exploring hyperbolic three-manifolds to reconstructing gothic vaults. Using some of the videotapes from the session, a German television station plans to put together an hour-long program.

Among the nonmathematical issues of interest at the meeting was how the field has been affected by the reunification of East and West Germany in 1990. Much of the structure supporting East German science perished after reunification because some of the research institutes there were not strong enough scientifically to survive once their political support was uprooted. In addition the institutes did not fit the Western administrative modes that everything had to conform to after reunification. Those scientists who had gotten jobs through political influence were in many cases fired. Many on university faculties were also fired, as the East German universities were considered to be overstaffed by the standards of West Germany. Adding to these difficulties is the fact that many of the best scientists emigrated as soon as they were able to (though there has not been an exodus on the scale of that in the former Soviet Union).

As it turns out, fewer mathematicians in East Germany lost their jobs in the reunification than did researchers in other areas of science. According to Willi Jäger, a professor in the Applied Mathematics Institute at Heidelberg, "mathematics is not a science close to politics," so problems of past political ties were not so severe in mathematics as in other areas. In addition he notes, "mathematics in East Germany had in certain fields—not in all, but in some—very high international standards." Today mathematics departments all



over eastern Germany are being rebuilt with the aid of committees of scientists from western Germany. Overall, says Jäger, "mathematics has not suffered by the reunification too much." He believes it will take financial contributions by both eastern and western Germany to insure that mathematics thrives, but in the end, "both sides will profit."

The Deutsche Forschungsgemeinschaft (DFG, the German equivalent of the National Science Foundation) has already begun investing in science in eastern Germany. "The DFG was very helpful in reorganizing the scientific landscape in East Germany," says Jäger, and "they did it very unbureaucratically." East German scientists were not accustomed to grants and peer review, he says, so the DFG initiated programs whereby Western scientists help colleagues in eastern Germany set up research projects and apply for funds.

After the reunification, the DMV merged with the Mathematische Gesellschaft der Deutschen Demokratischen Republik (MGDDR, Mathematical Society of the German Democratic Republic). Members of the MGDDR were automatically made members of the DMV, adding about 600 to the DMV membership of 2200. However, the merging was not entirely smooth. Jäger says that there were calls for the DMV to condemn some of the new members for their political pasts. To do so would require evaluating individuals on a case-by-case basis, an impossible task for the DMV.

Despite economic difficulties, mathematics in Germany has fared well in research funding. This year the Bundesministerium für Forschung und Technologie (Federal Ministry of Science and Technology) launched a new program to forge links between mathematics and industry. The new program will grant about 21 million DM (\$12.9 million) over its three-year lifetime; as a comparison, the DFG mathematics budget last year was 34 million DM (\$20.9 million). Industrial partners provide data, technical support, and proprietary information as needed, but no direct funds. Three mathematical areas are involved: dynamical systems and nonlinear differential equations, mathematical methods in graphics and image analysis, and discrete and continuous optimization. The application areas range from chemical engineering to transportation to robotics. Out of 256 applications, fifty-five awards were made this fall.

Was there some tension between pure and applied mathematics over this new infusion of funds into applied areas? DMV President Martin Grötschel of the Konrad-Zuse-Zentrum für Informationstechnik in Berlin (Konrad Zuse Center for Information Technology) says he expected more tension than he saw. "All those involved in this program are trying hard to do justice to both sides of mathematics," he explains. In addition "the division between pure and applied mathematics is not so visible anymore."

As president of DMV, Grötschel is a persuasive advocate for keeping pure and applied mathematics together in the DMV. He says the Gesellschaft für Angewandte Mathematik und Mechanik (Society for Applied Mathematics and Mechanics) has focused on engineering and has not provided

effective representation for newer, less traditional areas of applied mathematics. Grötschel, who in Heidelberg organized a special session on optimization, says that most of his U.S. colleagues are in industrial engineering, computer science, and operations research departments. This kind of applied research, he says, seems to have been "pushed out of mathematics departments [in the U.S.], which was a big mistake."

For a small organization with a shoestring staff, the DMV has quite a full plate. Among its major concerns is the near-dire situation for academic research libraries in Germany, which have cut back on book purchases and journal subscriptions due to lack of funds. Electronic communications is another important issue, and the DMV has, with federal funding, initiated a program to promote its use within the German mathematical community. Another concern is how mathematics is faring in the former Soviet Union. DMV members donated about 25,000 DM for stipends for fifteen mathematics doctoral students in the former Soviet Union.

Another growing concern in the DMV is the issue of women in mathematics. Ina Kersten, an associate professor at the University of Bielefeld, is the first woman to serve on the governing body of the DMV. She says the main difficulty for women mathematicians in Germany is that few are appointed to permanent positions. Talented young women opt for other fields because their prospects look poor in mathematics. Lack of role models exacerbates the problem. Under the auspices of the DMV, Kersten and Jäger have suggested a program that would establish a pool of government funds to create a small number of permanent positions for women in German mathematics departments. To get reactions to their plan they are circulating a draft proposal to the sixteen state ministers.

As the last speaker Faltings began his talk by addressing the problem of scarcity of blackboard space. He suggested that one only has to repeatedly halve the size of one's writing to fit it all on the board. Then, writing in extremely large letters which were to shrink continuously during his lecture, Faltings talked about the Verlinde formula in algebraic geometry. This formula gives the dimension of the space of sections of the powers of an ample line bundle on the moduli space of complex algebraic curves of fixed genus. It was first conjectured by physicists, and different proofs of it have been given recently by several mathematicians.

At the closing ceremonies Albrecht Dold, a mathematics professor at the University of Heidelberg who was on the local arrangements committee, pointed out how well the AMS and the DMV had worked together in planning and carrying out the meeting. He thanked all those involved, saying that "This collaboration has been very good indeed." The Heidelberg meeting was noteworthy not only for the high quality of the mathematics but also for the sense of warmth and fraternity among the participants, which made everyone attending look forward to the next one.

**Allyn Jackson**

# “New Order” for Federal Funding

## *Committees on Science Policy*

## *and on Education Face Shifts in Public Support*

The mathematical community is struggling to find its balance on the shifting sands of public support for science. Meetings of the AMS Committee on Education (COE) and the AMS Committee on Science Policy (CSP), held during three days in September in Washington, DC, were colored by what CSP member Rhonda Hughes of Bryn Mawr College called “a new order” in public perceptions of science and education.

Historically, the government has supported basic research in the belief that eventually research will improve the nation’s quality of life. However, the public’s current questioning of the value of basic research indicates that the scientific community has not done a good job of communicating just what those improvements have been; and scientific researchers, with a few heroic exceptions, have not made their way into the educational trenches to help address the nation’s problems with education. Amid ever-increasing budget pressures, the public is asking tough questions about the return it’s getting on the nation’s investment in science.

In the past few years hefty increases have flowed into the education directorate of the National Science Foundation (NSF), while research, especially the so-called “curiosity-driven” research, has been under increasing strain. The mathematical sciences community in particular has been affected by these trends for two reasons. On the one hand, mathematics has been central to the educational reform movement supported by the NSF. And on the other hand, mathematics has not been a big player in some of the strategic initiatives that have brought new research money to the NSF. These considerations formed the backdrop for the committees’ discussions.

### **Committee on Education**

The COE, established in 1990, has been charged with the task of guiding the Society’s actions in mathematics education. The COE has its difficulties, stemming mainly from the fact that, as an organization, the AMS has become involved in educational issues only recently. Traditionally, the AMS has been inclined to regard educational issues as the province of other organizations and to concentrate on promoting mathematics research. The Society’s recent strategic planning exercises included a new interpretation of the mission of the AMS that embraces education and professional development. The Society’s interest in education has been viewed in the

larger mathematics community with mixed feelings, often tinged with suspicion or cynicism.

The COE discussed how the AMS has attempted to get its feet wet in a number of educational projects but has been rebuffed by those who have been paying attention to education all along. There is “tremendously deep suspicion that the concern and interest of the research community are really there,” said COE member Deborah Hughes Hallett, who is at the University of Arizona this year, on leave from Harvard University. For many years, she pointed out, it appeared that the research community did not stand up for the educational community. “It will take a lot of these rebuffs... before the research community will be taken seriously.” COE member Alan Schoenfeld of the University of California at Berkeley went into education after getting a doctorate in mathematics. He said that the typical model for a mathematician’s involvement in education was to say it could be fixed, work for two years, conclude that people in education know nothing, and then leave. “It took years for people to believe that I was serious about education and was in it for the long haul,” he said.

What can be done? Hughes Hallett said it’s partly just persistence: the AMS has to take the rebuffs and keep making an effort until people are convinced that the Society is serious. Hyman Bass of Columbia University, chair of the Mathematical Sciences Education Board (MSEB), pointed out that such organizations as the MSEB and the Mathematicians and Education Reform Network have ties to both the research and education communities and can mediate when sparks start to fly. Part of the solution also lies in the rewards structure in mathematics departments. “There has been a pecking order,” said COE member Alan Tucker of the State University of New York at Stony Brook, pointing out that the AMS has been on “high ground” with regard to what the community valued in giving tenure, promotions, and grants. Rewarding educational involvement in the same way that research is rewarded will be a clear sign that the community is serious about education.

### **Evaluating Teaching Effectiveness**

The committee acknowledged that part of the difficulty of properly rewarding educational activities is the lack of an evaluation system. In particular, evaluating the “everyday” teaching done in mathematics departments may be more

difficult than evaluating contributions to education, which can be measured by papers written, presentations made at conferences, and so on. COE member Jerry Bona of Pennsylvania State University said that he knew how to get faculty to pay attention to teaching—"salaries!" But, he said, evaluating teaching in a rigorous way is difficult. There are no widely accepted ways to evaluate teaching (except perhaps for student evaluations, which are often regarded with suspicion). Bass says that what is needed is "to create a community that evaluates each other just as algebraic topologists evaluate others at a conference." Hughes Hallett ran off a list of different criteria by which to judge teaching, such as whether the teacher plods through each section of the textbook or thinks about the overall design of the course, whether the teacher discusses mathematics courses with faculty in client disciplines, whether the teacher is innovative in curricular reform, and so on. There may be some consensus that these are the kinds of things that need to be measured, but just how to measure and weigh them is unclear.

The committee agreed that the AMS could play a role in helping to bring about discussion and consensus on how to evaluate teaching, as well as other aspects of the rewards structure such as scholarship and service. Indeed, the discussion has begun through a study conducted by the Rewards Committee of the Joint Policy Board for Mathematics (see "Inside the AMS" in this issue of the *Notices*). William Adams of the University of Maryland, project director for the Rewards Committee, made a presentation before the COE about some of the findings of the study. Much of the COE's discussion of teaching evaluation was spurred by a presentation by Susan Forman of the MSEB staff, who described a report of a Board task force chaired by Uri Treisman of the University of Texas at Austin. This report, now under review by the National Research Council, explores means of promoting teaching growth and effectiveness on college and university campuses.

### Assessing Student Learning

Assessment—testing whether or not students are learning what the teacher is trying to teach—is an important component in evaluating teaching effectiveness. At the precollege level assessment is a huge industry that has been much criticized but that has nevertheless had an enormous influence on education. Traditionally, the emphasis has been on cheap, reliable, standardized tests that can be used in all kinds of classrooms: all you have to have is the test form and a No. 2 pencil. These tests have affected many aspects of education, from what gets taught in class, to how much funding school districts receive, to how many gray hairs parents get worrying what college their kids will get into.

The issue of assessment was raised when representatives from the National Council of Teachers of Mathematics (NCTM) met with the COE. NCTM President Mary Lindquist of Columbus College discussed the NCTM's draft document on assessment standards. This is the third in a series of standards documents produced by the NCTM in recent years; the first was "Curriculum and Evaluation Standards for School

Mathematics", and the second was "Professional Standards for Teaching Mathematics". Both have greatly influenced much of the mathematics education reform movement. A draft of the assessment standards will come out this fall and will be circulated for discussion during the academic year.\*

Bass said that in looking into assessment he found "more intellectual landscape than I knew existed". It doesn't matter if a curriculum is great, he said; if it is not coordinated with how one assesses students' knowledge, then it won't work. He pointed out that if one wants students to engage in multistep, complex thinking, one must ask questions to evoke that; if one wants students to work in groups or on long-term projects, one has to formulate ways to assess what they produce. "These issues apply to college and even graduate school," he noted. Although there is considerably more latitude in testing at the college level, COE member David Cox of Amherst College pointed out that his students often have a very narrow view of what an "answer" to a mathematics problem is. The students' expectations affect how college and university teachers prepare their examinations. Therefore, he said, reforms in assessment at the school level will also influence the collegiate level. In addition Lynn Arthur Steen, executive director of MSEB, noted that the influence of assessment is growing at the collegiate level; many state institutions have been pressed by accreditation boards or state legislatures to set goals for their major programs and to assess students to see whether those goals have been met.

The COE has two subcommittees, one on undergraduate education and one on graduate education and postdoctoral training. These subcommittees are discussing what actions the AMS can take to further its educational mission, such as initiating student organizations, publishing a newsletter for graduate students, and organizing sessions and social events for students at annual and sectional meetings. The ideas of the subcommittees will be considered as part of the AMS operating plan in coming years. In addition, the general discussions of the COE and meetings with representatives of other organizations who work in education will sow the seeds for future actions the AMS could take in this area.

### Committee on Science Policy

The COE has its difficulties, being a relative newcomer in the education world. But there is great potential for important contributions and collaborations, and the committee has a sense of excitement in facing this challenge. The Committee on Science Policy is in a very different position. Established in 1974, the CSP has in the last five years been quite influential in AMS affairs and has seen a number of its ideas come to fruition in the form of AMS programs and projects; in fact it was the CSP that recommended forming the Committee on Education. Today the CSP is in the thick of the fight to shore up federal support for basic scientific research, and the problems it is confronting are monumental.

\*Copies of the draft of the assessment standards can be obtained by contacting: National Council of Teachers of Mathematics, Executive Office, 1906 Association Drive, Reston, VA 22091; telephone: 703-620-9840, ext. 112.

Consider the gloomy scenario for fiscal year 1993 for the NSF's Division of Mathematical Sciences (DMS). In his presentation to the CSP, DMS Director Frederic Wan painted a picture of tight budgets and declining numbers of principal investigators. Although some of the numbers he put before the committee were in rough form, the overall message was not: six DMS programs suffered a 10%–17% decline between fiscal year 1992 and fiscal year 1993 in the number of investigators supported. (The exceptions were Classical Analysis (a 1% decline) and Computational Mathematics (a 5% rise); the latter fit into the federal high performance computing initiative.) By contrast, in the five years preceding 1992 there was a steady rise in summer salaries for investigators, the total number of investigators supported, and the total number of summer months funded.

What will happen in fiscal year 1994, which will have begun by the time this issue of the *Notices* reaches its readers, is unclear. But the foreshadowing does not look good. Wan described a report of the Senate appropriations subcommittee that oversees the NSF (the report was discussed in the "From the Executive Director" column, *Notices*, October 1993, page 970). The report states bluntly that if the NSF does not set clear and measurable goals for how it will contribute to solving national problems, then Congress should start shifting NSF funds elsewhere. In particular the report specified that not less than 60% of the NSF budget should go toward strategic research and cautioned that the NSF should not "shroud curiosity-driven activities under the rubric of strategic activities". Although disturbing, the Senate report language does not have the binding force of law (unless it survives the House-Senate Conference); it only communicates the recommendation of the subcommittee.

Nevertheless, the Senate report sent shock waves through the CSP as well as the entire scientific community, which has scrambled to come up with ways to rebut the report. What may be more significant than the Senate report, though, is a government memorandum, dated August 17, 1993, by John Gibbons, presidential science adviser, and Leon Panetta, director of the Office of Management and Budget. The memorandum calls for a new method of describing funding for research and development in federal budgeting by which all R&D would be listed under ten sectors: manufacturing, communication and information, natural resources and the environment, education and training, transportation, national security, energy supply and demand, food and fiber production, health, and "other". When Wan put up a transparency showing the ten categories, all eyes in the room scanned up and down the list searching to see where mathematics belonged. "Which category does Andrew Wiles fit into?" asked CSP member Eric Friedlander of Northwestern University. "Natural resources," joked CSP member Cathleen Morawetz of the Courant Institute. "He is one!"

The levity did not shake the chill of this clear manifestation of the "new order" in federal funding. Will every proposal submitted to the NSF bear a number specifying which R&D sector it falls into? It's not clear that the requirements will be so stringent. However, DMS program directors are likely

to be scouting out ways to explain how the mathematics that they fund would fit into those sectors. If proposal writers can help by providing that information in their proposals, all the better.

### A Skeptical View of Scientists

Ronald Douglas of the State University of New York at Stony Brook told the CSP about a recent National Research Council workshop he attended. The workshop brought together scientists and science policy observers and decision makers to discuss federal funding for science. He observed skepticism about the motives of the scientific community, which is seen as trying "to preserve our comfort while others sacrifice". Many of the policymakers are familiar with the system of academic science. "They don't believe the present system is sacrosanct," he declared. "They don't believe this is the only way to do science. And in particular, the system had not necessarily worked well for them." As for the kind of research being advocated, "it's hard for me to exaggerate how applied" it is, Douglas said. Referring to the memorandum with the ten categories for R&D funding, Douglas said, "that's really what they're talking about." "This doesn't mean we can't change minds," he said, "but the problem is deeper and more difficult than you can imagine."

Although the situation looks bad, it could have been worse. CSP chair Frank Warner of the University of Pennsylvania has been very active during his tenure in making contacts with agency staff and policymakers. The CSP discussed ways to influence the House and Senate compromise bill so that the final appropriation for NSF is cast in language more moderate than that of the Senate bill and hopefully with a larger budget. Some present at the CSP meeting had already met with Congressional representatives to try to explain the shortcomings of the viewpoint expressed in the Senate report. The Joint Policy Board for Mathematics and the AMS Washington Office are working together to get mathematicians to contact their Congressional representatives to protest the Senate report and support the more moderate recommendations of the House appropriations subcommittee.

In addition Warner has pushed to get out a draft of a national policy agenda for the mathematical sciences, which could play an important role in changing the image that the scientific community is a "special interest group" that is out of step with national interests. The Federal Policy Subcommittee of the CSP has been working on this task since January, and a preliminary draft of the agenda was reviewed by the CSP at their meeting. This document aims to inform the AMS membership, policymakers, and the public about some of the major policy issues facing the mathematical sciences community and also describes means for addressing these issues. The document discusses the importance of mathematical research, the contributions mathematics makes to societal welfare, the role of mathematics in science and technology, and the need for excellence in mathematics education at all levels. The subcommittee gathered comments during the meeting and is now working on producing a final draft.

**What Is "Adequate" Funding?**

Wan had asked the CSP for advice on what constitutes "adequate" funding for mathematics, both in terms of how a mathematics grant could be structured and in terms of how many investigators ought to be supported. His request took on increased urgency as he speculated during his presentation that because of the squeeze on the research budget the NSF may in the next couple of years consider eliminating salaries on grants. If that happens, what should a mathematics grant look like?

To get the discussion started Warner drew up a list of components of an individual investigator grant, such as summer salary, travel, visitors, materials and supplies, graduate students, postdocs, computing support, and so on. Wan made it clear that he was not setting any upper bound on what the community might ask for in providing advice to the DMS. It's a delicate question: if the community asks for too much, will it price itself out of the market? If it asks for too little, will it lose out?

Friedlander said Warner's list might be seen as "generous" rather than "adequate" support for mathematics. Perhaps specialized regional conferences, some travel for visitors, and cautious amounts of computing support would form the minimum for what the community could get by on. CSP member John Morgan of Columbia University saw it differently, saying that the committee should "reasonably and honestly" estimate the "full cost" of supporting mathematical research. "Maybe the ideal is unattainable" in the current climate, he said, but there should at least be a baseline description of what is needed for mathematical research to thrive.

Even if the community could come to a consensus on what "adequate support" means, there are other thorny questions. What if summer salaries are thrown out? Will what remains still constitute "adequate support"? Is a separate plan needed in the event that salaries go by the boards? These are delicate political gambles that are difficult to size up, and the CSP could not come to any clear agreement on what to do. Discussions will continue between now and the committee's next meeting.

Could it be that the "new order" will render such discussion obsolete? Rhonda Hughes said that while she felt there is some value in writing down an ideal scenario for what a grant should look like, the CSP needs to devote more energy to other alternatives. Many members of the mathematical community would be happy just to get a travel grant, she noted. The NSF has made it clear it cannot support a large-scale program of small grants, in part because of the high administrative costs. "This is the perfect place for the AMS to help mathematics on a broad scale," she said. And yet a proposal for an AMS small grants program, made a couple of years ago, was shot down. "People said, 'That's not right for mathematics; we're selling ourselves short; we can't show them that we can get

by on small grants.' " Instead of "nostalgia for the past," said Hughes, "Let's spend some time thinking about what the 'new order' is calling for."

**Allyn Jackson**

Frank Warner will finish his term as chair of the Committee on Science Policy in February 1994; his successor as chair will be John Morgan. Ramesh Gangolli will also finish his term as chair of the Committee on Education in February 1994; his successor as chair will be Ronald Douglas. Both committees invite comments and suggestions from the mathematical community. Inquiries can be directed to the committee chairs or to individual committee members or can be sent to the relevant committee at: American Mathematical Society, P.O. Box 6248, Providence, RI 02940-6248.

**Committee on Education**

Jerry L. Bona, Pennsylvania State University  
 Carl Cowen, Purdue University  
 David Cox, Amherst College  
 Ronald G. Douglas, State University of New York at Stony Brook (chair-elect)  
 Robert M. Fossum, University of Illinois (*ex officio*)  
 Ramesh A. Gangolli, University of Washington (chair)  
 Ronald L. Graham, AT&T Bell Laboratories (*ex officio*)  
 Rebecca Herb, University of Maryland  
 Deborah Hughes Hallett, Harvard University  
 William H. Jaco, AMS (*ex officio*)  
 Harvey B. Keynes, University of Minnesota  
 Maria M. Klawe, University of British Columbia  
 Judith Roitman, University of Kansas  
 Alan H. Schoenfeld, University of California, Berkeley  
 Alan C. Tucker, State University of New York at Stony Brook  
 Frank W. Warner III, University of Pennsylvania (*ex officio*)

**Committee on Science Policy**

Michael Artin, Massachusetts Institute of Technology (*ex officio*)  
 James A. Donaldson, Howard University  
 Richard E. Ewing, Texas A&M University  
 Robert M. Fossum, University of Illinois (*ex officio*)  
 Eric Friedlander, Northwestern University  
 Ramesh A. Gangolli, University of Washington (*ex officio*)  
 Ronald L. Graham, AT&T Bell Laboratories (*ex officio*)  
 Rhonda J. Hughes, Bryn Mawr College  
 William H. Jaco, AMS (*ex officio*)  
 Raymond L. Johnson, University of Maryland  
 Linda Keen, Herbert H. Lehman College, CUNY  
 James Lepowsky, Rutgers University  
 William James Lewis, University of Nebraska  
 Cathleen S. Morawetz, Courant Institute  
 John W. Morgan, Columbia University (chair-elect)  
 Melvyn B. Nathanson, Herbert H. Lehman College, CUNY  
 Anil Nerode, Cornell University  
 John Polking, Rice University  
 Linda Rothschild, University of California, San Diego  
 Frank W. Warner III, University of Pennsylvania (chair)  
 Susan Williams, University of South Alabama

# 1993 Annual AMS-IMS-MAA Survey

## (First Report)

Report on the 1993 Survey of New Doctorates, *Donald E. McClure*  
Salary Survey for New Doctorates  
Faculty Salary Survey  
Doctoral Degrees Conferred, 1992–1993

### Highlights

- U.S. institutions awarded 1202 doctorates in the mathematical sciences from July 1, 1992, to June 30, 1993, an increase of more than 14 percent from last year's fall count.
- The number of U.S. citizens reported to have received doctorates in the mathematical sciences is 526, which is 22 percent greater than the number earning doctorates last year. The count is 45 percent above the record lows reported in 1986–1987 and 1987–1988 and is the highest count of U.S. citizens since 1980–1981.
- The number of non-U.S. citizens receiving doctorates is a record high of 671 in 1992–1993, up 14.5 percent from the 1991–1992 count. The number of non-U.S. citizen recipients is more than twice the number reported ten years earlier.
- Of the 526 U.S. citizen doctoral recipients, 7 are black and 37 are members of other minority groups. In 1991–1992 the U.S. citizen doctorates included 6 blacks and 27 other minority members.
- The unemployment rate for new doctorates reached its second highest reported level since fall 1975. Among those whose employment status is known, 12.4 percent were unemployed as of late September 1993, nearly equaling the recent high figure of 12.7 percent in fall 1992. Total employment of new doctorates in the U.S. increased by 11 percent from the level reported in fall 1992.
- The number of women among U.S. citizen doctorates increased by 41 percent from last year's fall count to a new high count of 145. The percentage of women among U.S. citizen doctorates also reached a new high of 28 percent.
- The median starting salary of new doctorates reporting teaching (or teaching and research) was \$34,000 for men, unchanged from last year, and \$33,800 for women, down from last year's figure of \$34,900.
- In all but two instances the mean salary for Associate and Full professors reported for 1993–1994 increased less than 4 percent over the mean for 1992–1993.

This first report on the 1993 Survey includes a report on the 1993 survey of new doctorates, a report on salaries of new doctorates, salary data on faculty members in four-year colleges and universities, and a list of names and thesis titles for members of the 1992–1993 Ph.D. class. The report is based on information collected from questionnaires distributed in May to departments in the mathematical sciences in colleges and universities in the United States and later to the recipients of doctoral degrees granted by these departments between July 1992 and June 1993, inclusive. A further questionnaire concerned with data on fall enrollments, majors, and departmental size was distributed in September. These data will appear in the second report on the 1993 Survey, in a spring 1994 issue of the *Notices*.

The 1993 Annual AMS-IMS-MAA Survey represents the thirty-seventh in an annual series begun in 1957 by the Society. The 1993 Survey is under the direction of the AMS-IMS-MAA Data Committee, whose members are Edward A. Connors, Lincoln K. Durst (consultant), John D. Fulton, James F. Hurley, Don O. Loftsgaarden, David J. Lutzer, James W. Maxwell (*ex officio*), Donald E. McClure (chair), Donald B. Rubin, Donald C. Rung, and Ann K. Stehney. Comments or suggestions regarding this Survey may be directed to the committee.

For these reports, departments are divided into groups according to the highest degree offered in the mathematical sciences:

**Groups I and II** include the leading departments of mathematics in the U.S. according to the 1982 Assessment of Research-Doctorate Programs conducted by the Conference Board of Associated Research Councils in which departments were rated according to the quality of their graduate faculty.<sup>1</sup>

**Group I** is composed of 39 departments with scores in the 3.0–5.0 range.

**Group II** is composed of 43 departments with scores in the 2.0–2.9 range.

**Group III** contains the remaining U.S. departments reporting a doctoral program.

**Group IV** contains U.S. departments (or programs) of statistics, biostatistics and biometrics reporting a doctoral program.

**Group V** contains U.S. departments (or programs) in applied mathematics/applied science, operations research and management science which report a doctoral program.

**Group Va** is applied mathematics/applied science; **Group Vb** is operations research and management science.

**Group M** contains U.S. departments granting a master's degree as the highest graduate degree.

**Group B** contains U.S. departments granting a baccalaureate degree only.

<sup>1</sup>These findings were published in *An Assessment of Research-Doctorate Programs in the United States: Mathematical and Physical Sciences*, edited by Lyle V. Jones, Gardner Lindzey, and Porter E. Coggeshall, National Academy Press, Washington, D.C., 1982. The information on mathematics, statistics and computer science was presented in digest form in the April 1983 issue of the *Notices*, pages 257–267, and an analysis of the above classifications was given in the June 1983 *Notices*, pages 392–393. For a listing of departments in Groups I and II see the April 1988 *Notices*, pages 532–533.

# Report on the 1993 Survey of New Doctorates

Donald E. McClure

This report presents a statistical profile of recipients of doctoral degrees in the mathematical sciences awarded by universities in the United States during the period July 1, 1992, through June 30, 1993. It includes an analysis of the employment market for 1992–1993 doctoral recipients and a demographic profile summarizing characteristics of citizenship status, sex, and racial/ethnic group. Table 1 provides the response rates for the 1993 Survey of New Doctorates (see box on preceding page for description of Groups).

**TABLE 1: Response Rates**

Group I	39 of 39
Group II	40 of 43 including 5 with 0 degrees
Group III	81 of 90 including 22 with 0 degrees
Group IV	62 of 75 including 3 with 0 degrees
Group Va	14 of 18 including 4 with 0 degrees
Group Vb	17 of 33 including 1 with 0 degrees

Commencing with this thirty-seventh Annual Survey, the Institute of Mathematical Statistics (IMS) is a cosponsor with the AMS and MAA of the Annual Survey and other activities of the joint AMS-IMS-MAA Data Committee.

## Doctorates Granted

The number of new doctorates reported in 1992–1993 by U.S. mathematical sciences departments is 1202. Table 2A gives the fall and spring counts for the past four Annual Surveys together with the current fall count. This year's fall count will be updated in the Second Report of the 1993 Survey, to appear in a spring 1994 issue of the *Notices*.

**Table 2A: U.S. New Doctorates, Fall and Spring Counts**

Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring
88–89	89–90	90–91	91–92	92–93
905 919	933 950	1074 1125	1050 1062	1202 *

\* To appear in a spring 1994 issue of the *Notices*.

The fall count of the total number of new doctorates represents an increase of 14.5 percent from the fall count of 1050 in the 1992 Survey. This year's fall count shows an increase of 64 percent over the 1984–1985 fall count of 732 new doctorates from U.S. institutions, one of the lowest counts within the last twenty years.

Table 2B records the annual number of new doctorates in the mathematical sciences in the U.S. from the year 1988–1989, exclusive of Group Vb. The response rate for Group Vb, which includes some departments in engineering and management science, is the lowest of all groups.

**Table 2B: New Doctorates Awarded by Groups I–Va**

	88–89	89–90	90–91	91–92	92–93
I–Va	854	881	1034	1008	1104**

\*\* This is a fall count. The other entries in Table 2B are spring counts. Table 2B will be updated to include a spring count for 1992–1993 in a spring 1994 issue of the *Notices*.

A small part of the increased count is associated with the increased response rate in Group IV (statistics), but most of the increased numbers are due to higher rates of doctorate production by departments of all types. Only Group II showed a negligible decrease in the rate of production: 4.7 degrees per department in 1992–1993 vs. 4.8 degrees per department in 1991–1992. All other Survey Groups showed substantial increases in the rate of production of new doctorates (see Table 3B on the next page). The rate of awarding new doctorates increased by 6 percent in Groups I–III combined, by 13 percent in Group IV, and by 5 percent in Group V.

## Employment Status of U.S. New Doctorates, 1992–1993

The Annual Survey of New Doctorates provides a view of the employment market for new Ph.D.s in the mathematical sciences from the perspective of job applicants. Additional information about recruitment by four-year colleges and universities is reported in the Second Report of the Annual Survey; see the 1992 Second Report, *Notices*, July/August 1993, pages 601–610, for data on the numbers of positions departments attempted to fill and characteristics of the people hired.

Table 3A shows the employment status, by type of employer and field of degree, of the 1202 recipients of doctoral degrees conferred by the mathematical sciences departments in the U.S. between July 1, 1992, and June 30, 1993. The names of the individuals are listed with their thesis titles in a later section of this First Report of the 1993 Annual Survey. The employment information was obtained initially from the departments granting the degrees and subsequently from data provided by the degree recipients themselves.

Most new doctorates seek and accept academic positions. Of the 721 new doctorates employed in the U.S., a total of 554 (77 percent) hold jobs in academia. For comparison, last year's First Report showed 648 new doctorates employed in the U.S., including 538 (83 percent) in academic positions. Thus total U.S. employment of new doctorates has increased and the concentration of positions in academia has declined. Concomitantly, the number of nonacademic positions in the U.S. for new doctorates has increased by 52 percent to 167, the highest number of nonacademic positions taken by new doctorates since 1981–1982. Most of the increase in total U.S. employment is nonacademic.

AMS-IMS-MAA Annual Survey

**Table 3A: Employment Status of 1992–1993 U.S. New Doctorates in the Mathematical Sciences**

TYPE OF EMPLOYER	FIELD OF THESIS											TOTAL
	Algebra/ Number Theory	Real or Complex Analysis	Geometry/ Topology	Logic	Probability	Statistics	Applied Math	Discr. Math/ Combinatorics	Numerical Analysis	Linear or Nonlinear Optim.	Other	
Group I	19	24	30	2	5	2	14	3	2			101
Group II	3	7	12	1	3	3	13	1	1	2		46
Group III	4	10	3		3	10	16	4	3	2	1	56
Group IV						40						40
Group V					1	1	5			2		9
Masters	12	7	12	2	1	16	4	3	1	4	2	64
Bachelors	35	22	15	2	4	8	14	8	6	1	1	116
Two-year Colleges	5	5	3			3	2	3		1		22
Other Academic Departments	3	2	1	3	2	26	11	2	4	9	8	71
Research Institutes	3	4	6		1	4	7	2	2			29
Government	1	2			1	16	5		1	3	3	32
Business and Industry	7	3	5	3	6	59	17	7	10	11	7	135
Foreign, Academic	21	21	26	5	7	35	17	4	8	5	7	156
Foreign, Nonacademic		1	1		2	11	2	2			3	22
Not seeking employment	2	2	2			5	3	1				15
Still seeking employment	25	16	18	2	5	17	22	8	3	7	6	129
Unknown (U.S.)	11	8	7	3	4	16	26	7	4	5	7	98
Unknown (non-U.S.)*	7	6	4	2	2	15	10	4	4	2	5	61
Column Total	158	140	145	25	47	287	188	59	49	54	50	1202
Column Male	115	114	118	19	36	205	149	40	38	39	42	915
Subtotals Female	43	26	27	6	11	82	39	19	11	15	8	287

\*Non-U.S. citizens who returned to their country of citizenship and whose status is reported as "unknown" or "still seeking employment".

**Table 3B: Employment Status of 1992–1993 U.S. New Doctorates by Type of Granting Department**

TYPE OF EMPLOYER	TYPE OF DOCTORATE-GRANTING DEPARTMENT					ROW TOTAL	ROW SUBTOTALS	
	Group I Math	Group II Math	Group III Math	Group IV Statistics	Group V Applied Math/OR		Male	Female
Group I	84	7	4	1	5	101	74	27
Group II	19	17	4	2	4	46	35	11
Group III	20	9	20	7		56	42	14
Group IV	1	1		38		40	25	15
Group V	2				7	9	3	6
Masters	28	9	15	12		64	47	17
Bachelors	38	37	34	5	2	116	87	29
Two-year Colleges	2	6	13	1		22	17	5
Other Academic Departments	15	4	4	23	25	71	54	17
Research Institutes	18	1		4	6	29	20	9
Government	5	3	5	14	5	32	23	9
Business and Industry	24	13	18	48	32	135	104	31
Foreign, Academic	72	19	15	33	17	156	123	33
Foreign, Nonacademic	2		3	11	6	22	20	2
Not seeking employment	4	4	3	2	2	15	10	5
Still seeking employment	44	30	24	11	20	129	104	25
Unknown (U.S.)	38	19	15	11	15	98	78	20
Unknown (non-U.S.)*	23	8	10	10	10	61	49	12
Column Total	439	187	187	233	156	1202	915	287
Column Male	344	145	142	168	116	915		
Subtotals Female	95	42	45	65	40	287		

\*Non-U.S. citizens who returned to their country of citizenship and whose status is reported as "unknown" or "still seeking employment".



The 554 U.S. academic positions this year include a total of 252 in U.S. doctorate-granting departments (Groups I–V). This number is 24 percent higher than last year (204 positions in Groups I–V). The number hired by Group I has remained essentially constant at 100 since 1988. The numbers hired in Group II and Group III increased for the first time in three years and are slightly greater than the numbers reported in the 1991 Survey. The numbers of new doctorates employed by master's and bachelor's degree-granting colleges and universities decreased by 23 (11 percent) from the numbers reported last year.

The job market for 1992–1993 new doctorates has been equally as difficult as the market for 1990–1991 and 1991–1992 degree recipients. Table 3A shows that among those whose employment status is known, 12.4 percent are unemployed. (The corresponding rate of unemployment for 1991–1992 doctoral recipients from U.S. institutions, reported in fall 1992, was 12.7 percent.) The 1993 unemployment level ranks with the highest ever observed since employment information about new doctorates was first reported in the current format in 1971; it is exceeded only by the 1975 level of 13.7 percent and the 1992 level of 12.7 percent. In contrast to the current high unemployment rate, throughout the 1980s the rate reported in the November issue of the *Notices* ranged between a low of 3.7 percent in 1981 and a high of 6.8 percent in 1989, averaging 5.0 percent over the decade.

The data in Table 3A were obtained in many instances early in the summer of 1993 and do not reflect subsequent hiring. Nonetheless, the year-to-year comparisons are all based on data acquired over the same time period of each year and they reliably reflect the relative difficulty of this year's market. An update of Table 3A will appear in the Second Report in a spring 1994 issue of the *Notices*. At the time of the Second Report last year, the percentage of 1991–1992 new doctorates from U.S. institutions who had reported not finding employment was 6.7 percent (see *Notices*, November 1992, page 1028, and July/August 1993, page 603).

Beyond the unemployment statistics that are explicitly reported in Table 3A, the 1993 Survey reveals other indicators of a difficult job market. For example, 50 new doctorates are reported to hold part-time positions and, based on individual responses, approximately 20 of these individuals are still seeking full-time employment. Seventy-two new doctorates hold employment at the same institution that awarded their degree. All of these positions are not necessarily in the same department in which the degree was earned. However, out of the 252 jobs reported in the doctorate-granting departments, 55 positions are held by new doctorates from that same department. Both of these indicators of a weak employment market are worse than the corresponding statistics in 1992.

The Survey of New Doctorates per se does not reveal underlying causes of the high rates of unemployment and underemployment. However, data reported in the 1992 Second Report show that many faculty positions being vacated by death, incentive retirements, and other retirements are simply not being filled. Rates of faculty attrition due to deaths and retirements are currently relatively high, and levels of recruit-

ment have declined substantially for at least two successive years (*Notices*, July/August 1993, page 604).

Some information is available from the survey concerning the nature of the academic positions filled. To date, 276 individual responses have been received from new doctorates employed by academic institutions. Fifty-three percent of these respondents report that their position is not tenure-eligible, and the remaining 47 percent report that their position is a tenure-track position. Out of the 144 nontenure-eligible respondents, 35 percent can hold their current position for a maximum of one year and 53 percent can hold their position for up to two years. Thus the incumbents of many of the nontenure-eligible positions will again be seeking jobs during the current year.

The proportion of the jobs filled which are tenure-eligible varies significantly between the survey Groups. Among the 276 individual respondents holding jobs in academic institutions, 103 have positions in a doctorate-granting department and 91 have positions in a bachelor's or master's degree-granting department. In the doctorate-granting departments, 77 percent of the positions held by new doctorates are not tenure eligible, while only 23 percent of the positions in bachelor's and master's degree-granting departments are not tenure eligible. None of the 36 individual respondents whose position is in a Group I department holds a tenure-track position.

Table 3B reveals the dependence of employment patterns on the type of department from which the doctorate is received. The patterns of compartmentalization and stratification of the job market for new doctorates are similar to the patterns seen in the 1992 Survey. For example, Table 3B shows that persons hired for positions in doctorate-granting mathematics departments are drawn predominantly from mathematics doctorates: 91 percent of the positions filled in Groups I, II, and III are held by new doctorates who received their degree from a Group I, II, or III department. Similarly, 95 percent of the Group IV jobs went to Group IV degree recipients. Also, 83 percent of the Group I jobs went to Group I degree recipients.

Associated with the dependence of employment patterns on the type of department from which the doctorate is received are differing patterns of employment for men and women. Women represent 23.9 percent of the population of new doctorates, up from 21.2 percent in 1991–1992, but the proportion is not uniform across different types of departments. For example, 22.4 percent of the new doctorates in mathematics are women (up from 20 percent last year) and 27.9 percent of the new doctorates from statistics departments are women (up from 26.6 percent last year). The proportion of women among new doctorates hired by doctorate-granting mathematics departments (25.6 percent) is slightly higher than their proportion among mathematics doctorates. The rate of unemployment for the female new doctorates (9.8 percent) is lower than the rate for the male new doctorates (13.2 percent).

Table 3B shows different rates of unemployment for doctorate recipients from the five Groups. The percentages unemployed, among those whose employment status is known, are Group I–11.6 percent, Group II–18.8 percent, Group III–14.8 percent, Group IV–5.2 percent, and Group V–15.3 percent.

Table 3C shows the pattern of employment within broad job categories broken down by the citizenship status of the new doctorates from U.S. institutions. The citizenship status is known for 1193 of the 1202 new doctorates. The rate of unemployment is higher for non-U.S. citizens (14.2 percent of those whose job status is known) than it is for U.S. citizens (10.0 percent). The unemployment rate for U.S. citizens is 1.4 percentage points below the level reported in November 1992 for 1991–1992 new doctorates. The percentage of U.S. citizens in U.S. nonacademic jobs is considerably higher than the percentage of noncitizens in the same category (20.5 percent of citizens versus 12.2 percent of noncitizens whose job status is known). The percentages of U.S. citizens and of non-U.S. citizens holding positions in U.S. doctorate-granting departments are approximately the same (24 percent), while citizens hold positions in non-doctorate granting U.S. departments in substantially higher proportion than do noncitizens (37.3 percent of citizens compared to 16.7 percent of noncitizens); here

all percentages exclude new doctorates whose job status is unknown.

If complete information about the visa status of the non-U.S. citizens were known, then it would be more natural and common to group those holding permanent-resident status with the U.S. citizens for the comparison of employment patterns. However, the visa status is unknown for many of the non-U.S. citizens simply because this is a detail of their immigration status which is not always known to departmental staff; visa status is not known for 28 percent of the non-U.S. citizens.

Nonetheless, the distribution of job categories was reported for 93 noncitizen new doctorates who are known to be permanent U.S. residents. Of those whose employment status is known, 14 percent are employed by a doctorate-granting department in the U.S., 30 percent are employed by a non-doctorate granting department in the U.S., 20 percent hold a nonacademic position in the U.S., and 28 percent are unemployed.

**TABLE 3C: Employment Status of 1992–1993 U. S. New Doctorates by citizenship status\***

TYPE OF EMPLOYER	TYPE OF CITIZENSHIP				TOTAL DOCTORATES WHOSE CITIZENSHIP IS KNOWN*	
	U.S. Citizens		Non-U.S. Citizens		Number	Percent
	Number	Percent	Number	Percent		
U.S. Academic, Ph.D. Department	117	22	133	20	250	21
U.S. Academic, non-Ph.D. Department	180	34	93	14	273	23
U.S. Research Institute	16	3	13	2	29	2
U.S. Nonacademic	99	19	68	10	167	14
Foreign Academic	15	3	140	21	155	13
Foreign Nonacademic	2		20	3	22	2
Not seeking employment	5	1	10	1	15	1
Still seeking employment	48	9	79	12	127	11
Unknown status (U.S. address)	39	7	56	8	95	8
Unknown status (foreign address)	1		59	9	60	5
<b>TOTALS</b>	<b>522</b>	<b>100%**</b>	<b>671</b>	<b>100%**</b>	<b>1193</b>	<b>100%**</b>

\* The adjusted total varies from that on Table 5 because the data are gathered on different surveys.

\*\* Column percents are rounded to the nearest whole percent.

### Acknowledgments

The Annual AMS-IMS-MAA Survey attempts to provide an accurate appraisal and analysis of various aspects of the academic mathematical sciences scene for the use and benefit of the community and for filling the information needs of the professional organizations. Every year, college and university departments in the United States are invited to respond. The Annual Survey relies heavily on the conscientious efforts of the dedicated staff members of these departments for the quality of its information. On behalf of the AMS-IMS-MAA Data Committee and the Annual Survey staff, I thank the many secretarial and administrative staff members in the mathematical sciences departments for their cooperation and assistance in responding to the survey questionnaires.

Several people have made essential contributions to the preparation of the reports on the 1993 Annual AMS-IMS-MAA Survey. Elizabeth Foulkes has provided indispensable support and taken many initiatives to facilitate the Data Committee's work. Elizabeth Foulkes and Jim Maxwell share credit for the companion articles on starting salaries of new doctorates and on faculty salaries.

**TABLE 4A: Sex, Racial/Ethnic Group, and Citizenship of U.S. New Doctorates**  
July 1, 1992 — June 30, 1993

RACIAL/ETHNIC GROUP	MEN					WOMEN					TOTAL
	CITIZENSHIP				Total Men	CITIZENSHIP				Total Women	
	U.S.	Canada	Other	Not Known		U.S.	Canada	Other	Not Known		
Asian, Pacific Islander	22	1	339	3	365	11		77		88	453
Black	4	1	10		15	3		1		4	19
American Indian, Eskimo, Aleut Mexican American, Puerto Rican, or other Hispanic			30		30	4		14		18	48
White (non-Hispanic)	343	8	144		495	126	3	42		171	666
Unknown	12			2	14	1	1			2	16
Total	381	10	523	5	919	145	4	134		283	1202

### Sex, Racial/Ethnic Group, and Citizenship of U.S. New Doctorates, 1992–1993

Table 4A presents a breakdown according to sex, racial/ethnic group, and citizenship of the new doctorates. The information reported in this table was obtained in summary form from the departments granting the degrees and in a few cases from the recipients themselves.

The citizenship status is known for 1197 of the 1202 new doctorates, including 526 U.S. citizens. (Because different survey forms are used to compile the summary of sex, race, and citizenship than are used to learn the country of citizenship of each individual, and the unknown or missing items from the two survey forms may not coincide, this count of known citizenship status and of U.S. citizens differs from the count shown in Table 3C.) The number of U.S. citizen new doctorates is 22.3 percent greater than in 1991–1992. This year's count of U.S. citizens is the highest reported since 1981–1982. Table 5 shows the changes from year to year in the numbers and proportions of U.S. citizens.

The percentage of U.S. citizens among the new doctorates is 43.9 percent, up from the all-time low of 42.3 percent in 1991–1992. A total of 671 noncitizens were awarded doctorates by U.S. institutions in 1992–1993. This represents an increase of 85 individuals (14.5 percent) from last year's count. The 1992–1993 count is 132 percent greater than the number awarded by U.S. institutions ten years ago (289 in 1982–1983).

The areas of the world from which noncitizen new doctorates come are reported in Table 4B. (Table 4B is based on the survey of individual data, not on the summary survey used for Table 4A.) To show how the distribution of region of citizenship has changed, Table 4B also reports the percentage change in numbers for each region from the baseline period of 1983–1986. This four-year period in the mid-1980s was a time when the total number of new doctorates was relatively stable and near its recent low, the number of U.S. citizen new doctorates was declining moderately, and the sharp rise in the number of non-U.S. citizens had barely begun.

Among the U.S. citizens receiving doctoral degrees in the mathematical sciences, 7 are black (4 men and 3 women) and

4 are Mexican American, Puerto Rican, or other Hispanic (all women). Both of these counts are essentially the same as last year's counts.

Women account for 28 percent of the U.S. citizens receiving doctoral degrees in the mathematical sciences from U.S. universities. This is the highest percentage ever reported. The total number of U.S. citizen women (145) is the highest number ever reported, eclipsing last year's count by 42 (up 41 percent). See Table 6. Only a small part of the increased count can be attributed to the higher response rate in Group IV. In all types of departments the percentage of women among recipients of new doctorates increased, as described in the previous section with reference to Table 3B.

Note that in Table 5 and Table 6 all years prior to 1982–1983 include doctorates granted by computer science departments.

**TABLE 4B: Region of Citizenship of 1992–1993 U.S. New Doctorates**

GEOGRAPHICAL REGION	Number	% Change from 1983–86 Annual Average
U.S.A.	522	+26
Canada	15	+36
Central and South America	49	+36
Western Europe	84	+107
Eastern Europe*	40	+272
Middle East	36	-12
Southern Asia**	64	+65
Far East***	338	+193
Africa	26	+24
Australia and Oceania****	19	+58
Unknown country of citizenship	9	—
Total	1202	+61

\* Including European Republics of the former Soviet Union. The distinction between "east" and "west" for European countries is determined by the political geography of 1945–1991.

\*\* Bounded by Iran to the west, by the former Soviet Union and China to the north, and by Indochina to the east.

\*\*\* Including Indochina.

\*\*\*\* Including Central and South Pacific islands, Australia, New Zealand, and the Malay Archipelago.

**TABLE 5: U.S. Citizen Doctorates**

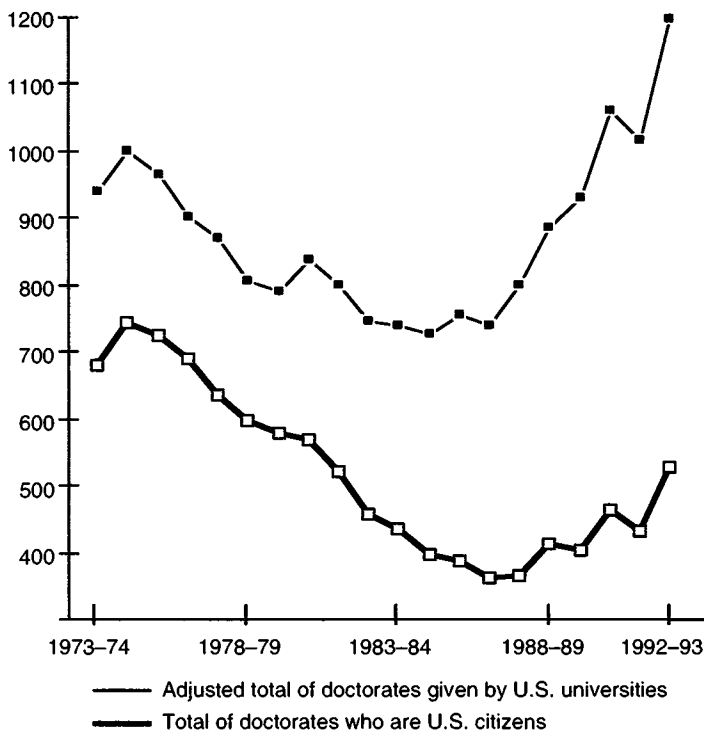
	Adjusted Total* of Doctorates Given by U.S. Universities	Total of Doctorates who are U.S. Citizens	%
1973-1974	938	677	72
1974-1975	999	741	74
1975-1976	965	722	75
1976-1977	901	689	76
1977-1978	868	634	73
1978-1979	806	596	74
1979-1980	791	578	73
1980-1981	839	567	68
1981-1982	798	519	65
1982-1983	744	455	61
1983-1984	738	433	59
1984-1985	726	396	55
1985-1986	755	386	51
1986-1987	739	362	49
1987-1988	798	363	45
1988-1989	884	411	46
1989-1990	929	401	43
1990-1991	1061	461	43
1991-1992	1016	430	42
1992-1993	1197	526	44

\*Number of doctorates whose citizenship is known. Total will vary from that on Table 3C because the data are gathered on different surveys.

**Graph for Table 5: U.S. Citizen Doctorates  
Total of Doctorates by Percent**



**Graph for Table 5: U.S. Citizen Doctorates**

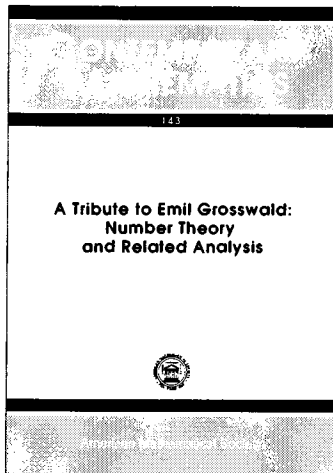


**TABLE 6: U.S. Citizen Doctorates, Male and Female**

	Doctorates who are U.S. Citizens	Male	Female	% Female
1973-1974	677	618	59	9
1974-1975	741	658	83	11
1975-1976	722	636	86	12
1976-1977	689	602	87	13
1977-1978	634	545	89	14
1978-1979	596	503	93	16
1979-1980	578	491	87	15
1980-1981	567	465	102	18
1981-1982	519	431	88	17
1982-1983	455	366	89	20
1983-1984	433	346	87	20
1984-1985	396	315	81	20
1985-1986	386	304	82	21
1986-1987	362	289	73	20
1987-1988	363	287	76	21
1988-1989	411	313	98	24
1989-1990	401	312	89	22
1990-1991	461	349	112	24
1991-1992	430	327	103	24
1992-1993	526	381	145	28

## Bibliography

- Albers, D. J., Loftsgaarden, D. O., Rung, D. C., and Watkins, A. E. *Statistical Abstract of Undergraduate Programs in the Mathematical Sciences and Computer Science in the U.S., 1990–1991 CBMS Survey*, MAA Notes No. 23, 1992.
- American Association of University Professors. *The Annual Report on the Economic Status of the Profession 1990–1991*, Academe: Bulletin of the AAUP, March/April 1991, Washington, DC.
- Bowen, W. G. and Rudenstine, N. L. *In Pursuit of the Ph.D.*, Princeton, NJ: Princeton University Press, 1992.
- Commission on Professionals in Science and Technology. Occasional Papers, prepared by Betty M. Vetter. *Supply and Demand for Engineers in the 1990s (90–1)*, April 1990. *Who is in the Pipeline? Science, Math, and Engineering Education (90–2)*, July 1990. *Recruiting Doctoral Scientists and Engineers for the Twenty-first Century (90–3)*, October 1990. *Women in Science and Engineering, An Illustrated Progress Report (90–4)*, December 1990. *Recruiting and Retaining a Diverse, Quality Technical Workforce (91–1)*, April 1991. *By the Year 2000: Myths and Facts (91–2)*, July 1991. *Cultural Diversity in Higher Education (91–3)*, October 1991. *Supply and Demand in Science and Engineering (91–4)*, January 1992. *American Minorities in Science and Engineering (92–1)*, April 1992. *Foreign Citizens Among U.S. Scientists and Engineers (92–2)*, July 1992. *What's Holding Up the Glass Ceiling? Barriers in the Workforce (92–3)*, October 1992. *Setting the Record Straight: Shortages in Perspective (92–4)*, January 1993. *New Technologies: Impact on Work, Workers, and the Workplace. (93–1)*, July 1993. CPST, Washington, DC.
- . *Salaries of Scientists, Engineers, and Technicians: A Summary of Salary Surveys*, 16th Ed., Washington, DC, 1993.
- . *Professional Women and Minorities—1992*. Washington, DC, 1992.
- . *Preparing for the 21st Century: Human Resources in Science and Technology*. Proceedings of a Symposium, March 26–27, 1992, Washington, DC, July 1992.
- Jackson, A. *Top Producers of Women Mathematics Doctorates*, Notices of the AMS, September 1991.
- Madison, B. and Hart, T. A. *A Challenge of Numbers: People in the Mathematical Sciences*. National Academy Press, Washington, DC, 1990.
- McClure, D. E. *Academic Hiring Survey, 1991–1992*, Notices of the AMS, April 1992.
- National Research Council. *Summary Report 1992, Doctorate Recipients from U. S. Universities*, National Academy Press, Washington, DC, 1993.
- . *Moving Beyond Myths: Revitalizing Undergraduate Mathematics*, National Academy Press, Washington, DC, 1991.
- . *Everybody Counts: A Report to the Nation on the Future of Mathematics Education*, National Academy Press, Washington, DC, 1989.
- . *Renewing U.S. Mathematics: A Plan for the 1990s*. National Academy Press, Washington, DC, 1990.
- National Science Board. *Science and Engineering Indicators—1991*. U.S. Government Printing Office, Washington, DC, 1991 (NSB 91–1).
- National Science Foundation. *Science and Technology Data Book*, NSF 92–331, National Science Foundation, Washington, DC, 1992.
- . *Science and Engineering Degrees: 1970–90*, NSF 92–327, Washington, DC, 1992.
- . *Science and Engineering Doctorate Awards: 1991*, NSF 92–309, Selected Data Tables, Washington, DC, 1992.
- . *Science and Engineering Doctorates: 1960–1991*, NSF 93–301, Detailed Statistical Tables, Washington, DC, 1993.
- . *Academic Science and Engineering: Graduate Enrollment and Support, 1989*, NSF 90–324, Detailed Statistical Tables, Washington, DC, 1991.
- . *Selected Data on Graduate Students and Postdoctorates in Science and Engineering, Fall 1991 (NSF 92–335)*. Selected Pamphlet No. 11: Institutional Listings (NSF 90–324–11); Selected Pamphlet No. 12: Postdoctorates and Other Nonfaculty Research Staff (NSF 90–324–12), Washington, DC, 1990.
- . *Survey of Mathematics and Statistics Departments at Higher Education Institutions*. Higher Education Surveys Report, Survey Number 5, December 1990.
- . *Foreign Participation in U.S. Academic Science and Engineering: 1991*, NSF 93–302, Washington, DC, 1993.



## Contemporary Mathematics, Volume 143

### A Tribute to Emil Grosswald: Number Theory and Related Analysis

Marvin Knopp and Mark Sheingorn, *Editors*

With contributions by some of the leading contemporary researchers in number theory, modular functions, combinatorics, and related analysis, this book will be of interest to graduate students and specialists in these fields. The high quality of the articles and their close connection to current research trends make this volume a must for any mathematics library.

1991 *Mathematics Subject Classification*: 05, 11, 14, 33  
**ISBN 0-8218-5155-1**, 612 pages (softcover), March 1993  
 Individual member \$47, List price \$79, Institutional member \$63  
 To order, please specify CONM/143NA

All prices subject to change. Free shipment by surface: for air delivery, please add \$6.50 per title. *Prepayment required*. Order from: American Mathematical Society, P.O. Box 5904, Boston, MA 02206-5904, or call toll free 800-321-4AMS in the U.S. and Canada to charge with VISA or MasterCard. Residents of Canada, please include 7% GST.



## Salary Survey for New Recipients of Doctorates, 1992–1993

The figures for 1993 were compiled from questionnaires sent to individuals who received doctorates in the mathematical sciences during the 1992–1993 academic year from universities in the United States.

Questionnaires requesting information on salaries and professional experience were distributed to 921 recipients of degrees using addresses provided by the departments granting the degrees. 381 individuals returned forms between late June and mid-September. Responses with insufficient data, or from individuals who indicated they had part-time employment, were not yet employed, or were not seeking employment, were considered unusable. Numbers of usable responses for each salary category are reported in the following tables.

Readers should be warned that the data in this report are obtained from a self-selected sample, and inferences from them may not be representative of the population.

**Key to Tables.** *Salaries* are listed in hundreds of dollars. Nine-month salaries are based on 9–10 months teaching and/or research, not adding extra stipends for summer grants or summer teaching or the equivalent. *Years* listed refer to the academic year in which the doctorate was received. *M* and *F* are Male and Female respectively. *One year or less experience* means that the persons had experience limited to one year or less in the same position or a position similar to the one

reported; some persons receiving a doctorate had been employed in their present position for several years. Quartile figures are given only in cases where the number of responses is large enough to make them meaningful.

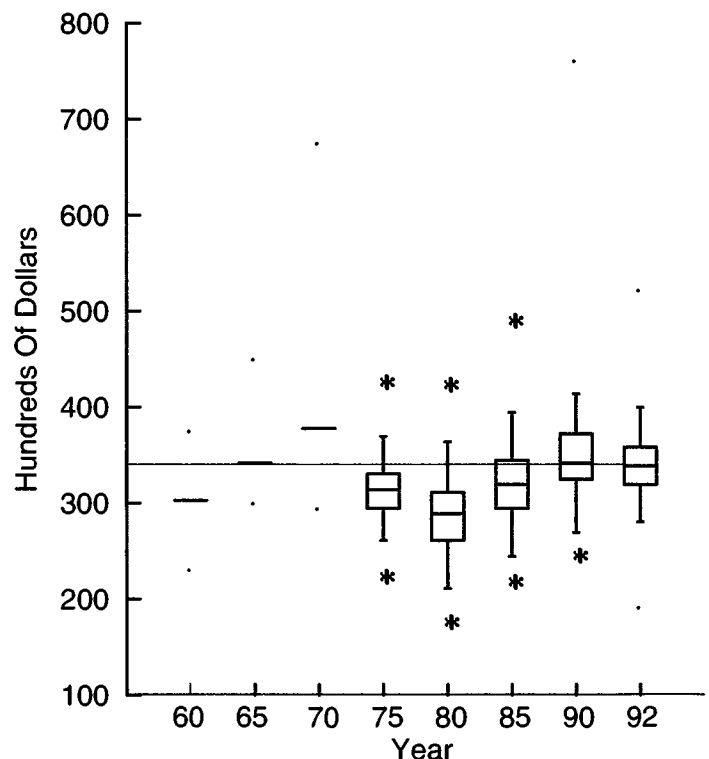
**Graphs.** The graphs show variants of standard box plots summarizing salary distribution information. The horizontal line shows the 1992 median salary in hundreds of dollars. Values plotted for other years are converted to 1992 dollars using the implicit price deflator prepared annually by the Bureau of Economic Analysis, U.S. Department of Commerce. The 1993 salary data are not shown on the graphs because the deflator is not yet available for this year.

For a given year, the box shows the first and third quartiles and the median salary. (Prior to 1975, the quartiles are not available, and only the median is depicted by the horizontal stroke.) The “whiskers” give additional information about the spread of the data, extending to points that are 1.5 interquartile distances from the median. Minimum and maximum salaries are depicted by asterisks or dots outside the whiskers; dots are used to distinguish extreme outliers, i.e., values that are more than 3 interquartile distances from the median.

Note that salaries for teaching or teaching and research have yet to return to their high point of 1970, although considerable progress has been made since 1980.

Nine-Month Salaries						
Ph.D. Year	Min	Q <sub>1</sub>	Median	Q <sub>3</sub>	Max	Reported Median in 1992 \$
TEACHING OR TEACHING AND RESEARCH (125 men + 50 women)						
1960	49		65		80	303
1965	70		80		105	341
1970	85		110		195	378
1975	90	120	128	135	173	315
1980	105	155	171	185	250	289
1985	170	230	250	270	380	321
1990	230	305	320	350	710	342
1991	150	310	330	360	610	340
1992	190	320	340	360	520	340
1993	160	310	340	370	750	—
<hr/>						
1990M	230	306	320	350	710	
1990F	250	300	325	360	493	
<hr/>						
1991M	150	310	330	360	610	
1991F	260	310	332	360	550	
<hr/>						
1992M	190	310	340	360	520	
1992F	250	330	349	371	500	
<hr/>						
1993M	160	310	340	370	750	
1993F	230	310	338	380	520	
<hr/>						
One year or less experience (91 men + 36 women)						
1993M	210	308	340	368	750	
1993F	250	311	334	367	422	

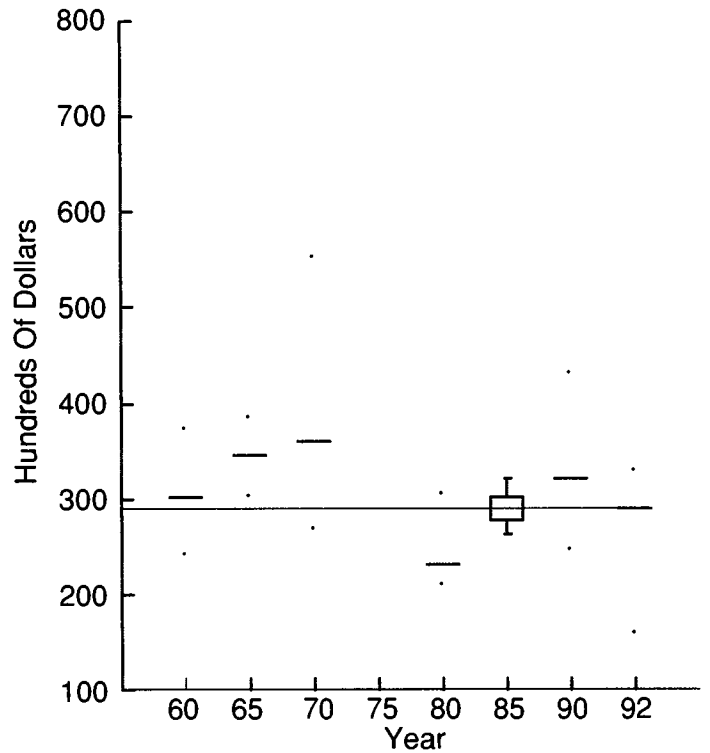
Nine-Month Teaching or Teaching and Research



**Nine-Month Salaries**

Ph.D. Year	Min	Median	Max	Reported Median in 1992 \$
<b>RESEARCH (5 men + 1 woman)</b>				
1960	52	65	80	303
1965	71	81	90	345
1970	78	105	160	361
1975	100	—	110	—
1980	125	137	180	231
1985	205	235	250	302
1990	230	300	404	321
1991	260	295	470	304
1992	160	290	330	290
1993	260	298	380	—
<hr/>				
1990M	230	300	404	
1990F	—	—	—	
<hr/>				
1991M	260	290	360	
1991F	—	—	—	
<hr/>				
1992M	160	290	330	
1992F	—	—	—	
<hr/>				
1993M	260	275	320	
1993F	—	—	—	
<hr/>				
One year or less experience (4 men + 1 woman)				
1993M	260	298	320	
1993F	—	—	—	

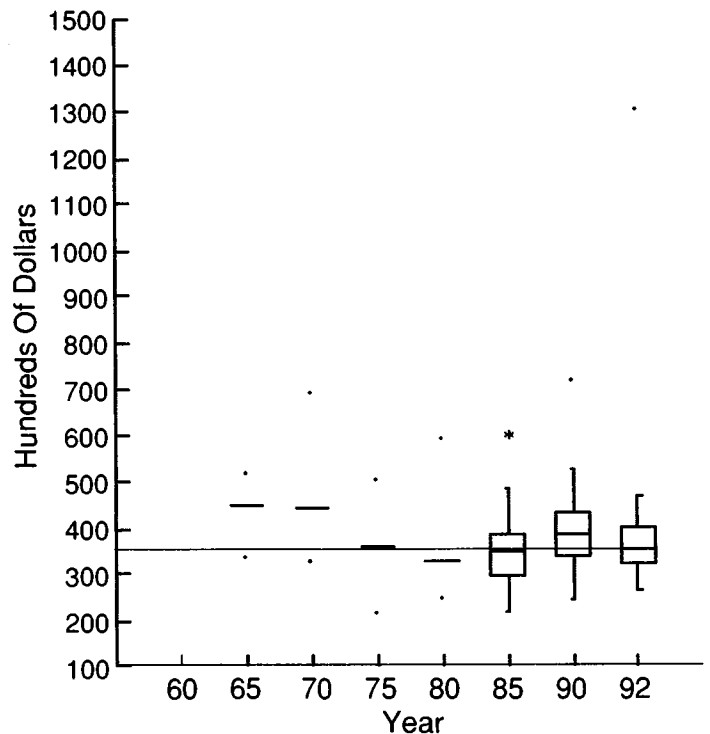
**Nine-Month Research**



**Twelve-Month Salaries**

Ph.D. Year	Min	Q <sub>1</sub>	Median	Q <sub>3</sub>	Max	Reported Median in 1992 \$	
<b>TEACHING OR TEACHING AND RESEARCH (7 men + 6 women)</b>							
1960	No data						
1965	78		104		121	444	
1970	95		128		200	440	
1975	87		145		204	357	
1980	143		195		350	329	
1985	220	230	273	300	470	350	
1990	225	318	365	404	670	390	
1991	290	310	350	408	758	360	
1992	265	325	355	402	1300	355	
1993	300	355	370	500	680	—	
<hr/>							
1990M	225	316	360	400	670		
1990F	250	320	383	420	425		
<hr/>							
1991M	290	310	350	400	530		
1991F	300	310	472	530	758		
<hr/>							
1992M	300	330	355	420	1300		
1992F	—	—	—	—	—		
<hr/>							
1993M	360	427	500	505	680		
1993F	300	334	353	370	370		
<hr/>							
One year or less experience (5 men + 6 women)							
1993M	360	389	464	500	510		
1993F	300	334	353	370	370		

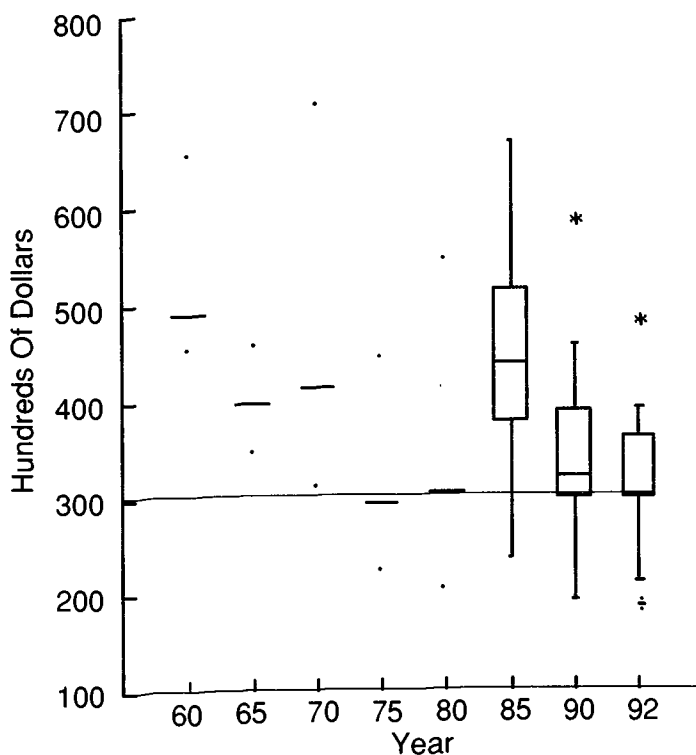
**Twelve-Month Teaching or Teaching and Research**



**Twelve-Month Salaries**

Ph.D. Year	Min	Q <sub>1</sub>	Median	Q <sub>3</sub>	Max	Reported Median in 1992 \$
<b>RESEARCH (11 men + 8 women)</b>						
1960	97		105		140	489
1965	81		93		107	397
1970	90		120		205	413
1975	90		119		180	293
1980	120		180		321	304
1985	190	295	342	400	520	439
1990	180	280	300	365	546	321
1991	190	277	320	380	480	329
1992	186	300	302	360	480	302
1993	237	300	330	400	570	—
1990M	180	280	300	360	546	
1990F	330	330	365	400	400	
1991M	190	290	310	360	480	
1991F	240	272	340	405	450	
1992M	210	300	300	358	480	
1992F	186	250	370	380	400	
1993M	237	272	310	365	480	
1993F	300	330	365	400	570	
One year or less experience (9 men + 4 women)						
1993M	237	270	300	330	480	
1993F	300	315	330	355	380	

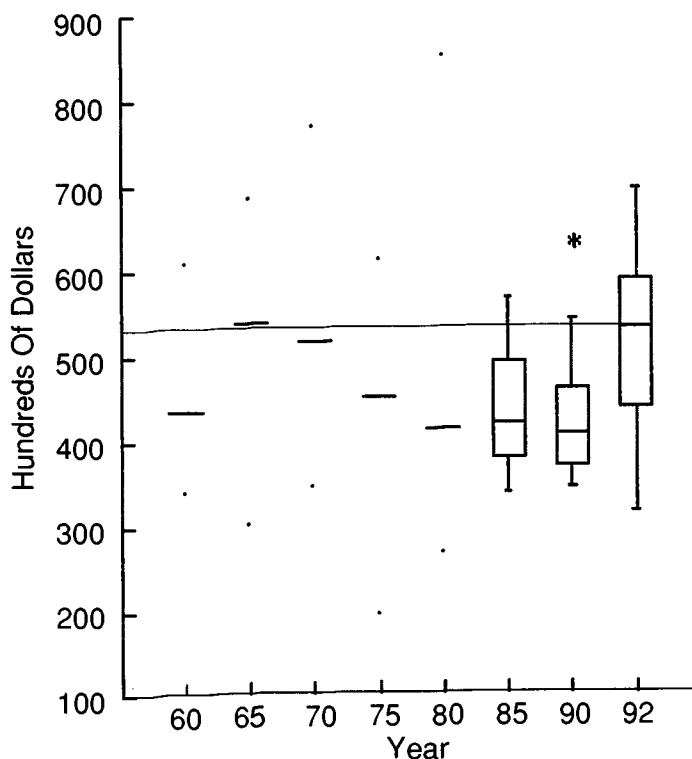
**Twelve-Month Research**



**Twelve-Month Salaries**

Ph.D. Year	Min	Q <sub>1</sub>	Median	Q <sub>3</sub>	Max	Reported Median in 1992 \$
<b>GOVERNMENT (8 men + 4 women)</b>						
1960	72		93		130	433
1965	70		126		160	537
1970	100		150		223	516
1975	78		182		247	448
1980	156		244		501	412
1985	263	294	325	381	440	417
1990	320	345	378	430	587	404
1991	230	365	423	497	630	435
1992	315	438	530	587	692	530
1993	300	378	412	571	800	—
1990M	320	345	375	430	587	
1990F	330	354	378	429	480	
1991M	230	345	424	497	630	
1991F	—	—	—	—	—	
1992M	315	419	460	615	692	
1992F	—	—	—	—	—	
1993M	300	402	480	611	800	
1993F	340	350	378	462	528	
One year or less experience (5 men + 4 women)						
1993M	300	400	404	540	620	
1993F	340	350	378	462	528	

**Twelve-Month Government**

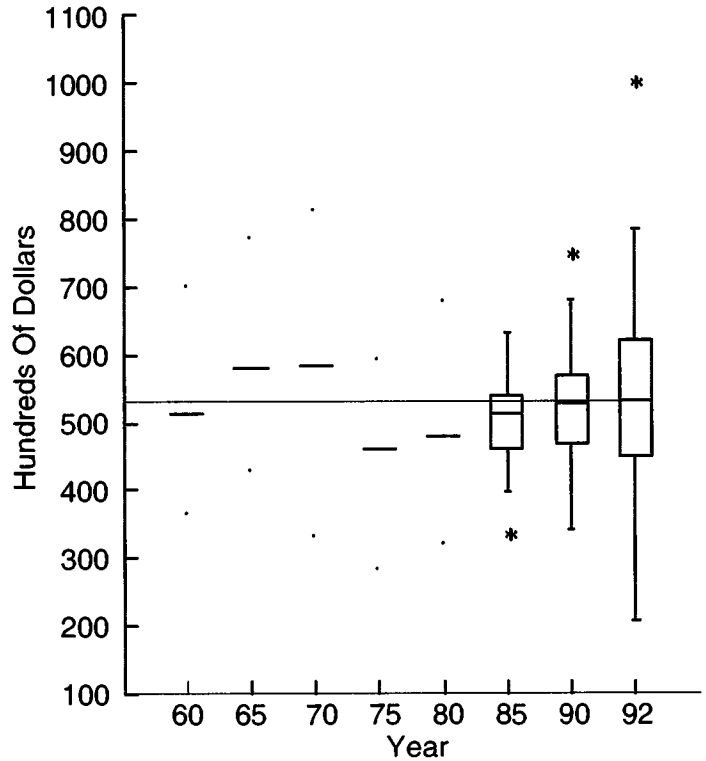




**Twelve-Month Salaries**

Ph.D. Year	Min	Q <sub>1</sub>	Median	Q <sub>3</sub>	Max	Reported Median in 1992 \$
<b>BUSINESS AND INDUSTRY</b> (33 men + 10 women)						
1960	78		110		150	512
1965	100		136		180	580
1970	96		170		235	585
1975	114		187		240	460
1980	190		284		400	480
1985	260	360	400	420	493	513
1990	320	438	495	533	700	529
1991	235	480	510	573	830	525
1992	208	450	530	620	1000	530
1993	270	480	560	600	1100	—
<hr/>						
1990M	320	443	490	533	630	
1990F	390	440	500	525	700	
<hr/>						
1991M	330	500	520	587	830	
1991F	235	420	481	554	720	
<hr/>						
1992M	300	440	520	625	1000	
1992F	208	528	549	591	850	
<hr/>						
1993M	270	500	560	600	1100	
1993F	424	475	568	600	670	
<hr/>						
One year or less experience (17 men + 7 women)						
1993M	270	480	543	600	700	
1993F	424	458	584	595	600	

**Twelve-Month Business and Industry**

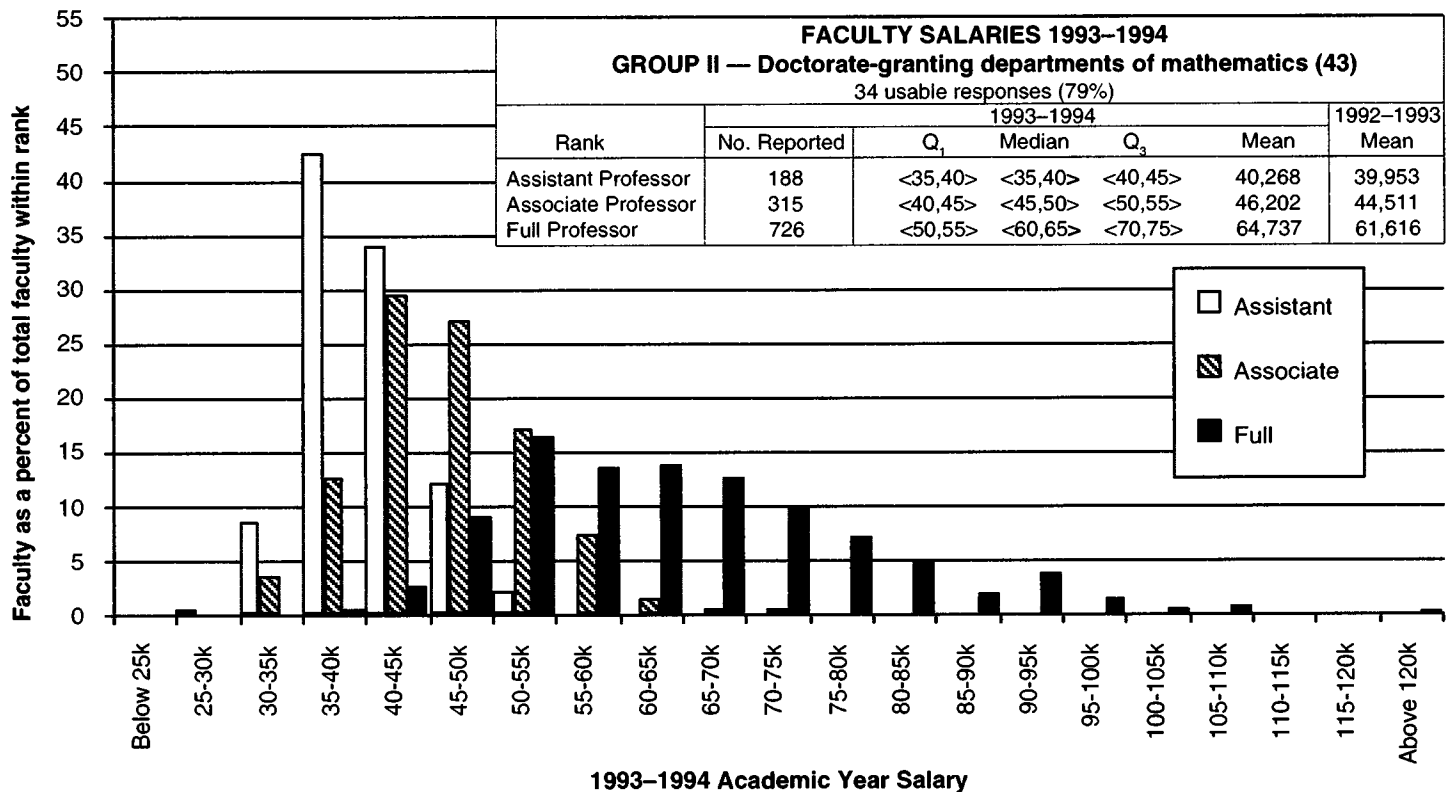
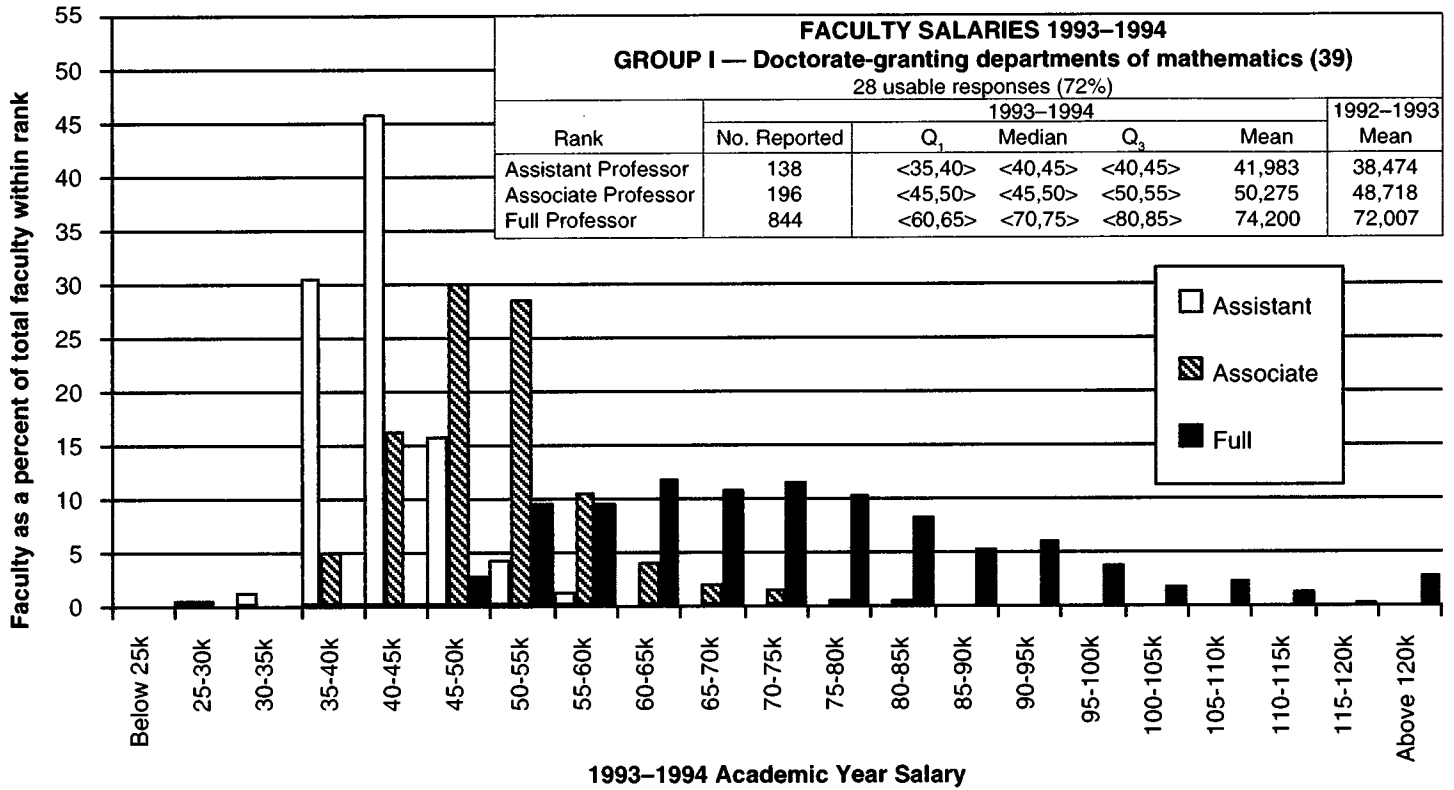


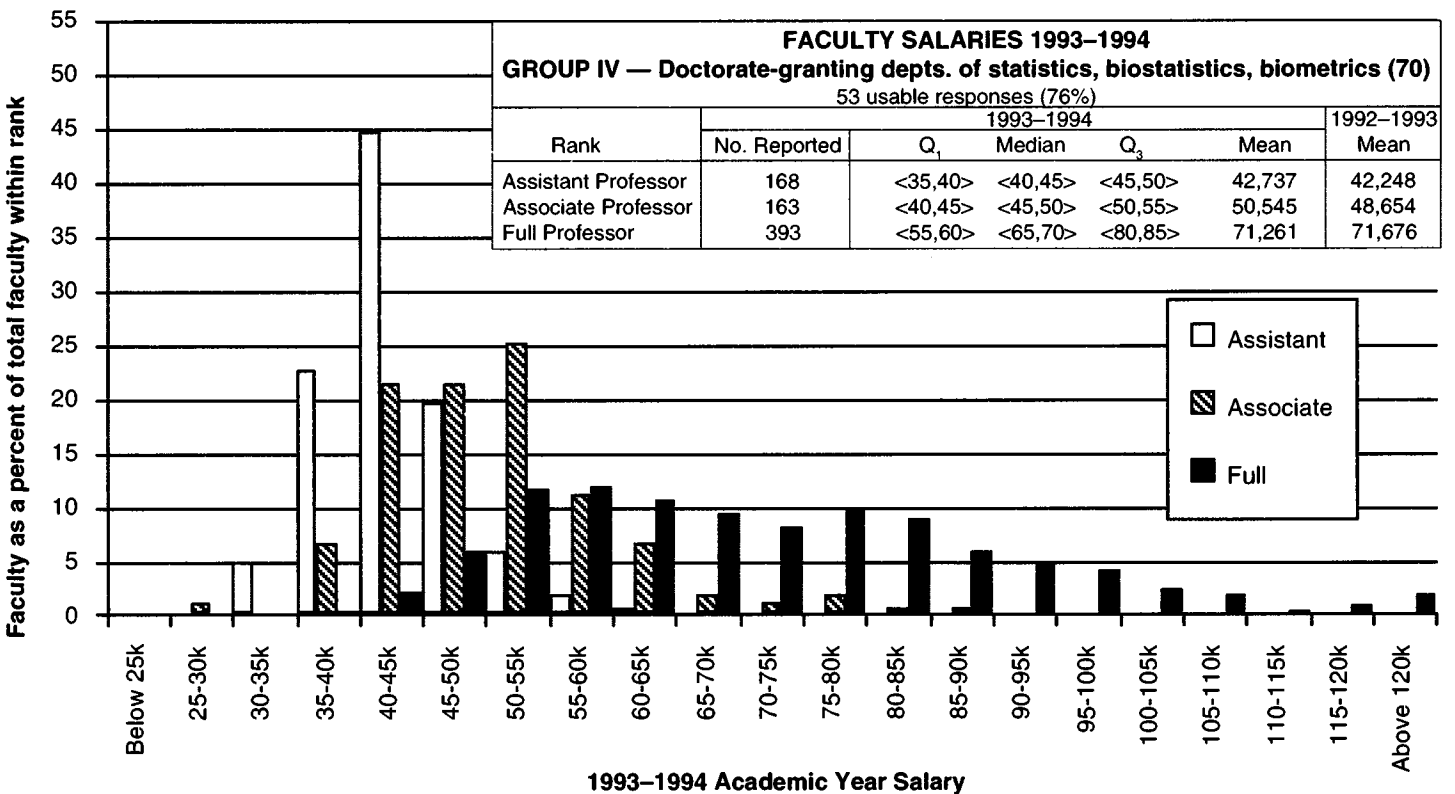
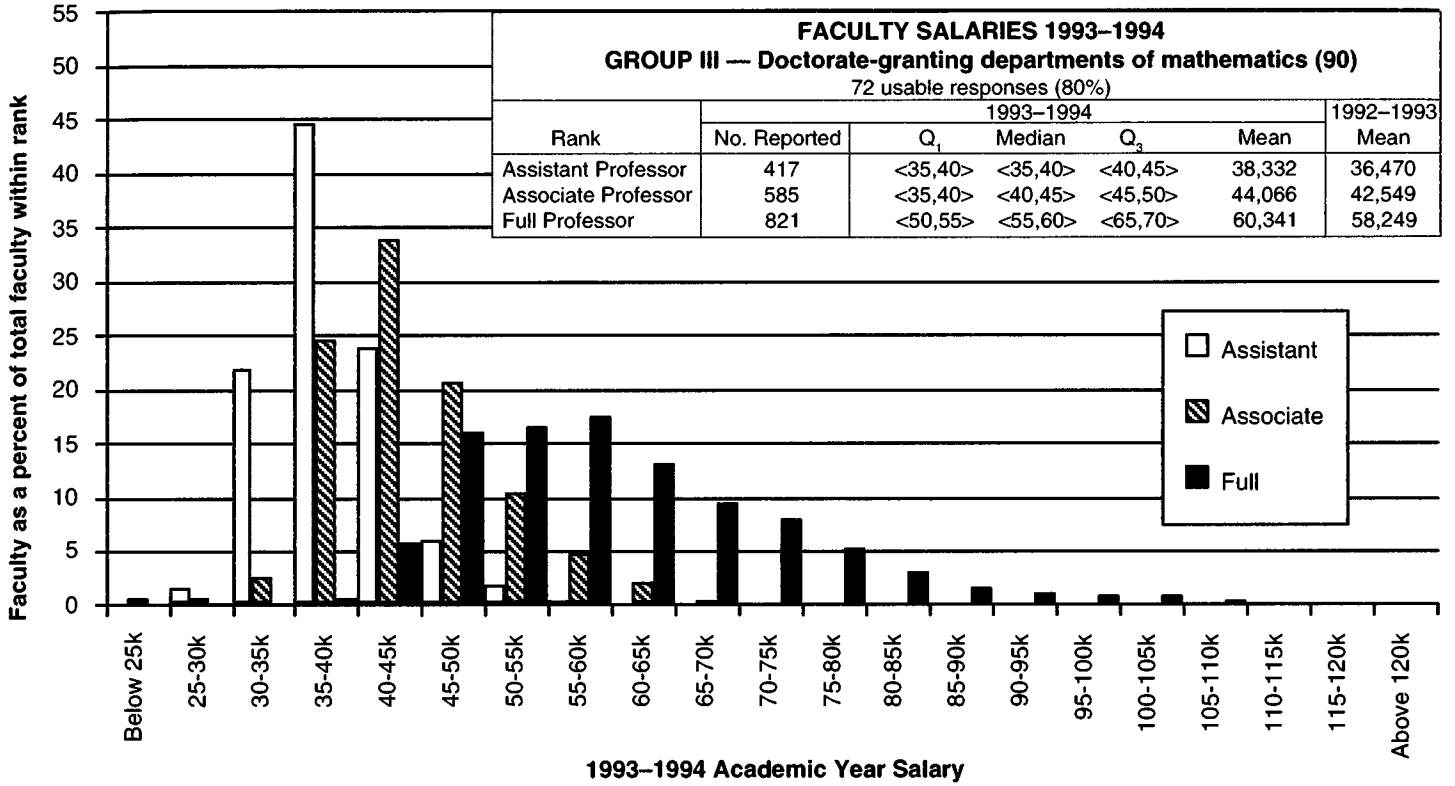
## Faculty Salary Survey 1993–1994 Salaries

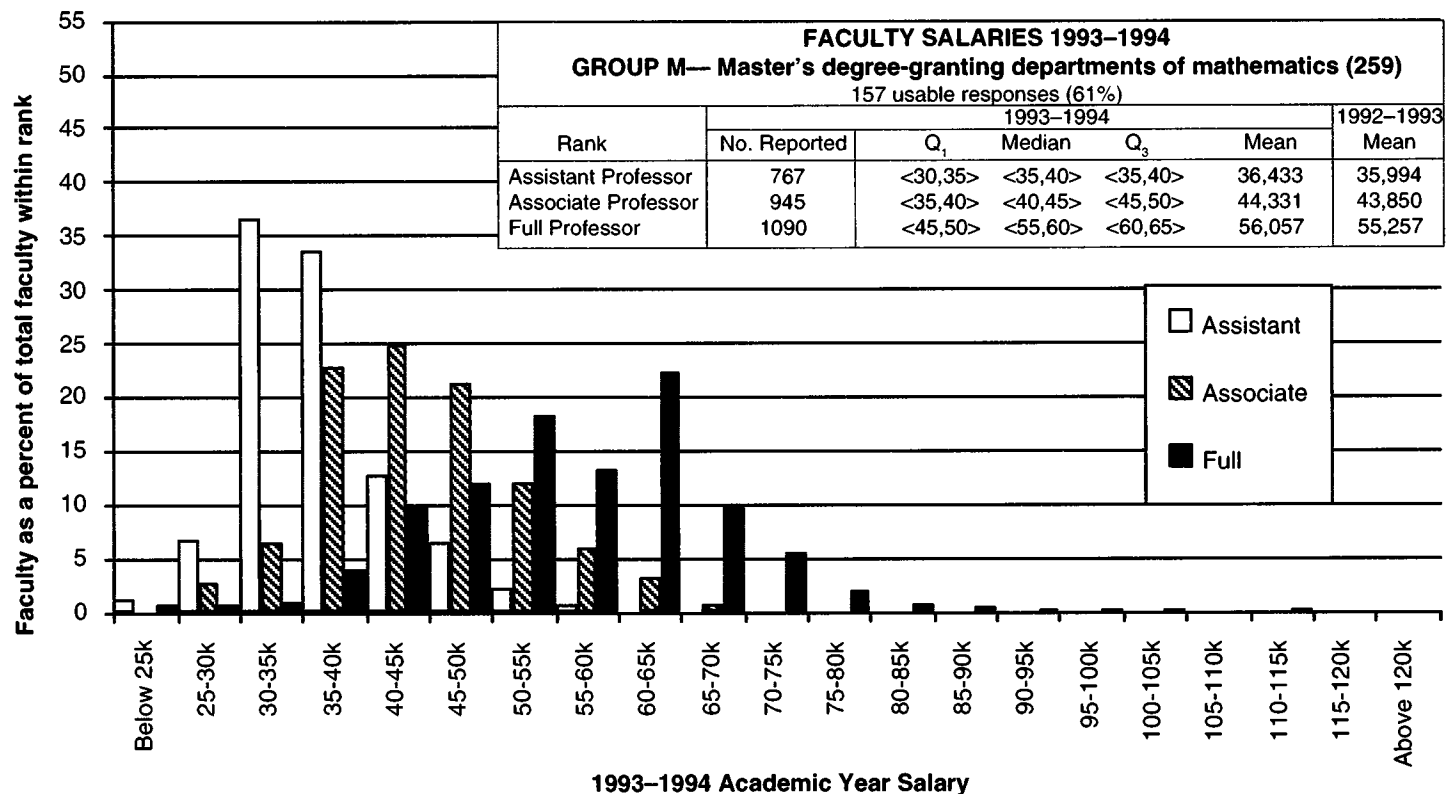
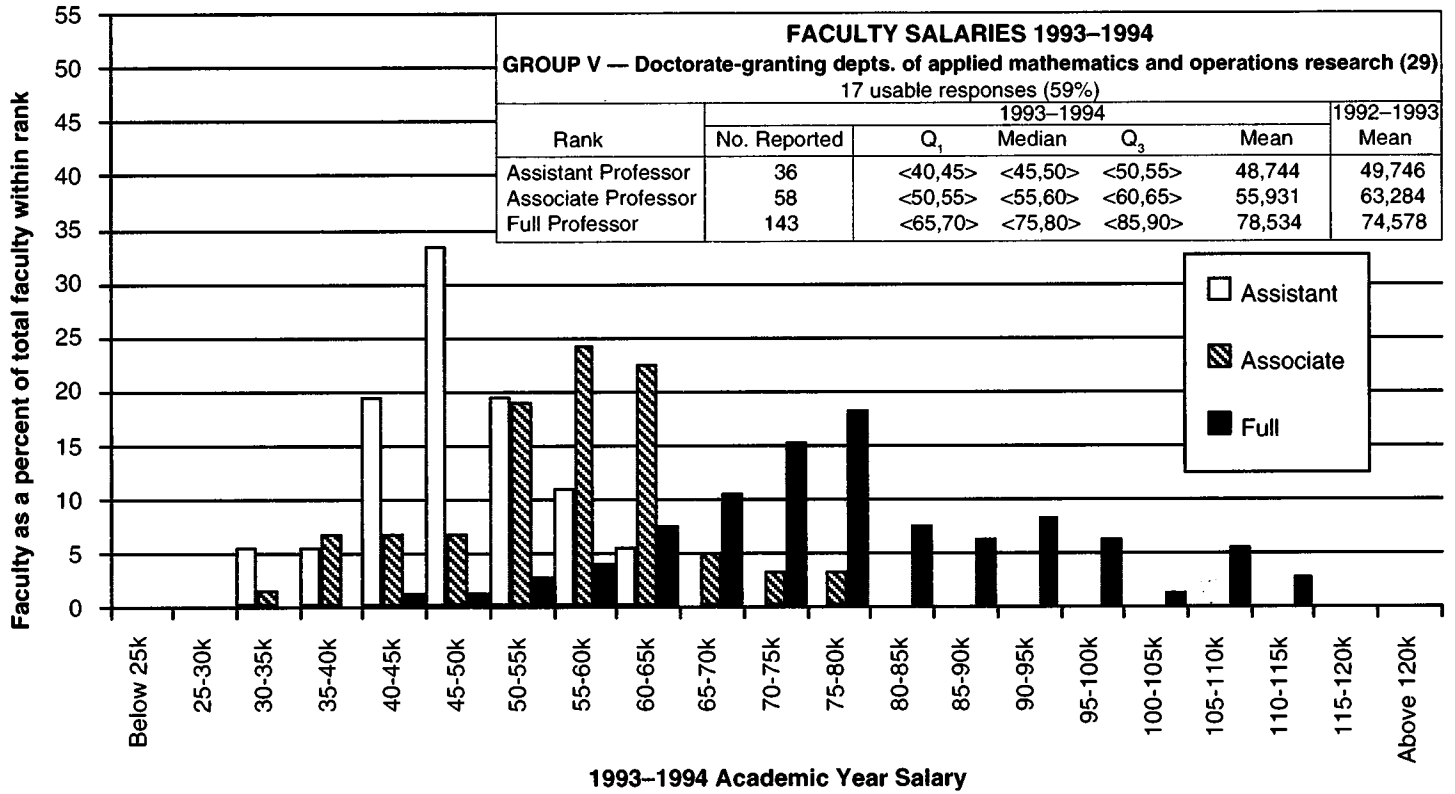
The charts on the following pages display faculty salary data for Groups I–V, M, and B: faculty salary distribution by rank, mean salaries by rank, information on quartiles by rank, and the number of usable returns for the group.

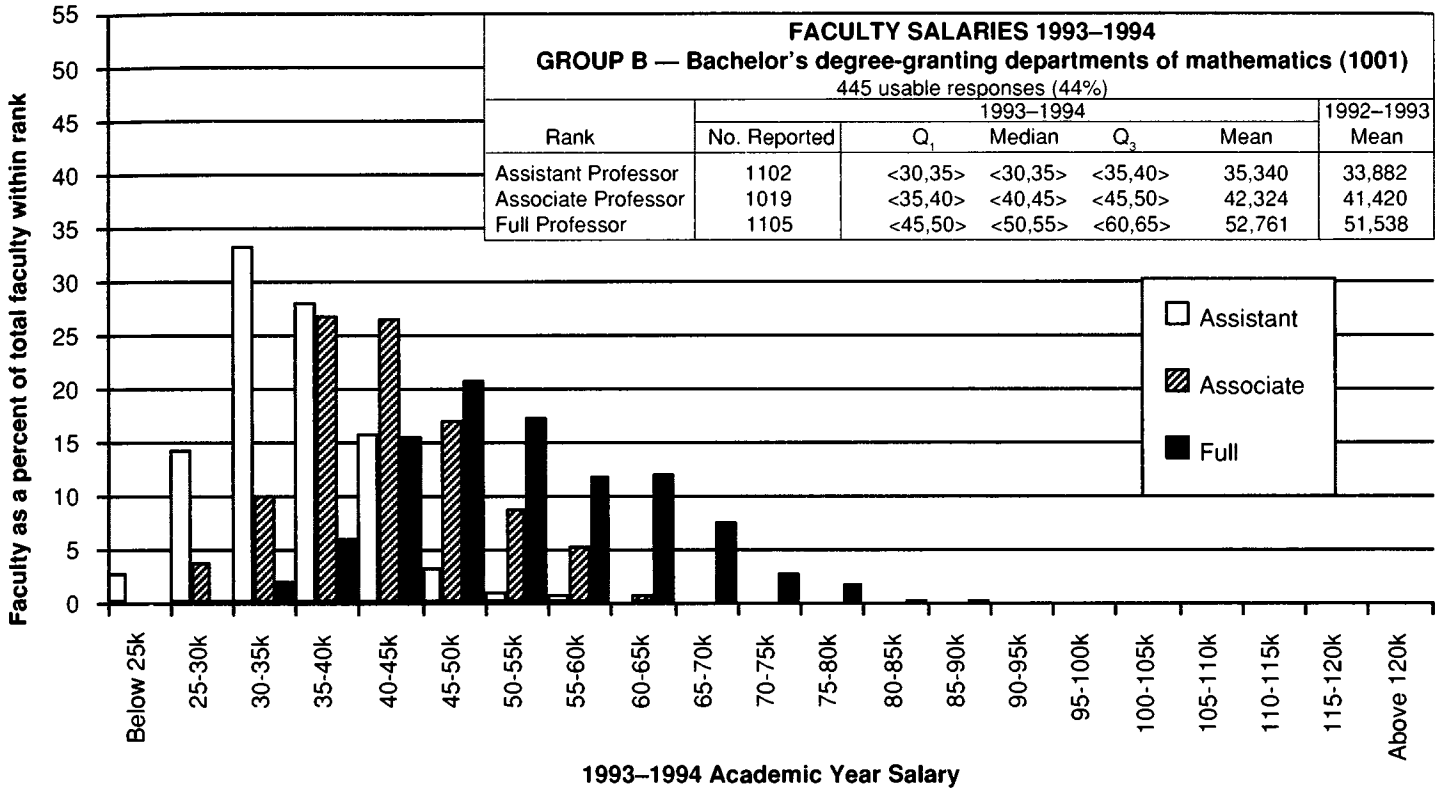
Departments were asked to report the number of faculty whose 1993–1994 academic-year salaries fell within given

salary intervals. Reporting salary data in this fashion eliminates some of the concerns about confidentiality but does not permit determination of actual quartiles. What can be determined is the salary interval in which the quartiles occur; the salary intervals containing the quartiles are denoted by <n,n>.









# Advertising in the *Notices*

## Classified Ads

Beginning in January 1994 classified advertising rates in the *Notices* will be \$70 per inch on a single column (one inch minimum), calculated from top of type; \$40 for each additional 1/2 inch or fraction thereof.

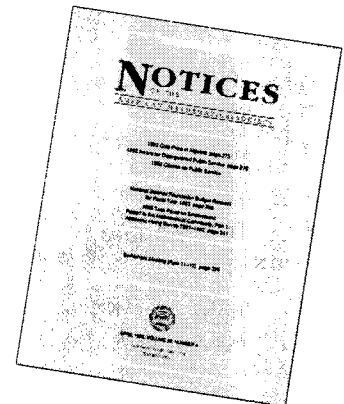
Advertisements in the "Positions Available" classified section are set with a minimum one-line headline, consisting of the institution name above body copy, unless additional headline copy is specified by the advertiser. Advertisements in other sections of the classified pages will be set according to the advertisement insertion.

Headlines are centered in boldface at **no extra charge**. Classified rates are calculated from the top of the type in the headline to the bottom of the type in the body copy, including lines and spaces within. Any fractional text will be charged at the next 1/2-inch rate.

## Display Ads

Display advertising is also available and can be accepted in camera-ready form or, for a minimal charge, can be typeset by our Promotions Department. Discounts are given for multiple insertions.

For complete details on advertising in the *Notices*, or in other publications, please call (401) 455-4084 or (800) 321-4AMS (3267). Direct your questions to Anne Newcomb, AMS, Promotions Department, P. O. Box 6248, Providence, RI 02940-6248 FAX 401-455-4004 e-mail aen@math.ams.org



## Doctoral Degrees Conferred 1992–1993

The following list contains the names and thesis titles of recipients of doctoral degrees in the mathematical sciences (July 1, 1992, to June 30, 1993) reported in the 1993 Annual AMS-IMS-MAA Survey by 219 departments in 142 universities in the United States. Each entry contains the name of the recipient and the thesis title. The number in parentheses following the name of the university is the number of degrees listed for that university. A supplementary list, containing names received since compilation of this list, will appear in a spring 1994 issue of the *Notices*.

### ALABAMA

#### Auburn University (1)

ALGEBRA, COMBINATORICS, AND ANALYSIS

Lange, Bernd, *On wavelets in  $L^2(\mathbb{R}^2)$  and complex planar splines*.

#### University of Alabama at Birmingham (3)

BIostatISTICS

Bass, John David, *A contribution to longitudinal data analysis: maximum quasi-likelihood generalized estimating equations*.

Russel, Carl M., *A simulation study of multivariate randomization testing applied to radiographic cephalometry*.

Tuamokumo, Francois O., *Statistical inference on the parameters of a generalized logistic distribution: Berkson's approach*.

#### University of Alabama, Huntsville (2)

MATHEMATICAL SCIENCES

England, David E., *A mathematical analysis of nocturnal slope flows*.

Johnson, Terri Wilhite, *Measures of domination and distance sets studied as prioritized multiproperty set problems*.

#### University of Alabama, Tuscaloosa (4)

APPLIED STATISTICS

Wade, Mark Russell, *A study of cause-selecting charts and Q-charts*.

MANAGEMENT SCIENCE AND STATISTICS

Caveny, Regina Smits, *Max-min allocation of a multi-item single machine production system with differential setup times*.

Ismail, Habib Ali, *Nonparametric comparison of treatments with a control: procedures based on the sign test*.

Miller, Diane, *A generalized architecture for intelligent reactive management systems*.

### ALASKA

#### University of Alaska, Fairbanks (1)

MATHEMATICAL SCIENCES

Lituanyi, Peter, *Transfer and Steenrod squares*.

### ARIZONA

#### Arizona State University (3)

MATHEMATICS

Lo, Eddisanter, *Numerical solution of neutral functional differential equations*.

Wen, Ixin, *Cohomology of permutation representations in combinatorial designs*.

Woo, Mahn Ling, *Parallel power-of-two fast Fourier transforms on a hypercube*.

#### University of Arizona (14)

APPLIED MATHEMATICS

Fierro, Leobardo, *Analysis of countercurrent exchange between paired blood vessels*.

Glasgow, Scott, *Velocity-tuned resonances in atomic diffraction by a standing wave light field*.

Moody, Marla, *Kriging of spatial data using constrained neighborhoods with kernel estimation as an auxiliary estimator*.

Porkorny, Martin, *The behavior of the spectrum of several quantum mechanical spin systems in the infinite volume limit*.

Rasmussen-Rhodes, Hannah, *Multivariate and geostatistical analysis of Phase I Eastern Lake survey data*.

Uribe, Guillermo, *On the relationships between discrete and continuous models for density-dependent size-structured population dynamics*.

MATHEMATICS

Ballot, Christian, *Density of prime divisors in linear recurring sequences*.

Cheng, Jian, *Horseshoes in the standard map*.

Files, Steve, *Mixed modules and endomorphisms over incomplete discrete valuation rings*.

Ke, Weng-Fong, *Structures of circular planar nearings*.

Liu, Zheng, *Dynamical system and its random perturbations*.

McShane, Janet, *Computation of polynomial invariants of finite groups*.

Zhu, Haolong, *Contributions to some areas in reliability theory*.

Zou, Mao Rong, *Geometry of two degree of freedom integrable Hamiltonian systems*.

### ARKANSAS

#### University of Arkansas at Fayetteville (3)

MATHEMATICAL SCIENCES

Lee, Hyun Woo, *Properties of solutions of a class of Volterra and functional differential equations*.

Weir, Gordon Barnett, *Ideal structure and positive operators on Banach lattices*.

Young, Paula Grafton, *The relationship of positive operators to various functional representations of Banach lattices*.

### CALIFORNIA

#### California Institute of Technology (3)

APPLIED MATHEMATICS

Ryan, Barry J., *Lie-Poisson integrators in Hamiltonian fluid mechanics*.

MATHEMATICS

Socrates, Jude Thaddeus U., *The quaternionic bridge between elliptic curves and Hilbert modular forms*.

Wang, Wensheng, *Carleman inequalities and unique continuation for higher order elliptic differential operators*.

#### Stanford University (27)

ENGINEERING-ECONOMIC SYSTEMS

Chan, Brian Y., *Structural controllability and observability in influence diagrams*.

Curtat, Laurent, *Supermodular stochastic games: existence and characterization of Markov equilibria*.

Fan, Stephen, *Technology, mobile capital, and strategic policies—a dynamic global capital market equilibrium study*.

Kumar, Shiv, *Location decisions for private facilities in the presence of elastic demand and externalities*.

Lilienthal, Peter, *Flexible dispatch for non-utility generators*.

Narongdej, Pol, *Interactive man-machine learning in a dynamic manufacturing environment*.

Yates, Andrew, *An efficient hierarchy for constrained economies*.

## MATHEMATICS

- Chen, Jingyi, *A study of linear and nonlinear PDE's in differential geometry.*
- Chiu, Patrick, *Extremal determinants, dense sphere packings and covering with Hecke points.*
- Haskell, Cymca, *Brownian motions and billiards on the torus.*
- Havlicek, John, *On the structure of spaces of holomorphic maps from two copies of the Riemann sphere to complex.*
- Ho, David, *Acoustic wave interaction with locally inhomogeneous surfaces.*
- Jenvey, Edward, *Structure of strongly stationary processes.*
- Nicol, Matthew, *The statistical stability of a Bernoulli toral linked twist map of infinite entropy.*
- Petridis, Ioannis, *Scattering theory for automorphic functions and its relation to L-functions.*
- Shen, Ying, *New results on some dynamical and stationary problems in geometry.*
- Wolfe, Andrea Sven, *Asymptotic and numerical analysis of linear and nonlinear eigenvalue problems.*

## OPERATIONS RESEARCH

- Brady, Stephen Dean, *New mathematical programming approaches to the problem of image reconstruction from projections.*
- Chatwin, Richard Edward, *Optimal airline overbooking.*
- Erdman, Eva Diane, *Complexity measures for testing binary keystreams.*
- Guu, Sy-Ming, *On  $P_0$  and its subclasses.*
- Krishnarao, Pinnamaneni V., *Additivity of minimum cost in dual network flows.*
- Mehrotra, Vijay, *An approximation procedure for general closed multiclass queueing networks with deterministic routing.*
- Mello, Margarida Pinheiro, *Generalized Leontief substitution systems and lattice programming.*
- Murray, Steve, *An interior point approach to the generalized flow problem with costs and related problems.*
- Pich, Michael, *The QNET method for two-moment analysis of open queueing networks with general workstation capabilities.*
- Skiadas, Constantinos, *Advances in the theory of choice and asset pricing.*

**University of California,  
Berkeley (53)**

## BIOSTATISTICS

- Ashby, Mark Arved, *Regression smoothing of pairwise-correlated data.*
- Chasalow, Scott Daniel, *Exact optimal response surface designs with random block effects.*

- Vittinghoff, Eric, *Semi-parametric estimation of growth curves using data from a prevalent cohort.*

## INDUSTRIAL ENGINEERING AND OPERATIONS RESEARCH

- Dessouky, Maged Mohamed, *An aggregate planning model considering processing time.*
- Du, Yafeng, *Fleet sizing and empty equipment redistribution for transportation networks.*
- Friedman, Eric J., *Topics in decentralization and coordination.*
- Hayakawa, Yu, *Bayesian parametric models for lifetimes from a subjectivistic viewpoint: model construction and characterizations of aging.*
- Hong, Sung-Pil, *About the strong polynomiality of some classes of convex quadratic programming.*
- Leem, Choon Seong, *Input feature scaling algorithm for competitive-learning-based cognitive modeling with two applications.*
- Lin, Margaret, *Modelling survey response with repeated interviewing attempts.*
- Liu, Chihwei, *A modular production planning system for semiconductor manufacturing.*
- Najmi, Adeel, *Management of cycle time in semiconductor wafer fabrication.*
- Saeed, Baruch Ismail, *Data envelopment analysis and convexity: formulations and sensitivity.*
- Svoboda, Alva Joseph, *Simulation of dispatchable demand-side management in electric power system operations planning.*
- Weng, Wei-Chih Willie, *Short-term scheduling of semiconductor burn-in.*

## MATHEMATICS

- Bloch, William Lester, *Extending flows from isolated invariant sets.*
- Brady, Noel, *The geometry of asynchronous automatic structures on groups.*
- Cooper, Duane Anthony, *Probably approximately correct learning on the class of Lipschitz functions.*
- Cruz-Uribe, David Vincente, *Piecewise monotonic doubling measures.*
- De Smit, Bart, *Class group relations and Galois module structure.*
- Dykema, Kenneth Jay, *Free products of hyperfinite von Neumann algebras and free dimension.*
- Engl, Gregory James, *Lower hemicontinuity of the Nash equilibrium correspondence and the hedonic core.*
- Fogel, Micah, *The algebra unknotting number.*
- Fowler, Neal Jay, *Free  $E_0$ -semigroups.*
- Ge, Guoqiang, *Algorithms related to multiplicative representations of algebraic numbers.*
- Gloor, James Alan, *Locatability on Banach spaces.*

- Gomprecht, David Warren, *Rank two vector bundles on genus two fibrations.*
- Greenig, Douglas Scott, *Convexity and the Markus-Yamabe conjecture.*
- Guan, Zhuang-dan Daniel, *On certain complex manifolds.*
- Hazan, Simone, *The projection property for orders and triangle-free graphs.*
- Herald, Christopher Mark, *Legendrian cobordism and Chern-Simons theory on 3-manifolds with boundary.*
- Hjorth, Gregory, *The influence of  $\mu_2$ .*
- Howe, Everett William, *Elliptic curves and ordinary abelian varieties over finite fields.*
- Huang, Liaw, *On joint deformation spaces.*
- Huang, Yili, *Solving nonlinear differential equations by one-step methods: global error and complexity analysis.*
- Hwang, Andrew David, *Extremal Kähler metrics on compact complex manifolds and a partial converse to a theorem of Lichnerowicz.*
- Impagliazzo, Russell Graham, *Pseudo-random generators for probabilistic algorithms and for cryptography.*
- Kidder, Jeffrey Nelson, *A theory of faulty dynamics.*
- Lee, Nany, *Some theorems on symmetric spaces.*
- Lobel, Perry David, *Correspondence with elliptic curves.*
- Michler, Ruth, *Hodge-components of cyclic homology of singular affine hypersurfaces.*
- Nagy, Gabriel, *A framework for deformation quantization.*
- Nazari, Saeid, *Rotational surfaces in Euclidean and hyperbolic spaces, mean curvature motion, and the moving finite element methods.*
- Pavlovic, Branka, *Automatic continuity of Lipschitz algebras.*
- Poon, Wing Yew, *On groups, automata, and games.*
- Priest, Douglas M., *On properties of floating point arithmetics: numerical stability and the cost of accurate computations.*
- Sageev, Michah El-Yakim, *Ends of pairs of groups and cube complexes of non-positive curvature.*
- Tenorio, Luis-Francisco, *Asymptotic dynamics of locally oblique solitary wave solutions of the KP.*
- Troyer, Todd William, *A Lyapunov method for correlational learning in two layer neural networks.*
- Volker, Runde, *Problems in automatic continuity.*
- Wang, Shuzhou, *General constructions of compact quantum groups.*
- Yang, Xiaodong, *Affine-scaling algorithms for linear programming.*
- Zabihi, Farhad, *The duality of analytic functions.*

**University of California, Davis (4)**

## MATHEMATICS

Jian, Alan Sonjun, *A multiplicative property of a nonabsolutely convergent integral.*

Zhu, Yi, *Multidimensional upwind finite-volume schemes for the Euler equations and finite difference schemes for the Maxwell's equations.*

## STATISTICS

Cavanaugh, Joseph, *Small-sample model selection in the general state-space setting.*

Song, Kaisheng, *Nonparametric estimation of curves and boundaries.*

**University of California, Irvine (6)**

## MATHEMATICS

Ahn, Ho Sung, *Nonstationary Anderson model with a Levy random potential.*

Davis, Mark Kelly, *Some results on groups of finite Morley rank.*

Kakarala, Ramakrishna, *Triple correlation on groups.*

Mingrone, Joseph R., *A collocation solution to the Dirichlet problem.*

Noble, John M., *Evolution equation with random potential.*

Schindler, Ian Edmund William, *Some variational methods for quasilinear elliptic differential equations on unbounded domains.*

**University of California, Los Angeles (29)**

## MATHEMATICS

Appleby, Glenn David, *Nilpotent matrices over discrete valuation rings.*

Bence, James, *Motion of multiple junctions: a level set approach.*

Boca, Florin-Petre, *Amalgamated product von Neumann algebras and subfactors.*

Brussel, Eric Saxton, *Noncrossed product division algebras and other examples over  $Q(t)$  and  $Q((t))$ .*

Chaderjian, Anie, *Some new classes of supplementary difference.*

Chen, Chun-Houch, *Interactive classification tree guided by sliced inverse regression: construction, modification and visualization.*

Cleary, Sean, *Groups of piecewise linear homeomorphisms.*

Daw, Edward Warwick, *Extended homotopy Brouwer theory.*

De Carli, Laura, *Unique continuation for higher order elliptic operators.*

De Pillis, Lisette G., *Far field behavior of slightly compressible flows.*

Dempsey, Kevin, *A mathematical formulation for the finite elastohydrodynamics of rings in 2D flows.*

Green, Larry, *An algebraic geometry approach to nonlinear differential equations.*

Grieser, Daniel,  *$L_p$  bounds for eigenfunctions and spectral projections of the Laplacian near a concave boundary.*

Handjani, Shirin Joy, *Symmetric nearest-particle systems.*

Iosevich, Alex, *Maximal operators associated to families of flat curves and hyper-surfaces.*

Liu, Guanghan, *On local smoothing and Bayesian estimation.*

Liu, Xu-Dong, *Nonoscillatory high order methods for the numerical solution of conservation laws.*

Murphy, Timothy, *Optimal control problems for parabolic boundary control systems governed by parabolic equations.*

Ono, Ken, *Congruences on the Fourier coefficients of modular forms on  $\Gamma_0(N)$  with number theoretic applications.*

Pao, Karen, *Computational aeroacoustics of low speed flows in two dimensions.*

Paoletti, Roberto, *Seshadri constants, free pencils and restriction of stable bundles.*

Qing, Jie, *The Dirichlet problem for harmonic maps from surfaces.*

Rieffel, Eleanor, *Some interactions between groups theory and the geometry of symmetric spaces.*

Sherman, William R., *On the Kneser-Haken finiteness theorem: a sharpness result.*

Vu, Hai, *Singularities of hyperbolic systems of partial differential equations.*

Wilson, Brad Lee,  *$p$ -adic Hecke algebras and  $L$ -functions.*

Xia, Huashi, *Degenerations of moduli of stable bundles over algebraic curves.*

Xu, Youyu, *Some topics in Riemannian geometry.*

Zhou, Yan, *Non-cooperative games with vector payoffs.*

**University of California, Riverside (7)**

## MATHEMATICS

Chen, Da-Quing, *Kernel coefficient ideals.*

Contreras, Martha Preciado, *Resonance and double resonance for higher order quasilinear elliptic partial differential equations between the first and second eigenvalue.*

Legner, Mary Margarita, *Quasilinear elliptic and parabolic partial differential equations with a derivative driving force.*

Prophet, Michael Patrick, *Codimension one minimal projections onto the quadratics and their adjoints.*

## STATISTICS

Chow, I-Shang, *Spectral analysis of random fields with random sampling.*

Derderian, Maria, *Robust experimental plan and its role in determining robust designs.*

Guy, David, *The application of higher order statistics to non-linear model identification and parameter estimation in the time and frequency domains.*

**University of California, San Diego (16)**

## MATHEMATICS

Angel, Jeffrey Patrick, *Finite upper half planes over finite rings and their associated graphs.*

Beck, Desiree Anne, *Permutation enumeration of the symmetric group and the hyperoctahedral group and the combinatorics of symmetric functions.*

Bloch, Stephen Austin, *Divide and conquer in parallel complexity and proof theory.*

Callahan, Kevin Eric, *The applications of Ahlfors's value distribution theory of covering surfaces to circle packings.*

Carbonara, Joaquin O., *The inverse Kosta matrix, its  $t$ -analog and applications.*

Curtis, Robert Rowen, Jr., *Examples of hypersurfaces with rational singularities.*

Julian, Alfredo J., *The variational form of Bayes estimators of normal variance in the linear models case.*

LeBorne, Richard Charles, *Numerical analysis of the a posteriori recursive least squares lattice prediction algorithm.*

Li, Tong, *The Ricci flow on surfaces with boundary.*

Robinson, David Hill, *Parallel algorithms for group word problems.*

Singer, Dan William,  *$q$ -analogues of Lagrange inversion and  $q$ -Sheffer sequences.*

Stankus, Mark, *Isosymmetric linear transformations on complex Hilbert spaces.*

Stephens, Peter Washington, *Bridge graphs and the Carrier poset for biconnected simple graphs.*

Walker, Michael L.,  *$H$ -infinity control of linear and nonlinear systems and parameter estimation algorithms for asymptotic expansion signal models.*

Wang, Zhenghan, *The classification of topological four manifolds with infinite cyclic fundamental group.*

Ying, Jianguang, *Revuz measures and the Feynman-Kac formula.*

**University of California, Santa Barbara (6)**

## MATHEMATICS

Bramlett, Lindsey L., *Construction of modular functions on certain subgroups.*

Lash, Alan Eliot, *Boundary curve space of the Whitehead complement.*

Schultens, Jennifer Carol, *Classification of Heegard splittings for some Seifert manifolds.*

Swiech, Andrzej Janusz, *Viscosity solutions of fully nonlinear partial differential equations with unbounded terms in infinite dimensions.*



Zhang, Fuzhen, *Numerical ranges and permanents*.

STATISTICS AND APPLIED PROBABILITY

Athanasopoulos, Bessy, *Probabilistic approach to the rounding problems with applications to fair representation*.

**University of California, Santa Cruz (1)**

MATHEMATICS

Tantalo, Patrick, *Geometric phases for the free rigid body with variable inertia tensor*.

**University of Southern California (3)**

MATHEMATICS

Heubner, Marianne, *Parameter estimation for stochastic partial differential equations*.

Lee, Young S., *Approximation and convergence of nonlinear semigroups*.

Mohseni, Sassan, *Non-positively curved metrics on a compact surface*.

**COLORADO**

**Colorado School of Mines (3)**

MATHEMATICS AND COMPUTER SCIENCES

Hart, Douglas I., *Learning algorithms for sequential decision making problems*.

Ke, Liu, *A neural net approach for nonlinear mappings of multi-dimensional continuous functions*.

Martin, Ephraim, *A methodology for reliability and maintainability analysis of equipment*.

**Colorado State University (13)**

MATHEMATICS

Liams, Joel E., *Non-existence results for Hadamard difference sets*.

Molina, Robert R., *Problems in graph reconstruction*.

Regnier, Kimberly J., *Brauer groups and reflexive modules on toric varieties*.

STATISTICS

Al-Eideh, Basel, *Stochastic models for population growth with catastrophes*.

Al-Zalzal, Yousef, *Analysis of competing independent and dependent risks*.

Anderson, Jana C., *Determination of dispersion patterns in spatial point processes*.

Donahue, Rafe M., *Estimation for nearest one-neighbor processes*.

Gui, Rongde, *Confidence intervals for ratios of linear combinations of variances in the components-of-variance model*.

Huzurbazar, Snehalata V., *Saddlepoint approximations in multivariate analysis*.

Johnson, Jeryl W., *Exact Gaussian likelihood for irregularly observed non-stationary processes*.

Mosier, Michael G., *Approximate confidence intervals for fixed effects in mixed linear models*.

Whitmore, James B., *Moments of several classes of linear permutation statistics and efficient computing forms*.

Zhu, Zhiyong, *Parameter estimation using Laplace transforms in the general queueing model*.

**University of Colorado, Boulder (5)**

MATHEMATICS

Beard, Mary Anne Deal, *New Bounds for certain Diophantine problems*.

Coleman, John P., *Topologies on free algebra*.

D'Ambrosia, James, *On a nearest neighbor statistic*.

Peterson, Douglas C., *Cardinal functions on ultraproducts, and the reaping number for Boolean algebras*.

Shin, Chang Eon, *On the structure of optimal stabilizing controls in dimension 4*.

**University of Colorado at Denver (3)**

MATHEMATICS

Anderson, Charles, *Niche graphs and niche numbers: new results and alternative definitions*.

Liu, Zhining, *Multigrid methods for simulation of flow transition*.

Oliveira, Suely, *Parallel multilevel methods for transport equations*.

**University of Northern Colorado (3)**

MATHEMATICAL SCIENCES

Gee, Mei-Jih, *A study of the measure of kurtosis as an index for the linear estimators*.

McCormick, David, *Formulae for estimating the power of 1 factor ANOVA designs*.

Pan, Hung-Ming, *A study of metacognitive behaviors in mathematics problem solving of older elementary students in Taiwan, the Republic of China*.

**CONNECTICUT**

**University of Connecticut (9)**

MATHEMATICS

Gao, Mei, *Measuring the distance from a system to the set of all uncontrollable systems*.

O'Donnell, Christopher Jay, *Maximal and minimal prime ideals in incidence algebras with applications to ring theory*.

Pan, Shiho, *Descriptive topological spaces and perfect maps*.

Towghi, Nasser, *Functions of finite, P-variations and stochastic integration*.

Wang, Ningyi, *Normal surfaces in fibered 3-manifolds*.

Ye, Taiping, *The numerical computation of the Douady-Earle extension and Teichmüller mappings*.

Zhang, Minxie, *Image reconstruction from Radon transform data*.

STATISTICS

Chattopadhyay, Saibal, *Comparing two populations of combining available independent sequential studies*.

Lee, Tai-Ming, *Comparison of sampling based approaches for Bayesian computations*.

**Wesleyan University (1)**

MATHEMATICS

Paras, Agnes Clotilde Tablante, *Aspects of abelian groups as modules over their endomorphism rings*.

**Yale University (10)**

BIOSTATISTICS

Weinberg, Vivian K., *The appropriateness of estimating partially observed data with a first order Markov process*.

MATHEMATICS

Akman, Fusun, *The semi-infinite Weil complex of a graded Lie algebra*.

Cherry, William Allen, *Hyperbolic p-adic analytic spaces*.

Fischer, John Edward, Jr., *Geometry of 2-categories*.

Jastrzebowski, Wojciech Zbigniew, *Involutions on four-manifolds*.

Lee, Soo Teck, *On some degenerate principal series representations of  $U(n, n)$* .

Pereyra, Maria Cristina, *Sobolev spaces on Lipschitz curves, paraproducts, and related operators*.

Warner, Frederick J., *Continuity of pressure for quadratic polynomials*.

STATISTICS

Ishwaran, Hemant, *Regular estimators and efficiency in semiparametric mixture models*.

Rozal, Gregory P., *Exploring features of multivariate distributions using constrained spanning trees*.

**DELAWARE**

**University of Delaware (7)**

MATHEMATICAL SCIENCES

Climent, John, *A simple procedure for testing homogeneity of variance when the variance and means are linear*.

Crato, Nuno, *Some misspecification problems in long-memory time series models*.

Gorman, Robert, *Goodness of fit for non-location scale families of distributions*.

Labriola, Dominic, *A multiple regression model to assess treatment effects in efficacy assessments for clinical research*.

Sweitzer, Dennis, *Current enhancement in random flow networks.*

Tao, Qi, *Robust quantile estimation using the generalized Tukey-Lambda distribution.*

Wainwright, Barbara, *The distribution and properties of the slope estimator of the linear structural relation using the minimum (weighted) norm distance technique: An empirical study.*

## DISTRICT OF COLUMBIA

### American University (4)

#### MATHEMATICS AND STATISTICS

Lee, Raymond, *The effects of a program utilizing environmental issues on achievement of finite mathematics students.*

Li, Yong, *Properties of a vector correlation coefficient with applications to geophysical data.*

Pierre, Charles, *Quality control in education.*

Vetter, John, *Estimation of covariance matrices using influences of eigenvectors and eigenvalues.*

### George Washington University (4)

#### OPERATIONS RESEARCH

Campodonico-Viacava, Sylvia Susana, *The signature as a covariate in reliability and biometry.*

Chen, Yiping, *Unification of software reliability models by self-exciting point processes.*

Lehmkuhl, Lee James, *A polynomial primal-dual interior point method for convex programming with quadratic constraints.*

Massimini, Sebastian Vincent, *Optimal inspection schedules using a Bayesian approach.*

## FLORIDA

### Florida Institute of Technology (3)

#### APPLIED MATHEMATICS

Devi, J. Vasundhava, *Qualitative behavior of impulsive differential systems.*

Kaymakcalan, Billur, *A unified approach to nonlinear dynamic systems on time scales.*

McRae, Farzana, *Some problems in impulsive control systems.*

### Florida State University (10)

#### MATHEMATICS

Bertram, Richard, *A computational study of the effects of Serotonin on the molluscan burster neuron  $R_{15}$ .*

Eberwein, Martin, *Cosemisimple Hopf algebras.*

Heydari, Shahryar, *Zeta regularized products and modular constants.*

Jayakumar, Puthenpura, *Spatio-temporal chaos in thermal convection: a computational study.*

Qian, Enping, *Self-consistent models of galaxies in equilibrium and potential-density relations of flat disks.*

#### STATISTICS

Burr, Thomas, *Estimating and modeling gene flow for a spatially distributed species.*

Herge, Donna, *Effects of inspection error on optimal inspection policies and software fault detection models.*

Li, Gang, *Generalized Pearson-Fisher chi-square goodness-of-fit tests, with applications to models with life history data.*

Park, Cheolyong, *A preliminary test for structure.*

Sun, Yanging, *Transformations of certain Gaussian random fields, with applications in survival analysis.*

### University of Florida (10)

#### MATHEMATICS

Burkett, John C., *On some problems of interpolation and approximation theory.*

Dhavakodi, Salai T., *On the parity of the number of small prime factors of integers.*

Hrvoje, Sikic, *Superprocesses.*

Woodward, Scott Davie, *On commutative  $f$ -rings which are rich in idempotents.*

Zhu, Huixia, *The generalized matrix product and its applications in signal processing.*

#### STATISTICS

Kundu, Sudeep, *A decision-theoretic approach to estimation of variances and various ratios.*

Nam, Eunwoo, *On the rate of convergence of series of random variables.*

Nangia, Narinder, *Bayesian analysis of small domain data in repeated surveys.*

Raychaudhuri, Aparna, *Rank tests for randomly right censored bivariate life-time data.*

Sharma, Divakar, *The tail-probability approximation for one and two samples  $U$ -statistics by saddlepoint methodology.*

### University of Miami (1)

#### MATHEMATICS AND COMPUTER SCIENCE

Wang, Xiabo, *Reward functions and Markov strategies in finite-stage stochastic decision problems.*

### University of South Florida (7)

#### MATHEMATICS

Chang, Tony Yu, *Domination numbers of grid graphs.*

Liu, Xiaoyan, *Generalization of de Montessus de Ballore Theorem on the row convergence of rational approximation.*

Qiao, Hongzhu, *Parametric and nonparametric statistical modeling: reliability analysis.*

Ruedemann, Richard W., *Some identities involving orthogonal polynomials.*

Schweiker, Kevin S., *Fractal measure theory.*

Suresh, Nalina, *Modeling and analysis of software reliability.*

Zhang, Ruiming, *On some formulas of William Gopsper and spectral properties of certain operators in weighted Hilbert spaces.*

## GEORGIA

### Emory University (3)

#### BIostatistics

Devine, Owen, *Empirical Bayes and constrained empirical Bayes methods for estimating incidence rates in spatially aligned areas.*

#### MATHEMATICS AND COMPUTER SCIENCE

Arasmith, David M., *Disjoint maximal independent sets.*

Williamson, Sylvia, *Fixed point properties in ordered sets.*

### Georgia Institute of Technology (5)

#### MATHEMATICS

Carvalho, Alexandre Nolasco de, *Infinite dimensional dynamics described by ordinary differential equations.*

Chen, Mingxiang, *Structural stability for time-periodic systems.*

Kelly, William Benjamin, *Convergence of numerical solution to multiphase Stefan-type problems.*

Shen, Wenxian, *Stability and bifurcation of traveling wave solutions.*

Shieh, Jung-sheng, *Some applications of the Bechhofer-Kiefer-Sobel generalized sequential probability ratio test to software reliability testing.*

### University of Georgia (2)

#### STATISTICS

Jones, Mary Mitchell, *Methods of interval hypothesis testing in multivariate analysis of variance.*

Xiong, Momiao, *Mathematical theory of neural learning and its applications to statistics and molecular biology.*

## HAWAII

### University of Hawaii at Manoa (4)

#### MATHEMATICS

Gefroh, Daniel, *Zeros of entire functions.*

Lewis, Wayne, *Almost completely decomposable groups with two critical types and their endomorphism rings.*

Reiser, Edward, *Hyperbolic geometry.*

#### PUBLIC HEALTH

Ng, Siu-Man, *Age-parity-duration-specific measures of fertility: application to China.*

## ILLINOIS

### Illinois Institute of Technology (1)

#### MATHEMATICS

Karamolengos, Michael, *Some new approaches to plasticity and damage—May 1992.*

**Northern Illinois University (7)**

## MATHEMATICAL SCIENCES

- Arnold, Mark, *Algorithms and conditioning for eigenvalue assignment.*
- Cornick, Jonathan, *On the homology of group graded algebras.*
- Dwyer, Howard, *Eigenvalues of matrix Sturm-Liouville problems with separated or coupled boundary conditions.*
- Mohanty, Radhagobinda, *Estimation of prediction error variance of a multivariate time series.*
- Mupasiri, Douglas, *Some results on complex convexity and the geometry of complex vector spaces.*
- Purkayastha, Avijit, *A parallel algorithm for the Sylvester observer equation.*
- Rincon, Fernando, *Feedback stabilization of second-order models.*

**Northwestern University (7)**

## MATHEMATICS

- Bajer, Anetta, *The May and related spectral sequence for a finite  $p$ -group.*
- Gottman, Joseph, *Characters on restricted Lie algebras.*
- Morrissey, Thomas, *Decoupling degenerate, diffeomorphisms.*
- Riffi, Mohamed, *Short-time asymptotics of the Neumann heat kernel for antipodal points on the exterior of a ball.*
- Schuster, Bjorn, *On the Morava  $k$ -theory of finite 2-groups.*
- Skelensky, Janice, *Torsion families of ideals and 1-divisible modules.*
- Van Buskirk, Mark, *Renegotiation in  $n$ -person oligopoly with imperfect monitoring.*

**University of Chicago (11)**

## MATHEMATICS

- Capozzoli-Diaz, Anthony, *Actions of discrete Kazhdan groups and semi-simple Lie groups on fiber bundles.*
- De Jeu, Rob, *Zaiger's conjecture and wedge complexes in algebraic  $K$ -theory.*
- Goetz, Edward, *Connection preserving action on fiber bundles.*
- Pilz, Brian Scott, *On the Loewy structure of projective modules for some semilinear groups.*
- Pugh, Mary Claire, *Dynamics of interfaces of incompressible fluids: the Hele-Shaw problems.*
- Sze, Chun-Wing, *Non-negative solutions of the initial Neumann problem for generalized porous medium equation in cylinders.*
- Yang, Yimin, *On the coefficient group of equivariant  $K$ -theory.*

## STATISTICS

- Lam, Ming-Long, *A weighted linear prediction approach.*
- Meyer, Peter M., *Using interactive recursive partitioning to improve rule-based expert systems.*
- Xiang, Xiaojing, *Asymptotic theory for linear functions of ordered observations.*
- Zhang, Biao, *Nonparametric function estimation.*

**University of Illinois, Chicago (9)**

## MATHEMATICS, STATISTICS AND COMPUTER SCIENCE

- Krecja, Sharon, *The origins of calculus.*
- Leung, Chiwah, *Classification of finite dimensional maximal risk estimation algebras with state space dimension 3.*
- Li, Yaxin, *Asymptotic analysis of queueing systems with service interruptions.*
- Robbert, Sharon, *On classical functions of real analysis.*
- Solymosi, Tamas, *On computing the nucleolus of cooperative games.*
- Srinivasa, Rao Arikati, *New results in algorithmic graph theory.*
- Xi, Zai-Qing, *Optimum replacement for selecting the best components: a dynamic approach.*
- Xie, Shisheng, *A ray method for analyzing the transient structure of models in applied probability.*
- Yang, Yongzhi, *Asymptotic properties of sojourn times in the queue  $G|M|1-K$  with processor-sharing service.*

**University of Illinois, Urbana-Champaign (15)**

## MATHEMATICS

- Atkinson, David Steen, *Scaling and interior point methods in optimization.*
- Carter, James Egar, *Steinitz classes of tamely ramified nonabelian extensions of algebraic number fields of degree  $P^3$ .*
- Chu, Liang-Ju, *Theory and algorithms for non-linear optimization and variational inequalities.*
- Evans, Dennis Neal, *Near atomic spaces.*
- Gaspari, Gregory, *The cat map on prime lattices.*
- Harris, William Richard, *Real even symmetric forms.*
- Holly, Charles Anthony, *Results on the fixed points of multifunctions with applications to problems in optimization and equilibrium.*
- Holly, Jan Elise, *Defnable equivalence relations and disc spaces and algebraically closed valued fields.*
- Huang, Margaret Janice Fernald, *Verification of the McKay-Alperin-Dade conjecture for the covering groups of the Mathieu group  $M_{22}$ .*

- Johnsgard, Karin Luisa, *The structure of the Cayley complex and a cubic-time algorithm for solving the conjugacy problem for groups of prime alternating knots.*
- Laradji, Abdellatif, *On  $P$ -radical  $P$ -blocks of group algebras.*
- Peifer, David Eugene, *Artin groups of extra-large type are biautomatic.*
- Reinhart, Georg, *Schanuel functions and algebraic differential equations.*
- Spoonamore, Janet Hurst, *Least square methods for solving systems of inequalities with application to an assignment problem.*

## STATISTICS

- Lai, Kunjung, *On logistic regression approach to survival data and power divergence statistics for life tables.*

**INDIANA****Indiana University (4)**

## MATHEMATICS

- Abe, Akira, *Rings characterized by pure-injective and pure-projective modules.*
- Kwon, Oh-Nam, *Iteration of holomorphic mapping in  $C^2$  with a semi-attractive fixed point.*
- Surdi, Rita Marie, *Decomposition of a compact symmetric space under a large group of isometries.*
- Thomas, Owen, *Skew-Hermitian forms over quaternion algebras.*

**Indiana University-Purdue University at Indianapolis (1)**

## MATHEMATICAL SCIENCES

- Perea, Vicumpriya Sriyantha, *Real valued spectral flow in a type  $II_\infty$  factor.*

**Purdue University (42)**

## INDUSTRIAL ENGINEERING

- Ahn, Yoomin, *Deformation about sliding indentation in ceramics and its application to fine finishing.*
- Aman, Amril, *On-line scheduling and dynamic task assignment.*
- Avramidis, Athanassios N., *Variance reduction techniques for simulation with applications to stochastic networks.*
- Benjaafar, Saifallah, *Modeling and analysis of flexibility in manufacturing systems.*
- Chao, Chin-Jung, *Development of a methodology for optimizing the elicited knowledge.*
- Flanigan, Mary Ann, *A flexible, interactive, graphical approach to modeling stochastic input processes.*
- Hebbar, Rajadasa R., *Micro-hole drilling by electrical discharge machining.*
- Jan, Hung-Kang, *Dynamic modeling of manufacturing process error patterns using distributed adaptive systems.*

Kim, Kang, *Cylindricity control in precision centerless grinding.*

Kreng, Bor-Wen, *Intelligent knowledge management environment for design and manufacturing.*

Lin, Yuh-Jiun Grace, *A distributed production control for intelligent manufacturing systems.*

Mou, Jong-I, *An adaptive methodology for monitoring and controlling of precision machining and on-machine inspection.*

Posey, Jack, *Pictorial and text editors for expert system rules.*

Rajan, Venkat, *Cooperation requirement planning for multi-robot assembly cells.*

Rembold, Bernhard, *An integrated framework for the design of material flow systems.*

Stanney, Kay, *Effects of diversity in field-articulation on human-computer performance.*

Webber, Detlef, *Information management architecture for an advanced integrated manufacturing enterprise.*

Zhao, Baijun, *A structured analysis and quantitative measurement of task complexity in human-computer interaction.*

#### MATHEMATICS

Fan, Kwai-Man, *On the fundamental groups of the complements of a class of projective plane curves.*

Feng, Xiaobing, *On miscible fluids in porous media and absorbing boundary conditions for electromagnetic wave propagation and on elastic and nearly elastic waves in the frequency domain.*

Henderson, Gregory D., *The cohomology of rank three Hopf algebras.*

Huang, I-Chiau, *Pseudofunctors on modules with 0-dimensional support.*

Kim, Mee-Kyoung, *Depth of Rees algebra and associated graded rings and integrally closed ideals in two-dimensional regular local rings.*

Lee, Moohyun, *Proper holomorphic correspondences and the Szegő kernel in  $\mathbb{C}$ .*

Li, Shikang, *Generalized Gauss-Radau and Gauss-Lobatto formulae.*

Li, Xian-Jin, *The Riemann hypothesis for polynomials orthogonal on the unit circle.*

Qian, Xiaojun, *Topics in differential games: 1. The existence of saddle points in games of generalized pursuit and evasion; 2. Games with information lags.*

Rau, Re-Bin, *An empirical Bayes approach to multiple decision procedures.*

Sastry, Swati, *Upper bound for value distribution of quasi-meromorphic maps.*

Swanson, Irena, *Tight closure, joint reductions, and mixed multiplicities.*

Wu, Yinghua, *Hilbert functions, reduction numbers, and relation types.*

Ye, Zhuang, *Topics in meromorphic functions.*

Zhou, Tonghang, *Algebraic Chern classes in de Rham cohomology.*

#### STATISTICS

Chang, Fu-Chuen, *A normal limit theorem for moment spaces, rigid designs and model selection for polynomial regression.*

Gatzouras, Dimitrios, *Self-affine fractals: deterministic and random constructions.*

Hong, Changkon, *Densities with optimal smoothness in moment problems.*

Kanniganti, Anu, *The frontier of a branching Brownian motion with killing.*

Kohatsu-Higa, Arturo, *Stochastic differential equations with jumps.*

Liao, Yuning, *On statistical selection procedures using prior information.*

Mukhopadhyay, Saurabh, *Inference and optimal design in Bayes and classical problems.*

Vidakovic, Branislav, *A study of the properties of computationally simple rules in estimation problems.*

Wang, Lei, *Correlations among coefficients in random coefficient linear regression models.*

#### University of Notre Dame (6)

##### MATHEMATICS

Bizaca, Zarko, *A family of exotic Casson handles and exotic  $\mathbb{R}^4$ .*

Cel, Jaroslaw, *Geometric characterizations of cones.*

Francis, Theresa, *A new presentation of the general linear group.*

Sokolovic, Zeljko, *The model theory of differential fields.*

Vlach, Alan, *Hyperarithmetical relations in expansions of recursive structure.*

Weller, Kirk, *Cohomology of twisted holomorphic forms of classical Lie groups.*

#### IOWA

#### Iowa State University (28)

##### MATHEMATICS

Bondari, Siamack, *Constructing the identities and the central identities of degree  $< 9$  of the  $n \times n$  matrices.*

Fan, Kaisheng, *Topics in nonlinear filtering.*

Fuad, Tengku Simonthy Renaldin, *Quasi-groups, right quasigroups, coverings, and representations.*

Haliloglu, Engin, *Bounds for Faber coefficients of functions univalent in an ellipse.*

Hobart, Michael Frederick, *Vector lattices.*

Hummer, Frank Agrell, *Loop transversal codes.*

Jayawardena, Kurugamega Clement, *A solution method to a new class of inverse problems.*

Joseph, Elizabeth C., *Stability radii of two dimensional bilinear systems: Lyapunov exponent approach.*

Maheswaran, Thiagarajah, *Recovery of a one dimensional impedance profile from transmission data.*

Medepalli, Anand, *The assignment problem in distributed computing.*

Saberi-Nadjafi, Jafar, *N-dimensional Laplace transformations and their applications in partial differential equations.*

Zafer, Agacik, *Oscillatory and nonoscillatory properties of solutions of functional differential equations.*

#### STATISTICS

Adam, Abdoulaye, *Covariance estimation for characteristics of the Current Population Survey.*

Chakak, Abderrahmane, *Some methods of constructing multivariate distributions.*

Croos, Joseph H. R., *Robust estimation in measurement error modules.*

Garrigoux, Christian, *Reliability analysis of components subject to degradation failure with in-service inspections.*

Iversen, Philip, *Dynamic graphics for experimental design.*

Lemke, Klaus Wilhelm, *A Bayesian approach to sequential assembly experiments.*

Liu, Jingyu, *Comparing two groups of ranked objects by pairwise matching.*

Navvabpour, Hamid Reza, *Statistical methods for multivariate survival data.*

Remadi, Sellem, *On multivariate covariance component problems.*

Sabran, Muhamad, *Survival probabilities of genes or gametic types in partially selfing populations.*

Sanger, Todd Michael, *Estimated generalized least squares estimation for the heterogeneous measurement error model.*

Sriplung, Kai-One, *Mispricing in the Black-Scholes model: an explanatory analysis.*

Tollefson, Margot Helena, *Variance estimation under random imputation.*

Yansaneh, Ibrahim Sorie, *Least squares estimation for repeated surveys.*

Yoo, Seongmo, *On Pitman domination.*

Yu, Yunn-hwu, *Aspects of statistical multiple tolerancing.*

#### University of Iowa (19)

##### MATHEMATICS

Alarcon, Francisco, *The lattice of ideals of a semiring.*

Carraminana, Rodrigo, *j-planes.*

Fu, Qing-Qing, *Numerical solution for differential-algebraic equations.*

Jeon, Youngmok, *Numerical analysis of boundary integral equations for the harmonic and biharmonic equations.*

Lam, Clement, *Torsion theory on semigroup automata.*

Leung, Eric, *On resolving the multiplicity problem of tensor product of irreducible representations of symplectic group.*

Lin, Kwun-Shen, *On the structure of subplane covered nets.*

Lin, Ying-Hsiung, *Reflexive Banach spaces with symmetric bases are primary.*

Musicki-Kovacevic, Vesna, *Hyperfinite approximation of Brownian meander and Brownian excursion.*

Paolucci, Anna, *A new example of quantum group.*

Park, Jeanam, *Finitely generated monoids of fractional ideals and related topics.*

Quan, Xiu-Chi, *Representations of Hopf  $C^*$ -algebras.*

Shi, Yixun, *Iterative methods for large scale nonlinear optimization.*

#### STATISTICS AND ACTUARIAL SCIENCE

Artega, Carmen de, *Order restricted tests apply as a quality control scheme.*

Bosch, Ronald, *Computational methods for regression quantiles with smoothing splines.*

Chang, Shaotung, *Statistical inference of multinomial distributions with order restriction.*

Lian, Ie-Bin, *The impact of variable selection procedure on the forced-in variable in linear and logistic regression.*

Nunez-Anton, Vicente, *Analysis of longitudinal data with unequally spaced observations and time dependent correlated errors.*

Park, Chul Gyn, *Statistical inferences for uniform stochastic ordering.*

### KANSAS

#### Kansas State University (6)

##### MATHEMATICS

Ahn, Joseph Inkyung, *Elliptic interacting systems with nonlinear diffusions.*

Gan, Xiao-Xiong, *On approximate antigradients and universal primitive functions.*

Vakil, Roozbeh, *A canonical combinatorial diagonalization of a subset of a finite integer lattice.*

##### STATISTICS

Chang, Kuo-Hsing, *One-sided multivariate permutation tests.*

Chui, Jaesung, *Hierarchical models.*

Remmenga, Marta, *On inference procedures in unbalanced split-plot designs.*

#### Wichita State University (2)

##### MATHEMATICS AND STATISTICS

Meyer, Ruth, *Approximation of solutions of free boundary problems for the  $p$ -Laplace equation.*

Tu, Renjin, *Order restricted inferences in polynomial regression.*

### KENTUCKY

#### University of Kentucky (4)

##### MATHEMATICS

Haywood, Joel Dinsmore, *A characterization of universal images of trees.*

##### STATISTICS

Gray, David Eugene, *Multivariate nonlinear models with applications to compartmental models.*

Lu, Mei, *Stochastic compartmental model with incomplete data.*

O'Neill-Rayens, Mary Katherine, *Properties of Tango's index for detecting clustering in time.*

### LOUISIANA

#### Louisiana State University (4)

##### MATHEMATICS

Asadian, Fariborz, *Banach space valued stochastic differential equations.*

Aucoin, Karen, *The congruence extension property, the ideal extension property, and ideal semigroups.*

Dumesnil, Jill, *The congruence property and related topics in semigroups.*

Lee, Kyoung-Sim, *On the characterization of finite-dimensional Hida distributions.*

#### University of Southwestern Louisiana (5)

##### MATHEMATICS

Covington, Judith Lynette, *Protopological groups.*

Lee, Enoch Kin Shun, *Prime ideals and prime radicals in near-rings.*

Lopez, Kathleen Domingue, *Endomorphisms and the lattice of group topologies.*

Ozalp, Nuri, *Global existence of solutions and quenching for parabolic mixed-boundary value problems.*

##### STATISTICS

Carpenter, David Mark, *Estimation of the smallest and largest of several exponential location parameters.*

### MARYLAND

#### Johns Hopkins University (6)

##### BIOSTATISTICS

Carey, Vincent, *Regression analysis of large binary clusters.*

Huang, Ying, *Competing risks models: applications in epidemiology.*

Kiao, Jiangang Liao, *An empirical Bayes approach to smoothing in deconvolution with application to AIDS.*

##### MATHEMATICS

Pan, Chen-Li, *A generalization of Tate's local zeta functional equations to certain twisted Igusa local zeta functions.*

Wolman, Abel, *The geometric quantization of the moduli space of Riemann surfaces with even spin structure.*

Ying, Kefeng, *On the convergence of the adelic zeta functions associated to IRPV.*

#### University of Maryland Baltimore County (6)

##### MATHEMATICS AND STATISTICS

Chen, Gong, *Proximal and decomposition methods in convex programming.*

Clements, Joseph Harvey, III, *Recursive methods for multiple signal direction finding.*

Kelly, Robert James, *Nonnegative estimation of variance components in some ANOVA and time series models.*

Li, Shidong, *The theory of multiresolution analysis frames and applications.*

Niyogi, Anindita, *Some contributions to nonnegative estimation of variance components.*

Sanders, Melvin John, Jr., *Nonlinear filtering of a class of independent increment processes.*

#### University of Maryland, College Park (17)

##### MATHEMATICS

Bernstein, Erica, *Generalized Riesz products for pyramidal schemes.*

Bulatek, Wojciech, *Smooth, weakly mixing, weakly isomorphic but not isomorphic flows.*

Chen, Gang, *A nonparametric approach in estimating the incubation period of AIDS disease: bootstrap with covariates.*

Grief, Anthony, *When is saturation preserved?*

Judge, Christopher M., *The Laplace spectrum of surfaces with cone points.*

Karagrigoriou, Alexandros, *Asymptotic efficiency of model selection procedures in time series.*

Leeb, Bernhard, *Metrics of nonpositive curvature on closed 3-manifolds and obstructions for the fundamental group of nonpositively curved  $N$ -manifolds.*

Li, Bao Qin, *Interpolation and value distribution in  $C^n$ .*

Li, Ta-hsin, *Multiple frequency estimation in mixed-spectrum time series by parametric filtering.*

Li, Yiwei, *The theoretical and numerical problems of plasticity and their applications.*

Liu, Biyue, *The linearized compressible Navier-Stokes equations: discontinuity of the solution and finite element methods.*

Liverance, Eric, *Heights of Heegner points in a family of elliptic curves.*

Petulante, Nelson, *Indefinite theta-functions and functional equations.*

Stark, Matthias J., *Hypersingular integrals and Lipschitz spaces.*

Testa, Mariella, *The analytical index of families of unbounded linear Fredholm operators and bifurcation for families of nonlinear operators.*

Vonta, Filia, *Efficient estimation of a structural parameter in a non-proportional hazards model in the two-sample problem.*

Zafra, Pablo Manuel Ruasol, *Theoretical and computational advances in the fictitious play method with applications to the solution of linear programming problems.*

## MASSACHUSETTS

### Boston University (4)

#### MATHEMATICS

Blundell, S. Frederick, *A spherically symmetric model in celestial mechanics.*

Cioczek-Georges, Renata Maria, *Conditional moments and regression for stable random variables.*

Griffith, John, *Maximum likelihood estimates for feed-forward multi-layer neural networks.*

Kokoszka, Piotr, *Self-similar stable processes.*

### Brandeis University (4)

#### MATHEMATICS

Brocco, Stefano, *On the non-vanishing of  $\Theta$ -liftings from  $U(1)$  to  $U(1)$ .*

Howe, Lawrence, *Conjectural lower bounds for the ranks of Mordell-Weil groups of elliptic curves in  $\text{PGL}_2(\mathbb{Z}_p^n)$ -extensions of  $\mathbb{Q}$ .*

Jiang, Mingchang, *On the holomorphic linearization and equivariant Serre problems.*

Magid, Alexander, *Enumeration of convex polyominoes. A generalization of the Robinson-Schensted correspondence and the Dimer problem.*

### Harvard University (34)

#### APPLIED SCIENCES

Balkanski, Cecile Tiberghien, *Actions, beliefs and intentions in multi-action utterances.*

Gau, Jyh-Lin Jack, *Knowledge-based software development for highly parallel computers.*

Gerbessiotis, Alexandros, *Topics in parallel and distributed computation.*

Hancock, Thomas Raysor, *The complexity of learning formulas and decision trees that have restricted reads.*

Kaklamanis, Christos Ioannis, *Optimal computing on mesh-connected processor arrays.*

Mavronicolas, Marios A., *Timing-based distributed computation: algorithms and impossibility results.*

Persiano, Giuseppe, *Interaction in zero-knowledge proof systems.*

Smith, Steven Thomas, *Geometric optimization methods for adaptive filtering.*

#### BIOSTATISTICS

Bienias, Julia, *Design and analysis of time-to-pregnancy studies.*

Dafni, Urania, *Evaluating surrogate markers of clinical outcome when measured with error.*

Fitzmaurice, Garrett Martin, *A likelihood-based method for analyzing longitudinal binary responses.*

Gauvreau, Kimberlee, *Multivariate logistic regression and the analysis of data from observational studies.*

Hu, Fu-Chang, *A statistical methodology for analyzing the casual health effect of a time-dependent exposure from longitudinal data.*

Parzen, Michael Isaac, *Computational methods in robust regression.*

SenChaudhuri, Pralay, *Exact and Monte Carlo inference for contingency tables.*

Williamson, John, *Methods for the analysis of clustered, correlated data, familial and ophthalmological.*

#### MATHEMATICS

Belsley, Eric David, *Rates of convergence of Markov chains related to association schemes.*

Caporaso, Lucia, *On a compactification of the universal Picard variety over the moduli space of stable curves.*

Cheng, Shun-Jen, *Differentiably simple Lie superalgebras.*

Dummigan, Neil, *The second descent for certain families of Mordell-Weil lattices.*

Ernst, Kaspar D., *On the ends of the monopole moduli space.*

Finkelberg, Michael, *Fusion categories.*

Hwang, Jun-Muk, *Global nondeformability of the complex hyperquadric.*

Karshon, Yael, *Hamiltonian actions of Lie groups.*

Kotz, David Allan, *A  $p$ -adic computation of singular moduli.*

Liu, Kefeng, *On modular invariance and rigidity theorems.*

Magyar, Peter, *Formulas for generalized Kazhdan-Lusztig polynomials.*

Maslen, David K., *Fast transforms and sampling for compact groups.*

Tolman, Susan, *Group actions and cohomology.*

Wang, Ron (Rongguang), *Essays on vortices, knots and monopoles.*

Weinstein, Eric R., *Extension of self-dual Yang-Mills equations across the eighth dimension.*

#### STATISTICS

Blackwell, Thomas, *Estimating consensus DNA sequences.*

Glickman, Mark Evan, *Paired comparison models with time-varying parameters.*

Meehan, Patricia Marie, *A deconvolution approach towards modelling diurnal hormone series.*

### Massachusetts Institute of Technology (27)

#### MATHEMATICS

Christiansen, Tanya J., *Scattering theory on compact manifolds with boundary.*

Chuah, Meng-Kiat, *Kaehler structures on  $K_c/N$ .*

Cowen, Lenore J., *On local representations of graphs and networks.*

Ehrenborg, Jöns Richard Gustaf, *Combinatorial methods in multilinear algebra.*

Ernstöm, Lars, *Duality for the local Euler obstruction with applications to real and complex singularities.*

Graham, William A., *Regular functions on the universal cover of the principal nilpotent orbit.*

Hajir, Farshid, *Unramified elliptic units.*

Kerswell, Richard R., *Elliptical instabilities of stratified, hydromagnetic waves and the Earth's outer core.*

Leung, Nai Chung Conan, *Differential geometric and symplectic interpretations of stability in the sense of Gieseker.*

Li, Zongyi, *Coadjoint orbits and induced representations.*

Lu, Qingyuan, *On wave interactions of rotational and irrotational flows.*

Marcus, Sherry E., *Contributions to higher recursion theory.*

Mekias, Mohamed, *Restriction to hypersurfaces of non-isotropic Sobolev spaces.*

Meng, Hsin-Fei, *Superfluidity and random media.*

Oliveira, Joseph S., *The theory of cubic lattices.*

Poe, Milja-Riitta, *A special  $S$ -unit equation.*

Schmid, Peter J., *Linear and nonlinear mechanisms in subcritical shear flow transition.*

Schulman, Leonard Y. J., *Communication in the presence of noise.*

Scott, Richard A., *Real, complex, and quaternionic toric spaces.*

Sun, Pu, *Interaction phenomena of waves in shear flows.*

Tabak, Esteban G., *Focusing of weak shock waves and the von Neumann paradox of oblique shock reflection.*

Tabakis, Evangelos, *Asymptotic and computational problems in single-link clustering.*

Toth, John A., *Various quantum mechanical aspects of quadratic forms.*

Tzimas, Dimitrios V., *A new framework of iterated forcing along a gap one morass at  $\omega_1$ .*

#### OPERATIONS RESEARCH

Gopalan, Ramasubramanian, *Exploiting process flexibility in metal forming operations.*

- Mondschein, Susana V., *Optimal sales strategies in stochastic, dynamic environments.*  
 Veatch, Michael, *Queueing control problems for production/inventory systems.*

### Northeastern University (6)

#### MATHEMATICS

- Diesel, Susan, *Same irreducibility and dimension theorems for families of height three Gorenstein algebras.*  
 Hammerstrom, LeRoy Philip, *A back-bayesian approach to the classical confidence interval.*  
 Moazzami, Dara, *Tenacity and its properties in stability calculation.*  
 Nadire, Abdelhag, *Nonsmooth conflicting control problems defined by ordinary differential equations.*  
 Wang, Lei, *Automorphisms of circulant and MCP graphs.*  
 Zhu, Qiji, *Problems with delayed and unbounded controls.*

### University of Massachusetts, Amherst (6)

#### MATHEMATICS AND STATISTICS

- Carter, Daniel J., *The minimal polygon for computing  $Z_f(0, b)$  over a real quadratic base field.*  
 Galaktionova, Elena, *Characterizations of character sheaves for complex reductive algebraic groups.*  
 Guan, Bo, *Boundary value problem for surfaces of prescribed Gauss curvature and fully nonlinear elliptic equations.*  
 Hartt, Keith, *Bayesian estimation of surface information from radar images.*  
 Rossman, Wayne, *Constant mean curvature surfaces in Euclidean and hyperbolic 3-space.*  
 Sun, Guozhang, *The new bifurcation method for periodic solutions of time-dependent partial differential equations.*

## MICHIGAN

### Michigan State University (11)

#### MATHEMATICS

- Ajmi, Hedi, *Harmonic Block functions on the upper half space.*  
 Cho, Junghee, *Independent sets in  $(r, s)$ -trees.*  
 Dempsey, Kathy J.,  *$q$ -analogues and vector spaces.*  
 Fejzic, Hajrudin, *The Peano derivatives.*  
 Huang, Liang Jiao, *Parallel homotopy algorithm for large sparse symmetric eigenproblems.*  
 Li, Weiping, *Floer homology for connected sums of homology 3-spheres.*  
 Mikhalkin, Grigory B., *The classification of the smooth closed manifolds up to blowups.*  
 Zeng, Xiangfei, *Toeplitz operators on Bergman spaces.*

#### STATISTICS AND PROBABILITY

- Abrouk, Nacer Eddine, *Some numerical methods for singular diffusions arising in genetics.*  
 Majumdar, Suman, *Asymptotically optimal and admissible estimators in compound compact Gaussian shift experiments.*  
 Zhu, Jin, *Asymptotic behavior of compound rules in compact regular and nonregular families.*

### University of Michigan, Ann Arbor (32)

#### BIOSTATISTICS

- Yuan, Weiyang, *Multivariate parallel line bioassays in complete and incomplete block designs.*

#### INDUSTRIAL AND OPERATIONS, ENGINEERING

- Adams, Paul, *The effects of protective clothing on worker performance: A study of size and fabric weight effects on range-of-motion.*  
 Choi, Thomas, *Salvation for U.S. Manufacturing? The role of value orientations and communication networks in spreading the continuous improvement (C) gospel.*  
 Frantz, James, *Effect of location, procedural explicitness, and presentation format on user processing of and compliance with product warnings and instructions.*  
 Gerth, Richard, *Demonstration of a process control methodology using multiple regression and tolerance analysis.*  
 Jay, Baron, *Dimensional analysis and process control of the body-in-white.*  
 Kerk, Carter, *Development and evaluation of a static hand force exertion capability model using strength, stability and coefficient of friction.*  
 Lee, Byoung-Ki, *Variation stack-up analysis using Monte Carlo simulation for manufacturing process control and specification.*

- Liang, Ren, *Optimal sampling strategies for surface roughness measurement.*

- Malen, Donald, *Engineering for the customer: decision methodology for preliminary design.*  
 Meller, Russell, *The single and multiple floor facility layout problem: applying simulated—annealing and mathematical—programming based heuristics.*

- Noh, Seung Jong, *Performance evaluation of the distributed queue dual bus metropolitan area network.*

- Sindi, Ahmed, *Acceptance of information technology: User acceptance of expert systems.*

- Thompson, Deborah, *The perception of physical stress as a measure of biomechanical tolerance.*

- Yeh, Ruey Huei, *Optimal maintenance policies for deteriorating systems.*

- Yoon, Jae, *Continuous improvement of process control using regression analysis of observational data.*

#### MATHEMATICS

- Albert, Martin K., *Triangle invariants from the quantum group  $U_q(\mathfrak{sl}_3\mathbb{C})$ .*  
 Boklan, Kent D., *The asymptotic formula in Waring's problem.*  
 Doran, William F. IV, *Shuffling lattices.*  
 Glassbrenner, Donna, *Invariant rings of group actions, determinantal rings, and tight closure.*  
 McGuire, Elizabeth Camp, *On low-dimensional orbifolds & compact cores.*  
 Neumann-Coto, Max, *Least area tori in 3-manifolds.*  
 Nimershiem, Barbara E., *Flat manifolds appearing as cusps of hyperbolic manifolds.*  
 Nitsche, Monika, *Axisymmetric vortex sheet roll-up.*  
 Petrovic, Srdjan, *A dilation theory for polynomially bounded operators.*  
 Smith, Karen E., *Tight closure of parameter ideals and  $F$ -rationality.*  
 Williams, Lori J., *Uniform stability of kernels of Koszul cohomology indexed by the Frobenius endomorphism.*  
 Wright, Gretchen M., *The Reshetikhin-Turaev representation of the mapping class group.*

#### STATISTICS

- Gasparini, Mauro, *Bayes nonparametrics for biased sampling and density estimation.*  
 Maligalig, Dalisay, *Weighting adjustments for unit nonresponse in sample survey.*  
 Tantiyaswasdikul, Chim, *Iostonic regression under sequential designs.*  
 Wei, Xiaoying, *Asymptotically efficient estimates of the index of regular variation.*

### Western Michigan University (4)

#### MATHEMATICS AND STATISTICS

- Dixon, Sherry, *Rank based procedures in the heteroscedastic linear model.*  
 Perry, Kimberly, *A critical examination of the use of preliminary tests in two-sample tests of location.*  
 Vakalis, Ignatious, *Multivariate quadrature on MIMD machines with shared or distributed memory.*  
 Winters, Steven, *Distances associated with subgraphs and subdigraphs.*

## MINNESOTA

### University of Minnesota, Minneapolis (20)

#### BIOSTATISTICS

- Shih, Joanna, *Models and analysis for multivariate failure time data.*

## MATHEMATICS

Anderson, Janet, *Resolutions of determinantal ideals associated with a symmetric matrix: a counterexample.*

Del Pino, Manuel Adrian, *Some semilinear elliptic systems without variational structure.*

Demoulini, Sophia, *Young measure solutions for a nonlinear heat equation of forward-backward type.*

Fishel, Susanna, *Nonnegativity results for generalized  $q$ -binomial coefficients.*

Guo, Yung-Jen, *The null boundary controllability for semilinear heat equations.*

Kuang, Jinghua, *Certain Siegel-Hilbert cuspforms of square-free levels are representable as theta series.*

Kumanduri, Ramanujachary, *Euler factors of global integrals.*

Ou, Biao, *Applications of variational method to problems in mathematical theory of liquid crystals and other areas.*

Pascual, Felino, *On periodic perturbations of uniform motion of a planetary ring.*

Smith, Samuel, *On the rational homotopy theory of function spaces.*

Sundquist, Thomas Scott, *Pfaffians, involutions and Schur functions.*

Sung, Cheng-Chih, *On a singular Dirichlet problem for the conformal Gaussian curvature equation.*

Tekman, Mehmet Okan, *Special values of  $L$ -functions attached to cuspforms on orthogonal groups of Hermitian type.*

Yan, Baisheng, *Topics in partial differential equations and the calculus of variations.*

Zou, Henghui, *The existence and non-existence and the asymptotic behavior of solutions of the equations of Chipot and Weissler.*

## STATISTICS

Cheng, Yi, *Group sequential strategies in two-armed bandit problems.*

Muruzabal, Jorge, *A machine learning approach to a problem in exploratory data analysis.*

Seo, Han Son, *Robust Bayesian optimal designs.*

Wetzel, Nathan Richard, *Coherent inferences for multivariate data models.*

## MISSISSIPPI

## University of Mississippi (3)

## MATHEMATICS

Campbell, Connie, *Minimal regular graphs with given girth pair.*

Hung Wei, Lin, *Independent sets in planar triangle-free graphs of maximum degree three.*

McColgan, Tamara, *Bipartite density of four-regular graphs.*

## MISSOURI

## St. Louis University (1)

## MATHEMATICS AND COMPUTER SCIENCE

Roberts, Craig William, *The projective connections of T. Y. Thomas and J.H.C. Whitehead on the principal  $R$ -bundle of volume elements.*

## University of Missouri, Columbia (4)

## MATHEMATICS

Tam, Sik-Chung, *Application of the local theory for quasi-normed spaces.*

## STATISTICS

Djojosingito, Rianto A., *Topics in nonparametric function estimation.*

Hu, Xiaomi, *LRTs for normal means constrained by two cones.*

Mukhopadhyay, Chiranjit, *Bayesian analysis of competing risks, change-point and related models.*

## University of Missouri-Rolla (1)

## MATHEMATICS AND STATISTICS

McCoy, Everett, *A class of entire functions generated by integral transforms: theory and applications.*

## Washington University (10)

## MATHEMATICS

Chen, Zhen-Qing, *On reflecting diffusion processes.*

Gornet, Ruth Elizabeth, *Spectral geometry on higher-step Riemannian nilmanifolds.*

Gu, Chi, *Besov space on non-homogeneous martingales.*

Laugesen, Richard Ian, *Extremal problems involving logarithmic and Green capacity.*

Liao, Ruijia, *Cyclic properties of the harmonic sequence of surfaces in  $\mathbb{C}P^n$ .*

## SYSTEMS SCIENCE AND MATHEMATICS

Jankovic, Mrdjan, *Observer design and identification of nonlinear systems.*

Ramadorai, Arvind, *Task-level control of multi-arm robotic systems.*

Situmeang, Hardiv Harris, *Online stabilization of power systems in emergencies using observation decoupled reference and feedback linearization.*

Venkatasubramanian, Vaithianathan, *A taxonomy of the dynamics of large differential-algebraic systems such as the power system.*

Wu, Yuanlan, *Artificial intelligence methodologies for aerospace and other control systems.*

## NEBRASKA

## University of Nebraska-Lincoln (1)

## MATHEMATICS AND STATISTICS

Schneider, John Martin, *Green's functions, Cauchy functions and cone theoretic eigenvalue results for differential equations.*

## NEW HAMPSHIRE

## Dartmouth College (5)

## MATHEMATICS AND COMPUTER SCIENCE

Atwill, Timothy, *Diagonalizing spaces of Hilbert cusp forms.*

Bozeman, James, *On monotonic pairs of solid tori.*

Germann, Gabriele, *Genus one Whitehead manifolds and torus pairs of wrapping number two.*

Kostelec, Peter, *Non-holomorphic cusp forms.*

Langley, Larry J., *Interval tolerance orders and dimension.*

## NEW JERSEY

## Princeton University (12)

## MATHEMATICS

Brock, Bradley, *Superspecial curves of genera two and three.*

Dafni, Galia, *Hardy spaces on strongly pseudoconvex domains in  $C^n$  and domains of finite type in  $C^2$ .*

Dou, Ze-Li, *Fundamental periods of certain arithmetic crisp forms.*

Eskin, Alex, *Counting lattice points on homogeneous spaces.*

Forni, Giovanni, *Construction of invariant measures and destruction of invariant curves for twist maps of the annulus.*

Khuri-Makdisi, Kamal, *Relations between Fourier coefficients of nonholomorphic Hilbert modular forms of half-integral weight and special values of Dirichlet series.*

Parmeggiani, Alberto, *Subunit balls for symbols of pseudodifferential operators.*

Sherry, Robert F., *A structure theorem for modules over  $A(2) \otimes \mathbb{F}_2[X, X^{-1}]$  and generalizations.*

Stalker, John, *Hölder and  $L^p$  estimates for  $\bar{\partial}, \bar{\partial}_b$  on domains of finite type.*

Underwood, Alice, *Constructing barriers to minimal surfaces from polyhedral data.*

Wroblewski, Jaroslaw, *A counterexample to an estimate for a hypoelliptic operator.*

Zhong, Jiaping, *Harmonic analysis for some Schrödinger type operators.*

## Rutgers University (14)

## MATHEMATICS

Dai Pra, Paolo, *Space-time large deviations for interacting particle systems.*



## NEW YORK

## CUNY, Graduate Center (6)

## MATHEMATICS

Arroyo, Fangjun, *Category coherence for symmetric monoidal categories.*

Georgatos, Konstantinos, *Modal logics for topological spaces.*

Geshwind, Frank, *The Weil transform and ambiguity functions.*

Hom, Susan, *Spanning trees of 3-polytopal graphs.*

Misir, Dasarot Totaram, *Colimits in the proper homotopy category.*

Reller, Austin Fielding, *The Helmholtz equation in  $S^1 \times R$ .*

## Clarkson University (3)

## MATHEMATICS

Kawamoto, Shunji, *An inverse scattering transform and hodograph transformations for the oscillating two-stream instability equation.*

Ryan, Elizabeth Ellen, *Numerical homoclinic instabilities and the complex modified Korteweg-de Vries equation.*

Zhang, Fengman, *A biologically realistic neuronal simulator.*

## Columbia University (9)

## BIostatISTICS

Cheng, Shu-Lin, *Nonparametric of data obtained under case-cohort design.*

## MATHEMATICS

Berger, Gabriel, *Hecke operators on noncongruence subgroups.*

Finkelstein, Elizabeth, *Incompressible surfaces in closed braid complements.*

Mao, Zhengyu, *Rank two Shimura correspondence and Salié sums.*

Rogers, Karen White, *Primitive simplices in  $Z^3$  and  $Z^4$ .*

Stanford, Ted, *Finite-type invariants of knots, links, and graphs.*

Zhou, Yuging, *On the density of Sobolev maps between two manifolds.*

## STATISTICS

Cadenillas, Abel, *Contributions to the stochastic version of Pontryagin's maximum principle.*

Molfino (McIntyre), Barbara Elsa, *Statistical modeling in paleoceanography: paleoestimation of upper water mass dynamics using marine microfossils.*

## Cornell University (28)

## APPLIED MATHEMATICS

Bond, Bradford Douglas, *An analysis of the horizontally forced spherical pendulum.*

Lubkin, Sharon Rebecca, *Circumnutation modeled by reaction-diffusion equations.*

Mitchel, Scott Alan, *Mesh generation with provable quality bonds.*

Stell, Laurel Liane, *A fixed domain method for injection governed by the Stokes equations.*

## BIOMETRICS

Cleary, Richard J., *Models for selection bias in meta-analysis.*

Gerow, Kenneth G., *Model-unbiased, unbiased-in-general estimation of the average of a regression function.*

Reichert, Deborah L., *Variance component estimators for binary data derived from the dispersion mean-model.*

## MATHEMATICS

Faught, John Darroch, *Local connectivity in a family of cubic polynomials.*

Govindachar, Suresh, *Explicit weight two motivic cohomology complexes and algebraic K-theory.*

Guo, Zhenchun, *The regularity of solutions to the heat equation over group-valued path space.*

Hall, Brian Charles, *The Bargmann-Segal "coherent state" transform for compact Lie groups.*

Lew, Vee-Ming, *The semistability at infinity for multiple extension groups.*

Li, Xiao'e, *Essays in mathematical economic theory.*

Reeves, Alyson April, *Combinatorial structure on the Hilbert scheme.*

Roberts, Rachael Clare Dedwydd, *Constructing taut foliations.*

Yang, Yue, *Priority methods and fragments of arithmetic.*

Yap, Weng-Yin, *A combinatorial geometry of the Whitehead torsion of finite Abelian groups.*

## OPERATIONS RESEARCH AND INDUSTRIAL ENGINEERING

Healy, Kevin, *Optimizing stochastic systems: a retrospective deterministic approach.*

McShane, Kevin, *Primal-dual interior point algorithms for linear programming and the linear complementarity problem.*

Onn, Shmuel, *Discrete geometry, group representations and combinatorial optimization: an interplay.*

Rao, Uday, *Multi-stage identical job cyclic scheduling for repetitive manufacturing.*

Sox, Charles, *Modeling and analysis of quick response in production-inventory systems.*

Tang, Loon Ching, *Markov random walks with application to queues and confidence intervals related to the inverse Gaussian distribution.*

Tuncel, Levent, *Asymptotic behavior of interior-point methods.*

Ke, Xin, *On Ramsey theory.*

Lin, Yuandan, *Lyapunov function techniques for stabilization.*

Liu, Wensheng, *Averaging theorems for highly oscillatory differential equations and the approximation of general paths by admissible trajectories for nonholonomic systems.*

Lu, Xiaoyun, *Hamilton cycles and games on graphs.*

Luo, Wenzhi, *Automorphic L-functions at special points.*

Neelson, Tejinder Singh, *Holomorphic extensions of CR functions and CR mappings.*

Riahi, Hasna, *Periodic orbits of N-body type problems.*

Roosen, Andrew Robert, *Modeling crystal growth in a diffusion field with fully-faceted crystals.*

Sessions, Stephen P., *Bipolynomial Hopf algebras associated to families of wreath products.*

Tang, Guoqing, *Regularity properties of time-optimal trajectories for certain classes of multi-input systems in low dimensions.*

## STATISTICS

Cook, Dianne Helen, *Grand tour and projection pursuit: Exploring multivariate data using projections.*

Karwe, Vatsala Vachaspati, *The distribution of the supremum of integer moving average processes with application to the maximum net charge in DNA sequences.*

Yeh, Bai-Yau, *On resampling and data depth.*

## Stevens Institute of Technology (1)

## MATHEMATICS

Kingston, Kathleen, *Bianchi groups of class number one.*

## NEW MEXICO

## New Mexico State University (3)

## MATHEMATICAL SCIENCES

Al-Ahmar, Mohamed, *Rotational stability of a rigid body in four dimensions.*

Stuart, Christopher, *Weak sequential completeness in sequence spaces.*

Wang, Ji-Sheng, *Minimax programming in Banach spaces.*

## University of New Mexico (3)

## MATHEMATICS AND STATISTICS

Pop, Florin, *Hochschild cohomology for finite von Neumann algebras.*

Wester, Michael James, *Symbolic calculation and expression swell analysis of matrix determinants and eigenstuff.*

White, Janis Elaine, *A new family of prior distributions under exponential sampling based on Laguerre polynomials.*

## STATISTICS

- Cleary, Richard Joseph, *Models for selection bias in meta-analysis.*
- Reichert, Deborah, *Variance component estimators for binary data derived from the dispersion-mean model.*
- Wang, Nai-Syin, *Semiparametric transform-both-sides regression models.*
- Yeo, Kwee-Poo, *Density estimation for bivariate censored data.*

**New York University,  
Courant Institute (14)**

## MATHEMATICS

- Attie, Oliver, *Quasi-isometries of free Abelian covers.*
- Birindelli, Isabella, *Second order elliptic equations in general domains: Hopf lemma and anti-maximum principle.*
- Clark, Karen, *Characterizing the possible conductivity functions of composite materials.*
- Girao, Pedro, *Convergence of a crystalline algorithm for motion by weighted curvature.*
- Han, Qing, *Level sets of solutions to differential equations.*
- Lewicki, Pawel, *Long time evolution of wavefronts in random media.*
- Lin, Patrick, *On the numerical solution of the heat equations in unbounded domains.*
- Lu, Shenglin, *Hydrodynamic scaling limits with deterministic initial configurations.*
- Moura, Monique, *On the numerical calculation of electrostatic fields in composite media.*
- Pavarino, Luca, *Domain decomposition algorithms for the p-version finite element method for elliptic problems.*
- Schmitt, Hans, *Operators with nilpotent p-curvature.*
- Taylor, Mark, *A high performance spectral code for nonlinear MHD stability.*
- Tippett, Michael, *Tokamak equilibria and transport based on Grad's thirteen moment description.*
- Vaninsky, Kirill, *Invariant Gibbsian measures of semilinear wave equations.*

**Rensselaer Polytechnic  
Institute (12)**

## DECISION SCIENCE AND ENGINEERING SYSTEMS

- Ali, Allahverdi, *Scheduling on multiple unreliable sources.*
- Court, Mary, *Output analysis for simulation models in the presence of random disruptions.*
- Lingayat, Sunil, *Models for order release in advanced manufacturing systems.*
- Shao, Yuehjen, *A real time stochastic control system for process manufacturing.*

## MATHEMATICAL SCIENCES

- Cooper, Douglas, *Two-dimensional minimum free energy spectral estimation using duality.*
- Gallagher, Timothy, *The visual appearance of convex surfaces.*
- Graham, Jeffrey, *Two dimensional scattering and invariant imbedding.*
- Hipfel, David, *The nonlinear differential complementarity problem.*
- Kropinski, Mary Catherine, *A study of optimal critical airfoils.*
- McComb, I-Heng, *Bifurcations of time-reversible, equivariant vector field families.*
- Song, Jung-Hwan, *Optimizing a linear function over an efficient set.*
- Tabak, John, *Statistical invariance and the modeling of multicomponent media.*

**SUNY at Albany (4)**

## MATHEMATICS AND STATISTICS

- Cummings, Paul E., *A bound on Van Kampen graphs.*
- Dansereau, Andrew P., *General integral families and multipliers.*
- Madigan, Kevin M., *Composition operators into Lipschitz type spaces.*
- Underwood, Robert G., *Hopf algebra orders over a complete discrete valuation ring, their ideals, and extensions of R-groups.*

**SUNY at Binghamton (7)**

## MATHEMATICAL SCIENCES

- Bacon, Michael, *The nonabelian tensor square and powers of a group.*
- Brodie, Marc, *Finite coverings by subgroups.*
- Harrison, John Watkins, *The dynamics of piecewise endomorphisms of free monoids.*
- Jonoska, Natasa, *Synchronizing representations of sofic systems.*
- Li, Gang, *Almost sure convergence of stochastic approximation procedures.*
- Schuck, Christopher H., *Some contributions to the study of nilpotent groups.*
- Van Wyk, Leonard, *Graph groups are biautomatic.*

**SUNY at Buffalo (9)**

## INDUSTRIAL ENGINEERING

- Helander, Mary, *A discrete framework for modeling and analyzing HIV transmission dynamics.*
- Mannur, Narasimhan R., *Implicit enumeration algorithms for solving 0-1 integer linear programming problems.*
- Sivakumar, Raj, *Transportation of hazardous materials: a new modeling perspective.*

## MATHEMATICS

- Gall, Walter, *Lyapunov-Schmidt reduction for the planar Benard problem.*

Gao, Xiaobin, *Steady-state/Hopf bicriticality and mode interaction in the MHD Taylor-Couette system.*

Huang, Yu-Tai, *Regularity of solutions of differential and convolution equations in spaces of distribution with restricted growth.*

Qi, Jincheng, *The k-scattered spaces and the  $P_k$ -spaces.*

Strzebonski, Adam, *Introduction to O-minimal and semialgebraic groups.*

Zhou, Ying, *Study of propagation along nonuniform excitable fibers.*

**SUNY at Stony Brook (19)**

## APPLIED MATHEMATICS

- Albert, Jose Ramon G., *Reliability applications of the EM algorithm.*
- Berger, Barbara, *The application of jackknife statistics to the problem of obtaining interval estimates of the recombination fraction in phase-unknown nuclear families.*
- Canic, Suncica, *Shock wave admissibility for quadratic conservation laws.*
- Chakrapani, Jaishankar, *Parallel heuristic solvability of quadratic assignment and related problems.*
- Chu, Teng-Chiao, *Goodness of fit test for two-component normal mixture—development and characterization of.*
- da Silva, Pantaleao Aluizio Fernandes, *The role of surface tension in multiphase flow regimes.*
- Kim, Tae-Geun, *Numerical solutions for inverse electromagnetic scattering.*
- Li, Jian-Hua, *Integral equation methods for mixed boundary problem of fracture mechanics.*
- Pereira, Felipe, *Stochastic geology and porous media flow: theory and simulations.*
- Wang, Hu, *Quasi-Gauss-Newton methods for solving nonlinear algebraic equations.*
- Xu, Qiu-Ping, *Global structure of scaled-invariant solutions of the Riemannian for three-phase flow model.*
- Yuan, Huixing, *The precision of the estimated discriminant score.*

## MATHEMATICS

- Bessa, Gregório Pacelli, *Differentiable sphere theorems for Ricci curvature.*
- Elizondo-Huerta, Enrique Javier, *The Euler-Chow series for toric varieties.*
- Gong, Donggeng,  *$L^2$ -analytic torsions, equivariant cyclic cohomology and the Novikov conjecture.*
- Misiolek, Gerard, *Stability of flows of ideal fluids and the geometry of the group of diffeomorphisms.*
- Traynor, Lisa Mae, *Symplectic embeddings of balls and the mapping problem.*

Zheng, Dechao, *Toeplitz and Hankel operators on the Bergman spaces of bounded symmetric domains and the Bergman-Fock-Segal spaces, and some disk algebras.*

Zhou, Shaojie, *Singular integral operators, contraction operators and principal currents.*

### Syracuse University (2)

#### MATHEMATICS

Brown, Peter C., *Non-split extensions over hereditary artin algebras of finite representation type.*

Chen, Wei, *Cohomogeneity-two  $G$ -invariant minimal submanifolds, minimal cones and the Bernstein problem.*

### University of Rochester (5)

#### MATHEMATICS

Cornea, Octavian Luca, *Cone-length and Lusternik-Schnirelmann category.*

Fajardo, Ricardo, *A limiting shape result for the heat equation with noise.*

Kim, In-Suk, *Resonances for difference operators.*

Ma, Yongjia, *The Ambrose symbol of Fourier integral operators.*

Tamaki, Dai, *Homological methods in the unstable chromatic phenomena.*

## NORTH CAROLINA

### Duke University (6)

#### MATHEMATICS

Carr, Danielle Denise, *Reaction-hyperbolic systems in one space dimension.*

Gordon, Michael Kenneth, Jr., *Perturbed scale-invariant initial value problems in one-dimensional dynamic elastoplasticity.*

Ivey, Thomas Andrew, *On solitons for the Ricci flow.*

McDonald, Michael Andrew, *Shock problems and particle chains.*

Mitchell, Ben C., *An empirical study of the effects of noise on the resolution of three-way linear mixtures.*

Tucker, Gary Allan, *Nonstandard representations of invariant means.*

### North Carolina State University, Raleigh (21)

#### OPERATIONS RESEARCH

Sheu, Ruey-Lin, *Contributions to the generalized path-following approach to solving linear programming problems.*

#### STATISTICS

Arellano, Consuelo, *Testing for trend stationarity versus difference stationarity.*

Arumugham, Thangam, *Curvature and experimental design for the Weibull model.*

Bazus, Jeffrey Sandor, *Instrumental variable estimation in generalized linear measurement error models.*

Bentley, James Arthur, *Quantum chemical investigation of the torsional potential in the neutral organic phosphite and phosphate esters.*

Doerge, Rebecca W., *Statistical methods for locating quantitative trait loci with molecular markers.*

Etchison, Tonya Lynn, *Model identification and selection techniques for stationary ARMA processes.*

Fenton Navarro, Victor Manuel, *Rates of convergence of Hermite expansion density estimators.*

Gonzalez Farias, Graciela Maria, *A new unit root test for autoregressive time series.*

Gray, Gerry W., *Misspecification bias and tests for the number of components in finite mixtures.*

Kendall, William Louis, *Robust design in capture-recapture sampling: modelling approaches and estimation methods.*

Kramer, David Alan, *Estimating the probability of southern pine beetle outbreaks via Bayesian-updated probabilistic cellular automata.*

Kwon, Se-Hyug, *Hypothesis testing and confidence intervals in group testing.*

Liu, Huimei, *Uniformly more powerful tests of hypotheses determined by linear inequalities for a bivariate normal mean.*

McSorley, Ellen O., *Maximum likelihood estimation with data from step-stress accelerated life.*

Muse, Spencer Vance, *Testing for equality of nucleotide substitution rates.*

Pastrana-Zuniga, Jose, *A model for the heat transfer processes that occur during canning, electrical resistance and scraped surface heat exchanger aseptic processing, of food products with large particles.*

Ramos Quiroga, Rogelio, *Estimation of nonlinear mixed effects and random coefficient models.*

Shin, Key-II, *A unit root test for multivariate autoregressive time series.*

Sierra Cavazos, Jorge Homero, *Tests of hypotheses defined by linear inequalities for elliptically contoured families.*

Teng, Hwa-Jen, *Environmental determinants of intra and interspecific competition in the container-breeding mosquitoes *Aedes albopictus* and *Aedes triseriatus*.*

### University of North Carolina, Chapel Hill (23)

#### BIostatISTICS

Davis, Randy L., *Evaluation of statistical methods for a 4 period 2 treatment crossover migraine headache trial with specific attention to alternative models for categorical data and carryover effects.*

De Oliveira, Nelson, *A nonparametric multivariate test of homogeneity based on a  $U$ -statistics of degree (2, 2).*

Grady, James J., *Structural covariance matrices for incomplete longitudinal data.*

Hadug, Alula, *Repeated measures data analysis with nonnormal outcomes.*

Meibohm, Anne Ruth, *Test of treatment effect using the Cox proportional hazards model with imputed covariate data.*

Sakurai, Emilia, *Simultaneous nonparametric tests in two-way layouts.*

Thorn, Michael D., *Automated classification of fatal cardiovascular end points in large scale multi-center clinical trials.*

Wallace, Dennis Dale, *An approximate  $F$  statistic for testing population effects in longitudinal studies via mixed models.*

#### MATHEMATICS

Brawner, James, *The Gaussian map  $\Phi_K$  for curves with special linear series.*

Day, Colin, *A topological construction of Vassiliev style invariants for links.*

Ganter, Frieda,  *$-P \cdot P$  for surfaces  $Z^n = f(x, y)$ , and inequalities involving  $-P \cdot P$ .*

Mast, Maura, *Closed geodesics in 2-step nilmanifolds.*

Molinek, Donna, *Asymptotic measures for skew products of Bernoulli shifts with Morse-Smale diffeomorphisms.*

Nunn, Carroll, *Numerical algorithms for liquid crystal droplet problems.*

#### OPERATIONS RESEARCH

Burk, Roger, *Full and partial multicommodity cuts.*

Wang, Ben-Hao, *Simultaneous minimization of several functions with application in economics and game theory.*

Yarberry, Lonnie Stephen, *Incorporating a dynamic batch size selection mechanism in a fixed-sample size batch means procedure.*

#### STATISTICS

Benchekroun, Kamal, *Association-balanced arrays with applications to experimental design.*

Brown, Jason, *A finite sampling plan, central limit theorem, and bootstrap algorithm for a homogeneous and isotropic random field on the 3-dimensional sphere.*

Das, Shubhabrata, *Restricted canonical correlations.*

Lund, Robert, *Some limiting and convergence rate results in the theory of dams.*

Ming, Zhang, *Adaptive statistical analysis of repeated measurements designs.*

Sherman, Michael, *Subsampling and asymptotic normality for a general statistic from a random field.*

## NORTH DAKOTA

### North Dakota State University (1)

#### MATHEMATICS

Burns, David, *On the convergence of ergodic averages over zero density sequences in topological dynamics.*

## OHIO

### Air Force Institute of Technology (1)

#### MATHEMATICS AND STATISTICS

Elewa, Salah Amin M., *Development of an environment for software reliability model selection.*

### Bowling Green State University (4)

#### MATHEMATICS AND STATISTICS

Bobek, Ludmila, *Groups acting on join semi-lattices.*

Chen, De-Xin, *Bayesian computation methods for the poly  $t$  density.*

Johnson, Bruce E., *Asymptotic tests for the equality of several correlation matrices.*

Koswatta, M. S. R., *The word problem for certain two-generator subgroups of the group of order automorphisms of the real line.*

### Case Western Reserve University (6)

#### MATHEMATICS AND STATISTICS

Sabbaghan, Masoud, *Non-coalescent minimal distal flows.*

Tolmatz, Leonid, *Exact tail asymptotics of a certain Wiener functional.*

#### OPERATIONS RESEARCH

Agbegha, Gerald Yinkefe, *An optimization approach to the auto-carrier problem.*

Arunapuram, Sundararajan, *Vehicle routing and scheduling problem for full loads.*

Ilyes, Amy Louise, *Using linear programming to solve convex quadratic programming problems.*

Viswanathan, S., *Integrated inventory and transportation policies.*

### Kent State University (3)

#### MATHEMATICS AND COMPUTER SCIENCE

Alexopoulos, John, *Weakly compact sets in Banach spaces.*

Liszka, Kathy, *Generalizing bitonic and odd-even merging networks.*

Sharma, Naveen, *Synthesis of sequential and parallel programs for finite element analysis.*

### Ohio State University (23)

#### MATHEMATICS

Anderson, Michael, *Hecke algebras associated to Weyl groups.*

Bishop, Greg, *Ultrafilters generated by a closed set of functions and  $K$ -covering sets.*

Gethner, Ellen, *Rational period functions for the modular group and related discrete groups.*

Haaland, Inger, *Uniform distribution of generalized polynomials.*

Huang, Xiaoming, *On external properties of algebraic polynomials.*

Icaza, Maria Ines, *Effectiveness of positive definite quadratic forms.*

Kane, Stephen, *Significance test of probability non-stationarity of security price returns.*

Lang, Cheng Lien, *Existence and stability of a planar wave solution to a combustion model.*

Liu, Kecheng, *Stationary subsets of  $\{N\}^N$ .*

Narayani, Laksmhi, *Composition codes and designs.*

Sheu, Shin-Pyng, *Blacklund transformation and homoclinic solutions to the coupled nonlinear Schrödinger system.*

Sofer, Adriana,  *$P$ -adic interpolation of square roots of central values of Hecke  $L$ -series.*

Spieler, Barry, *Non-positively curved orbifolds.*

Szabo, Tamas, *Sequences and additive functions.*

Tang, Shu-Leung, *Iwasawa invariants over quadratic fields.*

Yue, Zhao, *On the edge reconstruction of planar graphs.*

Zha, Xiaoya, *Closed 2-cell embeddings of 2-connected graphs in surfaces.*

Zong, Susan Bong, *A model for the AIDS epidemic.*

#### STATISTICS

Fei, Lin, *On a stochastic optimization technique: Stochastic probing.*

Maa, Jen-Fue, *Simulation-based parameter estimation for multivariate distribution.*

Padilla, Mari Lourdes R., *The generalized Hellinger transform as a measure of information and its role in the comparison of statistical experiments.*

Zheng, Ming, *The use of copulas in dependent competing risk theory.*

Zhu, Yuangen, *Robustness of designs and robust optimality of designs.*

### Ohio University (2)

#### MATHEMATICS

Cho, Myung Hyun, *Conditions under which countable-compact-covering maps are compact-covering.*

Saleh, Mohammad Ali, *A study on weakly projective modules.*

## OKLAHOMA

### Oklahoma State University (4)

#### MATHEMATICS

Flood, Timothy Wayne, *The functional equation of the twisted  $L$ -function associated with an automorphic form on  $GL(3, \mathbb{R})$ .*

#### STATISTICS

Maier, Christoph, *A new sequential allocation method.*

Salihima, Astini, *The study of simultaneous optimization for several responses.*

Steiner, Robert, *Three estimation procedures for the parameter  $K$  of the negative binomial.*

### University of Oklahoma (4)

#### BIostatistics and EPIDEMIOLOGY

Duke, James C., *Sample size and the estimated odds ratio in logistic regression: a study with repeated samples from a low birth weight population.*

Murray, Cynthia K., *A feasibility study of the use of three PC expert system shells in epidemiologic research.*

#### MATHEMATICS

Nelson, Graydon, *Faithful representations of Lie algebras over power series.*

White, Frances T., *Controllability of nonlinear retarded functional differential equations.*

## OREGON

### Oregon State University (4)

#### MATHEMATICS

Cho, Yong-kum, *Multiparameter maximal operators and square functions on product spaces.*

Park, Young Kou, *On perturbation and location of roots of polynomials by Newton's interpolation formula.*

#### STATISTICS

Delongchamp, Robert, *Analysis of epidemiological data with covariate errors.*

Lebow, Patricia K., *Estimation of discriminant analysis error rate for high dimensional data.*

### University of Oregon (6)

#### MATHEMATICS

Clauss, Jon M., *Elementary chains of invariant subspaces of a Banach space.*

- Ford, Benjamin, *Overgroups of irreducible linear groups.*
- Jones, Amelia, *Composite two-generator links.*
- Liu, Chen, *Tensor products of finite and infinite dimensional representation of quantized enveloping algebras.*
- Lutgen, Jeffrey, *Flatness of higher order jet bundles of differentiable manifolds.*
- McKenzie, Thomas, *Separable polynomials and weak henselizations.*

## PENNSYLVANIA

### Carnegie Mellon University (4)

#### MATHEMATICS

- Cheng, Chih-Wen, *The Lavrentiev phenomenon and its applications in nonlinear elasticity.*
- Matias, José Carlos Pedro Cardoso, *On the Stefan problem with crystalline interfacial energy.*
- Matsko, Vincent J., *Mathematical concepts of special relativity.*
- McGillen, Donald James, *A low velocity approximation for the relativistic Vlasov-Maxwell system.*

### Drexel University (1)

#### MATHEMATICS AND COMPUTER SCIENCE

- Salsburg, Michael Allen, *The formulation and implementation of a stochastic model that explores HIV infection.*

### Lehigh University (5)

#### MATHEMATICS

- Dabeet, Elias A., *Tests for goodness of fit based on folded kernel density estimation.*
- Janssen, Jeannette C. M., *Even and odd Latin squares.*
- Kropp, Karl V., *Asymptotics of a free boundary problem resulting from the determination of an amortizing loan's refinance option.*
- McKayle, Camille A., *Approximation of solutions to certain types of differential equations using polynomial operators.*
- Rose, Kimberly J., *Generalized Reed-Muller codes and finite geometries.*

### Pennsylvania State University (18)

#### MATHEMATICS

- Arlinghaus, Francis Anthony, *Involutions in classical groups and related topics.*
- Bouwsma, Janet, *Semigroups presented by a single relation.*
- Chaiyasena, Arjuna Peter, *Radar and sonar ambiguity functions and group theory.*
- Chen, Kuo-Jye, *An asymptotic formula in partition theory.*
- Jirari, Alouf, *Second-order Sturm-Liouville difference equations and orthogonal polynomials.*

- Linares, Jose Filipe, *On nonlinear dispersive equations.*

- Marcone, Alberto Giulio, *Foundations of BQO theory and subsystems and second order arithmetic.*

- Poletaeva, Elena, *Integrability of the analogues of conformal and Riemannian structures on the classical superspaces.*

- Rajopadhye, Shubha Vilas, *Propagation of bores.*

- Sch lindwein, Charles William, *Consistency of Suslin's hypothesis, a non-special Aronszajn tree, and GCH.*

- Sellers, James Allen, *A generalization of the partition function.*

- Torre, Carlos Alberto, *On a theorem of Kirillov.*

- Youssfi, El Hassan, *Geometric function theory of several variables, operator theory in  $\pi_\kappa$ -spaces, and the indefinite moment problem.*

#### STATISTICS

- Anderson, George, *Generalized Wilcoxon methods.*

- Basu, Srabashi, *Model-based estimation of attributable risk for categorical data.*

- Kannan, Nandini, *Estimation of directions of arrival in signal processing models.*

- Macchiavelli, Raul, *Likelihood-based procedures and order selection in higher order antedependence models.*

- Petkova, Eva, *Generalized procedures for analysis of collapsibility in generalized linear models.*

### Temple University (10)

#### MATHEMATICS

- Gao, Bo, *Shape preserving approximation by rational functions.*

- Han, Jongsook, *The topology of the Radon transform on the Grassmannian and its restrictions.*

- Knappenberger, Johathan C., *Simultaneously forcing two conditions.*

- Simonelli, Italo, *Interacting particle systems.*

#### STATISTICS

- Barber, Beth, *Topics in group testing.*

- Chakravarty, Alaka, *On Bayesian analysis of bivariate contingency tables using prior information of association.*

- Kwong, Koon, *Evaluation and applications of the multivariate normal distribution with a singular negative product correlation structure.*

- Lai, Sue-Ling, *Spline-based survival estimation for censored and truncated data with covariates.*

- McCool, John, *The analysis of a two way layout with two parameter Weibull response.*

- Shen, Frank, *Robust and bootstrap testing procedures for bioequivalence.*

### University of Pennsylvania (10)

#### MATHEMATICS

- Colding, Tobias Holck, A. D. *Alexandrov's spaces in Riemannian geometry.*

- Escher, Christine, *Minimal isometric immersions of spherical space forms into spheres.*

- Jensen, Kjeld Knudsen, *Foundations of an equivariant cohomology theory for Banach algebras.*

- Katz, Nets, *Noncommutative determinants and applications.*

- Lau, Chi-Fong, *An arithmetic capacity on Grassmannian varieties.*

- Li, Jiangfan, *Extremal unit vector fields and extremal almost complex structures.*

- Pan, Liu-Hau, *Existence and uniqueness of volume-minimizing cycles in Grassman manifolds.*

- Schwachhoefer, Lorenz, *Connections with exotic holonomy.*

#### STATISTICS

- Gu, Xing, *A comparison and evaluation of recent developments for multivariate matching in observational studies.*

- Marcus, Sue M., *Parallel randomized and nonrandomized clinical trials.*

### University of Pittsburgh (11)

#### BIostatistics

- Tan, Lingshi, *A multivariate growth curve model with random effects and CAR(1) errors.*

- Wang, Shu-Chuan, *Developments in the two-event modeling of cohort data with time-dependent exposure patterns: analytical methods for fitting and ROC analysis for model assessment.*

#### MATHEMATICS AND STATISTICS

- Barnhart, Huiman Xie, *Models for multivariate random length data with applications in clinical trials.*

- Barnhart, Ronald E., *Generalized metric properties of topological semigroups.*

- Law, Chun-Kong, *On rational solutions of the Painleve equations.*

- Lee, Ca-Sing, *Quadrature approximation in nonlinear structural errors-in-variables model.*

- Li, Song-Ying, *Boundary value problems for equations of complex Monge-Ampere type.*

- Lu, You-Min, *Asymptotics and connection formulas of the fifth Painleve transcendent.*

- Qian, Shixian, *Algorithms for isotonic regression and related theory.*

- Raghavan, Shuba, *A singular perturbation problem arising from the Kuramoto-Sivashinsky equation.*

- Sunmonu, Adefemi, *Numerical analysis of coupled nonlinear partial differential equations modelling electro-thermal applications.*

## RHODE ISLAND

## Brown University (19)

## APPLIED MATHEMATICS

Frankel, Paul Henry, *On coupling between neural cells.*

Goldman, Daniel, *Spatiotemporal chaos in the complex Ginzburg-Landau equation and other studies in nonlinear dynamics.*

Katsoulakis, Markos, *Boundary value problems for 2nd order nonlinear PDEs.*

McEneaney, William Michael, *Connections between risk-sensitive stochastic control, differential games, and  $H^{00}$  control: the nonlinear case.*

Miller, Neil, *Matrix models in population biology.*

Perakis, Georgia, *Geometric, interior point, and classical methods for solving finite dimensional variational inequality problems.*

Rogerson, Audrey, *Stability and dynamics of miscible displacements in porous media flows under gravity.*

## MATHEMATICS

Arone, Gregory Zvi, *The Taylor tower of the stable homotopy of the mapping spaces.*

Cai, Hongsheng, *Dispersive smoothing effects for generalized and high order KdV type equations.*

Cervone, Davide P., *Vertex-minimal simplicial immersion of surfaces into three-space.*

Chen, Yen-Mei Julia, *Descent via 3-isogenies on elliptic curves.*

Chua, Seng-Kiat, *Arithmetic of étale quotient varieties.*

Guo, Yan, *Boundary problems for the Vlasov-Maxwell system.*

Lee, Chaujun (Isaac), *Generalized affine rotation surfaces.*

Lim, Nancy Lee,  *$L^p$ -Dirichlet problem for second order elliptic operators with nonsmooth coefficients.*

Lydakis, Manos George, *Fixed point problems, equivariant stable homotopy, and a trace map for the algebraic K-theory of a point.*

Men, Guo-wu, *The stability theorem for smooth concordance imbeddings.*

Sauerberg, James John, *Kummer theory for Lubin-Tate formal groups.*

Towse, Christopher, *Weierstrass points on cyclic covers of the projective line.*

## SOUTH CAROLINA

## Clemson University (11)

## MATHEMATICAL SCIENCES

Bibelnieks, Eric, *Backbone network design and some results on tolerance graphs.*

Bibelnieks, Tracy A., *Time series analysis of variation in fiber assemblies.*

Carlson, Rolf E., *Three dynamical systems for hypergraph factorization and consistent labeling.*

Dunlap, Karen L., *Algorithms for numerical shade sorting.*

Getachew, Teodros, *A recursive algorithm for multiple-objective network optimization with time-variant link costs.*

Johnson, Terri A., *New linear programming-based solution strategies for the quadratic assignment problem.*

Knisely, James E., *A study of cyclic gossiping in graphs.*

Lassiter, Julie B., *Persistence in 0-1 optimization.*

TenHuisen, Matthew L., *Generalized Lagrangian duality multiple objective programming.*

Zheng, Deda, *On polychrome tree in edge-colored complete graphs.*

Zheng, Quan, *Integral global optimization of robust discontinuous functions.*

## University of South Carolina (8)

## MATHEMATICS

Bdeir, Yousef, *P-minimal and P-closed spaces.*

Day, Colin, *Spectral mapping theorems for fractionally integrated semigroups.*

Hsiao, Chia-Chang, *Rectangular wavelets and compression of operators.*

Kyriazis, George, *Wavelet decompositions and spaces of functions.*

Lin, Yan-Chyuan, *Planar graphs with few vertices of small degree.*

Yarnall, Kenneth, *Sampling theorems and wavelet bases.*

## STATISTICS

Diniz, Carlos A. R., *Segmented plane regression.*

Lee, Robert Edwin, *The comparison of successive effects.*

## TENNESSEE

## Memphis State University (3)

## MATHEMATICAL SCIENCES

Bowman, Dale D., *Analysis of developmental data using parametric, non-parametric and Bayesian bootstrap procedures.*

Fathnezhad, Faramarz, *Generalized degree and connectivity conditions that imply edge Menger path systems.*

McDaris, Robert L., *On the existence of periodic solutions to certain functional differential equations.*

## University of Tennessee (1)

## MANAGEMENT SCIENCE

Pillai, Rekha, *The travelling salesman problem with one additional constraint.*

## Vanderbilt University (4)

## MATHEMATICS

Al-Khayer, Adnan, *One and two compartment mathematical models of mechanical ventilation.*

Bass, Thomas Preston, *Globals of graph algebras.*

Boyd, Sheri Renee Jordan, *Interassociativity.*

Markus, Lisa Rosann, *Degree, neighbourhood and claw conditions versus traversability in graphs.*

## TEXAS

## Rice University (10)

## COMPUTATIONAL AND APPLIED MATHEMATICS

Abd El-Aziz, Mohammedi, *Numerical safeguarded use of the implicit restarted Lanczos algorithm for solving nonlinear eigenvalue problems and its monotonicity analysis.*

Alexandrov, Natalia, *Multilevel algorithms for nonlinear equations and equality constrained optimization.*

Lee, Eva, *Solving structured 0/1 integer program arising from truck dispatching scheduling problems.*

Maciel, Maria, *A global convergence theory for a general class of trust region algorithms for equality constrained optimization.*

## MATHEMATICS

Richardson, Kenneth S., *Critical points of the determinant of the Laplace operator.*

Wang, Shiah-Sen, *Singularities of subanalytic sets and energy minimizing maps.*

Zweck, John, *Compactification problems in the theory of characteristic currents associated with a singular connection.*

## STATISTICS

Go, Kerry Wayne, *Nonparametric estimation of transitions in cancer.*

Minnotte, Michael Charles, *A test of mode existence with applications to multimodality.*

Spears, Floyd Martin, *Multi-stage designs in dose-response studies.*

## Southern Methodist University (6)

## MATHEMATICS

Ho, Ka Ho (Eric), *Hamiltonian systems with dissipations: basins of attractions and nearly homoclinic orbits.*

Hosea, Michael, *Studies in the numerical solution of ordinary differential equations.*

## STATISTICAL SCIENCE

Cheng, Qiu-Chang, *Transfer function model and GARMA II model.*

Han, Joonghee, *Estimation in variance components.*

Hong, Sunho, *Parameter estimation for kriging models.*

Qiu, Wenzhi, *Rank tests for unbalanced two-way ANOVA.*

**Texas A&M University (8)**

**MATHEMATICS**

Bagley, Scott William, *Polynomial near-rings, distributor and  $J_2$  ideals of generalized centralizer near-rings.*

Bui, Dat Duc, *The inverse electromagnetic scattering problem for a spatially homogeneous, dispersive and dissipative medium.*

Caudill, Lester Frank, Jr., *Identification and reconstruction of potentials in two space dimensions.*

Farmer, Jeffrey Darrell, *Extensions and applications of infinite dimensional Banach space theory.*

Hudson, Timothy Dean, *Ideals in triangular AF algebras.*

Yu, Fan, *Information-based complexity applied to numerical transport theory.*

**STATISTICS**

Bartlett, Randy John, *Measures of capability under non standard conditions.*

Gomez Meza, Marco Vinicio, *Estimation of variance components and diagnostic analysis in unbalanced mixed linear models.*

**Texas Tech University (2)**

**MATHEMATICS**

Chang, Guang-Hwa, *Nonparametric analysis of covariance in block designs.*

He, Jianqiu, *A root locus methodology for parabolic boundary control systems.*

**University of Houston (3)**

**MATHEMATICS**

Jia, Wenyao, *Iterative methods for the Hartree and Hartree-Fock eigenproblems.*

Nasser, Mahmoud George, *Numerical methods for multibody elastic systems and contact.*

Vinod, Vaidyanath, *Structural stability of Riemann solutions for a multiphase kinematic conservation law model that changes type.*

**University of North Texas (8)**

**MATHEMATICS**

Badawi, Ayman Rateb,  *$\pi$ -regular rings.*

Dawson, Charles Bryan, *Convergence of conditional expectation operators and the compact range property.*

Dawson, Dan Paul, *Concerning integral approximations of bounded finitely additive set functions.*

Emerson, Sharon Sue, *Overrings of an integral domain.*

Gadam, Sudhasree, *Existence and multiplicity of solutions for semilinear elliptic boundary value problems.*

Jiminez, Debora Maria Tejada, *Universal branched coverings.*

Kim, Keehwan, *Steepest descent for partial differential equations of mixed type.*

Yoon, Young-Jin, *Characterizations of some combinatorial geometries.*

**University of Texas at Arlington (5)**

**MATHEMATICS**

Kim, Jeongsook, *Estimation of regression coefficients and influence function in multivariate regression models with prior information.*

Nagarajan, Nanayanaswamy, *Solution concepts for cooperative games with leading coalitions.*

Rahimi, Amin Massoud, *Some results on the stable range in commutative rings.*

Shibberu, Yosi, *Discrete-time Hamiltonian dynamics.*

Wyatt, Bryant Morgan, *Molecular dynamics simulation of colliding microdrops of water.*

**University of Texas, Austin (13)**

**MATHEMATICS**

Chang, Kuei-Fang, *Wavelet analysis on Hilbert spaces.*

Clark, Gordon Wayne, *Microstructure modeling of fluid flow in a layered medium.*

Cook, John Douglas, *Diffusion models with microstructure and secondary flux.*

Holt, Jeffrey John, *Radial analogues of some extremal Beurling-Selberg functions.*

Liu, Zhuxing, *On operators in  $(L^*)$ .*

Menegatto, Valdir Antonio, *Interpolation on spherical spaces.*

Morin, Chris Lyman, *A characterization of handlebodies, homotopy and homology unknotting numbers of a knot.*

Packer, Lindsay Arthur, *The regularized layered medium equation.*

Patton, Robert Max, *Incompressible punctured tori in the complements of alternating knots.*

Pinner, Christopher G., *On the number of irreducible factors of a polynomial.*

Schafer, Robert P., Jr., *Rigidity for dynamically defined Cantor sets and expanding circle maps.*

Vona, Bi Roubolo, *Parallel multilevel iterative models.*

Yu, Yuan, *Automated proofs of object code for a widely used microprocessor.*

**UTAH**

**Brigham Young University (2)**

**MATHEMATICS**

Swenson, Eric Lewis, *Negatively curved groups and related topics.*

Xun, Jian Ping, *Metastable patterns for the Cahn-Hilliard equation.*

**University of Utah (9)**

**MATHEMATICS**

Bratten, Timothy Clark, *Realizing globalizations of Harish Chandra modules on a generalized flag manifold.*

Dillon, Robert Henry, *A mathematical model of vertebrate limb development.*

Kasparaian, Azniv, *Variations of Hodge structure of maximal dimension with associated Hodge numbers  $H^{2,0} > 2$  and  $H^{1,1} = 2Q+1$ .*

Kim, Joo-Mok, *Series representations and self-similar processes.*

Ma, Tina Seon, *Some goodness-of-fit indices and their distributions in structural equations.*

McGough, Jeff, *On solution continua in quasilinear elliptic problems.*

Szabo, Endre, *Complete intersection subvarieties of general hypersurfaces and divisorial log terminal singularities.*

Tang, Yuanhua, *Mathematical modeling of signal transduction and pattern formation.*

Westhoff, Randall F., *Curves and normal functions on threefolds with numerically effective anticanonical bundles.*

**Utah State University (2)**

**MATHEMATICS AND STATISTICS**

Xu, Yuhua, *Disconjugacy and oscillation theory of linear differential and difference equations.*

Ye, Shumin, *Linear operators that preserve qualitative matrix structures.*

**VIRGINIA**

**George Mason University (6)**

**APPLIED AND ENGINEERING STATISTICS**

Ball, Celesta G., *Two-stage path smoothing using L-spline estimation.*

Morad, Osama, *Migratory global scheduling in a network environment.*

Priebe, Carey E., *Nonparametric maximum likelihood estimation with data-driven smoothing.*

**OPERATIONS RESEARCH AND ENGINEERING**

Anderson, Paul Bernard, *Nonlinear optimization methods for X-ray crystallographic phase determination.*

Tibbs, Richard Warner, *A class of methods solving networks of queues with dynamic routing probabilities.*

Yarrow, Leslie-Ann, *Obtaining minimum-correlation latin hypercube sampling plans using discrete optimization techniques.*

**Old Dominion University (1)**

**MATHEMATICS AND STATISTICS**

Kerr, Gilbert, *Boundary value problems in rectilinearly anisotropic thermoelastic solids.*

**University of Virginia (14)**

## APPLIED MATHEMATICS

Curfman, Lois V., *Solution of convective-diffusive flow problems with Newton-like methods.*

Freitag, Lori A., *Parallel solution of the generalized Helmholtz equation on distributed memory architectures.*

McMillan, Christine A., *Minimax game theory problems for partial differential equations.*

Nayar, Narinder, *Computation of selected eigenvalues of the eigenvalue problem.*

Polignone, Debra A., *A bifurcation approach modeling cavitation in anisotropic nonlinearly elastic solids.*

Richman, Shu-Mei C., *Parallel performance analysis of iterative methods for solving nonsymmetric linear systems.*

Smith, Anne C., *Lagrangian and Eulerian models for fiber motion in industrial processes.*

Warne, Paul, *Foundations for the nonlinear Boussinesq problem and the theory of Lie groups as applied to the equations of nonlinear elastostatics.*

## MATHEMATICS

Abbott, Stephen D., *Vectorial Hankel operators with Toeplitz weights.*

King, Daniel, *Linear and quadratic Jordan superalgebras.*

Robbins, Marian, *Composition operators between Hilbert spaces of analytic functions.*

Shaker, Richard, *Fixed sets of commuting involutions.*

Spickler, Donald, *Universally coefficient domains and their relation to the cancellation problem for rings.*

Winstead, Mark, *Torsion in the cohomology of mapping spaces.*

**Virginia Commonwealth University (2)**

## BIostatistics

Mensah, Robert D., *Consistent estimators of the variance-covariance matrix in the GMANOVA model with missing data.*

Wagner, Pamela, *Threshold models in risk assessment for a combination.*

**Virginia Polytechnic Institute and State University (15)**

## MATHEMATICS

Ellingsen, Harold, *Growth of algebras, words, and graphs.*

Inch, Scott Eugene, *Precise energy decay rates for some viscoelastic and thermo-viscoelastic rods.*

Lei, Peng, *Cauchy problem of diffusive Vlasov-Enskog equations.*

Liu, Rong, *Perturbation theory of Boltzmann equations.*

Rakowska, Joanna, *Tracing parametrized optima for inequality constrained nonlinear minimization problems.*

Spies, Ruben Daniel, *Mathematical modelling, finite dimensional approximations and sensitivity analysis for phase transitions in shape memory alloys.*

Zhang, Xiaohong, *Optimal feedback control for nonlinear discrete systems and applications to optimal control of nonlinear ordinary differential equations.*

## STATISTICS

Baran, Gary Steven, *A two-stage experimental design procedure under dispersion effects.*

Heise, Mark Alan, *Optimal designs for a bivariate logistic regression model.*

Jo, Jinnam, *Construction and properties of Box-Behnken designs.*

Kim, Yoon, *A response surface approach to data analysis in robust parameter design.*

Mays, D'Arcy Paul, III, *Design and analysis for a two-level factorial in the presence of dispersion effects.*

Savarese, Paul Tenzing, *New design comparison criteria in Taguchi's robust parameter design.*

See, Kyoungah, *Three-mode principal component analysis of designed experiments.*

Sutherland, Sindee, *Sequential design augmentation with model misspecification.*

**WASHINGTON****University of Washington (16)**

## BIostatistics

Arnold, Alice, *Non-parametric approaches to the reliability of psychometric tests in Alzheimer's disease.*

Emond, Mary Jane, *Efficient estimation in the generalized semilinear model.*

Huang, Chisheng, *A system for graphical data analysis.*

Li, Yoichi, *Generalized linear model with measurement error.*

Mancl, Lloyd, *Regression analysis of correlated discrete and continuous data: evaluation of an estimating equation approach.*

Rosenkrantz, Susan, *Use of the Bayes factor for model evaluation in a hierarchical Poisson model for health event counts.*

## MATHEMATICS

Baxter, James Arthur, *The Demailly phenomenon for certain holomorphic fiber bundles over annuli.*

Gao, Ping, *Some problems in elliptic diffusions.*

Qian, Maijian, *Variable metric proximal point algorithm: convergence theory and applications.*

Tomas, Brian M., *Theory and applications of frequency selective wavelets.*

Xu, Yeren, *Extension problems in several complex variables.*

## STATISTICS

Huges, James Patrick, *A class of stochastic models for relating synoptic atmospheric patterns to local hydrologic phenomena.*

Lin, Shili, *Markov chain Monte Carlo estimates of probabilities on complex structures.*

Schimert, James, *A high order hidden Markov model.*

York, Jeremy Charles, *Bayesian methods for the analysis of misclassified or incomplete multivariate discrete data.*

Zhou, Haibo, *Auxiliary and missing covariant data in failure time regression.*

**Washington State University (6)**

## MATHEMATICS

Cochran, Lyle Eric, *Orthogonal Laurent polynomials with an emphasis on the symmetric case.*

Jones, Charles H., *Triangle intersection graphs and visibility graphs.*

Luo, Dali, *Some properties of the Kaplan-Meier estimator and a method to find system reliability.*

Peterson, Blake Ellis, *Integer polyhedra and the perfect box.*

Raines, Allen Crawford, III, *A class of Hamiltonian-symplectic methods for solving the algebraic Riccati equation.*

Zhang, Limin, *Mathematical stability analyses on the effect of suspended particles on Raleigh-Bénard convection.*

**WEST VIRGINIA****West Virginia University (1)**

## MATHEMATICS

Seldomridge, Gary A., *Generalized disconnection numbers.*

**WISCONSIN****Marquette University (1)**

## MATHEMATICS, STATISTICS, AND COMPUTER SCIENCE

Harris, Ondine A., *The polymerase chain reaction: a stochastic model, methods of quantification, and applications to HIV.*

**University of Wisconsin-Madison (30)**

## MATHEMATICS

Dzamonja, Mirna, *A set-theoretic approach to some problems in measure theory.*

Haloupek, William J., *Differentiation and analytic continuation of functions defined on arbitrary sets in the plane.*

Ingenoso, Marc J., *Stability analysis for certain queueing systems and multi-access communication channels.*



Jarvis, Peter M., *The effect of quadratic maps of  $R^2$  on the uniform invertibility of the Fourier transform of functions initially in  $A(R^2)$ .*

Kaddah, Deborah S., *Uniformity in the recursively enumerable degrees and infima in the degrees of the differences of recursively enumerable sets.*

Kim, Sang Dong, *Preconditioning collocation method by finite element method.*

Lee, Chanyoung, *Stability in modules for classical Lie superalgebras.*

Li, Wenbo, *Small ball estimates for Gaussian measures with applications to strong limit theorems.*

Maia, Liliane de Almeida, *Problems on waves in stratified fluids.*

Massey, Jennifer Jean Quinn, *Colorings and cycle packings in graphs and digraphs.*

McDonald, Judith Joanne, *Combinatorial spectral theory of  $M$ -matrices.*

Muller, Carl D., *On the polynomial hulls of the unions of convex sets in  $\mathbb{C}^n$ .*

Newman, William Glen, *Nonlinear string and beam equations.*

Peters, Karl M., *Non-restricted representations of classical Lie algebras.*

Reisewitz, Tammo M., *Hyperarithmetical relations and existentially decidable models in recursive model theory.*

Shin, Dongho, *Fast solvers for finite difference approximations for the Stokes and Navier-Stokes equations.*

Tan, Chik How, *Codes in affine matrix schemes.*

Tao, Jinhua, *Multi-type branching random walk.*

Wang, Qing, *On the tori and Cartan subalgebras of Lie algebras of Cartan type.*

Williams, John C., *Character correspondences in finite groups.*

Wong, Sze-Ping, *Preconditioning of nonconforming finite element methods for second-order elliptic boundary value problems.*

Zhang, Ende, *Functional differential equation models in epidemiology with theoretical and numerical studies.*

Zhao, Kang, *Density of the dilates of a shift-invariant subspace.*

STATISTICS

Gao, Feng, *On combining data from multiple sources with unknown relative weights.*

Guven, Bilgehen, *Estimation in simple linear regression with a nested error.*

Jung, Sin-Ho, *A test for adequacy of quasi-likelihood and survival analysis with median regression models.*

Omori, Yasuhiro, *Random effects in survival analysis.*

Reboussin, David, *Exact inference for multivariate linear rank statistics on complete and incomplete data.*

Ritter, Christian, *Modern inference for nonlinear least squares regression.*

Yap, Sook Fwe, *Partially nonstationary multivariate autoregression moving average model.*

**University of Wisconsin-Milwaukee (6)**

MATHEMATICAL SCIENCES

Avirappattu, George Anthony, *On the boundary integral equation methods for an extended time-harmonic Maxwell type system.*

Karmakar, Satyajit, *Compositions of random Mobius transformations and their applications.*

Liu, Youming, *Construction and sampling in wavelet subspaces.*

Schmitter, Joel, *Asymptotic distribution of standardized empirical processes under the proportional hazards model.*

Stalder, Shubhangi N., *Properties of strong band graded rings.*

Yang, Jianping, *Newton's method and dynamical systems.*

**WYOMING**

**University of Wyoming (6)**

MATHEMATICS

Munasinghe, A. Ranjith, *Composants, unstable sets, and minimal sets of inverse limit spaces.*

Shen, Jian, *Mixed finite element methods: analysis and computational aspects.*

Tsaur, Tzong, *Variants of symmetric block designs.*

Wang, Hong, *Eulerian-Lagrangian localized adjoint methods: analyses, numerical implementations and their applications.*

STATISTICS

Chao, Li, *Multidimensional estimating of covariance function and spectrum.*

Montopoli, George J., *The analysis of discrete choice set experiments with correlated error structure and other related logistic topics.*

**Doctoral Degrees Conferred  
1991-1992  
Supplementary List**

The following list supplements the list of thesis titles published in the November 1992 *Notices*, pages 1042-1060 and the April 1993 *Notices*, page 327.

**OKLAHOMA**

**University of Oklahoma (1)**

BIostatistics and EPIDEMIOLOGY

Kenny, Susan J., *The effect of dichotomization of a continuous variable in the linear logistic regression model.*

**TEXAS**

**University of Texas at Arlington (2)**

MATHEMATICS

Mahdavi, Mehran, *Contribution to the theory of functional differential equations involving abstract Volterra operators.*

Shin, Jun Yong, *Study of some nonlinear differential equations arising in elasticity.*

## Forum

The Forum section publishes short articles on issues that are of interest to the mathematical community. Articles should be between 1000 and 2500 words long. Readers are invited to submit articles for possible inclusion in Forum to:

*Notices* Forum Editor  
American Mathematical Society  
P.O. Box 6248  
Providence, RI 02940

or electronically to [notices@math.ams.org](mailto:notices@math.ams.org)

### **The Impact of Electronic Publication on Scholarly Journals**

*John Franks*

*Northwestern University*

What will electronic journals be like? When most mathematicians consider this question they naturally interpret it to mean what will electronic journals be like for them—how will their daily use of research journals be different when these journals are routinely accessed on their desktop computers. But another interpretation of the question may be more important—it is certainly more controversial. What will the organization and economics of electronic journals be like? What does electronic publication mean for the publisher and the librarian? Will the editorial or peer review process be affected? Will the way journals are funded and marketed change? And how will all this affect the mathematician?

### **Declining and Shifting Costs**

Electronic publishing will come to scholarly research journals before it comes to other kinds of publications. There are several reasons that we academics will be the first. The content of our journals is relatively homogeneous and generally amenable to being put in an electronic form. Also, the readership is much more highly connected to the Internet than the general population, and we are generally more favorably inclined to dealing with documents in electronic format. Finally, at the present time most libraries are under extreme financial pressure. What librarians refer to as the “serials crisis” has

been brought about by dramatic increases in the cost of scholarly journals (an average of 13.5% annually for more than a decade) combined with financial constraints facing most academic institutions today. The result is a strong economic motive to find less expensive ways for scholars to communicate their work.

We don't know what the economics of electronic publishing will turn out to be, but several of its aspects are becoming clear. The relationship of electronic publishing to traditional publishing is analogous to the relationship of personal computing to mainframe computing. Electronic publishing is likely to be much more decentralized. It is much easier to do, and the costs can be much less than traditional publishing. This is especially true for an organization or department which must have a computing infrastructure for other purposes. In such a setting the marginal cost of an electronic publication can be quite low.

Moreover, the costs which remain are being redistributed. For example, the emergence of  $\text{\TeX}$  as a near standard for mathematics moves much of the cost of composition and typesetting to the author or the author's institution. This trend will accelerate—there will be increasing pressure on authors to provide manuscripts in a standard form which needs little massaging by the publisher. Since transferring articles from an electronic source to paper will normally be done by the reader, the printing costs will be shifted to the user or to the user's library. Distribution *via* the Internet is not free, contrary to popular opinion, but the costs are largely borne by the reader's institution and perhaps to a smaller extent by the taxpayer. Since the reader's institution usually must have Internet access for other reasons, the marginal cost is low.

The effect on scholarly journals of all of these shifts is to decrease the value added by the publisher and to increase the value added by the institutions of the author and reader. It is worth examining who contributes to the value of a journal and which “value-added” items contribute to the cost. The contribution of the author of a scholarly article (presumably the primary value) is almost never a direct contributing factor to the cost of the journal.

The next most important value added is the certification achieved by the editorial and peer review process. While the publisher plays an important organizational role in this process, the work of the editor and the referee is usually done

by unpaid volunteers, at least for primary journals. What the publisher of a traditional journal does provide is printing, distribution, and "production editing". Production editing is a relatively costly item which improves and standardizes the style of articles. It is what makes the difference between a "camera ready copy" journal and a typeset one.

The cost shifts which will come with electronic publishing, together with the dramatic increases in the cost of commercial scholarly journals, have led some in the library community to suggest that it may be time for a dramatic restructuring of the process of research publication. Patricia Battin, then university librarian and vice-president for information systems at Columbia, urged that universities take a much greater role in the publishing enterprise [1].

"The advent of electronic capabilities provides the university with the potential for becoming the primary publisher in the scholarly communication process. At the present time we are in the untenable position of generating knowledge, giving it away to the commercial publisher, and then buying it back for our scholars at increasingly prohibitive prices. The electronic revolution provides the potential for developing university-controlled publishing enterprises through scholarly networks supported either by individual institutions or consortia."

Battin might have added that we are also giving away our efforts as editors and peer reviewers and then buying them back, at rapidly increasing prices.

### Access versus Ownership

Not surprisingly, others, especially publishers, have a very different vision of how electronic delivery might change the nature of scholarly publication. To quote Ann Okerson of the Association of Research Libraries [2],

"We have lived for many generations with a world in which the technology of publication meant that access required ownership. . . . New electronic technologies allow the possibility of uncoupling ownership from access, the material object from its intellectual content. This possibility is revolutionary, perhaps dramatically so."

I don't know what Okerson has in mind as a revolutionary possibility, but I think I know what commercial publishers mean by uncoupling ownership from access. It is a code phrase for a possibility I find disturbing. If I subscribe to a mathematics journal and receive an issue, what I have acquired, aside from a certain quantity of paper, is a limited right to use the content of the articles printed on the paper. I have the right to read the issue and to make limited photocopies for my personal use. I do not have the right to make large-scale reproductions or to sell reproductions. But my limited rights to the contents last as long as the paper on which they are printed.

Unfortunately, what publishers seem to have in mind when they speak of access without ownership is a model in which a one-year subscription entitles the subscriber to one year of access. When the subscription ends, so does the access. This has little to do with ownership—no matter what the form of the journal, the subscriber always owns the *medium* and

never owns the *message*. It is a question of limited rights in perpetuity versus the same rights but with a fixed time limit which makes it necessary to repeatedly repurchase access.

Such an arrangement is very advantageous to the publisher. It becomes much harder for a library to cancel a long-running subscription if, for example, the quality of a journal declines or the price increases dramatically. The big loser in such a model is the librarian who is supplanted as archiver and probably cataloger by the publisher. In fact, with this model the librarian becomes little more than a purchasing agent for scholarly journals. Even this role could be threatened by publishers who have hopes of marketing their journals directly to individuals rather than to libraries.

### A New Form of Publishing

In light of these very different visions of electronic publishing it is interesting to see what new developments are actually taking place.

Since the time when photocopying machines became widely available, the informal distribution of "preprints" of scholarly articles has been an important component of scholarly communication. Some would argue that it is now the most important component because formal publication is such a time-consuming process. A major criticism of this "scholarship by preprint" system is that scholars who have not managed to break into the right distribution circles may not have timely access to scholarly work in their field.

It is natural that with the arrival of electronic mail this process is tending to move from paper to an electronic format. The ease and economy with which articles can be widely distributed electronically have led a number of volunteers to set up article data bases for their subdiscipline or their organization. For example, one of the best of these is run by the Institute for Mathematical Sciences at Stony Brook. It provides access to the articles in their preprint series in both  $\text{\TeX}$  and PostScript format [3].

As scholars have gained experience with this kind of publishing, they have learned that e-mail is not a very good way to do electronic document distribution. Its sole advantage is widespread availability, but it is by far the most cumbersome method for the user. Anonymous ftp is a substantial improvement, but still better are distributed electronic document browsers like Gopher and Mosaic, which were explicitly designed for this purpose.

These article collections certainly constitute a form of electronic publication, but are they journals? The main thing missing, of course, is the peer review process. Also at present it is normally assumed that articles in such a collection are preprints and will be formally published elsewhere in a traditional journal.

This raises several questions, as yet unanswered. Commercial publishers would like to have preprints removed from electronic data bases when an article appears in a traditional journal. This may seem reasonable at first, but in fact tends to conflict with the interests of the author. When I publish an article I receive a certain number of reprints which I am free to distribute to interested scholars. If that supply is

exhausted, I routinely photocopy more and continue to distribute them. This practice is surely widespread and, I believe, perfectly consistent with copyright transfer agreements of most journals.

It would be both easier and cheaper for me to respond to these reprint requests electronically. I would be disinclined to publish in a journal which did not permit me to do so. And if requests for electronic reprints become routine, I will certainly want to automate the process of sending them to such an extent that no intervention on my part is required. At that point I am running my own electronic data base in conflict with the publisher's wishes. Indeed, with modern electronic document delivery systems using client programs like Gopher and Mosaic, it is quite possible for my electronic reprints to reside physically on my desktop computer but appear to others to be in a discipline-oriented data base. This is an issue whose resolution is not clear; but current practice seems to be to leave articles available electronically after publication, and I know of no instances of publishers attempting to enforce their removal.

Not surprisingly, it has occurred to some that the main thing required to turn a preprint data base into a true journal is a volunteer editor. In fact, there now exist electronic journals, edited and fully refereed, and available to scholars electronically without cost. The costs of running such a journal are comparable to those of an article data base and are typically borne by the editor's institution or research grant.

### What Happens Next?

In some form or other, free electronic access to scholarly articles seems to be here to stay. There are simply too many advantages for the author, the librarian, and the university as a whole. The author has a strong incentive to have his or her work easily accessible to other scholars, and he or she has the final say on where it is published. How great the competition free journals will provide for commercial journals remains to be seen. Certainly a younger scholar trying to establish research credentials for promotion or tenure may prefer a traditional publication even if it offers less accessibility to his or her work.

A great deal depends on the reaction of librarians to these innovative publications. A serious journal needs to be archived by libraries or consortia of libraries. Librarians have two strong incentives to support this new model of publication. First, it preserves their traditional role of archiver and cataloger—a role which at least some publishers seem to covet. Second, library budgets can surely better support the cost of archiving than the “prohibitive prices” that Patricia Battin complains about.

Faced with increases in the prices of traditional journals, librarians have begun to take action by campaigning to persuade faculty not to submit papers to the most expensive journals or to serve on their editorial boards. Whether they will equally vigorously support inexpensive or free electronic publications by archiving them or forming archive consortia remains to be seen. The rapid change in the nature of publication is just beginning to impact the librarian, but that impact will be profound. For the most part librarians are not well prepared for the changes being forced upon them by the pace of technological developments. It will be a difficult time for them. But on the plus side, being a librarian is rapidly becoming a glamorous high-tech position.

How will it all turn out? No one knows for sure, but likely we will see a mixture of models. I doubt that primary research journals can be successfully marketed in a way that requires an annual repurchase of access rights, but specialized data bases which have greater value added by the publisher perhaps can.

We will see more free subscription journals, but I doubt they will supplant traditional journals. However, as traditional journals gradually move to an electronic format, they will be under great pressure to cut costs and pass on the savings to subscribers. Printing and distribution account for about 30% of the cost of a traditional research journal and hence represent substantial potential savings. Journals can also save by making greater efforts to shift composition costs to the author. This will take the form of stricter requirements for the format of submissions (or real page charges if those requirements are not met). This is a desirable thing. The scholar too must contribute to ameliorating the serials crisis.

Most likely traditional journals will sell electronic subscriptions much as they currently do subscriptions to paper versions. Their customers will continue for the most part to be libraries. With a journal subscription a library will receive the right to redistribute the contents to its institutional patrons and the responsibility of assuring that it distributes only to those patrons. The library also will acquire the right and responsibility to archive those journal contents, perhaps as part of a consortium.

### References

1. Battin, Patricia. *The Library: Center of the Restructured University*, College and Research Libraries, vol. 45, 1984, pp. 170–176.
2. Okerson, Ann. *Synopsis in University Libraries and Scholarly Communication, A Study Prepared for The Andrew W. Mellon Foundation*, Association of Research Libraries, 1992, available via Gopher from [orion.lib.virginia.edu port 70](http://orion.lib.virginia.edu:port70).
3. Institute for Mathematical Sciences, preprint series, anonymous [ftp to math.sunysb.edu](http://ftp.math.sunysb.edu).

*Edited by Keith Devlin*

## This month's column

Richard Pinch of the University of Cambridge in England heads off this month's column with an article on the primality testing algorithms used by four popular computer algebra systems: *Mathematica*, *Maple V*, *Pari/GP*, and *Axiom*. (The first three systems have already received general reviews in this column; a general review of *Axiom* is expected within the coming months.)

This is followed by a plea from Greg Kuperberg of the University of Chicago that all mathematics departments adopt the electronic address `math.school.edu`. As one who frequently has to make electronic contact with mathematicians at other institutions, I can but echo this plea. Life would also be simpler if users would have login names, or at least mail aliases, consisting purely of the first eight letters of their surname or first initial followed by the first seven letters of the surname; but many users seem to be deeply attached to the use of nicknames or simply their first names, and some systems administrators appear to be unable to function without the use of totally unmemorable alphanumeric strings generated by some formal grammar or other.

Kuperberg provides a list of schools that currently do use the `math.school.edu` convention. This list is as complete and accurate as he has been able to make it; he asks for additions and corrections to be sent to him.

A review of *Harmonic Function Theory* comes next. This is a *Mathematica* package designed to accompany the book of the same name by Axler, Bourdon, and Ramey. The reviewer is Paul Abbott of the University of Western Australia.

Finally, there are a few small items of general information.

Editor's address:

Professor Keith Devlin  
School of Science  
Saint Mary's College of California  
P.O. Box 3517  
Moraga, California 94575

Correspondence by electronic mail is preferred, to:

`devlin@msri.org`.

## Some Primality Testing Algorithms

R. G. E. Pinch\*

**ABSTRACT.** We describe the primality testing algorithms in use in some popular computer algebra systems and give some examples where they break down in practice.

### Introduction

In recent years fast primality testing algorithms have been a popular subject of research, and some of the modern methods are now incorporated in computer algebra systems (CAS) as standard. In this review I give some details of the implementations of these algorithms and a number of examples where the algorithms prove inadequate.

The algebra systems reviewed are *Mathematica*, *Maple V*, *Axiom*, and *Pari/GP*. The versions we were able to use were *Mathematica* 2.1 for Sparc, copyright dates 1988–1992; *Maple V* Release 2, copyright dates 1981–1993; *Axiom* Release 1.2 (version of February 18, 1993); *Pari/GP* 1.37.3 (Sparc version, dated November 23, 1992). The tests were performed on Sparc workstations.

Primality testing is a large and growing area of research. For further reading and comprehensive bibliographies the interested reader could consult the works of Bressoud [11], Brillhart et al. [12], Knuth [26], Koblitz [27], Ribenboim [40, 41], or Riesel [42].

### Primality Tests

The first and most obvious test is *trial division*: that is, given an integer  $n$ , try all integers from 2 up to  $\sqrt{n}$  to see whether any are factors of  $n$ . If one is found, then  $n$  is composite; if not, then  $n$  is prime.

This test has two drawbacks, the most obvious being that the time taken (even with obvious refinements) is, in the worst case (which will occur when  $n$  is prime), of the order of  $\sqrt{n}$ ; and this is not a practical proposition for  $n$

\*Richard G. E. Pinch is a number theorist in the department of pure mathematics and mathematical statistics at the University of Cambridge, 16 Mill Lane, Cambridge CB2 1SB, U.K. His email address is `rgpe@pmms.cam.ac.uk`.

of the order likely to occur in practice. This is in itself a sufficient reason for searching for other, more efficient, tests. The second drawback, less obvious, is that the test does not always produce a *certificate* for its answer. When  $n$  is composite, then a factor  $f$  will be found, and the character of  $n$  can then be verified quickly: it is much easier to show that  $n$  is divisible by some number  $f$  than to find  $f$  in the first place. Unfortunately when  $n$  is prime, all that emerges from the computation is a bare assertion that no factor was found, and in order to check the calculation (for example, to check whether any error has occurred or to convince a skeptical onlooker), it is necessary to repeat it all over again.

Most modern algorithms depend in some way on the converse of Fermat's Theorem, that if  $p$  is prime then, for  $1 \leq a < p$ , we have  $a^{p-1} \equiv 1 \pmod{p}$ . Given a number  $n$  to be tested for primality, we see that if there is an  $a$  with  $1 < a < n$  and  $a^{n-1} \not\equiv 1 \pmod{n}$ , then  $n$  must be composite, and  $a$  is a certificate for the compositeness of  $n$  (although no factor of  $n$  need have been found). Since  $a^{n-1}$  can be computed modulo  $n$  in about  $\log n$  multiplications modulo  $n$ , this condition is very fast to check. This is the *Fermat test*, and  $a$  is the *base*.

What happens if we find that  $a^{n-1} \pmod{n}$  is 1? We cannot conclude that  $n$  is prime from just one test; for example, given  $n = 341 = 11 \times 31$  and  $a = 2$ , we find that  $a^{n-1} = 2^{340} \equiv 1$ . We describe  $n$  as a *Fermat pseudoprime base 2*.

It is not hard to show that there are infinitely many Fermat pseudoprimes to any given base, although it is true that Fermat pseudoprimes are rarer than primes. Put

$$L(X) = \exp\left(-\frac{\log X \log \log \log X}{\log \log X}\right).$$

If  $P_{F,a}(X)$  denotes the number of Fermat pseudoprimes base  $a$  less than  $X$ , then Pomerance has shown [35, 36] that

$$\exp\left((\log X)^{5/14}\right) \leq P_{F,a}(X) \leq XL(X)^{1/2}$$

for sufficiently large  $X$ ; compare this with the number  $\pi(X)$  of primes up to  $X$ , which is well known to be asymptotic to

$$\frac{X}{\log X} = X \exp(-\log X).$$

For  $X = 10^{13}$ , calculations [33] show that  $P_{F,2}(X) = 264239$ , compared with  $\pi(X) = 37607912018$ .

Even worse, if we take  $n = 561 = 3 \times 11 \times 17$ , then we find that  $a^{n-1} \equiv 1 \pmod{n}$  for every base  $a$  which is coprime to  $n$ . Such an  $n$  is called an *absolute Fermat pseudoprime*, or a *Carmichael number*, and it has recently been proved by Alford, Granville, and Pomerance [1] that there are infinitely many Carmichael numbers—see Granville's article in these *Notices* [22]. Carmichael numbers are of course less numerous than Fermat pseudoprimes to any fixed base: letting  $C(X)$  denote the number of Carmichael numbers up to  $X$ , we have [1, 35]

$$X^{2/7} \ll C(X) \ll XL(X)$$

and for  $X = 10^{16}$  we have [31]  $C(X) = 246683$  compared with  $\pi(X) = 279238341033925$ .

It seems plausible to conjecture that in fact both  $C(X)$  and  $P_{F,a}(X)$  exceed  $X^{1-\epsilon}$  for sufficiently large values of  $X$ .

We describe a number which passes the Fermat test (or one of the derivatives to be described later) as a (*Fermat*) *probable prime*. We should emphasize at this point that the phrase “probable prime” is to be read as if it were a single word.<sup>1</sup> It has become standard because a number which passes the test is “probably prime” in the intuitive sense that there are “fewer” pseudoprimes than primes. We shall make this qualitative shortly.

To improve the performance of the Fermat test, we observe that, since we may assume  $n$  is odd,  $n - 1$  is even and so  $a^{n-1}$  is a square. If  $n$  is a prime, 1 has only two square roots,  $\pm 1 \pmod{n}$ . If an odd number  $n$  passes the Fermat test (faster primality tests are possible for even numbers!), then  $a^{n-1} \equiv 1$  is a square, so we require that  $a^{(n-1)/2} \equiv \pm 1 \pmod{n}$ . This further requirement we call the *Fermat–Euler test* (although the result was already known to Fermat).

Iterating, we arrive at the *strong* or *Miller–Rabin test* [28, 39]. Write  $n - 1 = 2^r s$ , where  $s$  is odd. For base  $a$  form the Miller–Rabin sequence

$$a^s, a^{2s}, \dots, a^{2^{r-1}s} \equiv a^{\frac{n-1}{2}}, a^{2^r s} \equiv a^{n-1} \pmod{n}$$

in which each term is the square root of its successor. Then  $n$  passes the test base  $a$  if the last term in the sequence is 1 (this is just the requirement of the Fermat test) and if the first occurrence of 1 either is the first term or is preceded by  $-1$ .

Since the strong test includes the Fermat test, the number of strong pseudoprimes for a fixed base  $a$  up to  $X$ ,  $P_{MR,a}(X)$  is bounded above by  $P_{F,a}(X)$ , but the best upper bound known is no better than that implied by the upper bound for  $P_{F,a}(X)$  above. It is known that there are infinitely many strong pseudoprimes base 2. For  $X = 10^{13}$  we have [10, 33]  $P_{MR,2}(X) = 58897$ .

As with the Fermat test, the strong test with a single base does not characterize primes: for example, if  $n = 2047 = 23$ , then  $n - 1 = 2^1 \cdot 1023$ , and the Miller–Rabin sequence is  $2^{1023} \equiv 1, 2^{2046} \equiv 1$ . So 2047 is an example of (indeed, the smallest) *strong pseudoprime base 2*. We have however made an advance: if  $n$  is composite then it passes the strong test to at most  $1/4$  of the bases  $a \pmod{n}$ . (Thus composite numbers can be detected in random nondeterministic polynomial time.)

Miller [28] observed that a theorem of Ankeny [2] could be applied to turn the strong test into a conditional polynomial-time characterization of primes: the quantitative version due to Bach [7] states that *provided a suitable generalization of the Riemann hypothesis (GRH) holds, a number  $n$  is prime iff it passes the strong test to all bases  $a$  with  $1 < a \leq 4(\log n)^2$* .

If one does not assume the GRH then a result of Burgess [14] implies that testing up to  $a \leq n^{1/4\sqrt{e}} < n^{.151633}$  is sufficient.

<sup>1</sup>Students of the English legal system may be reminded of the title of Lord Privy Seal, who is neither a Lord, nor . . .

In the opposite direction it follows from the result of Alford, Granville, and Pomerance [1, 22] that there are infinitely many numbers which are strong pseudoprimes with respect to any fixed finite set of bases.

We shall call a primality test *probabilistic* if it employs some random input, so that the precise sequence of operations performed may vary from call to call, even if the input parameters remain the same. A test is *deterministic* otherwise: such a test will repeat exactly the same operations and give exactly the same output for the same input.

Consider a probabilistic algorithm consisting of  $t$  rounds of the strong test with bases chosen uniformly and independently at random modulo  $n$ . If the input  $n$  is composite, the chance of it passing such a test is at most  $4^{-t}$ . Assuming that there is a probability distribution on the input  $n$ , we can say

$$\begin{aligned} & \text{prob}(\text{test gives wrong answer}) \\ &= \sum_n \text{prob}(\text{test gives wrong answer for } n) \text{prob}(n \text{ is input}) \\ &= \sum_n \text{prob}(n \text{ passes } t \text{ rounds} \mid n \text{ is composite}) \\ & \quad \times \text{prob}(n \text{ is composite} \mid n \text{ is input}) \text{prob}(n \text{ is input}) \\ &\leq 4^{-t}. \end{aligned}$$

Let us note at this point that if the test is deterministic, we can make no such assertion without some knowledge of a probability distribution on the input  $n$ . For example, with a deterministic test always using base 2 and a probability distribution on the input concentrated at  $n = 2047$ , the test is certain to produce the wrong answer.

It is possible to do considerably better given reasonable assumptions on the probability distribution on the input numbers  $n$ . If, for example, we assume that  $n$  is distributed uniformly over all  $k$ -bit odd integers, then it can be shown, using the methods of Kim, Pomerance, Damgård, and Landrock [18, 19, 24], that for  $k \geq 100$  and  $5 \leq t \leq k/9 + 2$

$$\begin{aligned} & \text{prob}(n \text{ is composite} \mid n \text{ passes } t \text{ rounds}) \\ &\leq 0.4 k 2^t \left( 0.6 \cdot 2^{-2\sqrt{k(t-2)}} + 2^{-t\sqrt{k/2}} \right); \end{aligned}$$

and for  $t > k/9 + 2$

$$\begin{aligned} & \text{prob}(n \text{ is composite} \mid n \text{ passes } t \text{ rounds}) \\ &\leq 0.4 k \left( 11.32\sqrt{k} 2^{-2t-k/3} + 2^{t-t\sqrt{k/2}} \right). \end{aligned}$$

For  $t = 6$  and  $k = 250$  this is less than  $2^{-56}$ , and for  $t = 10$  and  $k = 2000$  the probability of a wrong answer is less than  $2^{-228}$ .

If we consider a deterministic algorithm using  $t$  rounds of the strong test, say, with the first  $t$  primes as bases, we cannot immediately say that the same estimates apply. It is plausible to suppose that tests with distinct prime bases behave independently, although this will not be so for multiplicatively dependent bases: if  $n$  is a strong pseudoprime base  $a$  and base  $b$ , it is likely, although not certain, to be a strong pseudoprime base  $ab$ .

Assuming that a deterministic test with a fixed set of  $t$  multiplicatively independent bases behaves in the same way

as a probabilistic test with random bases, then the test should characterize primes for values of  $k$  for which the expected number of pseudoprimes is less than 1. This suggests that  $k$  should not exceed  $3t$  or, as a rule of thumb,  $t$  should be about the number of decimal digits in the input. The result of Bach implies that, if the GRH holds, taking  $t > 2k^2$  is sufficient to characterize primes.

The number  $341550071728321 = 10670053 \times 32010157$  of 15 digits, 49 bits, is a strong pseudoprime for all bases up to 22, that is, for 8 primes; the number

$$68528663395046912244223605902738356719751082784386681071$$

of 56 digits, 186 bits, is a strong pseudoprime for all bases up to 100, that is, for 25 primes.

### Quadratic Tests

A common feature in the Fermat test and its refinements is the use of a group defined algebraically modulo  $n$  which has a predictable number of elements when  $n$  is prime, the group in this case being the multiplicative group modulo  $n$  with order  $n - 1$  when  $n$  is prime.

We can extend our tests by considering further groups. One important case is taking the multiplicative group of the quadratic extension  $\mathbb{Z}/n[\sqrt{d}]$  when  $d$  is not a quadratic residue of  $n$ . If  $n$  is prime, then this quadratic ring is the finite field of  $n^2$  elements, with a multiplicative group of order  $n^2 - 1$ . The elements of  $\mathbb{Z}/n[\sqrt{d}]$  may be represented in the form  $x + y\sqrt{d}$  with  $x$  and  $y$  taken modulo  $n$  and multiplication defined in the obvious way, with  $\sqrt{d} \cdot \sqrt{d}$  defined to be  $d \pmod{n}$ . The *norm* of such an element will be  $x^2 - dy^2$ , and the elements of norm 1 form a subgroup of the multiplicative group of exponent  $n + 1$  when  $n$  is prime. If we let  $d$  be the discriminant of the equation  $X^2 - tX + u = 0$  and let  $\alpha$  be a root, then if the Jacobi symbol  $\left(\frac{d}{n}\right)$  is  $-1$  and  $n$  is prime, the map  $\alpha \mapsto \alpha^n$  will be the Frobenius automorphism of the finite field  $\text{GF}(n^2)$ ; and so  $\alpha^n$  must be equal to  $\alpha'$ , where  $(x + y\sqrt{d})' = x - y\sqrt{d}$ . This is the *Lucas test*.

The equivalent of the Fermat test for this group would be to require  $\alpha^{n^2-1} = 1$ , but this is not as strong as the Lucas test, as we shall see. We can make a better parallel with the Fermat test by considering the elements of norm 1, i.e., with  $u = 1$ . The condition  $\alpha^n = \alpha'$  is equivalent to  $\alpha^{n+1} = \alpha\alpha' = 1$ . The *norm-one Lucas test* consists of taking the smallest  $t$  such that the Jacobi symbol is  $-1$  and then requiring that  $\alpha^{n+1} \equiv 1 \pmod{n}$ .

As before, we call  $n$  a *Lucas probable prime* if it passes the Lucas test and a *Lucas pseudoprime* if it is a composite probable prime. A refinement of the norm-one Lucas test proceeds by considering the iterated square roots of  $\alpha^{n+1}$ : as in the Miller–Rabin test, let  $s$  be the odd part of  $n + 1$  and then repeatedly square  $\alpha^s$ . Let us call this the *strong norm-one Lucas test*.

Letting  $P_{L,d}(X)$  denote the number of Lucas pseudoprimes, with respect to  $d$  as a quadratic nonresidue, up to  $X$

we have

$$\exp((\log x)^c) \leq P_{F,a}(X) \leq XL(X)^{1/3}$$

for some constant  $c$ .

We should note that finding a quadratic nonresidue is not guaranteed to be easy: the best results are those of Bach (on the GRH) and Burgess (unconditionally) mentioned above.

Pomerance et al. [34] describe two methods of finding a suitable  $d$  and element  $\alpha$ . They have issued a challenge (with a total prize now \$620) for an example of a composite number which passes both the strong test base 2 and one of the versions of the Lucas test they propose or for a proof that no such number exists. At present the prize is unclaimed: the computations of [32, 33] show there is no such number less than  $10^{13}$ .

### Primality Proofs

The probable-prime tests we have described all test for properties which  $n$  must have if it is prime. Hence the failure of any of these tests proves the compositeness of  $n$ , and in all the methods described the test also furnishes a certificate of the compositeness which may be verified quickly (in time polynomial in  $\log n$ ). We now turn to methods for proving the primality of  $n$ . It is well known that the only odd numbers  $n$  for which the multiplicative group modulo  $n$  is cyclic are those  $n$  which are prime powers. Since it is possible to test whether  $n$  is a perfect power quickly, we assume that  $n$  is known not to be a perfect power, so that  $n$  is prime if and only if the multiplicative group is cyclic. To prove  $n$  prime, it suffices to find an element of exact order  $n - 1$  and, indeed, to find elements whose orders have least common multiple  $n - 1$ . A certificate then consists of a list of such elements together with their orders.

Unfortunately, to exhibit an element of exact order  $d$ , it is necessary to show that the order is not any proper factor of  $d$ , and this requires factorization of  $d$ . So we need to be able to factorise  $n - 1$  in order to use this method.

Assuming for the moment that we can do this, we obtain the factorization of  $n - 1$  as a list of primes and their exponents. The factorization method will undoubtedly use some form of primality test to decide when a prime factorization has been obtained. To certify that  $n$  is prime will require a certificate that the factors of  $n - 1$  are themselves prime, and so the certification will be recursive: Atkin has called this "Downrun". Verification of the certificate is fast; see Pratt [38].

This proof method works well on numbers of special form, for example,  $n - 1 = 2^r s$  with  $s < 2^r$ . Suppose that  $a^{2^{r-1}} \equiv -1 \pmod{n}$ . Then if  $n$  is composite, take  $p$  to be the smallest prime factor of  $n$ , so that  $p < \sqrt{n}$ . In particular,  $p < 2^r$ . But  $a$  is an element of order  $2^r$  modulo  $p$ , so  $2^r \leq p - 1$  is a contradiction. The partial factorization, if  $n - 1$  together with the base  $a$  forms a certificate of primality.

### Elliptic Curve Tests

The primality proof method just described depends on the factorization of  $n - 1$ . In cases where this is difficult, one

can work in a suitable quadratic extension (as in the Lucas method) and instead try to factorize  $n + 1$ .

Morain [6, 29] suggested replacing these multiplicative groups by the group of points on an elliptic curve modulo  $n$ , which can have any order between  $n + 1 \pm 2\sqrt{n}$  when  $n$  is prime. The order of this group is determined by the theory of complex multiplication, and the certificate consists of the order, its factorization, the points on the curve of orders with least common multiple of the group, and (recursively) certificates of the primality of the factors.

### The Tests Performed

We used three lists of composite numbers to exercise the primality testing routines of the various systems. The first list,  $\mathcal{X}$ , was that of the 246683 Carmichael numbers up to  $10^{16}$  described in [30, 31]; the second,  $\mathcal{Y}$ , was that of the 264239 Fermat pseudoprimes base two [32, 33]; and the third,  $\mathcal{Z}$ , was a "zoo" of special cases specifically intended to defeat various tests, largely obtained from Arnault [3, 4, 5], Bleichenbacher [9, 10], and Davenport [20].

### The Maple isprime Function

*Maple V* provides a function `isprime` (also invoked as `type/primeint`).

The *Maple V* language reference manual [15] §1.2, p. 7, simply asserts that *Maple* can test integers for primality. The *Maple* library reference manual [16] §2.1.164, p. 120, and the online documentation state

```
isprime (n, iter).
```

The function `isprime` is a probabilistic primality testing routine.

It returns false if  $n$  is shown to be composite within *iter* tests and returns true otherwise. If `isprime` returns true,  $n$  is "very probably" prime—see Knuth, Vol. 2, 2nd edition, section 4.5.4, algorithm P for a reference.

and

```
type (expr, primeint).
```

This function returns true if *expr* is a prime integer and false otherwise.

The function `isprime` is used to check the primality of *expr*, once *expr* has been determined to be an integer.

The algorithm employed by `isprime` tests initially for divisibility by primes up to 1000, and then performs the strong test with the first *iter* primes as base (up to a maximum of 25 tests). The default value of *iter* is 5.

There are 2 numbers in list  $\mathcal{Y}$  which pass the strong test bases 2, 3, 5, 7, and 11 and which have no factor under 1000: they are  $2152302898747 = 6763 \times 10627 \times 29947$  and  $3474749660383 = 1303 \times 16927 \times 157543$ , and `isprime` accordingly declares them prime. (Curiously, there are no such pseudoprimes with a factor less than 1000.) We find that  $3474749660383$  is a strong pseudoprime base 13 as well and so passes `isprime` with *iter* set to 6, the smallest number to do so.



There are three further numbers from list  $\mathcal{X}$  which pass `isprime`:  $10710604680091 = 3739 \times 18691 \times 153259$ ,  $4498414682539051 = 46411 \times 232051 \times 417691$ , and  $6830509209595831 = 21319 \times 106591 \times 3005839$ .

Surprisingly, the integer factorization function `ifactor` gave the correct answer for 3474749660383, although for the remaining four numbers it returns the number itself.

The `ifactor` function is described in [16] §2.1.151, p. 107, and the online documentation as

`ifactor` returns the complete integer factorisation of  $n$ .

The first step in this function is to extract prime factors up to 1699. Then, in subprocedure `ifact0th`, a call is made to `isprime` before embarking on any of the more sophisticated algorithms which `factor` can use. This explains the discrepancy between the results of `isprime` and `ifactor` on  $1303 \times 16927 \times 157543$ .

There is also a discrepancy between the behavior of `isprime` and the `safeprime` function from the `numtheory` package [16] §4.4.26, p. 528.

The function `safeprime` will compute the smallest safe prime that is greater than  $n$ . A safe prime is a number  $p$  such that  $p$  is prime and  $(p-1)/2$  is prime.

The `safeprime` function does not call `isprime` internally but declares a number to be prime if it has no factor  $\leq 113$  and passes the Fermat–Euler test for bases 2, 3, 5, 7, and 11. This test is rather weaker than the strong test used by `isprime` and fails, for example, by declaring  $p = 1879894019$  to be a safe prime even though  $(p-1)/2 = 939947009 = 263 \times 1049 \times 3407$  and is declared composite by `isprime`. This is the smallest counterexample: there are four such  $p$  up to  $10^{12}$ . Fortunately, if  $p$  is declared a safe prime by this method, and  $(p-1)/2$  is indeed prime, then it will be true that  $p$  is prime as well, since 2 is an element of order at least  $(p-1)/2$  modulo  $p$ . I was not able to find any examples with both  $p$  and  $(p-1)/2$  composite.

Gaston Gonnet has informed me that he plans to include a stronger version of `isprime` in a new release.

### The *Mathematica* PrimeQ and ProvablePrimeQ functions

The *Mathematica* version 2 number theoretic functions are reviewed by Wagon [44] (who discusses version 1 functions in [43] §1.1).

The *Mathematica* built-in primality test `PrimeQ` is described briefly in [4] (first edition)

`PrimeQ[expr]` yields `True` if `expr` is a prime number and yields `False` otherwise.

and less tersely in the online documentation

`PrimeQ[expr]` yields `True` if `expr` is a prime number and yields `False` otherwise. In the current version of *Mathematica* the algorithm used for large integers is probabilistic but very reliable (pseudoprime test and Lucas test).

Unfortunately, all these assertions are incorrect. The value `True` is returned if the argument is a probable prime, and there are at least two pseudoprimes which it fails to detect. Finally, it appears from the more extensive description [13] below that the algorithm is in fact deterministic. (Perhaps the documenter confused a probable-prime test with a probable prime-test.)

In *Mathematica* 2.0, the built-in function `PrimeQ` uses the Rabin strong pseudoprime test and the Lucas test. This procedure has been proved correct for all  $n < 2.5 \times 10^{10}$  and for special numbers of the form  $a2^b + 1$ , where  $a < 2^b$ . As of April 1991 the procedure has not been proved correct for larger  $n$ , nor has a counterexample been found. However, it is a mathematical theorem that when `PrimeQ[n]` returns `False`, the number  $n$  is genuinely composite. Thus `PrimeQ[n]` can only fail if  $n$  is composite but `PrimeQ` declares it to be prime. It is important to note that `PrimeQ` is deterministic; no computations based on random numbers are involved.

We note in passing that it is not correct to state that if  $n$  is a strong probable prime base 2 and  $n$  is of the form  $a2^b + 1$  where  $a < 2^b$ , then  $n$  is prime. Consider  $n = 4294967297 = 641 \times 6700417 = 2^{25} + 1$  (the fifth, and first composite, Fermat number). It is of the special form stated and a strong pseudoprime base 2: the Miller–Rabin sequence of repeated squares of 2 clearly contains  $2^{25} \equiv -1 \pmod{n}$ . Clearly any composite Fermat number will have this property. For numbers of the special form stated, as described above, the strong test is capable of proving primality if that the occurrence of  $-1$  in the sequence is sufficiently late.

The second edition of [45] states correctly

- In *Mathematica* 2.0, the built-in function `PrimeQ` uses the Rabin strong pseudoprime test and the Lucas test. This procedure has been proved correct for all  $n < 2.5 \times 10^{10}$ . As of 1990, however, the procedure has not been proved correct for larger  $n$ , and it is conceivable that it could claim that a composite number was prime (though not vice-versa). Nevertheless, as of 1990 no example of such behaviour is known.

On applying the function to lists  $\mathcal{X}$  and  $\mathcal{Y}$ , there were two composite numbers for which the test returns the result `True`:  $38200901201 = 89 \times 11551 \times 37159$  and  $6646915915638769 = 7309 \times 321553 \times 2828197$ .

Examination of the source code shows that the function `PrimeQ` first performs the strong test base 2. Next, the smallest  $t \geq 2$  for which the Jacobi symbol  $(1 - 4t^2 | n) = -1$  is found. Let  $\alpha$  denote a root of  $X^2 - t^{-1}X + 1$  modulo  $n$ . Then a variant of the strong Lucas test is performed, except that iterated square roots of the  $(n^2 - 1)$ -power of  $\alpha$  are used, rather than of the  $(n + 1)$ -power. If we consider  $n = 6646915915638769$ , we find that  $t = 9$  and  $\alpha^n \equiv \alpha \pmod{n}$ . This would cause  $n$  to fail the Lucas test, which requires that  $\alpha^n \equiv \alpha'$ ; the variant used by *Mathematica* is strictly weaker. The other exceptional number also fails the stricter Lucas test. The test performed

by *Mathematica* is therefore not that referred to by Pomerance et al. [34]; there appears to have been confusion between the Lucas test and the norm-one Lucas test.

The package `NumberTheory`PrimeQ`` already referred to contains the routine `ProvablePrimeQ[n]`, described [13] as

This package implements primality proving. If `ProvablePrimeQ[n]` returns `True`, then the number  $n$  can be mathematically proven to be prime. In addition `PrimeQCertificate[n]` prints a certificate that can be used to verify that  $n$  is prime or composite. In *Mathematica* version 2.0 the built-in primality testing function `PrimeQ` does not actually give a proof that a number is prime. However, as of this writing, there are no known examples where `PrimeQ` fails.

The certificate returned can be complicated, involving several methods of primality proof recursively. It would be of considerable assistance to the user if the methods were more comprehensively documented.

The description in [13] continues:

As noted above there is a possibility that `PrimeQ` is incorrect, i.e., it asserts that a number is prime when it is really composite. It is unclear whether `ProvablePrimeQ` always detects this, but if it does, an error message is generated and a counterexample to `PrimeQ` is returned.

Applying the `ProvablePrimeQ` function to 38200901201, the function appears to enter a loop (possibly looking for a primitive root?). Applied to 6646915915638769, the function prints out a number of error messages, finishing with the message `PrimeQCertificate::false: Warning: PrimeQCertificate has detected a counterexample to PrimeQ` and then returns the value `True`—this is a bug.

The second edition of [45] states

- In *Mathematica* version 2.0 the package `NumberTheory`PrimeQ`` contains a much slower `PrimeQ` based on a procedure which has been proved correct for all numbers.

This seems to be incorrect: the results from `PrimeQ` do not appear to differ if the package `NumberTheory`PrimeQ`` has been preloaded. Perhaps the author means "... a much slower primality test... ", referring to `ProvablePrimeQ`.

Dan Grayson has stated that a future version of `PrimeQ` will use the strong norm-one Lucas test and deal correctly with the two counterexamples to the present version.

### The *Axiom* `prime?` Function

The *Axiom* package `IntegerPrimesPackage` includes the function `prime?` described in [24] §9.30.2, p. 384, as

The operation `prime?` returns true or false depending on whether its argument is a prime.

There is greater detail documented in the source code:

`prime?(n)` returns true if  $n$  is prime and false if not. The algorithm used is Rabin's probabilistic primality test (reference: Knuth, Volume 2, Semi Numerical

Algorithms). If `prime? n` returns false,  $n$  is proven composite. If `prime? n` returns true, `prime?` may be in error, however, the probability of error is very low and is zero below  $25 \cdot 10^9$  (due to a result of Pomerance et al.), below  $10^{12}$  due to a result of Pinch, and below 341550071728321 due to a result of Jaeschke. Specifically, this implementation does at least 10 pseudo prime tests and so the probability of error is  $< 4^{-10}$ . The running time of this method is cubic in the length of the input  $n$ , that is  $O((\log n)^3)$ , for  $n < 10^{20}$  beyond that, the algorithm is quartic,  $O((\log n)^4)$ . Two improvements due to Davenport have been incorporated which catches some trivial strong pseudo-primes, such as [Jaeschke, 1991]  $1377161253229053 \times 413148375987157$ , which the original algorithm regards as prime.

The results referred to are Pomerance et al. [34], Pinch [32], Davenport [20], and Jaeschke [unpublished].

The algorithm is deterministic and rather sophisticated; see Davenport [20] for a full description.

The initial stage is a simple check for divisibility by small primes (up to a limit of 313).

For numbers less than  $10^{20}$  the next stage is to apply the strong test with a suitable set  $\mathcal{B}$  of bases and a set  $\mathcal{E}$  of exceptional pseudoprimes. For input up to  $25 \cdot 10^9$ ,  $\mathcal{B} = \{2, 3, 5\}$  with  $\mathcal{E}$  of order 12; up to  $10^{12}$ ,  $\mathcal{B} = \{2, 3, 7, 10\}$  with  $\mathcal{E}$  of order 7; and up to  $10^{20}$ ,  $\mathcal{B} = \{2, 3, 5, 7, 11, 13, 17\}$  with  $\mathcal{E}$  empty. It is shown in [34], [32], and [23] that the sets  $\mathcal{E}$  are indeed the pseudoprimes for this stage of the test—that is, the answer returned is correct for all input up to  $10^{20}$ .

For input greater than  $10^{20}$  the next stage is to perform the strong test with the first ten primes as base. Then a test is made for numbers of the form  $3n + 1$  or  $8n + 1$  a perfect square (in which case  $n$  has an obvious factorization). Finally, for  $n$  of  $d$  decimal digits, up to  $d/2$  strong tests are made with successive primes as base.

The `prime?` function is correct for numbers up to  $10^{20}$ , except that in the current distribution (updated 9 April 1993) the set of  $\mathcal{E}$  of exceptional pseudoprimes up to  $25 \cdot 10^9$  has been incorrectly transcribed, and so the test incorrectly reports that  $19887974881 = 81421 \times 244261$  is prime.

There were two composite numbers for which the function incorrectly returns true:

$$168790877523676911809192454171451 \\ = 266420043451 \times 4674035851 \times 135547039651$$

and

$$68528663395046912244223605902738356719751082784386681071 \\ = 18215745452589259639 \times 4337082250616490391 \\ \times 867416450123298079.$$

The first is a strong pseudoprime for bases 2 to 82; the second for bases up to 100. These numbers were obtained by Bleichenbacher [9].

We note that up to  $10^{13}$  one can take  $\mathcal{B} = \{2, 3, 5, 7, 11\}$  with an exceptional set  $\mathcal{E}$  of size 2 [33], or even  $\mathcal{B} = \{2, 3, 5, 7, 61\}$  with no exceptions, as observed by Bleichenbacher [10].

James Davenport has told me that the misprint mentioned

has been corrected and that a new version of `isprime?` will use an improved test.

### The *Pari/GP* `isp` and `isprime` Functions

The *Pari* `isp` and `isprime` functions are described in the user manual [8] and the online documentation:

`isp(x)`: true (1) if  $x$  is a strong pseudo-prime for a randomly chosen base, false (0) otherwise. `isprime(x)`: true (1) if  $x$  is a strong pseudo-prime for 10 randomly chosen bases, false (0) otherwise.

*Pari* declared all the numbers in lists  $\mathcal{X}$ ,  $\mathcal{Y}$ , and  $\mathcal{Z}$  composite. Since the algorithm is probabilistic, the analysis above applies; and we conclude that for  $k$ -bit numbers,  $k \geq 100$ , the probability of *Pari* returning an incorrect answer is at most  $4.1 k 2^{-\sqrt{8k}}$ . For  $k = 100$  this is less than  $2^{-19}$ .

The *Pari* factor function, when applied to integers, calls the library routine `auxdecomp` which declares a number to be prime if it passes 10 initial rounds of the strong test with random bases, followed by a further 5 rounds for every 32 bits. Curiously, then, `factor` is more likely to detect compositeness than `isprime`.

### Conclusions

All of the tests reviewed fall short to some extent of what I would look for. Among the features I regard as desirable are:

- **Predictability.** If a "random" choice of bases is to be used, there should be an option to reset the random number generator to a consistent initial state.
- **Consistency.** The same tests should be used in all routines in the package.
- **Speed versus certainty.** The user should be able to specify the use of a fast test with possibility of error or a slower test with "proof" status.
- **Documentation.** Whatever the method used, the documentation should make it clear what the algorithm is, what the known classes of exception (if any) are, and an indication of the probability of an incorrect answer. No test which may accept composite numbers should be described as a test for primality. *Axiom*, *Maple*, and *Mathematica* all make this claim.
- **Nomenclature.** I strongly suggest that tests for probable primality should be called by names which reflect their status, such as `IsProbPrime`.
- **Power.** Routines which use the strong test only should use as many bases as decimal digits in the input.

### Acknowledgments

I am grateful to Daniel Bleichenbacher, James Davenport, Gaston Gonnet, Roman Maeder, Carl Pomerance, Stan Wagon, and Sam Wagstaff, Jr., for helpful discussions on the topics covered in this review. Thanks are also due to the Department of Pure Mathematics and Mathematical Statistics; the Isaac Newton Institute for Mathematical Sciences; the University Computing Service, Cambridge; and the Mathematical Sci-

ences Research Institute, Berkeley, for use of their computer facilities.

### References

1. W.R. Alford, A. Granville, and C. Pomerance, *There are infinitely many Carmichael numbers*, *Ann. Math.* (to appear).
2. N.C. Ankeny, *The least quadratic non-residue*, *Ann. of Math.* **55** (1952), 65–72.
3. F. Arnault, *Carmichaels fortement pseudo-premiers, pseudo-premiers de Lucas*, Université de Poitiers preprint, Jan. 1993 (1993).
4. \_\_\_\_\_, *Rabin–Miller primality test: composite numbers which pass it*, Université de Poitiers preprint, Sep. 1992 (1992).
5. \_\_\_\_\_, *Le test de primalité de Rabin–Miller: un nombre composé qui le "passe"*, Université de Poitiers preprint, Nov. 1991 (1991).
6. A.O.L. Atkin and F. Morain, *Elliptic curves and primality proving*, *Math. Comp.* (1993) (to appear).
7. E. Bach, *Explicit bounds for primality testing and related problems*, *Math. Comp.* **55** (1990), 355–380.
8. C. Batut, D. Bernardi, H. Cohen, and M. Olivier, *User's Guide to PARI-GP*, 1992.
9. D. Bleichenbacher, *Re: Pseudoprimes too strong for Maple*, Usenet *sci.math* posting 1993Apr27.141249.29080 @ neptune.inf.ethz.ch, 27 Apr 1993.
10. D. Bleichenbacher and U. Maurer, *Finding all strong pseudo-primes  $\leq x$* , Extended abstract (1993).
11. D.M. Bressoud, *Factorization and Primality Testing*, Springer, New York, 1989.
12. J. Brillhart, D.H. Lehmer, J.L. Selfridge, B. Tuckermann, and S.S. Wagstaff, Jr., *Factorizations of  $b^n \pm 1$*  (2nd ed.), American Mathematical Society, Providence, RI, 1988.
13. P. Boyland et al., *Guide to standard Mathematica packages*, *Mathematica* technical reports (1991).
14. D.A. Burgess, *The distribution of quadratic residues and non-residues*, *Mathematika* **42** (1957), 106–112.
15. B.W. Char, K.O. Geddes, G.H. Gonnet, B.L. Leong, M.B. Monaghan, and S.M. Watt, *Maple V language reference manual*, Springer, New York, 1991.
16. \_\_\_\_\_, *Maple V library reference manual*, Springer, New York, 1991.
17. \_\_\_\_\_, *First leaves: a tutorial introduction to Maple V*, Springer, New York, 1992.
18. I. Damgård and P. Landrock, *Improved bounds for the Rabin primality test*, Proc. 3rd IMA Conference on Coding and Cryptography, Cirencester, Dec. 1991 (M. Ganley, ed.), Oxford University Press, 1993.
19. I. Damgård, P. Landrock, and C. Pomerance, *Average error estimates for the strong probable prime test*, Submitted.
20. J.H. Davenport, *Primality testing revisited*, Proc. ISSAC 1992 (P.S. Wang, ed.), ACM, New York, 1992, pp. 123–129; (revised) *Axiom* technical report, 1993.
21. S. Goldwasser and J. Kilian, *Almost all primes can be quickly certified*, Proc. 18th ACM Symposium on Theory of Computing, 1986, pp. 316–329.
22. A. Granville, *Primality testing and Carmichael numbers*, *Notices Amer. Math. Soc.* **37** (1992), 696–700.
23. G. Jaeschke, *On strong pseudoprimes to several bases*, *Math. Comp.* (1993) (to appear).
24. R.D. Jenks and R.S. Sutor, *Axiom: the scientific computation system*, Springer, New York, 1992.
25. S.H. Kim and C. Pomerance, *The probability that a random probable prime is composite*, *Math. Comp.* **53** (1989), 721–741.
26. D.E. Knuth, *The art of computer programming II: seminumerical algorithms*, 2nd ed., Addison–Wesley, Reading, Mass., 1981.
27. N. Koblitz, *A course in number theory and cryptography*, Springer, New York, 1987.

28. G.L. Miller, *Riemann's hypothesis and tests for primality*, Proc. 7th Annual ACM Symposium on Theory of Computing, Albuquerque 1975, pp. 234–239.
29. F. Morain, *Distributed primality proving and the primality of  $(2^{3539} + 1) / 3$* , INRIA Tech. Report **1152** (1989).
30. R.G.E. Pinch, *The Carmichael numbers up to  $10^{15}$* , Math. Comp. (1993) (to appear).
31. \_\_\_\_\_, *The Carmichael numbers up to  $10^{16}$* , preprint (1993).
32. \_\_\_\_\_, *The pseudoprimes up to  $10^{12}$* , unpublished (1992).
33. \_\_\_\_\_, *The pseudoprimes up to  $10^{13}$* , preprint (1993).
34. C. Pomerance, J.L. Selfridge, and S.S. Wagstaff, Jr., *The pseudoprimes to  $25 \cdot 10^9$* , Math. Comp. **35** (1980), 1003–1026.
35. C. Pomerance, *On the distribution of pseudoprimes*, Math. Comp. **37** (1981), 587–593.
36. \_\_\_\_\_, *A new lower bound for the pseudoprime counting function*, Illinois J. Math. **26** (1982), 4–9.
37. \_\_\_\_\_, *Two methods in elementary analytic number theory*, Number Theory and Its Applications (R.A. Mollin, ed.), Kluwer, Dordrecht, 1989.
38. V.R. Pratt, *Every prime has a succinct certificate*, SIAM J. Comput. **4** (1975), 214–220.
39. M.O. Rabin, *Probabilistic algorithm for testing primality*, J. Number Theory **12** (1980), 128–138.
40. P. Ribenboim, *The book of prime number records*, Springer, New York, 1988.
41. \_\_\_\_\_, *The little book of big primes*, Springer, New York, 1991.
42. H. Riesel, *Prime numbers and computer methods for factorization*, Birkhauser, Boston, MA, 1985.
43. S. Wagon, *Mathematica in action*, W.H. Freeman, San Francisco, 1991.
44. \_\_\_\_\_, *Review: Number theory*, Mathematica Journal **2** (1992), 24–26.
45. S. Wolfram, *Mathematica: a system for doing mathematics by computer*, Addison-Wesley, Redwood City, CA, 1988; (2nd ed.), 1991.

## Using the “Math.school.edu” convention

Greg Kuperberg\*

Over 100 academic institutions in the U.S. and Canada have adopted the convention of using `math.school.edu` as a standard address for mathematics department computers. Although it is not the only such convention, it has become quite popular and is particularly easy to use and follow for most mathematicians and mathematics departments.

One competing convention that should be mentioned in particular is the use of `user@school.edu` for directory information and e-mail. Even if your school does have a `school.edu` service, it is still useful for the mathematics department to adopt `math.school.edu`.

Here is an example of how to rely on the `math.school.edu` convention where it is available. The example is illustrated with standard Unix commands; commands on other operating systems such as VMS might differ.

Suppose you wanted to communicate with me at the University of Chicago. You might begin by verifying my login name with the command

\*Greg Kuperberg is at the University of Chicago. He can be reached by email at `greg@math.uchicago.edu`.

```
% finger kuperberg@math.uchicago.edu.
```

Based on the reply, you would know to send me e-mail with the command

```
% mail greg@math.uchicago.edu.
```

If you had a particularly urgent message and the `finger` command informed you that I am currently logged in and active, then you might attempt a phone-style link with me with the command

```
% talk greg@math.uchicago.edu.
```

Currently, “talk” is unlikely to be fruitful in my case because `math.uchicago.edu` is only one of many computers that share computer accounts, and I am unlikely to be logged into that particular one. However, there exist modified `talk` and `finger` services that understand local computer networks with shared computer accounts.

If I had granted you access to my account (for example, with an “.rhosts” file), you might log into it with the command

```
% rlogin math.uchicago.edu -l greg.
```

Finally, if I had made some information available by anonymous `ftp`, you might retrieve it with the command

```
% ftp math.uchicago.edu
```

and login via `ftp` as anonymous. Currently, anonymous `ftp` at the University of Chicago’s Mathematics Department does not conform to the `math.school.edu` convention; it is instead available at `zaphod.uchicago.edu`. However, some other schools do have anonymous `ftp` available at the conventional address.

If you are a computer user, you adopt the following practices to help establish the `math.school.edu` convention:

- Circulate `user@math.school.edu` as your e-mail address among colleagues, when registering at conferences, with the AMS, and so forth.

- Send e-mail to others at `user@math.school.edu` and update your list of mail aliases as appropriate.

In addition your institution can take any or all of the following steps to conform as fully as possible to the convention. Most universities with large mathematics departments now conform at least minimally to the convention, although very few if any have adopted all of the suggestions below. For various reasons some of the suggestions may be inconvenient at some institutions; however, it is rarely the case that none of the suggestions can be adopted.

- Accept mail addressed to `user@math.school.edu`.

The easiest way to do this is to have an “MX” entry (for mail exchange) in the Internet registry.

- Establish `math.school.edu` as a valid address for direct Internet connections (TCP/IP).

This can be done with either an “A” entry (for address) or “CNAME” entry (for connect name; it represents a pseudonym for an existing, named address) in the Internet registry. In the absence of an “MX”, mail is routed using “A” and “CNAME” entries.

- Establish mail forwarding for members of the department who use computers that do not share mail with `math.school.edu`.

There are many computer systems where some people have an account on a computer named “math” but never

read its mail, or they have the option of having an account on "math" but they have not exercised that option. Their mail should be forwarded as appropriate if they have other computer accounts.

- Establish `user@math.school.edu` as the default return address on outgoing mail.

Many people rely on return addresses to remember e-mail addresses. If your outgoing mail is not labelled as being from `user@math.school.edu`, its recipients might never learn that your school conforms to the convention. On Unix systems this can be achieved by altering files used by the program "sendmail".

- Establish `user@math.school.edu` as the default address for articles posted to Usenet.

This is a good idea for the same reason as return addresses.

- Allow ftp, talk, finger, or login access at the address `math.school.edu`, or configure the machine "math.school.edu" to direct users to other computers with these services.

On some systems a machine known as "math.school.edu" exists but does not have enough resources to allow logins, ftp, or other services. In such circumstances it should tell people if the services are available elsewhere. If the services are simply unavailable, the machine "math.school.edu" can report that too rather than silently refusing the connection.

- Update finger service to give accurate information about login sessions on all computers on a local Ethernet ring.

Unfortunately, the standard Unix finger service might report that a user has never logged in if the service is queried at `math.school.edu`, when in fact the user has logged in recently on another computer with the same files and accounts. As mentioned above there are other finger services that understand local networking better.

To finish, I present a list of institutions that conformed to the `math.school.edu` convention as of September 9, 1993. If you have additions or corrections, please contact me at `greg@math.uchicago.edu`.

The first group of addresses can be used with mail and standard Internet services, such as ftp, finger, and telnet (not all services are always available):

Address	Institution
<code>math.albany.edu</code>	State University of New York at Albany
<code>math.arizona.edu</code>	University of Arizona
<code>math.berkeley.edu</code>	University of California at Berkeley
<code>math.binghamton.edu</code>	State Univ. of New York at Binghamton
<code>math.brandeis.edu</code>	Brandeis University
<code>math.bu.edu</code>	Boston University
<code>math.caltech.edu</code>	California Institute of Technology
<code>math.clemson.edu</code>	Clemson University
<code>math.cofc.edu</code>	College of Charleston
<code>math.colgate.edu</code>	Colgate University
<code>math.columbia.edu</code>	Columbia University
<code>math.cornell.edu</code>	Cornell University
<code>math.dickinson.edu</code>	Dickinson College
<code>math.drexel.edu</code>	Drexel University
<code>math.du.edu</code>	University of Denver
<code>math.duke.edu</code>	Duke University
<code>math.fit.edu</code>	Florida Institute of Technology
<code>math.fsu.edu</code>	Florida State University

<code>math.gatech.edu</code>	Georgia Institute of Technology
<code>math.gmu.edu</code>	George Mason University
<code>math.gwu.edu</code>	George Washington University
<code>math.harvard.edu</code>	Harvard University
<code>math.hawaii.edu</code>	University of Hawaii
<code>math.hope.edu</code>	Hope College
<code>math.howard.edu</code>	Howard University
<code>math.ias.edu</code>	The Institute for Advanced Study
<code>math.idbsu.edu</code>	Boise State University
<code>math.iupui.edu</code>	Indiana Univ.-Purdue Univ. at Indianapolis
<code>math.jhu.edu</code>	Johns Hopkins University
<code>math.kent.edu</code>	Kent State University
<code>math.ksu.edu</code>	Kansas State University
<code>math.lamar.edu</code>	Lamar University
<code>math.lfc.edu</code>	Lake Forest College
<code>math.lsu.edu</code>	Louisiana State University
<code>math.macalstr.edu</code>	Macalester College
<code>math.miami.edu</code>	University of Miami
<code>math.mit.edu</code>	Massachusetts Institute of Technology
<code>math.montana.edu</code>	Montana State University
<code>math.msstate.edu</code>	Mississippi State University
<code>math.msu.edu</code>	Michigan State University
<code>math.mtu.edu</code>	Michigan Technological University
<code>math.ncsu.edu</code>	North Carolina State University
<code>math.nd.edu</code>	University of Notre Dame
<code>math.niu.edu</code>	Northern Illinois University
<code>math.njit.edu</code>	New Jersey Institute of Technology
<code>math.nmsu.edu</code>	New Mexico State University
<code>math.nwu.edu</code>	Northwestern University
<code>math.ohio-state.edu</code>	Ohio State University
<code>math.okstate.edu</code>	Oklahoma State University
<code>math.orst.edu</code>	Oregon State University
<code>math.princeton.edu</code>	Princeton University
<code>math.psu.edu</code>	Pennsylvania State University
<code>math.purdue.edu</code>	Purdue University
<code>math.rice.edu</code>	Rice University
<code>math.rochester.edu</code>	University of Rochester
<code>math.rutgers.edu</code>	Rutgers, State University of New Jersey
<code>math.sdsu.edu</code>	San Diego State University
<code>math.sfasu.edu</code>	Stephen F. Austin State University
<code>math.sfsu.edu</code>	San Francisco State University
<code>math.sjsu.edu</code>	San Jose State University
<code>math.smu.edu</code>	Southern Methodist University
<code>math.stolaf.edu</code>	St. Olaf College
<code>math.sunysb.edu</code>	State Univ. of New York at Stony Brook
<code>math.syr.edu</code>	Syracuse University
<code>math.tamu.edu</code>	Texas Agricultural and Mechanical Univ.
<code>math.temple.edu</code>	Temple University
<code>math.toronto.edu</code>	University of Toronto
<code>math.trenton.edu</code>	Trenton State College
<code>math.uah.edu</code>	University of Alabama at Huntsville
<code>math.uakron.edu</code>	University of Akron
<code>math.ucdavis.edu</code>	University of California at Davis
<code>math.uchicago.edu</code>	University of Chicago
<code>math.uci.edu</code>	University of California at Irvine
<code>math.ucla.edu</code>	University of California at Los Angeles
<code>math.ucr.edu</code>	University of California at Riverside
<code>math.ucsb.edu</code>	Univ. of California at Santa Barbara
<code>math.ucsd.edu</code>	University of California at San Diego
<code>math.udel.edu</code>	University of Delaware
<code>math.ufl.edu</code>	University of Florida
<code>math.uh.edu</code>	University of Houston
<code>math.uic.edu</code>	University of Illinois at Chicago
<code>math.uiowa.edu</code>	University of Iowa
<code>math.uiuc.edu</code>	Univ. of Illinois at Urbana-Champaign

math.umass.edu	University of Massachusetts
math.umbc.edu	Univ. of Maryland Baltimore County
math.umd.edu	University of Maryland
math.umn.edu	University of Minnesota
math.unc.edu	Univ. of North Carolina at Chapel Hill
math.unh.edu	University of New Hampshire
math.unr.edu	University of Nevada at Reno
math.uoknor.edu	University of Oklahoma at Norman
math.uoregon.edu	University of Oregon
math.urich.edu	University of Richmond
math.usc.edu	University of Southern California
math.usf.edu	University of South Florida
math.usfca.edu	University of San Francisco
math.utah.edu	University of Utah
math.utexas.edu	University of Texas at Austin
math.uwax.edu	University of Wisconsin at La Crosse
math.uwsuper.edu	University of Wisconsin at Superior
math.vcu.edu	Virginia Commonwealth University
math.washington.edu	University of Washington
math.waterloo.edu	University of Waterloo
math.wayne.edu	Wayne State University
math.wisc.edu	University of Wisconsin at Madison
math.wpi.edu	Worcester Polytechnic Institute
math.wustl.edu	Washington University at St. Louis
math.wvu.edu	West Virginia University
math.yale.edu	Yale University
math.ysu.edu	Youngstown State University

math.vt.edu	Virginia Polytechnic Inst. and State Univ.
math.wellesley.edu	Wellesley University
math.widener.edu	Widener University

## Reviews of Mathematical Software

### *Harmonic Function Theory*

Reviewed by Paul C. Abbott\*

#### 1. Introduction

The *Mathematica* package *HFT.m* is designed for the symbolic manipulation of harmonic functions. The package is based upon material from the book *Harmonic Function Theory* [1].

Although *HFT.m* is primarily intended for mathematicians, this review is taken from the viewpoint of a physicist. Physicists are interested in the applications of harmonic functions to areas including: solutions to the Laplace (potential theory), Helmholtz (scattering theory), and Schrödinger (atomic and nuclear physics) equations; spherical harmonics (central to the study of angular momentum); approximate solutions to few-particle systems (hyperspherical harmonics); and generalizing physical problems to  $n$ -dimensions so that the large and small  $n$  limits can be studied.

#### 2. Getting the Package

*HFT.m* and its documentation are available via ftp (from otter.stanford.edu in the directory /mma/Analysis) and by e-mail (from Sheldon Axler at axler@math.msu.edu).

#### 3. Loading the Package

The package is loaded into a *Mathematica* session using the command:

```
In[1]:= <<HFT'
Out[1]= HFT; Version 2.11, 5 April 1993 ...
```

This message shows the version of *HFT.m* that was reviewed. All computations used *Mathematica* version 2.1 with the front end running on a Macintosh PowerBook 180 talking to a remote kernel on a DECstation 5100.

---

\*Paul Abbott received his Ph.D. in theoretical atomic physics from the University of Western Australia in 1987. His research relied heavily on computer algebra. In 1989 Abbott was involved with the foundation of *The Mathematica Journal* as Technical Editor. In 1991 he founded Analytica, a company based in Perth, Western Australia, that sells and supports a range of technical software packages. In 1992 he was appointed to the staff of the Department of Physics at the University of Western Australia. His current address is: department of physics, University of Western Australia, Nedlands 6009, Australia. He can be reached by email at: paul@earwax.pd.uwa.edu.au.

The following addresses are valid for mail but not Internet services:

Address	Institution
math.apstate.edu	Appalachian State University
math.auburn.edu	Auburn University
math.byu.edu	Brigham Young University
math.colostate.edu	Colorado State University
math.csufresno.edu	California State University at Fresno
math.emory.edu	Emory University
math.enmu.edu	Eastern New Mexico State University
math.grin.edu	Grinnell College
math.ilstu.edu	Illinois State University
math.indiana.edu	Indiana University
math.jmu.edu	James Madison University
math.luc.edu	Loyola University at Chicago
math.nau.edu	Northern Arizona University
math.nyu.edu	New York University
math.odu.edu	Old Dominion University
math.ohiou.edu	Ohio University
math.scarolina.edu	University of South Carolina
math.stanford.edu	Stanford University
math.tufts.edu	Tufts University
math.tulane.edu	Tulane University
math.uab.edu	University of Alabama at Birmingham
math.uconn.edu	University of Connecticut
math.ucsc.edu	University of California at Santa Cruz
math.uga.edu	University of Georgia at Athens
math.ukans.edu	University of Kansas
math.uky.edu	University of Kentucky
math.uni.edu	University of Northern Iowa
math.unm.edu	University of New Mexico
math.uno.edu	New Orleans University
math.upenn.edu	University of Pennsylvania
math.usu.edu	Utah State University
math.utk.edu	University of Tennessee at Knoxville

## 4. Functions

Using standard *Mathematica* syntax it is straightforward to obtain a complete listing of all functions defined in the *HFT* package:

```
In[2]:= ?HFT'
```

AnnularDirichlet	MacSymbols
Ball	Neumann
BasisH	Norm
BergmanKernel	NormalD
BergmanKernelH	Orthonormal
BergmanProjection	Partial
BiDirichlet	Phi
Delta	PoissonKernel
Dimension	PoissonKernelH
DimensionH	S
Dirichlet	Schwarz
Divergence	SetDimension
ExpandNorm	Sphere
ExteriorDirichlet	Subscripts
Gradient	SurfaceArea
HarmonicConjugate	Symbols
HilbertSchmidt	Taylor
Homogeneous	Togetherness
IdentityMatrix	Trace
IntegrateBall	Tracer
IntegrateSphere	Transpose
Inversion	TurnOff
Jacobian	TurnOn
Kelvin	Volume
KelvinM	ZonalHarmonic
Laplacian	

More detailed information is available on any of these functions, e.g.,

```
In[3]:= ?BasisH
```

`BasisH[m, x, options]` gives a basis for the space of harmonic polynomials homogeneous of degree  $m$  in the variable  $x$ .

## 5. Examples

I will try to indicate the scope of a package by a few examples. My bias is towards physical examples, and the reader is encouraged to obtain the  $\text{\TeX}$  documentation for mathematical examples.

### 5.1 Simple examples

#### 5.1.1 Euclidean norm

The function `Norm[x]` gives the Euclidean norm of  $x$ . An example of the type of manipulations that *HFT* is capable of is a verification of the *symmetry lemma*:

```
In[4]:= Norm[ x/Norm[x] - Norm[x]y ] -
Norm[ y/Norm[y] - Norm[y]x ]
```

$Out[4] = \left| \frac{1}{|x|} x - |x|y \right| - \left| \frac{1}{|y|} y - |y|x \right|$   
is simplified using (% denotes the previous expression):

```
In[5]:= ExpandNorm[%]
```

```
Out[5]= 0
```

which verifies the identity.

#### 5.1.2 Partial derivatives

*HFT* introduces `Partial` for computing partial derivatives. For example, the partial derivative of  $e^{ik \cdot x}$  with respect to  $x_5$  is

```
In[6]:= Partial[ Exp[I k.x], x[5]]
```

```
Out[6]= I EI k.x k5
```

The syntax follows the general *Mathematica* style. The authors (wisely) decided not to implement the functionality of `Partial` by overloading the *Mathematica* `D` operator, as such built-in operators have a number of internal simplification rules that are not easily modified.

#### 5.1.3 Operator identities

Some useful operator identities are easily verified, e.g., the  $n$ -dimensional Laplacian acting on scalar functions  $f$  and  $g$ .

```
In[7]:= Laplacian[f[x] g[x], x]
```

```
Out[7]= 2 Gradient[f][x].Gradient[g][x] +
g[x] Laplacian[f][x] + f[x] Laplacian[g][x]
```

which may be more recognizable as

$$\Delta fg = f \Delta g + g \Delta f + 2 \nabla f \cdot \nabla g.$$

## 5.2 Physical examples

### 5.2.1 Potential theory

Potential theory requires solutions to Laplace's equation in  $n$ -dimensions. *HFT* is capable of working in an arbitrary number of dimensions. Throughout the following define

```
In[8]:= r = Norm[x]
```

```
Out[8]= |x|.
```

Choosing  $x$  to be  $n$ -dimensional:

```
In[9]:= SetDimension[x, n]
```

one finds that

```
In[10]:= Laplacian[1/r, x]
```

```
Out[10]=  $\frac{3-n}{3|x|}$ 
```

which reveals that (apart from the singularity at  $r = 0$ ) the Coulombic potential,  $1/r$ , is a formal solution to Laplace's equation in three dimensions.

### 5.2.2 Scattering theory

In scattering theory one studies asymptotic solutions to the Schrödinger equation where the potential vanishes faster than  $1/r$  for large  $r$ . This leads to the Helmholtz equation  $(\Delta + k^2) \psi(r) = 0$ .

In standard texts the asymptotic solution is stated without proof. The incident particle beam is usually chosen to be monoenergetic particles travelling in direction  $k$ . Using *HFT* it is easy to show that the incident solution can be represented by a plane wave  $e^{ik \cdot x}$ :

```
In[11]:= Laplacian[E^(I k . x), x]-
k.k E^(I k . x)
Out[11]= 0.
```

As this expression does not depend on the dimensionality, it is clear that plane waves are solutions of the Helmholtz equation in  $n$  dimensions.

Far from the scattering center, the scattered solution must represent an outgoing spherical wave. It is easily verified that the radial behavior of the scattered solution is  $e^{ikr}/r$ :

```
In[12]:= Laplacian[E^(I k r)/r, x]-
k^2 E^(I k r)/r // Factor
Out[12]=
```

$$\frac{I |x| k}{I E^{(-3+n)} (I + |x| k)} - \frac{3 |x|}{3 |x|}$$

but only in three dimensions:

```
In[13]:= % /. n -> 3
Out[13]= 0.
```

The Green's function exhibiting purely outgoing wave behavior satisfies  $(\Delta + k^2) G_0^{(+)}(k, x, y) = \delta(x - y)$  with the solution

```
In[14]:= green[k, x, y] = -E^(I k Norm[x-y])/
(4Pi Norm[x-y])
Out[14]=
```

$$\frac{-E^{I |x-y| k}}{4 \text{Pi} |x-y|}$$

Restricting attention to three dimensions:

```
In[15]:= SetDimension[x,3]
In[16]:= SetDimension[y,3]
```

this result can be (formally) verified for  $x \neq y$ :

```
In[17]:= Laplacian[green[k,x,y], x] -
k^2 green[k,x,y] // ExpandNorm
Out[17]= 0.
```

### 5.2.3 Schrödinger equation

One often needs to factor off the asymptotic behavior of solutions to a differential equation. As an example, the Schrödinger equation for a Coulombic potential can be written

$$\left(-\frac{1}{2}\Delta - \frac{Z}{r} - E\right) \psi(r) = 0$$

and implemented using Laplacian as

```
In[18]:= Schroedinger[f, x] :=
-1/2 Laplacian[f, x] - z/r f - e f.
```

For large  $r$  the exponentially decaying asymptotic form  $e^{-ar}$  is easily factored off:

```
In[19]:= Schroedinger[g[x] E^(-a r), x]/
E^(-a r) // Expand
```

```
Out[19]=
```

$$\frac{-a^2 g[x]}{|x|} - e g[x] + \frac{a \text{Gradient}[g][x] \cdot x}{|x|} + \frac{a g[x]}{|x|} - \frac{z g[x]}{|x|} - \frac{\text{Laplacian}[g][x]}{2}$$

yielding an equation which can be further simplified by rescaling and suitable choice of the parameter  $a$ .

### 5.2.4 Statistical physics

In statistical physics multidimensional volume and surface integrations are often required. For example here is the volume:

```
In[20]:= Volume[4]
```

```
Out[20]= Pi
```

```
----
```

```
2
```

of a unit sphere in four dimensions.

IntegrateBall, which integrates over the unit ball, can be used to compute the normalization integrals for many-electron atomic wavefunctions:

```
In[21]:= IntegrateBall[r^m Exp[-a r], x]
```

```
Out[21]= 4 a^-3 - m Pi Gamma[3 + m, 0, a]
```

and partition function integrals

```
In[22]:= IntegrateBall[Exp[-a x.x], x]
```

```
Out[22]=
```

$$4 \text{Pi} \left( \frac{-1}{a} + \frac{2 a E \text{Sqrt}[\text{Pi}] \text{Erf}[\text{Sqrt}[a]]}{3/2 a} \right)$$

### 5.2.5 Spherical harmonics

The command BasisH[m, x, options] gives a basis for the space of harmonic polynomials homogeneous of degree  $m$  in the variable  $x$ , e.g.,

```
23]:= BasisH[2, {x, y, z}]
```

```
Out[23]=
```

$$\{x^2 - 2y^2 + z^2, z y, x^2 + y^2 - 2z^2, y x, z x\}$$

for an explicit set of three-dimensional cartesian coordinates. Alternatively, in three dimensions:



```
In[24]:= SetDimension[x, 3]
the normalized harmonics can be obtained directly:
In[25]:= spherical = BasisH[2, x,
Orthonormal -> Ball].
It is easily verified that each harmonic, e.g.,
In[26]:= spherical[[1]]
Out[26]=
```

$$\frac{\sqrt{\frac{35}{\pi}} (-|x| + 3x^2)}{4}$$

is orthonormal by computing the appropriate integrals. For example,

```
In[27]:= IntegrateBall[spherical[[1]]^2, x]
Out[27]= 1
reveals that spherical[[1]] is correctly normalized.
```

## 6. Conclusions

The quality of the *HFT* package is demonstrated by its utility in a domain that its authors may not have deliberately intended. The package is well-written and the documentation is readable and concise.

Where possible, *HFT* follows standard *Mathematica* conventions. A brief study of the source code showed it to be a well-written package that could be easily customized.

Although there is an admirable effort to incorporate input and output typesetting (using specific key sequences) for functions such as *Norm* and *Integrate*, and *Partial*, this feature is presently restricted to the Macintosh platform. Not all functions are typeset on input or output (e.g., *Gradient*). These deficiencies serve to highlight the need for a uniform typesetting functionality presently missing from *Mathematica* and should not be viewed as a criticism of the *HFT* package itself.

Some extensions to the package that I would like to see include the capability of computing integrals like

$$\text{IntegrateBall}[1/(\text{Norm}[x-q]^{\backslash, \backslash^{\backslash, 2+1}), q]$$

(which presently produces an error message), explicit access to spherical coordinates in  $n$ -dimensions, and the capability of handling distributions (e.g., the Dirac delta function).

## 7. References

1. Axler, S., Bourdon, P. and Ramey, W., *Harmonic Function Theory*, Springer-Verlag (1992).

## Update on Harmonic Function Theory

Sheldon Axler

*The following announcement concerning the package Harmonic Function Theory was distributed by electronic mail in August 1993.*

This message is being sent to everyone who has requested the *Mathematica* package (usually called *HFT*) that accompanies the book *Harmonic Function Theory*, by Sheldon Axler, Paul Bourdon, and Wade Ramey.

You should request a new version of the *HFT* package if either of the following conditions applies to you:

1. The version number of your *HFT* package is anything before 2.10 and you use any functions that depend upon computation of the Poisson integral (for example, the functions *Dirichlet*, *ExteriorDirichlet*, *AnnularDirichlet*, *Neumann*, and *BiDirichlet*). The version number of your *HFT* package is displayed each time you load the package into *Mathematica*. New algorithms for computing Poisson integrals of polynomials implemented in the current version of the *HFT* package are much, much faster than the algorithms used before version 2.10 of the package.

2. You are using a Macintosh computer and version 2.2 of *Mathematica*. The feature in our package that allowed the use of special Macintosh symbols during input does not work with *Mathematica* 2.2. This feature has been removed from the new version of the *Mathematica* package.

The new version of the *HFT* package (version 2.12) works with versions 2.0, 2.1, and 2.2 of *Mathematica* on all computers that run *Mathematica*. The *HFT* package and its documentation are distributed free of charge by electronic mail. To request a copy send an e-mail message to me at [axler@math.msu.edu](mailto:axler@math.msu.edu).

## Announcements

### Archive of sci.math.research

Since its inception in 1991, the Usenet newsgroup *sci.math.research* has been a forum in which mathematicians ask questions about problems arising in their research and make important announcements to the mathematical community. During this time Dan Grayson at the University of Illinois at Champagne has graciously served as the group's moderator, screening articles for their appropriateness.

Recently, the department of mathematics and computer science at Lake Forest College began archiving this newsgroup, making available all current and past postings. The archive is available via GOPHER to [math.lfc.edu](mailto:math.lfc.edu). You will find the archive in the directory

Mathematics Related Items/

Archive of sci.math.research USENET newsgroup.

If you have difficulty accessing math.lfc.edu, try davinci.lfc.edu. If your computer does not have a gopher client, you can use the AMS's e-MATH system to access their gopher client.

math.lfc.edu is listed as

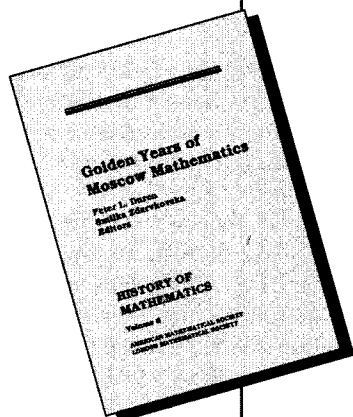
Other Math-Related Gophers/  
Lake Forest College MathCS

In addition the archive can be downloaded using anonymous ftp to math.lfc.edu. The files are in gzipped format. For more information regarding Gopher or anonymous ftp contact your local system administrator. For questions and comments about the archive contact Michael Boardman, Department of Mathematics and Computer Science, Lake Forest College, Lake Forest, IL 60045, e-mail: boardman@davinci.lfc.edu; telephone: 708-735-5158.

## Corrections

In the July/August issue of the *Notices*, p. 617, the reference to the directory pub/Symbolic\_Math should have been pub/Symbolic\_Soft. Thanks to Rad Dimitric for pointing this out.

Donald G. Malm (malm@vela.acs.oakland.edu) writes in connection with the reference to *UBASIC* in the list of software reviews published in the same issue (p. 621). Malm points out that he is not a distributor of *UBASIC*. The language is written by Prof. Y. Kida (e-mail: kida@rkmth.rikkyo.ac.jp). Malm wrote part of the software provided with the language.



## HISTORY OF MATHEMATICS

### Golden Years of Moscow Mathematics

Peter L. Duren and Smilka Zdravkovska, Editors  
Volume 6

This volume contains articles on Soviet mathematical history, many of which are personal accounts by mathematicians who witnessed and contributed to the turbulent years of Moscow mathematics. In today's climate of glasnost, the stories can be told freely for the first time, with a candor uncharacteristic of the "historical" accounts published under the Soviet regime. The articles focus on mathematical developments in that era, the personal lives of Russian mathematicians, and political events that shaped the course of scientific work in the Soviet Union. An important feature is the inclusion of two articles on Kolmogorov, perhaps the greatest Russian mathematician of the twentieth century. The volume concludes with an annotated English bibliography and a Russian bibliography for further reading. This book appeals to mathematicians, historians, and anyone else interested in Soviet mathematical history. The History of Mathematics series is published jointly with the London Mathematical Society (LMS).

1991 *Mathematics Subject Classification*: 01  
**ISBN 0-8218-9003-4**, 269 pages (hardcover), October 1993  
**Individual member** \$56, List price \$94, **Institutional member** \$75  
 To order, please specify HMATH/6NA

\* Members of the LMS are entitled to member prices. The LMS is incorporated under Royal Charter and is registered by the Charity Commissioners.



All prices subject to change. Free shipment by surface: for air delivery, please add \$6.50 per title. *Prepayment required.* Order from: American Mathematical Society, P.O. Box 5904, Boston, MA 02206-5904, or **call toll free 800-321-4AMS (321-4267)** in the U.S. and Canada to charge with VISA or MasterCard. Residents of Canada, please include 7% GST.

### **Recognition and Rewards: What Does the Community Value?**

The Committee on Professional Recognition and Rewards (known as the Rewards Committee) is working on some of the thorniest issues facing the mathematics profession. A committee of the Joint Policy Board for Mathematics, it has been working for about a year and a half and expects to put out its report in early 1994. Its recommendations could have profound effects on the culture of the mathematical sciences community.

The Rewards Committee is looking at the panorama of issues surrounding the question of what contributions are recognized and rewarded in mathematics departments. In reports and in presentations at conferences many in the community have been advocating the importance to the profession of such activities as teaching, curriculum development, mentoring, public awareness of mathematics, expository writing, and service to the community. One of the reasons the Committee was established is that many in the community believe that the rewards structure is not flexible enough to properly recognize the full range of activities of the mathematics professor.

The first thing the Rewards Committee did was set about finding out how various activities are valued in mathematics departments and in colleges and universities. The Committee made site visits to twenty-three academic mathematics departments, ranging from Ph.D.-granting departments to departments in two-year colleges. They also conducted a survey of over 600 mathematics department chairs and nearly 2000 faculty members. The Committee gathered input from the mathematical community at panel discussions and presentations at national and sectional meetings of the AMS, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics. At this point the Committee has examined the information and data from the survey and the site visits and is preparing its final report.

One interesting finding from the survey was that the perceptions of department chairs and faculty often differ considerably. For example, the percentage of chairs who think teaching ability is important to salary increases is significantly larger than the percentage of faculty who think so. This pattern was found in all institutional types in the surveys. The Committee will be looking at the significance of these kinds

of differences. An important finding is that the overwhelming majority of those responding—chairs and faculty from four-year colleges, from comprehensive universities, and from research universities—say that research is now and should continue to be “very important” in decisions about salary increases and about promotion and tenure. The committee was also able to discern some interesting trends. For example, the survey found that, in departments where the major emphasis has traditionally been on research, teaching has become more important; conversely, in departments where the major emphasis has traditionally been on teaching, research has become more important.

Among the questions the Committee will explore in its report are the degree to which faculty are dissatisfied with the current rewards system and what aspects of it they would like to see changed. The Committee is also examining how well departments communicate internally and with their deans, provosts, and presidents; and how teaching and other activities such as service and scholarship are evaluated. In addition to presentation and interpretation of the survey and site visit findings, the report will make recommendations to departments and to the community for ways to improve the rewards system. The Committee hopes to produce a report that will provide information about the present rewards system in mathematics and make recommendations that the community can utilize.

**Allyn Jackson**

### **Report of a Special Committee on Professional Ethics**

This Committee was instructed to make findings and recommendations to Council on the complaint of Richard K. Skora. We have spoken with Dr. Skora, Dr. Paul A. Sundheim, Professor Cameron M. Gordon, and others involved in the dispute. We have studied all the mathematical papers in question, including unpublished preprints; we have read the files provided by the AMS's Committee on Professional Ethics (COPE) and the Inquiry Report prepared at the University of Texas.

### History of the Case

This report can be brief because we require no difficult weighing of conflicting testimony. The issues as we see them can be resolved using facts on which all parties now agree.

The dispute concerns the thesis and subsequent papers of Paul Sundheim, who was a student of Cameron Gordon at the University of Texas. The subject of his thesis had been studied earlier by Richard Skora, and it is this overlap that is at issue. Specifically, we are called on to judge whether Sundheim's thesis and papers gave inadequate recognition of Skora's priority.

Knots and links are 1-manifolds regarded as imbedded in 3-manifolds; i.e., two of them are equivalent if one can be obtained from the other by an isotopy of the containing 3-manifold. In the classical theory, the 3-manifold is  $\mathbb{S}^3$ . In 1986 or 1987, Skora embarked on the extension of some central classical results to knots imbedded in general 3-manifolds. Gordon, unaware of this, suggested the same area of research to Sundheim, who had passed his qualifying examination in August 1987.

The first of these classical results is Markov's Theorem. Links in the 3-sphere are all obtainable up to isotopy as closed braids (Alexander's Theorem). Markov's Theorem tells when two closed braids are isotopic: one must be obtainable from the other by "Markov moves", a small inventory of special transformations. The reference given for a full development of this theory is Joan Birman, *Braids, Links and Mapping Class Groups*, 1974. Skora gave the generalization in a preprint which was circulated in October 1988, and in particular was sent to Gordon and Sundheim. Skora's proof imitates that in Birman's book, and the conclusion is a generalization of Markov's; the main complication is that one does not—can not—begin the definition of a braid by reference to an unknotted closed curve.

The second of the classical results is Reidemeister's Theorem. This tells how to recognize any equivalence between two links in  $\mathbb{S}^3$  in a standard way from their "diagrams"—the pattern of over- and under-crossings they yield following a projection (of  $\mathbb{R}^3$ ) to a disk. A small inventory of "Reidemeister moves", particular transformations of diagrams, is specified, and the theorem states that two links are equivalent if and only if the diagram of one can be taken to the diagram of the other by a sequence of Reidemeister moves. Skora gave the generalization in a preprint which was circulated in December 1988, in particular to Gordon and Sundheim. The definition of diagram is not so straightforward as in the classical case, but uses ideas which have been around for many years. The result differs from the classical result: a new Reidemeister move must be introduced. The classical Reidemeister moves involve local changes in the diagram; the new move is not capable of localization.

Sundheim had begun work on these matters before receiving the preprints. His generalization of the Markov Theorem appeared in preprint form in October 1989; of the Reidemeister Theorem, in June 1989, revised in January 1990. His thesis was approved in May 1990.

Both authors have had manuscripts rejected or returned

for revision on these subjects. However, Skora's "Closed braids in 3-manifolds", on his generalized Markov Theorem, is forthcoming in *Math. Zeitschrift*; Skora's "Knot and link projections in 3-manifolds," on his generalized Reidemeister theorem (final revision May 1990) appeared in *Math. Zeitschrift* **206** (1990), 345–350. Sundheim's "The Alexander and Markov Theorems via diagrams for links in closed orientable 3-manifolds" is forthcoming in *Trans. Amer. Math. Soc.*; and Sundheim's "Reidemeister's theorem for 3-manifolds" (final revision May 1990) appeared in *Math. Proc. Camb. Phil. Soc.* **110** (1991), 281–292. We found no significant divergences between Sundheim's thesis and the papers based on it, or for that matter between early and late versions of the papers of either author.

In 1989 and 1990, Skora several times pointed out privately to Gordon that Sundheim's presentation of these results required acknowledgment of Skora's priority. Beginning in January 1991, Skora complained formally to the University of Texas and the American Mathematical Society that Sundheim was incorrectly representing the two theorems as new work whereas he had learned them from Skora's preprints. The Society's Committee on Professional Ethics submitted a report in September 1991, recommending "that it be suggested to Sundheim that in the interests of amity he make a stronger statement giving priority to Skora, even though he has already given Skora proper credit". Indeed, Sundheim and Gordon declared to COPE their willingness to acknowledge Skora's priority. (This aspect is examined in detail below.) However, Skora was dissatisfied with the implication he saw in COPE's wording that the "stronger statement giving priority" was needed only to assuage his hurt feelings; he complained vigorously both to the Society and to the University of Texas. The present report is the outcome of the Society's reconsideration of the matter. Meanwhile, the University conducted interviews and assembled a lengthy report, which remains confidential but which we were permitted to read. This report, on behalf of the Department of Mathematics and the Graduate School, concluded that "the charges against Dr. Cameron M. Gordon and his student, Dr. Paul Arnold Sundheim, are without foundation".

As we stated at the outset, there are no substantive disagreements remaining about the facts. What makes the clash seem sharp is that the word "plagiarism" has been used by Skora and some sympathizers. But this word in common language means "taking another's ideas and presenting them as one's own", so that applied to Sundheim it sounds like an accusation that he presented in his thesis and papers proofs he had copied from Skora, in the guise of new proofs of his own. This accusation could not be sustained. Letters by Dr Skora and Professor Gordon since 1991 have agreed in stipulating that Sundheim's proofs were different, though there may be disagreement on how essential their novelty was.

Sundheim's proof of the generalized Markov Theorem uses a technique of H.R. Morton called threading of a diagram, mentioned but bypassed in Skora's paper. Morton's paper was on Sundheim's reading list before he heard of Skora's work, and he was probably committed to this line

of proof. Sundheim's new Reidemeister move is somewhat different from Skora's, a simplification which streamlines Skora's proof is not used in his, and the induction on which he relies has no counterpart in Skora's proof.

In short, there is no indication that Sundheim was influenced by the 1988 preprints, or even that he read them. He did know they existed; they were available to him, and he acknowledges that they were. He had the reinforcement of knowing the results were true, but he set out to find for himself why they were. He could have presented his thesis as new proofs of theorems of Skora; whether its novelty is sufficient to give his work interest is a question for his thesis committee and the editors receiving his papers, not for this Committee. When one presents a new proof of a known result, one may enhance the value of the exposition to the reader by commenting on the differences from the predecessor's approach, and Sundheim did not do this; the question of whether such comment was needed here might be subject to judgment by thesis committee or editors, but is not before this Committee.

The case would be altogether different if Sundheim had essentially proved the theorems before Gordon and he received the Skora proofs. He had done some work. To assess it at this late date is perhaps impossible. What we can say (and it is sufficient basis for excluding this 1988 work from our considerations) is that by Sundheim's own account it did not comprise publicly presentable proofs and it had not been communicated to Gordon or anyone else.

There remains the matter of attribution. The Sundheim thesis, May 1990, says

Similar results have been independently discovered by Richard Skora using other methods

and refers to Skora's 1988 preprints without giving any date for them. Sundheim's paper in *Proc. Camb. Phil. Soc.* says

This result was also obtained previously and independently by Richard Skora

and refers to the appropriate preprint giving the wrong date: 1991 instead of 1988 (though this paper's final revision is said to have been received also in May 1990).

Skora's papers and preprints do not mention Sundheim. The obligation was evidently less in this direction; still, it is normal practice in such a case to refer to other treatments.

## Conclusions

We concur with the formulation of the AMS Committee, 13 September 1991, that by that date the only difference between the parties was that Sundheim

claims a higher level of independence of his work than Skora would allow him, though he cedes the priority to Skora.

We concur also that a proper form of citation would have been the following, cited by that report and agreeable to both parties:

A generalization of the Markov [resp. Reidemeister] Theorem was proved first by Richard Skora [...] (1988). Here we give a different proof [...].

More remains to be said.

To give an accurate report of the sources and publication of an idea is the responsibility of the author of a public scholarly paper. The potential damage from the inadequacy of Sundheim's report was small, but the responsibility was there; it was incumbent on Professor Gordon as thesis director to make this responsibility clear to Sundheim and to ensure that it was discharged in the official version of the thesis as accepted by the University.

We are aware that lapses of this sort, even more serious ones, often occur, and are often ignored. This particular incident came to wide public attention only because Skora's doggedness and at times his overstatements kept it salient.

The responsibility to tell a reasonably accurate life story of a theorem serves several purposes. Omitting the story can create the inaccurate impression of independence from previous work, slighting the work done by others. But this responsibility is not just a courtesy to placate rivals. The object is to lay down in the literature a correct record, for the sake of readers. It is therefore a responsibility to the profession, and the Society shares the duty to preserve it.

## Committee on Ethical Conduct

Lee D. Mosher

Frank S. Quinn

Chandler Davis (chair)

## News and Announcements

### **Boris Moishezon 1937–1993**

Boris G. Moishezon of Columbia University, an algebraic geometer and Soviet dissident, died on August 25, 1993.

Moishezon was born on October 26, 1937, in Odessa, Ukraine, then part of the Soviet Union. He received his diploma in mathematics in 1959 from Tadjic State University in Dushanbe and the candidate degree in physical and mathematical sciences in 1962 from the Mathematics Institute at the Soviet Academy of Sciences in Moscow. He taught mathematics at the Pedagogical Institute of Oeckovo-Zuevo from 1964 until 1967. In 1967 he received his doctorate from Moscow State University. That same year he was awarded the Prize of the Moscow Mathematical Society for his work on algebraic spaces. He went on to become a senior scientist at the Central Institute of Mathematical Economics in Moscow.

Moishezon was one of a number of Soviet dissidents who spoke out about the barriers Jews encountered in the upper echelons of science and mathematics. In 1972 he and nine others signed a public statement denouncing the exorbitant fees the government charged for exit visas. The government said the fees, up to \$25,000, were to reimburse the state for the education the émigrés had received. Moishezon also publicly demonstrated against the killing of Israeli athletes during the 1972 Olympic Games. Later that year he and five other Jewish scientists communicated with the National Academy of Sciences in Washington, DC, about harassment by Soviet authorities, isolation from the outside world, and forced manual labor.

In 1972 Moishezon and his family were granted exit visas and moved to Israel, where he took a position as a mathematics professor at Tel Aviv University. In 1975 he received the Caplun Prize from Hebrew University. He went to the University of Utah as a visiting professor in 1977 and the following year went to Columbia University, where he remained until his death. Even after leaving the Soviet Union, Moishezon continued to be active in human rights organizations and conferences. He was also an advocate for increased instruction in mathematics and science in public schools in the U.S.

Early in his career Moishezon was involved in foundational work in complex analytic and algebraic geometry. He lent his name to fundamental concepts such as “Moishezon manifolds” (complex manifolds bimeromorphic to Kähler manifolds) and the “Nakai-Moishezon criterion” for ampleness of a divisor. Later on he devoted himself to the study of algebraic surfaces, particularly their topological properties. His lecture-notes volume on elliptic surfaces, published in 1977, was the beginning of a detailed investigation by many mathematicians of elliptic surfaces, which is still flourishing.

Moishezon made a number of highly original contributions to this subject, many of them related to the methods of braid monodromy. His ideas on braid monodromy led him, in joint work with M. Teicher, to construct the first examples of simply connected algebraic surfaces with nonnegative signature, thus disproving two basic conjectures in the classification theory of surfaces of general type. He was also the first to give

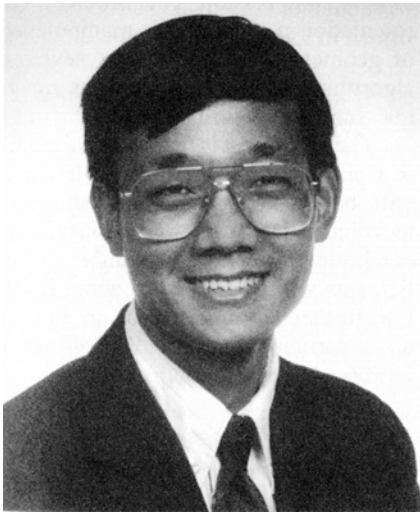
examples of homeomorphic but nondiffeomorphic surfaces of general type. At the time of his death he was studying a new class of smooth four-manifolds, which he called “semi-algebraic surfaces”. Moishezon’s original ideas on this and other topics will continue to be a source of inspiration for algebraic geometers and topologists for years to come.

### **Zhihong Xia Named First Recipient of Blumenthal Award**

ZHIHONG XIA of the Georgia Institute of Technology has been named the first recipient of the Leonard M. and Eleanor B. Blumenthal Award for the Advancement of Research in Pure Mathematics. The award was presented during a special prize session on August 15, 1993, during the International Joint Mathematics Meetings in Vancouver. During the prize session Professor Xia presented a lecture entitled “The Existence of Non-collisional Singularities in Newtonian Systems”.

Professor Xia received the award in recognition of his solution of a problem that goes back nearly one hundred years to Painlevé and Poincaré and that had been attempted by many prominent mathematicians. The problem is this: Is it possible to specify initial conditions for the  $n$ -body problem in classical mechanics that will result in a singularity in finite time not caused by the collision of two or more of the bodies? Professor Xia’s affirmative answer is elegant and conceptually simple, yet involves ingenious, highly technical arguments. His paper containing this result appeared in *Ann. Math.*, **135** (1992), 411–468.

The primary purpose of the Leonard M. and Eleanor B. Blumenthal Trust for the Advancement of Mathematics is to assist the department of mathematics at the University of Missouri at Columbia, where Leonard Blumenthal served as a professor for many years. The secondary purpose of the trust is to recognize distinguished achievements in mathematics through the Blumenthal Award, to be made every four years. The trust is administered by Boone County National Bank in Columbia, Missouri. The net income is paid to the award recipient each year for four years. Professor Xia's award is expected to total approximately \$20,000 over four years.



Zhihong Xia

On the selection committee for this year's prize were Vaughan F. R. Jones of the University of California at Berkeley, Robert P. Langlands of the Institute for Advanced Study, Gregori Margulis of Yale University, J. Peter May of the University of Chicago, and Wilfried Schmid of Harvard University (chair). According to the stipulations of the trust the recipient must accept the award in person at a meeting and present a lecture on the work for which the award was given. In addition the awardee is to present his or her research in an address during at least one meeting over the course of the four years of the award.

Zhihong Xia was born on September 20, 1962, in Dongtai, Jiangsu, China. He received his bachelor's degree in astronomy in 1982 from Nanjing University in

China and his doctorate in mathematics in 1988 from Northwestern University, where his thesis advisor was Donald G. Saari.

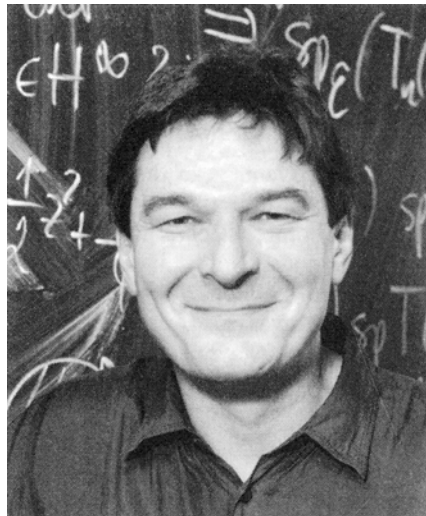
Before accepting his present position as associate professor at the Georgia Institute of Technology, Professor Xia was a Benjamin Peirce Lecturer and assistant professor at Harvard University (1988–1991). He has held visiting positions at the Universidade Federal de Pernambuco, Brazil (December 1992), and at Northwestern University (spring 1992).

Professor Xia was a Sloan Fellow during 1989–1991. He received the Sigma Xi Scientific Research Society Best Paper Award in 1993. He has presented lectures at mathematics meetings and in mathematics departments across the U.S. and in Latin America.

Dynamical systems, Hamiltonian systems, and celestial mechanics are Professor Xia's main areas of research.

**Albrecht Böttcher  
Receives Krupp Award**

ALBRECHT BÖTTCHER, professor of mathematics at the Technical University of Chemnitz (Germany), has received the



Albrecht Böttcher

Alfried Krupp Förderpreis für junge Hochschullehrer of 1992. This prize, a five-year, DM 850,000 fellowship, was initiated by the Alfried Krupp Foundation in 1986. It is awarded annually to a young university professor in the natural sciences and engineering who has

demonstrated unusual creative ability in research and teaching.

Böttcher's work focuses on analysis and operator theory. His main field of research is Toeplitz and Wiener-Hopf operators; he has made a large number of high-quality contributions to the spectral theory and numerical analysis of these classes of operators and obtained results of fundamental importance on the asymptotic behavior of Toeplitz determinants. Böttcher is author and coauthor of two books and about sixty papers.

He earned his master's degree in 1979 from the Technical University of Chemnitz, his doctoral degree in mathematics in 1984 at Rostov-on-Don State University (Russia), and his habilitation in 1987 at the Technical University of Chemnitz. Böttcher held a research position at Rostov-on-Don State University from 1980 to 1984 and was an assistant professor at the Technical University of Chemnitz from 1984 to 1992, where he was appointed professor in 1992.

**Ford Foundation  
Fellowships Awarded**

The National Research Council (NRC) has announced the names of recipients in the Ford Foundation Predoctoral and Dissertation Fellowship Program and in the Ford Foundation Postdoctoral Fellowships for Minorities Program. Both programs are administered by the NRC and support minority scholars in a range of academic areas.

Predoctoral fellowships provide stipends and tuition for three years, and dissertation fellowships provide a nine- or twelve-month stipend. The aim of the programs is to increase the presence of underrepresented minorities on the nation's college and university faculties. The postdoctoral fellowships enable individuals to engage in postdoctoral research and scholarship in an environment free from the usual professional duties. The aim of this program is to allow scholars to achieve their full potential and attain greater recognition in their respective fields.

Among the fifty-five Predoctoral Fellows, three are in the mathematical sciences: LISSETTE NYDIA LUGO of New York University, whose field is algebra; THOMAS FRANK REESE of the University

of California at Berkeley, whose field is probability and statistics; and STEPHEN MATTHEW WALKER of Stanford University, whose field is fluid dynamics.

None of the Dissertation Fellows or the Postdoctoral Fellows was in the mathematical sciences.

**News from the Geometry Center  
University of Minnesota  
at Minneapolis**

The Geometry Center will host four workshops during the coming academic year.

**Advances in Nonlinear Astrodynamics**  
November 8–10, 1993.

This workshop will highlight new low-energy methods to deliver scientific payloads to the moon, asteroids, Mars, and the sun's gravitational lens. Included in the discussion will be Farquhar's techniques for ISEE-C and missions to comets and asteroids as well as the newly discovered ballistic lunar capture transfer as demonstrated by the Japanese spacecraft *Hiten* in 1991–1992. Applications of these and other methods to small spacecraft will also be addressed. In this industry/lab/academic conference there will also be presentations by experts in celestial mechanics about the mathematical context in which the discoveries and practical orbit computations have been made.

Keynote speakers and their titles will be R. Farquhar, APL-Johns Hopkins, "The Use of Nonlinear Astrodynamics in Missions to Comets and Asteroids," and L. Friedman, director of the Planetary Society, "Exploration of the Solar System: Celestial Mechanics to the Rescue". Other speakers will include E. Belbruno, JPL and The Geometry Center; R. Broucke, University of Texas; K. Mease, Princeton; and C. Simo, Barcelona.

Because the workshop will be self-supporting, there is a registration fee of \$325. Very limited support for academic participants may be available. For registered students the registration fee will be waived. For more information and details please contact the Organizer, Dr. Edward Belbruno, at The Geometry Center: belbruno@geom.umn.edu or 612-626-1845 or 626-0888; fax: 612-626-7131.

**Joint Workshops on Geometric Group Theory**

January 3–14, 1994, at The Geometry Center and March 17–20, 1994, at DIMACS, the Center for Discrete Mathematics and Theoretical Computer Science, Rutgers University, New Brunswick, NJ.

In recent years investigation of geometric and language-theoretic aspects of Cayley diagrams of finitely generated groups has engendered a remarkable interplay between group theory, geometry, and the theory of automata and formal languages. Perhaps the best-known result of this interplay has been the introduction of *automatic groups* which include the *hyperbolic groups* of M. Gromov. Computation in both its theoretical and practical aspects has been an important part of these developments, and The Geometry Center is organizing two related workshops on computational aspects of geometric group theory. The Geometry Center workshop will focus on problems of practical computation. It will take advantage of the special resources of the Center and will involve people interested in programming. The DIMACS workshop will cover areas of more theoretical interest as well as communicating the relevant results of the first workshop to a broader audience. This division into two workshops mirrors the division between the practical and theoretical aspects of computation and takes advantage of the strengths of each host institution.

The Geometry Center workshop will include about twenty-five people. D. Bayer, Jim Cannon, John Cannon, B. Floyd, G. Havas, D. Holt, C. Miller, R. Needham, M. Newman, E. O'Brien, S. Rees, I. Rivin, M. Schonert, and M. Van Leeuwen have indicated their intention to participate.

The following people have accepted invitations to speak at the DIMACS conference: S. Gersten, D. Holt, P. Papasoglu, E. Rips, and J. Stallings. DIMACS is located on the main campus of Rutgers University.

The organizing committee (for both parts) consists of R. Gilman (Chair), G. Baumslag, D. B. A. Epstein, H. Short, and C. Sims. For information on participation please contact R. Gilman, Dept of

Math., Stevens Institute of Technology, Hoboken, NJ 07030; 201-216-5448 or rgilman@vaxc.stevens-tech.edu.

**Wavelet Analysis as a Tool for Geometric Synthesis and Analysis**

May 2–6, 1994.

Wavelets, and more generally adapted waveform analysis, provide a rich collection of (orthogonal) templates. These can be used for the efficient representation and construction of geometric structures, from fractals to surfaces and images. These methods provide a simple unifying mathematical framework for such tasks as singularity analysis, feature and parameter extraction, as well as data compression. This efficient representation permits faster manipulation of geometric data, providing new fast algorithms for CAD as well as image matching and deformation.

The workshop is being organized by R. Coifman of Yale University. Its focus will be on algorithmic/computational techniques. Because of limited staff and computing resources, the number of participants will be limited to about thirty. For further information or to inquire about participation write: R. Coifman at coifman@jules.math.yale.edu.

**Elliptic and Parabolic Methods in Geometry**

May 23–27, 1994.

A number of challenging geometrical problems whose statements or whose likely methods of solution involve methods of elliptic or parabolic partial differential equations/geometric measure theory have appeared in recent years. Some of the specific areas of recent research of great interest are Willmore flow, harmonic mappings, the Yamabe problem, mean-curvature flow, intrinsic Ricci flow, minimal and constant mean curvature surfaces.

Interaction between these areas has been remarkably productive: frequently, ideas and techniques of one area have been crucial to progress in another area. For example, the monotonicity estimates of mean-curvature problems suggested a key step for understanding harmonic mappings and are related to the clearing-out phenomenon of mean-curvature flow.



The availability of powerful hardware and software makes it possible to address geometrical questions in low dimensions by numerical simulation and to represent results in a meaningful and flexible visual format. These questions were previously accessible only to the imagination. The majority of mathematicians pursuing these questions in traditional pencil-and-paper ways, however, have no ready access to the intelligent use of computers to attack geometrical problems. At the same time, the best ideas and most fundamental contributions to the understanding of geometrical phenomena have not always been available to the people who are writing software. One goal of this workshop is to bring these two sides together in fruitful ways.

The Geometry Center plans to organize each of the five days, Monday through Friday, into about seven talks or software demonstrations. There will be at least two short courses on useful software packages, with repeated opportunities for workshop participants to see what the program can do, ask questions, propose alternative experiments, or get some hands-on experience in the use of the software. In addition we will allow some time for less formal interaction between participants.

The following mathematicians have accepted (at least tentatively) our invitation to give a lecture or demonstration: F. Almgren, S. Altschuler, B. Andrews, S. Angenent, K. Brakke, C. Evans, R. Hamilton, Z.-C. Han, B. Hardt, L. Hsu, G. Huisken, J. Hutchinson, T. Ilmanen, N. Kapouleas, R. Kusner, J. Lee, P. Li, F. Lin, J. Pitts, K. Polthier, J. Rade, R. Schoen, L. Simon, J. Spruck, I. Sterling, M. Struwe, G. Tian, F. Wei, B. White, L.-F. Wu, D. Yang, S.-T. Yau, R. Ye. Also, in addition to the organizers, the following mathematicians will be participating in the workshop: S. Adams, P. Burchard, P. Daskalopoulos, L. Green, C. Leung, J. Nitsche, D. Pollack, Y. Shen, T. Toro, and L. Wang.

The workshop is partially sponsored by the Institute of Mathematics and Its Applications under its participating institution program.

The Geometry Center welcomes additional mathematicians who wish to

attend the workshop. If you are planning to attend, please notify The Geometry Center staff (preferably by e-mail to the following address). The Organizing Committee, Ben Chow, Bob Gulliver, John Sullivan, University of Minnesota, [epmg@geom.umn.edu](mailto:epmg@geom.umn.edu).

**News from the  
Mathematical Sciences Institute  
Cornell University,  
State University of New York  
at Stony Brook, and  
the University of Puerto Rico**

There are four definitions of the word "gopher". A gopher is a short-tailed, burrowing mammal; a native of Minnesota, the Gopher State; a person who runs errands and delivers documents; and, most important for this discussion, a software package which follows a simple protocol for tunneling through a TCP/IP internet.

The Gopher protocol for exploring data sets on the Internet was developed by the University of Minnesota and has recently been adopted by Cornell University.

As of this month the Mathematical Sciences Institute will join Cornell's CUINFO Gopher network. Other nodes on the net include the Cornell Theory Center and the Cornell Library. Users on the Internet will be able to access updated workshop schedules, staff directories, and the MSI Technical Report series.

While CUINFO Gopher will become MSI's primary means of distributing information electronically, we will continue to support our current FTP service on [msiadmin.cit.cornell.edu](mailto:msiadmin.cit.cornell.edu). For more information about CUINFO contact [cuinfo-admin@cornell.edu](mailto:cuinfo-admin@cornell.edu). For specific questions about MSI contact [deedee@msiadmin.cit.cornell.edu](mailto:deedee@msiadmin.cit.cornell.edu).

**AMATYC Drafting  
National Standards**

The American Mathematical Association of Two-Year Colleges (AMATYC) has launched a project to develop national standards for curriculum and instruction for two-year colleges and lower-division mathematics courses at the level

of algebra and precalculus. The goal is to revitalize the content of such courses so that students will be engaged as active learners in worthwhile mathematical tasks that prepare them for future careers and that help them to become informed citizens. The project will also aim to encourage students to pursue careers in mathematics education.

With funding from the National Science Foundation and the Exxon Education Foundation, the project will be directed by AMATYC President-elect Marilyn Mays of North Lake College in Irving, Texas; AMATYC President Karen Sharp of Mott Community College in Flint, Michigan; and AMATYC Past President Dale Ewen of Parkland College in Champaign, Illinois. The eighteen-month project will also involve representatives from the Mathematical Association of America, the National Council of Teachers of Mathematics, and the National Association of Developmental Education.

A draft of the national standards will be circulated for comments during the 1993-1994 academic year. AMATYC expects to release the final standards document in late fall 1994.

Copies of the draft document are available by writing to: AMATYC Office, State Technical Institute at Memphis, 5983 Macon Cove, Memphis, TN 38134.

**ISF Requests Help  
with Proposal Review**

In the coming months many in the mathematical sciences community will receive requests to review proposals by mathematical colleagues in the former Soviet Union. The proposals are in response to a program of the International Science Foundation (ISF), an American charitable organization established by George Soros, the purpose of which is to support basic research in the natural sciences in the former Soviet Union (fSU) and Baltic States. The ISF's initial mandate is to allocate \$100 million during 1993 and 1994. The ISF is one of the sponsors of the AMS fSU Aid Fund.

The proposals may include requests for individual financial support, infrastructure, and other expenses in the range

of \$10,000 to \$100,000 over a two-year period. The ISF's objective is to evaluate and select proposals through a competitive review system based on scientific merit. The review process consists of three phases: administrative screening to ensure proposal eligibility and completeness, mailing of proposals to expert reviewers, and consideration of the proposals and reviewers' comments by disciplinary panels.

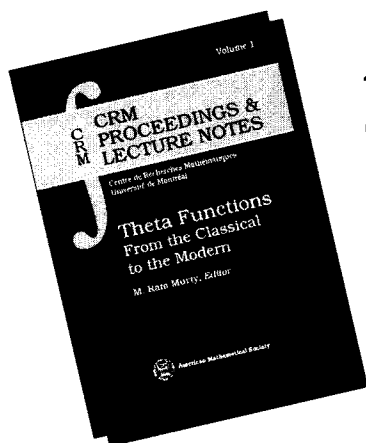
To expedite the review process, fSU proposal authors nominate reviewers. The first round of proposals was due September 25, 1993; a second competi-

tion will be held in February 1994. Some 3,000 to 5,000 proposals are expected in the first round. All proposals are in English and limited to about ten pages. Over the past summer Robert MacPherson, chair of the AMS Advisory Committee on fSU Mathematics, organized an e-mail network of U.S. mathematicians who prereviewed the mathematical portion of some proposals; however, it was not possible to prereview many of them in this manner.

Many in the mathematical sciences community already contribute a substantial amount of time to reviewing

proposals. The proposals to the ISF program will require special attention, not only because of language difficulties but also because many of the proposers have never written grant applications before. However, the ISF hopes that the mathematical community will see this as a way to contribute to basic research in the countries of the fSU.

For more information on this program contact: International Science Foundation, 1054 31st Street, NW, Suite 110, Washington, DC 20007; telephone 202-342-2760; fax 202-342-2765; e-mail: info@isf.org.



## NEW SERIES!

## CRM PROCEEDINGS & LECTURE NOTES

# Theta Functions From the Classical to the Modern

Volume 1 • M. Ram Murty, *Editor*

This book contains lectures on theta functions written by experts well known for excellence in exposition. The lectures represent the content of four courses given at the Centre de Recherches Mathématiques in Montréal during the academic year 1991-1992, which were devoted to the study of automorphic forms. Aimed at graduate students, the book synthesizes the classical and modern points of view in theta functions, concentrating on connections to number theory and representation theory. An excellent introduction to this important subject of current research, the book is suitable as a text in advanced graduate courses.

1991 *Mathematics Subject Classification*: 11; 22, 33

ISBN 0-8218-6997-3, 174 pages (hardcover), June 1993

Individual member \$35, List price \$58, Institutional member \$46

To order, please specify CRMP/INA



All prices subject to change. Free shipment by surface; for air delivery, please add \$6.50 per title. *Prepayment required.* Order from: American Mathematical Society, P.O. Box 5904, Boston, MA 02206-5904, or call toll-free 800-321-4AMS (321-4267) in the U.S. and Canada to charge with VISA or MasterCard. Residents of Canada, please include 7% GST.

# Funding Information for the Mathematical Sciences

## University-Industry Postdoctoral Research Associateships in the Mathematical Sciences

The Division of Mathematical Sciences (DMS) of the National Science Foundation (NSF) plans to award ten to fifteen University-Industry Postdoctoral Research Associateships in the Mathematical Sciences in fiscal year 1994, contingent upon available funding, as a new component of the Mathematical Sciences Postdoctoral Research Fellowship Program. This new component will provide opportunities for recent doctoral recipients to broaden their knowledge, experience, and perspectives by exposing them to industrial environments and will give industry the opportunity to interact with talented researchers who are beginning their careers.

The postdoctoral researchers will spend approximately half their time engaged in research in an industrial setting and half in a university environment. Normally, a university principal investigator will serve as scientific mentor for a postdoctoral associate with an identified industrial sponsor. However, in special circumstances, an industrial scientist may serve as scientific mentor with a corresponding academic sponsor identified. Mentors will submit the proposals and will be responsible for initiating the university-industry connection. Proposals will identify a particular individual or will describe a recruitment/selection process to identify the postdoctoral associate.

Awards from the NSF will total \$71,000 for a twenty-four month period. The industrial sponsor will generally be expected to provide matching funds in the amount of \$20,000 per year for a total of \$40,000. The total award and matching will support: (a) a stipend/fringe benefit allowance for the postdoctoral associate of \$96,000 for the twenty-four month award period (including \$40,000 per year for the stipend and an allowance of \$8,000 per year for fringe benefits); (b) an allowance of \$4,500 for the award period to the sponsoring academic institution, in lieu of indirect costs, as partial reimbursement for expenses incurred in support of the research; (c) a \$4,500 research allowance for the award period for the postdoctoral associate; and (d) a \$6,000 allowance for the award period for the faculty mentor for research-related expenses.

The deadline for proposals is **December 13, 1993**. Program announcements may be obtained from the Office of Special Projects, Division of Mathematical Sciences, National Science Foundation, telephone 202-357-3453; e-mail [msprf@nsf.gov](mailto:msprf@nsf.gov) (Internet) or [msprf@nsf](mailto:msprf@nsf) (Bitnet). Specify University-Industry Postdocs, NSF 93-139; please include a postal address. The program announcement is also available on the Science and Technology Information System (STIS), NSF's online information service.

## Special Opportunity in Algebra and Number Theory

It appears that the Division of Mathematical Sciences at the National Science Foundation is considering making available special funds in its fiscal year 1994 budget to assist mathematical scientists in the understanding and expanding of the mathematical foundations supporting Andrew Wiles's proof of Fermat's Last Theorem.

"We are hoping to be able to fund several activities, including one major special year, several regional special years, workshops and conferences, and supplements to existing grants," says Algebra and Number Theory Program Director Ann Boyle. Boyle says that the program encourages innovative proposals that exploit this mathematical opportunity, as well as proposals that lead to an understanding of the mathematical techniques by undergraduates.

All proposals to the National Science Foundation must conform to the guidelines for proposal preparation given in "Grants for Research and Education in Science and Engineering" (NSF 92-89, October 1992). For additional information please contact Ann Boyle ([aboyle@nsf.gov](mailto:aboyle@nsf.gov) on Internet, [aboyle@nsf](mailto:aboyle@nsf) on Bitnet) or D. Madden ([dmadden@nsf.gov](mailto:dmadden@nsf.gov) on Internet, [dmadden@nsf](mailto:dmadden@nsf) on Bitnet). The telephone number is 202-357-3695.

# 1994 AMS Election

## *Nominations by Petition*

### **Vice-President or Member-at-Large**

One position of vice-president and member of the Council *ex officio* for a term of three years is to be filled in the election of 1994. The Council intends to nominate at least two candidates, among whom may be candidates nominated by petition as described in the rules and procedures.

Five positions of member-at-large of the Council for a term of three years are to be filled in the same election. The Council intends to nominate at least ten candidates, among whom may be candidates nominated by petition in the manner described in the rules and procedures.

Petitions are presented to the Council, which, according to Section 2 of Article VII of the bylaws, makes the nominations. The Council of 23 January 1979 stated the intent of the Council of nominating all persons on whose behalf there were valid petitions.

Prior to presentation to the Council, petitions in support of a candidate for the position of vice-president or of member-at-large of the Council must have at least fifty valid signatures and must conform to several rules and operational considerations, which are described below.

### **Editorial Boards Committee**

Two places on the Editorial Boards Committee will be filled by election. There will be four continuing members of the Editorial Boards Committee.

The President will name at least four candidates for these two places, among whom may be candidates nominated by petition in the manner described in the rules and procedures.

The candidate's assent and petitions bearing at least 100 valid signatures are required for a name to be placed on the ballot. In addition, several other rules and operational considerations, described below, should be followed.

### **Nominating Committee**

Three places on the Nominating Committee will be filled by election. There will be six continuing members of the Nominating Committee.

The President will name at least six candidates for these three places, among whom may be candidates nominated by petition in the manner described in the rules and procedures.

The candidate's assent and petitions bearing at least 100 valid signatures are required for a name to be placed on the ballot. In addition, several other rules and operational considerations, described below, should be followed.

---

### **Rules and Procedures**

Use separate copies of the form for each candidate for vice-president, member-at-large, or member of the Nominating and Editorial Boards Committees.

1. To be considered, petitions must be addressed to Robert M. Fossum, Secretary, P. O. Box 6248, Providence, Rhode Island 02940, and must arrive by 28 February 1994.

2. The name of the candidate must be given as it appears in the *Combined Membership List (CML)*. If the name does not appear in the list, as in the case of a new member or by error, it must be as it appears in the mailing lists, for example on the mailing label of the *Notices*. If the name does not identify the candidate uniquely, append the member code, which may be obtained from the candidate's mailing label or the Providence office.

3. The petition for a single candidate may consist of several sheets each bearing the statement of the petition, including the name of the position, and signatures. The name of the candidate must be exactly the same on all sheets.

4. On the next page is a sample form for petitions. Copies may be obtained from the secretary; however, petitioners may make and use photocopies or reasonable facsimiles.

5. A signature is valid when it is clearly that of the member whose name and address is given in the left-hand column.

6. The signature may be in the style chosen by the signer. However, the printed name and address will be checked against the *Combined Membership List* and the mailing lists. No attempt will be made to match variants of names with the form of name in the *CML*. A name neither in the *CML* nor on the mailing lists is not that of a member. (Example: The name Robert M. Fossum is that of a member. The name R. Fossum appears not to be.)

7. When a petition meeting these various requirements appears, the secretary will ask the candidate to indicate willingness to be included on the ballot. Petitioners can facilitate the procedure by accompanying the petitions with a signed statement from the candidate giving consent.

# NOMINATION PETITION FOR 1994 ELECTION

The undersigned members of the American Mathematical Society propose the name of

\_\_\_\_\_

as a candidate for the position of (check one):

- Vice-President**
- Member-at-Large of the Council**
- Member of the Nominating Committee**
- Member of the Editorial Boards Committee**

of the American Mathematical Society for a term beginning 1 February, 1995.

Name and Address (printed or typed)

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Signature

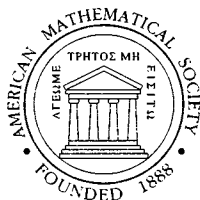
\_\_\_\_\_  
Signature

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Signature

# ***CALL FOR SUGGESTIONS***



There will be a number of contested seats in the 1994 AMS elections.  
Your suggestions are wanted by

## **THE NOMINATING COMMITTEE**

for vice-president, trustee, and five  
members-at-large of the council  
and by

## **THE PRESIDENT**

for three Nominating Committee members and two  
Editorial Boards Committee members.

*In Addition*

## **THE EDITORIAL BOARDS COMMITTEE**

requests suggestions for appointments to various editorial boards  
of Society publications.

*Send your suggestions for any of the above to:*

Robert M. Fossum, Secretary  
American Mathematical Society  
Department of Mathematics  
University of Illinois  
1409 West Green Street  
Urbana, Illinois 61801  
e-mail: r-fossum@uiuc.edu

# International Joint Mathematics Meeting

## Merida, Yucatan, Mexico, December 1–4, 1993

### *Preliminary Program*

The first joint meeting of the AMS and the Sociedad Matemática Mexicana (SMM) will take place December 1–4, 1993, (Wednesday–Saturday) at the University of Yucatan, Merida, Mexico. The Program Committee was coordinated by AMS secretary Robert M. Fossum and includes Luis Gorostiza, Jorge Ize, and Juan Carlos Gómez Larrañaga from SMM; and Idun Reiten, Mary Ellen Rudin, and William Velez from AMS.

#### *Invited Addresses*

By invitation of the Program Committee there will be six invited addresses. The names and affiliations of the speakers and the titles of their talks, where available, are as follows:

**Maurice Auslander**, Brandeis University, *Representation theory of Artin algebras*;

**Xavier Gómez-Mont**, Centro de Investigación en Matemáticas A.C. (CIMAT), *An algebraic formula for the index of a vector field on a variety with an isolated singularity*;

**Luis Montejano**, Instituto de Matemáticas, Universidad Nacional Autónoma de México (UNAM), *Some applications of topology to the theory of geometric tomography*;

**Cathleen S. Morawetz**, New York University-Courant Institute, *The role of self-similar solutions for solving Euler's equations for fluid flow*;

**Daniel W. Stroock**, Massachusetts Institute of Technology, *Gibb states, where they come from*;

**William P. Thurston**, Mathematical Sciences Research Institute, *title to be announced*.

#### *Special Sessions*

By invitation of the same committee there will be nine special sessions of selected twenty-minute papers. The topics of these sessions and the names and affiliations of the organizers are as follows:

*Representations of algebras*, **Raymundo Bautista**, UNAM, and **Idun Reiten**, University of Trondheim;

*Graphs and combinatorics*, **Gilberto Calvillo Vives**, Banco de México, and **Joseph P. Kung**, University of North Texas;

*Asymptotic and numerical methods in mechanics and biology*, **Carlos Castillo-Chavez**, Cornell University, and **Cristóbal Vargas Jarillo**, Centro de Investigación y Estudios Avanzados (CINVESTAV), Instituto Politécnico Nacional (IPN);

*Nonlinear analysis*, **Michael G. Crandall**, University of California, Santa Barbara; **Mónica Clapp**, Instituto de Matemáticas, UNAM; and **Jorge Ize**, Instituto de Investigaciones en Matemáticas Aplicadas y en Sistemas, UNAM;

*Holomorphic systems and geometry*, **Xavier Gómez-Mont**, and **Domingo Toledo**, University of Utah;

*Geometric topology in low dimensions*, **Francisco J. González-Acuña**, Instituto de Matemáticas, UNAM; **C. M. Gordon**, University of Texas at Austin; and **Jonathan K. Simon**, University of Iowa;

*Stochastic analysis*, **Luis Gorostiza**, CINVESTAV, IPN; **Thomas G. Kurtz**, University of Wisconsin, Madison; and **Victor M. Pérez-Abreu Carrión**, CIMAT;

*Noncommutative rings*, **Sergio R. Lopez-Permouth**, Ohio University; **Francisco Raggi Cárdenas**, Instituto de Matemáticas, UNAM; and **José Ríos Montes**, Instituto de Matemáticas, UNAM;

*General topology*, **Jerry E. Vaughan**, University of North Carolina at Greensboro, and **Richard Wilson**, Universidad Autónoma Metropolitana, Unidad Iztapalapa.

The deadline for submission of abstracts for consideration in any of these sessions has expired.

#### *Workshops*

By invitation of the Program Committee a two-part workshop on *Technology in the classroom*, organized by **David Lomen**, University of Arizona, will be held in the Auditorio Facultad de Arquitectura on Thursday from 9:00 a.m. to noon and from 4:00 p.m. to 7:00 p.m.

#### *Forums*

The Board on Mathematical Sciences (BMS) of the United States Research Council and the Sociedad Matemática Mexicana (SMM) will cosponsor two forums on Saturday, December 4, in the Auditorio Facultad de Arquitectura.

The first forum is *Employment of mathematical scientists in business and industry*. The panelists are **Gilberto Calvillo**, Banco de México, and **John Lavery**, Board on Mathematical Sciences. It will take place from 10:00 a.m. to 10:50 a.m.

An increasing number of mathematical scientists are finding employment in business and industry in settings where direct cooperation with managers, scientists, business planners, and engineers is important. Master's and Ph.D. graduates who seek to work in business or industry need to be able to assume, without extensive retraining, positions in multidisciplinary groups. To do this they need both deep background in one area and less deep but broad experience in other areas in which they will have to collaborate. In addition to experience in core mathematics they need experience in applied mathematics, statistics, optimization, modeling, and computation. Communication skills are also important. The

two panelists will discuss specific jobs in finance, banking (operations research), airplane design, design of fluorescent lamps, medical imaging, and biotechnology that need both breadth and depth.

The second forum, *How strategic reports on the mathematical sciences can be used to improve the competitive position of mathematical sciences departments*, is scheduled from 11:00 a.m. to 11:50 a.m.

Reports of the BMS and the Committee on Applied and Theoretical Statistics are strategic reports designed to enrich the research, educational, and professional activities of departments of mathematical sciences. Reports that have been completed recently include "Mathematical Sciences, Technology, and Economic Competitiveness" (1991), "Mathematical Foundations of High-Performance Computing and Communications" (1991), "Educating Mathematical Scientists: Doctoral Study and the Postdoctoral Experience in the United States" (1992), "Combining Information: Statistical Issues and Opportunities for Research" (1992), "Statistics and Physical Oceanography" (1993), "Mathematical Research in Materials Science: Opportunities and Perspectives" (1993), "Clinical Trials and Statistics" (1993), "Transportation and the Mathematical Sciences" (1993), and "Calculating the Secrets of Life: Applications of the Mathematical Sciences in Molecular Biology" (1993). How these and other strategic reports can be used by department chairs to improve the competitive positions of mathematical sciences departments will be discussed by **John Lavery**.

#### *Contributed Paper Sessions*

There will be sessions of ten-minute contributed papers. The deadline for submission of abstracts for these sessions has expired. Unfortunately, late papers cannot be accommodated.

#### *Registration*

Registration will be open on Wednesday from 9:00 a.m. to 6:00 p.m.; on Thursday and Friday from 9:00 a.m. to 1:30 p.m. and 5:00 p.m. to 8:00 p.m.; and on Saturday from 10:00 a.m. to 1:00 p.m. The registration desk will be in the central yard of the university's main building. The registration fee is US\$30 for all participants.

#### *Social Events*

The SMM cordially invites all registered participants to a complimentary reception on Wednesday evening. On Thursday an informal snack bar with show will be offered. Both events will be held in the university's main building at 8:45 p.m.

A conference dinner with an after-dinner show included will take place on Friday at 9:00 p.m. Interested participants must make reservations at the registration desk. Cost is about US\$25 per person.

Also, arrangements have been made for a tour of the archaeological zone of Uxmal at 2:00 p.m. on Saturday. Tickets are about US\$40 each and will be available at the registration desk.

#### *Accommodations*

**Los Aluxes** and **Casa del Balam** are five-star hotels that have been selected as the official hotels for the meeting. A limited number of rooms have been blocked at special rates. Participants should make their own reservations directly with the hotels by **November 24, 1993**. Be sure to mention the AMS-SMM meeting. Prices are quoted in U.S. dollars and include taxes and chambermaid tips; porter service is an extra US\$2. **The AMS is not responsible for rate changes or the quality of the accommodations offered by these hotels.**

#### **Los Aluxes**

Calle 60, No. 444  
Telephone: 52-99-24-2199 or 800-782-8395  
Fax: 52-99-23-3858  
Single/Double \$82 Triple \$96

#### **Casa del Balam**

Calle 60 No. 488  
Telephone: 52-99-24-8844 or 800-624-8451  
Fax: 52-99-24-5011  
Single/Double \$70 Triple \$83

Those who would like accommodations other than at the official hotels are encouraged to contact either their local travel agent or Viajes Algaro, the official travel management company for the meeting (telephone: 52-5-370-2803 or 5996; fax: 52-5-370-5824).

#### *Travel*

Continental Airlines has been declared the official U. S. airline for the meeting. Special airfares include a 25% discount off the full "Y" or "F" class fares or a 5% discount off the lowest applicable fare. Please call Continental at 1-800-468-7022 Monday through Friday, 6:00 a.m. to 11:59 p.m., and Saturday and Sunday, 8:00 a.m. to 9:00 p.m., for reservations and details of applicable restrictions if any. Refer to Easy Access Number ZMW17. Once reservations have been made, tickets may be purchased from any licensed travel agency, Continental ticket office, or airport ticket counter.

Merida International Airport is served by several direct flights from Houston, Miami, and Mexico City. Viajes Algaro will be happy to assist you with airline reservations. Ground transportation from the airport is available on an individual (about US\$25) or collective (about US\$7) basis.

#### *Local Information*

Merida, a beautiful city founded by the Spaniards in 1542, where the Mayans left rich cultural traditions, is situated in the eastern part of the country, some 1500 km from Mexico City. Participants will have an opportunity to explore archaeological sites; enjoy the natural beauty of the "cenotes"; and discover handicraft shops, museums, theaters, parks, restaurants, and colonial architecture.

In December the sky is sunny and cloudless. It is warm during the day and cools off in the evening. Daily average temperatures are between 68°F (20°C) and 86°F (30°C).



# CIUDAD DE MERIDA, YUCATAN MEXICO

**HOTELS**

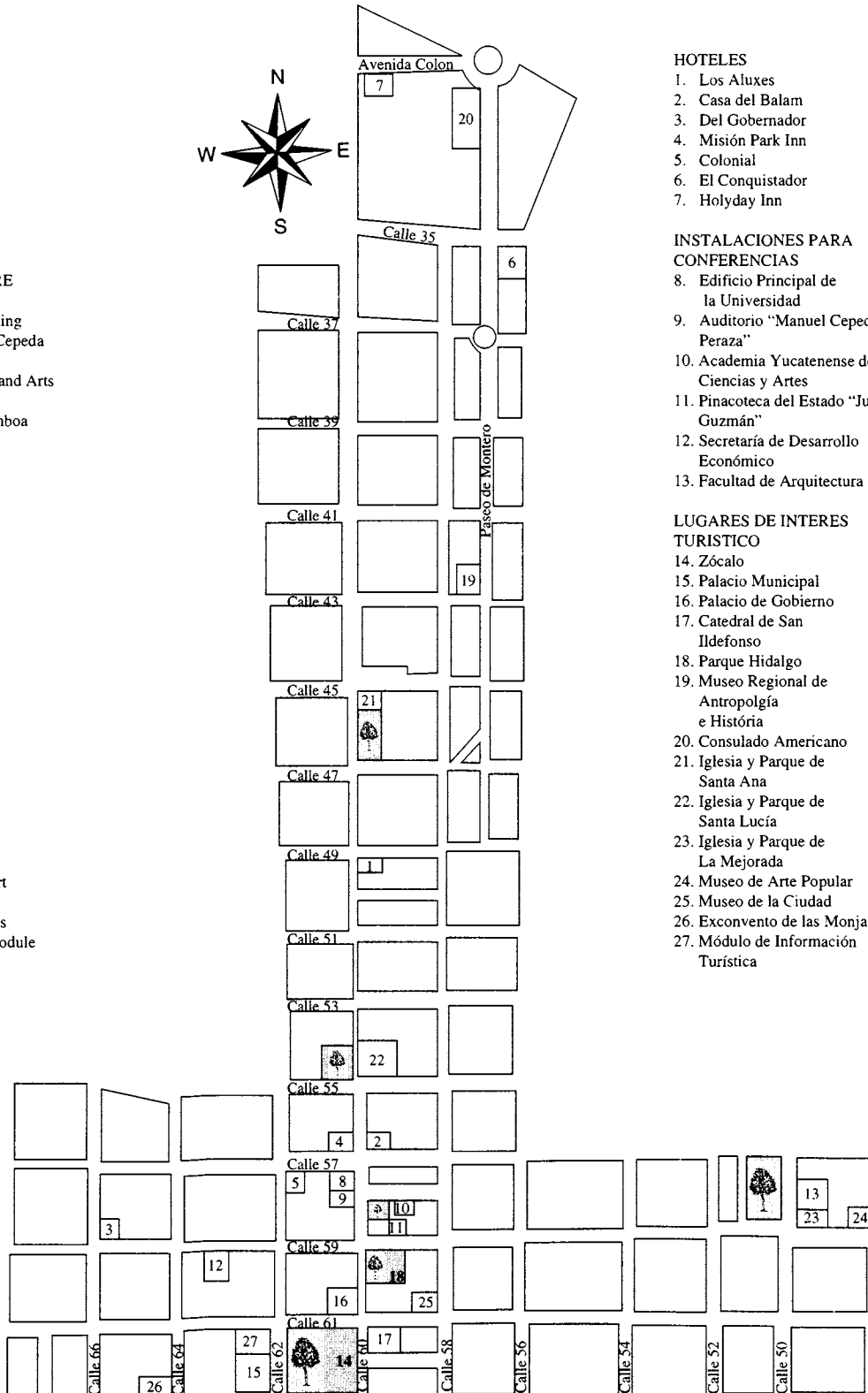
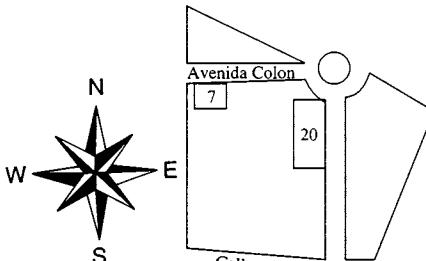
1. Los Aluxes
2. Casa del Balam
3. Del Gobernador
4. Misión Park Inn
5. Colonial
6. El Conquistador
7. Holyday Inn

**CONFERENCE LECTURE FACILITIES**

8. University Main Building
9. Auditorium "Manuel Cepeda Peraza"
10. Academy of Sciences and Arts of the Yucatan
11. Art Gallery "Juan Gamboa Guzmán"
12. Office of Economical Development
13. Arquitecture School

**SIGHTSEEING**

14. Main Plaza (Zócalo)
15. Municipal Palace
16. Government Palace
17. Cathedral of San Ildefonso
18. Hidalgo Park
19. Regional Museum of Anthropology and History
20. American Consulate
21. Santa Ana Park and Church
22. Santa Lucia Park and Church
23. La Mejorada Park and Church
24. Museum of Popular Art
25. City Museum
26. Ex-convent of the Nuns
27. Tourist Information Module



**HOTELES**

1. Los Aluxes
2. Casa del Balam
3. Del Gobernador
4. Misión Park Inn
5. Colonial
6. El Conquistador
7. Holyday Inn

**INSTALACIONES PARA CONFERENCIAS**

8. Edificio Principal de la Universidad
9. Auditorio "Manuel Cepeda Peraza"
10. Academia Yucatanense de Ciencias y Artes
11. Pinacoteca del Estado "Juan Gamboa Guzmán"
12. Secretaría de Desarrollo Económico
13. Facultad de Arquitectura

**LUGARES DE INTERES TURISTICO**

14. Zócalo
15. Palacio Municipal
16. Palacio de Gobierno
17. Catedral de San Ildefonso
18. Parque Hidalgo
19. Museo Regional de Antropología e Historia
20. Consulado Americano
21. Iglesia y Parque de Santa Ana
22. Iglesia y Parque de Santa Lucia
23. Iglesia y Parque de La Mejorada
24. Museo de Arte Popular
25. Museo de la Ciudad
26. Exconvento de las Monjas
27. Módulo de Información Turística

# Presenters of Papers

Numbers following the names indicate the speakers' positions on the program.

● Invited Lecturer

\* Special Session Speaker

- \* Alfaro, R., 135
- \* Alvarez-Scherer, M. d., 21
- \* Armendariz, E. P., 56
- \* Arocha, J. L., 116
- \* Arroyo Paniagua, M. J., 131
- Auslander, M., 34
- \* Aviñó, M. A., 155
- \* Banelos, R., 173
- \* Barrett, C., 180
- \* Bautista, R., 78
- \* Beattie, M., 179
- \* Bell, A. D., 58
- \* Bennett, M. K., 114
- \* Bleiler, S. A., 23
- \* Blount, D. J., 28
- \* Bonin, J. E., 83
- Bosch, C., 67
- \* Boyer, S., 125
- \* Bracho, J., 13
- \* Brambila-Paz, L., 100
- \* Brittenham, M. W., 170
- \* Caballero, E. M., 127
- \* Campo, E. R., 3
- \* Carlson, J. A., 163
- Carrillo, H., 142
- Castillo, F., 144
- \* Castillo-Chavez, C., 161
- \* Clapp, M., 94
- \* Coelho, F. U., 81
- \* Crandall, M. G., 7
- \* Culler, M., 55
- \* D'Antona, O., 43
- \* Dauns, J., 105
- \* Dawson, D. A., 24
- \* Dlab, V., 35
- \* Elizondo, J., 18
- \* Esteban, M. J., 93
- \* Eudave-Munoz, M., 53
- \* Facchini, A., 136
- \* Faith, C., 181
- \* Falk, M. J., 6
- \* Feighn, M., 52
- \* Feldman, R. E., 25
- \* Fenley, S. R., 171
- \* Fisk, S., 41
- \* Flaherty, F. J., 162
- \* Flores, G., 8
- Florio, J. S., 74
- \* Frohman, C., 20
- Futorny, V., 150
- \* García-Ferreira, S., 30
- Garnica, E., 75
- \* Gaytan-Iniestra, J., 111
- \* Gentle, R., 79
- Gilmer, R., 149
- Gilsdorf, T. E., 69
- \* Giraldo, L., 164
- Gomez-Mont, X., 76
- \* González-Barrios, J., 175
- \* Gorostiza, L. G., 130
- \* Green, E., 156
- \* Greenspan, D., 87
- \* Haberman, R., 117
- \* Hastings, A., 158
- \* Heath, R. W., 65
- \* Hempel, J., 19
- \* Herbera, D., 61
- \* Hernández, L., 165
- \* Hill, G., 40
- \* Hohne, H. V., 39
- \* Huisgen, B. Z., 77
- \* Illanes, A., 138
- \* Iozzi, A., 102
- \* Ize, J., 92
- Izquierdo B. G., 147
- \* Jorge, M. C., 10
- \* Just, W., 33
- \* Khoshnevisan, D., 174
- \* Kierstead, H. A., 113
- \* Kleiner, M., 152
- \* Kopperman, R. D., 139
- \* Kotelenz, P., 177
- \* Krause, G., 104
- \* Kung, J. P., 2
- \* Kurtz, T. G., 27
- \* Lacomba, E. A., 46
- \* León, J. A., 126
- \* Lindgren, W. F., 63
- \* Long, D. D., 51
- López, M., 146
- \* López de Medrano, S., 50
- \* Lopez-Mimbela, J. A., 26
- \* Ludwig, D., 159
- \* Luecke, J., 121
- \* Macias, S., 66
- \* Mallet-Paret, J., 11
- \* Martinez-Bernal, J., 115
- \* Martinez Villa, R., 36
- Massopust, P. R., 143
- \* Minzoni, A. A., 157
- Montejano, L., 151
- Morawetz, C. S., 182
- \* Muciño-Raymundo, J., 14
- \* Mueller, B. J., 133
- \* Muñoz-Masqué, J., 15
- \* Neumann-Coto, M., 169
- \* Neumann-Lara, V., 85
- Nicolas, A., 72
- \* Niederhausen, H., 112
- \* Nieto, I., 166
- \* Núñez, V., 124
- \* Okoh, F., 154
- \* Olive, V. M., 118
- \* Olvera, A., 48
- \* Padilla, P., 96
- \* de la Peña, J. A., 153
- \* de la Peña, V. H., 176
- \* Peralta, R., 88
- \* Perez, J. C., 178
- \* Pérez-Abreu, V., 129
- \* Pérez-Esteva, S., 12
- \* Ponce, G., 49
- \* Poritz, J. A., 101
- Poznyak, A., 71
- \* Protter, P., 128
- \* Puga, I., 64
- \* Raggi, F., 109
- \* Raggi Cardenas, A. G., 80
- \* Ramachandran, M., 167
- \* Ramírez, A., 122
- \* Rand, R., 90
- \* Readdy, M. A., 44
- \* Recillas, S., 103
- \* Rios-Montes, J., 59
- \* Riskin, A., 84
- \* Rizvi, S. T., 134
- \* Rogers, J., 140
- \* Roseman, D., 54
- \* Sabina, F. J., 89
- \* Sanchez, G. T., 57
- \* Sanchez-Arroyo, A., 4
- \* Sánchez-Bringas, F., 16
- \* Sánchez-Valenzuela, O. A., 17
- \* Scharlemann, M., 123
- \* Schmitt, K., 45
- \* Searle, C. E., 98
- Seibert, P., 73
- Shapiro, M. V., 70
- \* Signoret Poillon, C. J., 60
- \* Simon, J., 168
- \* Snow, D. R., 86
- \* Souganidis, P. E., 47
- Stroock, D. W., 110
- \* Summers, D. W., 172
- \* Swiech, A., 9
- \* Taft, E. J., 5
- Tapia-Recillas, H., 148
- \* Tartar, L. C., 95
- \* Tataru, D., 97
- \* Teply, M. L., 107
- Thurston, W. P., 1
- \* Tkačenko, M., 62
- \* Tkachuk, V., 32
- \* Tomé, B., 38
- \* Urrutia, J., 82
- \* Vallejo, E., 42
- Van Fleet, P. J., 145
- \* Vargas, C., 120
- \* Vargas, C. A., 91
- Vasilevski, N. L., 68
- \* Vaughan, J. E., 29
- \* Velasco-Hernández, J. X., 160
- \* Vila-Freyer, R. F., 99
- \* Viola-Prioli, J. E., 108
- \* Watson, S., 137
- \* Wicke, H., 31
- \* Wilson, R. G., 141
- \* Wisbauer, R., 132
- \* Wu, Y.-Q., 22
- \* Zacharia, D., 37
- \* Zelmanowitz, J. M., 106
- \* Zhevandrov, P., 119

# Program of the Sessions

The time limit for each contributed paper in the sessions is ten minutes. In the special sessions, the time limit varies from session to session and within sessions. To maintain the schedule, time limits will be strictly enforced.

Abstracts of papers presented in the sessions at this meeting will be found in the November 1993 issue of *Abstracts of papers presented to the American Mathematical Society*, ordered according to the numbers in parentheses following the listings below.

For papers with more than one author, an asterisk follows the name of the author who plans to present the paper at the meeting.

## Wednesday, December 1

### Opening Ceremony

18:30–19:00

18:30 *Opening Ceremony.*

### Invited Address

19:30–20:30

- (1) *Title to be announced.*  
**William P. Thurston**, Mathematical Sciences  
Research Institute, Berkeley, California (888-99-185)

## Thursday, December 2

### Special Session on Graphs and Combinatorics, I

09:00–11:50

- 09:00 *The lines-planes inequality in binary matroids.*  
(2) **Joseph P.S. Kung**, University of North Texas, Denton (888-05-81)
- 09:30 *A note on spanning trees with bounded degrees.*  
(3) Preliminary report.  
**Eduardo Rivera Campo**, UAM-I (888-05-60)
- 10:00 *Total colouring of some graphs.*  
(4) **Abdon Sanchez-Arroyo**, Facultad de Ciencias-UNAM (888-05-61)
- 10:30 Discussion
- 11:00 *Hadamard invertibility of linearly recursive sequences in several variables.*  
(5) **Earl J. Taft**, Rutgers University, New Brunswick, New Jersey (888-05-14)
- 11:30 *The  $K(\pi, 1)$  property for two classes of graphic arrangements.* Preliminary report.  
(6) **Michael J. Falk**, Northern Arizona University, Flagstaff (888-52-157)

### Special Session on Nonlinear Analysis, I

09:00–11:50

- 09:00 *On Hamilton Jacobi equations in infinite dimensions.*  
(7) **Michael G. Crandall**, University of California, Santa Barbara (888-35-153)
- 09:30 *Layered solutions to a bistable reaction - diffusion equation.*  
(8) **Gilberto Flores**, IIMAS-UNAM (888-34-112)  
(Sponsored by Jorge A. Ize)
- 10:00 *Second order Hamilton-Jacobi-Bellman equations in infinite dimensional Hilbert spaces.*  
(9) **Andrzej Swiech**, Georgia Institute of Technology (888-35-95)
- 10:30 *Examples of bifurcation from a continuum of eigenvalues and from the continuous spectrum.*  
(10) **M. C. Jorge\*** and **A. A. Minzoni**, IIMAS-UNAM (888-35-131) (Sponsored by Jorge A. Ize)
- 11:00 *Stable equilibria of the discrete Cahn-Hilliard equation.*  
(11) **John Mallet-Paret\***, Brown University, Rhode Island, **Shui-Nee Chow**, Georgia Institute of Technology, Atlanta, and **Erik Van Vleck**, Colorado School of Mines, Boulder (888-35-151)
- 11:30 *Determination of a coefficient in a parabolic equation.*  
(12) Preliminary report.  
**John R. Cannon**, University of Central Florida, Orlando, and **Salvador Pérez-Esteve\***, IMATE-UNAM (888-35-119) (Sponsored by Michael G. Crandall)

### Special Session on Holomorphic Systems and Geometry, I

09:00–11:50

- 09:00 *Immobilization of solids.*  
(13) **J. Bracho\***, **L. Montejano**, IMATE-UNAM, **H. Fetter** and **D. Mayer**, UAM-I (888-14-160)
- 09:30 *Bifurcations of meromorphic vector fields in the Riemann sphere.*  
(14) **Jesus Muciño-Raymundo\*** and **Carlos Valero-Valdés**, IMATE-UNAM (888-14-127)
- 10:00 *Finiteness theorems for gauge actions.*  
(15) **Jaime Muñoz-Masqué**, CSIC, Madrid, Spain (888-53-126)

## Thursday, December 2 (cont'd)

- 10:30 *Local principal configurations of an immersed surface*  
(16) *in  $\mathbb{R}^n$* . Preliminary report.  
**Ana Irene Ramirez**, UNAM, and **Federico Sánchez-Bringas\***, Facultad de Ciencias-UNAM (888-53-123)
- 11:00 *An alternative to Berezin's integration formula*.  
(17) Preliminary report.  
**J. Monterde**, University of Valencia, Spain, and **O. A. Sánchez-Valenzuela\***, CIMAT (888-58-122) (Sponsored by Xavier Gomez-Mont)
- 11:30 *The Euler series of restricted Chow varieties*.  
(18) **Javier Elizondo**, IMATE-UNAM (888-14-129)

### Special Session on Geometric Topology in Low Dimensions, I

#### 09:00–11:50

- 09:00 *Positive Heegaard diagrams*.  
(19) **John Hempel**, Rice University, Houston, Texas (888-57-171)
- 09:30 *TQF obstructions to embeddings in  $S^3$* .  
(20) **Charles Frohman\***, University of Iowa, Iowa City, and **Joanna M. Kania-Bartoszyńska**, Boise State University, Idaho (888-57-143) (Sponsored by Jonathan K. Simon)
- 10:00 *There are disk knots whose exterior is exterior of infinitely many non-equivalent disk knots*.  
(21) **Ma de la Paz Alvarez-Scherer**, IMATE-UNAM (888-57-17)
- 10:30 Discussion
- 11:00 *Dehn surgery on some knots in handlebodies*.  
(22) Preliminary report.  
**Ying-Qing Wu**, University of Iowa, Iowa City (888-57-32) (Sponsored by Jonathan K. Simon)
- 11:30 *Two-generator 3-manifolds*. Preliminary report.  
(23) **Steven A. Bleiler\***, Portland State University, Oregon, and **Amelia C. Jones**, University of California, Davis (888-57-134)

### Special Session on Stochastic Analysis, I

#### 09:00–11:50

- 09:00 *Path properties of super-2 processes*.  
(24) **Donald A. Dawson**, Carleton University, Canada (888-60-168)
- 09:30 *Particle representation of functionals of a superprocess*.  
(25) **Raisa Epstein Feldman\*** and **Srikanth K. Iyer**, University of California, Santa Barbara (888-60-152)
- 10:00 *An occupation time approach for convergence of measure-valued processes and the dead mass of a branching system*.  
(26) **Luis G. Gorostiza**, CIEA-IPN, and **J. A. Lopez-Mimbela\***, CIMAT (888-60-42)
- 10:30 Discussion

- 11:00 *Infinite particle representations of measure-valued population processes*.  
(27) **Peter Donnelly**, Queen Mary & Westfield College, United Kingdom, and **Thomas G. Kurtz\***, University of Wisconsin, Madison (888-60-40)
- 11:30 *Law of large numbers for a local nonlinear reaction-diffusion model*.  
(28) **Douglas J. Blount**, Arizona State University, Tempe (888-60-99)

### Special Session on General Topology, I

#### 09:00–11:50

- 09:00 *A countably compact, separable space that is not absolutely countably compact*. Preliminary report.  
(29) **Jerry E. Vaughan**, University of North Carolina, Greensboro (888-54-37)
- 09:30 *Quasi  $M$ -compact spaces*.  
(30) **Salvador García-Ferreira**, IMATE-UNAM (888-54-102)
- 10:00 *On a generalization of perfect maps and open complete maps*.  
(31) **Winfried Just** and **Howard Wicke\***, Ohio University, Athens (888-54-65)
- 10:30 Discussion
- 11:00 *On perfect normality of the spaces  $C_p(X)$* .  
(32) **Vladimir Tkachuk**, UAM-I (888-54-54) (Sponsored by Richard G. Wilson)
- 11:30 *Sequential continuity on dyadic compacta and topological groups*.  
(33) **A. V. Arhangel'skii** and **Winfried Just\***, Ohio University, Athens (888-54-66)

### Workshop, Part I

#### 09:00–12:00

*Technology in the classroom..*

### Invited Address

#### 12:30–13:30

- (34) *Representation theory of Artin algebras*.  
**Maurice Auslander**, Brandeis University, Waltham, Massachusetts (888-16-140)

### Special Session on Representations of Algebras, I

#### 16:00–18:50

- 16:00 *Characterizations of some classes of quasi-hereditary algebras*. Preliminary report.  
(35) **V. Dlab**, Carleton University, Canada (888-16-182)

Program of the Sessions

- 16:30 *Algebras of infinite dominant dimension and torsion theories.* (36)  
**Roberto Martinez Villa**, IMATE-UNAM (888-55-96)
- 17:00 Discussion
- 17:30 *Hochschild homology.* Preliminary report. (37)  
**Dan Zacharia**, Syracuse University, New York (888-16-50)
- 18:00 *Coil enlargements of algebras.* (38)  
**Ibrahim Assem**, University of Sherbrooke, Canada, **Andrzej Skowronski**, Nicholas Copernicus University, Poland, and **Bertha Tomé\***, Facultad de Ciencias-UNAM (888-16-136) (Sponsored by Idun Reiten)
- 18:30 *Bipartite posets of finite projective type.* (39)  
**H. V. Hohne**, UNAM (888-13-177) (Sponsored by Idun Reiten)

---

Special Session on Graphs and Combinatorics, II

16:00–18:50

- 16:00 *A generalized metric association scheme.* (40)  
 Preliminary report.  
**Gregory Hill**, University of North Texas, Denton (888-05-38)
- 16:30 *Coloring the icosahedron and the 120 cell.* (41)  
**Steve Fisk**, Bowdoin College, Brunswick, Maine (888-05-84)
- 17:00 *The ring of operations on Burnside rings generated by the generalized symmetric powers.* Preliminary report. (42)  
**Ernesto Vallejo**, ITAM, Rio Hondo (888-05-03)
- 17:30 Discussion
- 18:00 *An upper bound to the crossing number of  $K_n - x$  drawn on  $q$  pages.* (43)  
**P. Salemi**, ISAB Gruppo ERG, Italy, **F. Broggi**, **E. Damiani** and **O. D'Antona\***, University of Milan, Italy (888-05-30)
- 18:30 *A new proof of the interval of ranks case for the Boolean algebra.* (44)  
**Margaret A. Readdy**, University of Quebec at Montreal, Canada (888-06-146)

---

Special Session on Nonlinear Analysis, II

16:00–18:50

- 16:00 *Asymptotics for solution branches of semilinear elliptic problems.* Preliminary report. (45)  
**Klaus Schmitt**, University of Utah, Salt Lake City (888-35-174)
- 16:30 *Stability of almost circular periodic orbits in Hill's problem.* (46)  
**Ernesto A. Lacomba\*** and **Joaquin Delgado**, UAM-I (888-70-117)
- 17:00 *Hydrodynamic limits in statistical mechanics and front propagation.* (47)  
**P. E. Souganidis**, University of Wisconsin, Madison (888-60-154)

- 17:30 *Creation of elliptic periodic orbits in the twist maps.* (48)  
**Arturo Olvera\***, IIMAS-UNAM, and **Carles Simo**, Universitat de Barcelona, Spain (888-58-115)
- 18:00 *The initial value problem for the generalized Korteweg-de Vries equation.* (49)  
**Gustavo Ponce**, University of California, Santa Barbara (888-35-149)
- 18:30  *$C^r$ -sufficiency of jets.* (50)  
**Shirley Bromberg**, UAM-I, and **Santiago López de Medrano\***, IMATE-UNAM (888-58-120) (Sponsored by Jorge A. Ize)

---

Special Session on Geometric Topology in Low Dimensions, II

16:00–18:50

- 16:00 *Bundles and finite foliations.* (51)  
**D. Cooper**, **D. D. Long\*** and **A. W. Reid**, University of California, Santa Barbara (888-57-28)
- 16:30 *The topology of the closure of outer space.* (52)  
 Preliminary report.  
**Mark Feighn\***, Rutgers University, New Jersey, and **Mladen Bestvina**, University of Utah, Salt Lake City (888-57-34)
- 17:00 *Essential punctured tori on the exterior of simple knots.* (53)  
**Mario Eudave-Munoz**, IMATE-UNAM (888-57-18)
- 17:30 Discussion
- 18:00 *On the mathematical utility of visualizing knotted surfaces in four-dimensions.* (54)  
**Dennis Roseman**, University of Iowa, Iowa City (888-57-190)
- 18:30 *Volume estimates for hyperbolic Haken 3-manifolds.* (55)  
**Marc Culler\*** and **Peter B. Shalen**, University of Illinois, Chicago (888-57-161)

---

Special Session on Non-Commutative Rings, I

16:00–18:50

- 16:00 *On rings with all prime ideals maximal.* (56)  
 Preliminary report.  
**Efraim P. Armendariz**, University of Texas at Austin (888-16-10)
- 16:30 *Torsion theories and types.* Preliminary report. (57)  
**Gustavo Tapia Sanchez**, ITESM (888-16-70) (Sponsored by Sergio R. Lopez-Permouth)
- 17:00 *Algebras of bounded finite dimensional representation type.* Preliminary report. (58)  
**Allen D. Bell\***, University of Wisconsin, Milwaukee, and **K. R. Goodearl**, University of California, Santa Barbara (888-16-87)
- 17:30 *On atomic dimension in module categories.* (59)  
 Preliminary report.  
**Jose Rios-Montes**, IMATE-UNAM (888-16-74) (Sponsored by Sergio R. Lopez-Permouth)

## Thursday, December 2 (cont'd)

- 18:00 *Modules with fl-critical composition series.*  
(60) Preliminary report.  
**Carlos J. E. Signoret Poillon**, UAM-I (888-16-72) (Sponsored by Sergio R. Lopez-Permouth)
- 18:30 *The endomorphism ring of a linearly compact module is semilocal.*  
(61) **Delors Herbera\***, Rutgers University, New Brunswick, New Jersey, and **Ahmad Shamsuddin**, American University of Beirut, Lebanon (888-16-85)

### Special Session on General Topology, II

#### 16:00–18:50

- 16:00  $\Sigma$ -spaces satisfying open ( $G$ ). Preliminary report.  
(62) **Michael Tkačenko**, UAM-I (888-54-55)
- 16:30 *The space  $Seq$  and countable compactness.*  
(63) Preliminary report.  
**W. F. Lindgren\*** and **Andrzej Szymanski**, Slippery Rock University of Pennsylvania (888-54-36)
- 17:00 *OEI property is dendroids.* Preliminary report.  
(64) **Victor Neumann-Lara**, IMATE-UNAM, and **Isabel Puga\***, Facultad de Ciencias-UNAM (888-54-110)
- 17:30 Discussion
- 18:00 *Strong monotone normality.* Preliminary report.  
(65) **Robert W. Heath**, University of Pittsburgh, Pennsylvania (888-54-92)
- 18:30 *On the covering spaces of the Minc-Rogers continua.*  
(66) **Sergio Macias**, IMATE-UNAM (888-54-57) (Sponsored by Richard G. Wilson)

### General Session, I

#### 16:00–18:00

- 16:00 *On regularity of inductive limits.* Preliminary report.  
(67) **Carlos Bosch\***, ITAM, Rio Hondo, and **Jan Kucera**, Washington State University, Pullman (888-46-08)
- 16:15 *Local principles in the theory of operator algebras.*  
(68) **N. L. Vasilevski**, CINVESTAV IPN (888-16-170)
- 16:30 *Baire-like properties on bounded disks.*  
(69) Preliminary report.  
**Thomas E. Gilsdorf**, University of North Dakota, Grand Forks (888-46-12)
- 16:45 *Metaharmonic Clifford analysis.* Preliminary report.  
(70) **Michael V. Shapiro\***, CINVESTAV IPN, and **Vladislav V. Kravchenko**, Odessa State University, Ukraine (888-32-172)

- 17:00 *New form of the strong large numbers law for dependent sequences.*  
(71) **Alexander Poznyak**, CINVESTAV IPN (888-60-169) (Sponsored by Michael V. Shapiro)
- 17:15 *Optimal control for advection-diffusion systems.*  
(72) Preliminary report.  
**Alfredo Nicolas\*** and **David Parra**, UAM-I (888-65-21) (Sponsored by Onesimo Hernandez-Lerma)
- 17:30 *Persistence of asymptotic stability in semidynamical systems.*  
(73) **Peter Seibert**, UAM-I (888-34-26)
- 17:45 *On the foundations of bifurcation theory.*  
(74) **Jose S. Florio**, Facultad de Ingenieria-UNAM (888-34-27)
- 18:00 *Decomposition on the Langlands subrepresentations for a Lie group in the Harish-Chandra class.* Preliminary report.  
(75) **Eugenio Garnica**, IMATE-UNAM (888-22-189)

### Workshop, Part II

#### 16:00–19:00

*Technology in the classroom.*

### Invited Address

#### 19:30–20:30

- (76) *Formula for the index of a vector field on a variety with an isolated singularity.*  
**Xavier Gomez-Mont**, CIMAT (888-14-114)

## Friday, December 3

### Special Session on Representations of Algebras, II

#### 09:00–11:50

- 09:00 *Homology of tiled classical orders.*  
(77) **Birge Zimmermann Huisgen**, University of California, Santa Barbara (888-16-11)
- 09:30 *Quadratic forms and bocses algorithms.*  
(78) Preliminary report.  
**Raymundo Bautista\***, IMATE-UNAM, and **Juan Boza**, University of Costa Rica, San Jose, Costa Rica (888-13-175) (Sponsored by Idun Reiten)
- 10:00 Discussion
- 10:30 *Realization of positive primitive formulae in the category of covariant finitely presented functions*  
(79) **Ron Gentle**, Eastern Washington University, Washington (888-13-179) (Sponsored by Idun Reiten)

- 11:00 *On a theorem of Voight.*  
(80) **Alberto G. Raggi Cardenas**, IMATE-UNAM (888-16-132)
- 11:30 *Homological properties of tilted algebras.*  
(81) **Flavio Ulhoa Coelho**, Universidade de Sao Paulo, Brasil (888-16-178)

---

Special Session on Graphs and Combinatorics, III

---

09:00–11:50

- 09:00 *Flood light illumination problems.*  
(82) **Jorge Urrutia**, University of Ottawa, Canada (888-05-59)
- 09:30 *Recent results on Dowling lattices.*  
(83) **Joseph E. Bonin**, George Washington University, Washington, D.C. (888-05-39)
- 10:00 *On the enumeration of  $n$ -polyhedral embeddings of cartesian products of cycles.* Preliminary report.  
(84) **Adrian Riskin**, Northern Arizona University, Flagstaff (888-05-135) (Sponsored by Joseph P. Kung)
- 10:30 Discussion
- 11:00 *Clique divergence in graphs. Some variations.*  
(85) **Victor Neumann-Lara**, IMATE-UNAM (888-05-63)
- 11:30 *A simple algorithm to generate the Bernoulli and Euler polynomials.*  
(86) **Donald R. Snow**, Brigham Young University, Provo, Utah (888-05-137)

---

Special Session on Asymptotic and Numerical Methods in Biology, I

---

09:00–11:50

- 09:00 *Recent results and models in molecular and quasimolecular modelling.*  
(87) **Donald Greenspan**, University of Texas, Arlington (888-92-139) (Sponsored by Carlos Castillo-Chavez)
- 09:30 *An iterative scheme for the Milne problem in radiative transfer.*  
(88) **Francois Golse**, University of Paris VII, France, and **Raymondo Peralta\***, IIMAS-UNAM (888-65-101)
- 10:00 Discussion
- 10:30 *Waves in cracked materials.*  
(89) **F. J. Sabina\***, IIMAS-UNAM, **V. P. Smyshlyaev** and **J. R. Willis**, University of Bath, United Kingdom (888-73-107)
- 11:00 *The dynamics of resonant capture.*  
(90) **D. Quinn**, **R. Rand\*** and **J. Bridge**, Cornell University, Ithaca, New York (888-34-89) (Sponsored by Carlos Castillo-Chavez)
- 11:30 *On the horizontal momentum of a vertically oscillating string.*  
(91) **A. A. Minzoni** and **C. A. Vargas\***, IIMAS-UNAM (888-73-105)

---

Special Session on Nonlinear Analysis, III

---

09:00–11:50

- 09:00 *Applications of the equivariant degree.*  
(92) Preliminary report.  
**Jorge Ize**, IIMAS-UNAM (888-58-133)
- 09:30 *Symmetry breaking for minimizers of symmetric variational problems.*  
(93) **Maria J. Esteban**, University of Paris-Dauphine, France (888-35-141)
- 10:00 *Critical point theory for indefinite functionals with symmetries.* Preliminary report.  
(94) **Thomas Bartsch**, University of Heidelberg, Germany, and **Monica Clapp\***, IMATE-UNAM (888-35-118)
- 10:30 *Closedness properties for nonlinear partial differential equations.*  
(95) **Luc C. Tartar**, Carnegie Mellon University, Pittsburgh, Pennsylvania (888-35-166)
- 11:00 *The maximum principle and the principal eigenvalue for second order elliptic operators on Riemannian manifolds.*  
(96) **Pablo Padilla**, IIMAS-UNAM (888-35-116)
- 11:30 *Compensated compactness and the Von Karman model for plates.*  
(97) **Daniel Tataru**, Northwestern University, Evanston, Illinois (888-35-155)

---

Special Session on Holomorphic Systems and Geometry, II

---

09:00–11:50

- 09:00 *Cohomogeneity one manifolds of positive curvature in lower dimensions.* Preliminary report.  
(98) **Catherine E. Searle**, CINVESTAV IPN (888-53-06)
- 09:30 *On an asymptotic  $G$ -winding number.*  
(99) Preliminary report.  
**Ricardo F. Vila-Freyer**, CIMAT (888-58-121)
- 10:00 *Vector bundles of type  $T_3$  over a curve.*  
(100) **L. Brambila-Paz**, UAM-I (888-14-130)
- 10:30 *Parabolic vector bundles and Hermitian-Yang-Mills connections over a Riemann surface.*  
(101) **Jonathan A. Poritz**, University of Maryland, College Park (888-53-187)
- 11:00 *Limit sets of exotic hyperbolic groups.*  
(102) Preliminary report.  
**Kevin David Corlette**, University of Chicago, Illinois, and **Alessandra Iozzi\***, University of Maryland, College Park (888-53-188)
- 11:30 *The fiber of the Prym map in genus 4.*  
(103) **Sevin Recillas**, IMATE-UNAM (888-14-124)

## Friday, December 3 (cont'd)

### Special Session on Non-Commutative Rings, II

#### 09:00–11:50

- 09:00 *Lying over for finite extensions of noetherian algebras.* (104)  
**Günter Krause**, University of Manitoba, Canada (888-16-25)
- 09:30 *Generalized finiteness conditions.* Preliminary report. (105)  
**John Dauns**, Tulane University, New Orleans, Louisiana (888-16-01)
- 10:00 *Dominant extensions and applications to orders in Artinian-type rings.* (106)  
**Ming-Sun Li**, University of Minnesota, Morris, and **Julius M. Zelmanowitz\***, University of California, Santa Barbara (888-16-07)
- 10:30 *On the idempotence and stability of kernel functors.* (107)  
**Mark L. Teply**, University of Wisconsin, Milwaukee (888-16-75)
- 11:00 *Module categories with closed subcategories linearly ordered.* (108)  
**Ana M. de Viola-Prioli**, **Jorge E. Viola-Prioli\***, University of Simon Bolivar, Venezuela, and **Robert Wisbauer**, University of Düsseldorf, Germany (888-16-68) (Sponsored by Sergio R. Lopez-Permouth)
- 11:30 *A special kind of injectivity.* Preliminary report. (109)  
**Francisco Raggi**, IMATE-UNAM (888-16-73) (Sponsored by Sergio R. Lopez-Permouth)

#### Invited Address

#### 12:30–13:30

- (110) *Gibbs states, where they come from.*  
**Daniel W. Stroock**, Massachusetts Institute of Technology, Cambridge (888-82-33)

### Special Session on Graphs and Combinatorics, IV

#### 16:00–18:50

- 16:00 *Multiobjective traffic assignment model for Toluca City.* Preliminary report. (111)  
**Juan Gaytan-Iniestra\*** and **Felipe Camacho-Mejia**, UAEM (888-05-62)
- 16:30 *Selected problems in lattice paths enumeration.* Preliminary report. (112)  
**Heinrich Niederhausen**, Florida Atlantic University, Boca Raton (888-05-145)
- 17:00 *The square of paths and cycles.* (113)  
**Genghua Fan** and **Henry A. Kierstead\***, Arizona State University, Tempe (888-05-156)

- 17:30 *Partition lattices and affine geometry.* (114)  
**M. K. Bennett**, University of Massachusetts, Amherst (888-06-31)
- 18:00 *The combinatorics of the product of sums of squares problem.* Preliminary report. (115)  
**Gilberto Calvillo**, **Isidoro Gitler** and **Jose Martinez-Bernal\***, CINVESTAV IPN (888-05-64)
- 18:30 *Projective polyhedral manifolds.* Preliminary report. (116)  
**Jorge L. Arocha\***, **Javier Bracho** and **Luis Montejano**, IMATE-UNAM (888-05-58) (Sponsored by Joseph P. Kung)

### Special Session on Asymptotic and Numerical Methods in Biology, II

#### 16:00–18:20

- 16:00 *The slow accommodation of traveling waves to their leading tail for reaction-diffusion equations.* (117)  
**Richard Haberman**, Southern Methodist University, Dallas, Texas (888-35-88)
- 16:30 *Two applications of the complex WKB method.* (118)  
**Victor M. Olive\***, **Vladimir Belov**, CINVESTAV IPN, and **Serguei Dobrokhotov**, Russian Academy of Science, Russia (888-81-108)
- 17:00 Discussion
- 17:30 *Edge waves over a gently sloping beach: The proof.* (119)  
**Peter Zhevandrov**, CINVESTAV IPN and Academy of Science, Russia (888-76-104)
- 18:00 *The continuation method to study periodic orbits of a symplectic map of four dimensions.* (120)  
**Arturo Olvera**, IIMAS-UNAM, and **Cristobal Vargas\***, CINVESTAV-IPN (888-65-109)

### Special Session on Geometric Topology in Low Dimensions, III

#### 16:00–18:50

- 16:00 *Dehn surgery and knots in the 3-sphere.* Preliminary report. (121)  
**John Luecke\*** and **Cameron Gordon**, University of Texas, Austin (888-57-181)
- 16:30 *Coverings of Seifert links and generalization of Riley's conjecture B.* Preliminary report. (122)  
**F. González-Acuña**, IMATE-UNAM, and **Arturo Ramirez\***, CIMAT (888-57-15)
- 17:00 *Thin position for 3-manifolds.* (123)  
**Martin Scharlemann\***, University of California, Santa Barbara, and **Abigail Thompson**, University of California, Davis (888-57-53)
- 17:30 Discussion
- 18:00 *Seifert manifolds that double cover  $S^2 \times S^1$ ,  $S^2 \otimes S^1$  and  $P^2 \times S^1$ .* (124)  
**Victor Núñez**, Universidad Juarez Autónoma de Tabasco de Ciencias Básicas, Cunduacan, Mexico (888-57-16) (Sponsored by Wilbur Whitten)
- 18:30 *Finite Dehn surgery on knots.* (125)  
**Steven Boyer\*** and **Xingru Zhang**, Université du Québec à Montréal, Canada (888-57-183)



Special Session on Stochastic Analysis, II

16:00–18:50

- 16:00 *Some relationships between anticipating integrals.* Preliminary report. (126)  
**Jorge A. León**, CINVESTAV IPN (888-60-45) (Sponsored by Luis G. Gorostiza)
- 16:30 *Regularity of the density of the solution of a non adapted stochastic differential equation (NASDE).* (127)  
**Emilia Ma Caballero\***, IMATE-UNAM, **Begoña Fernández**, Facultad de Ciencias UNAM, and **David Nualart**, Universidad de Barcelona, Spain (888-60-41) (Sponsored by Luis G. Gorostiza)
- 17:00 *An extension of Itô's formula to non- $C^2$  functions.* (128)  
**Philip Protter\***, Purdue University, West Lafayette, Indiana, and **Hans Föllmer**, University of Bonn, Germany (888-60-167)
- 17:30 Discussion
- 18:00 *Multiple Wiener-Itô integrals and chaos expansions: A review.* (129)  
**Victor Pérez-Abreu**, CIMAT (888-60-43) (Sponsored by Luis G. Gorostiza)
- 18:30 *On the trajectorial fluctuations of particle systems.* (130)  
**Luis G. Gorostiza**, CIEA-IPN (888-60-44)

Special Session on Non-Commutative Rings, III

16:00–18:50

- 16:00 *Some aspects of spectral torsion theories.* Preliminary report. (131)  
**Maria Jose Arroyo Paniagua**, UAM-I (888-16-71) (Sponsored by Sergio R. Lopez-Permouth)
- 16:30 *When is the central closure of a semiprime ring biregular?* (132)  
**R. Wisbauer\***, University of Düsseldorf, Germany, and **K. I. Beidar**, Moscow State University, Russia (888-16-51) (Sponsored by Sergio R. Lopez-Permouth)
- 17:00 *The second singular ideal of a self injective ring.* Preliminary report. (133)  
**Bruno J. Mueller**, McMaster University, Canada (888-16-04)
- 17:30 *Relative continuous modules.* Preliminary report. (134)  
**Kiyochi Oshiro**, Yamaguchi University, Japan, and **S. Tariq Rizvi\***, Ohio State University, Lima (888-16-93)
- 18:00 *H-separability and Galois actions.* (135)  
**Ricardo Alfaro**, University of Michigan, Flint (888-16-09)
- 18:30 *Abelian categories in which linear algebra is possible.* (136)  
**Claudi Busqué**, University of Murcia, Spain, and **Alberto Facchini\***, University of Udine, Italy (888-16-86) (Sponsored by Delors Herbera)

Special Session on General Topology, III

16:00–18:50

- 16:00 *The measure of plane continua: An application of topology to the theory of pattern recognition as applied to computer vision.* (137)  
**Stephen Watson**, York University, Canada (888-68-158)
- 16:30 *Aposyndesis in hyperspaces.* (138)  
**Alejandro Illanes**, IMATE-UNAM (888-54-103)
- 17:00 *An example from asymmetric topology.* (139)  
**R. D. Kopperman**, City College, City University of New York (888-54-83)
- 17:30 Discussion
- 18:00 *Homogeneous curves that contain arcs.* (140)  
**James Rogers**, Tulane University, New Orleans, Louisiana (888-54-48)
- 18:30 *On connectedness in graphs and topological spaces.* (141)  
**Victor Neumann-Lara**, IMATE-UNAM, and **Richard G. Wilson\***, UAM (888-54-56)

General Session, II

16:00–18:00

- 16:00 *Singular perturbation analysis of a neuron model.* Preliminary report. (142)  
**Humberto Carrillo\***, Facultad de Ciencias-UNAM, **John Rinzel**, National Institute of Health, Bethesda, Maryland, and **Steven M. Baer**, Arizona State University, Tempe (888-34-180)
- 16:15 *A Wavelet-Galerkin method for the numerical solution of differential equations using multigrid relaxation methods.* (143)  
**Peter R. Massopust**, Sam Houston State University (888-35-79)
- 16:30 *Theoretical and numerical aspects of some semilinear hyperbolic problems.* (144)  
**F. Castillo\***, ITESM CEM, **H. Juarez** and **A. Nicolas**, UAM-I (888-35-49)
- 16:45 *On the moments of fractal functions and Dirichlet spline functions.* (145)  
**Peter R. Massopust** and **Patrick J. Van Fleet\***, Sam Houston State University, Texas (888-33-80)
- 17:00 *On the solvability of mixed problems for parabolic equations.* Preliminary report. (146)  
**M. López**, ITESM CEM (888-35-23)
- 17:15 *Approximation to Schrödinger operators by confined systems.* Preliminary report. (147)  
**Gustavo Izquierdo B**, UAM-I (888-65-22) (Sponsored by Richard G. Wilson)
- 17:30 *Goppa codes over a covering curve.* Preliminary report. (148)  
**Horacio Tapia-Recillas\***, UAM-I, and **Carlos Rentería**, IPN (888-94-20)
- 17:45 *On the imbeddability of a commutative ring in a finite-dimensional ring.* Preliminary report. (149)  
**Robert Gilmer\***, Florida State University, Tallahassee, and **William Heinzer**, Purdue University, West Lafayette, Indiana (888-13-98)

## Friday, December 3 (cont'd)

- 18:00 *BGG duality in some categories of Lie algebra modules.*  
(150) **V. Futorny**, Queen's University, Kingston, Canada (888-17-186)

### Invited Address

#### 19:30–20:30

- (151) *Some applications of topology to the theory of geometric tomography.*  
**Luis Montejano**, IMATE-UNAM (888-52-113)

## Saturday, December 4

### Special Session on Representations of Algebras, III

#### 09:00–11:50

- 09:00 *Relatively projective modules over Artin algebras.* Preliminary report.  
(152) **Mark Kleiner**, Syracuse University, New York (888-16-91)
- 09:30 *Tame algebras of tree type.*  
(153) **Jose Antonio de la Peña**, IMATE-UNAM (888-60-100)
- 10:00 Discussion
- 10:30 *Torsion-free modules over wild algebras.* Preliminary report.  
(154) **Frank Okoh**, Wayne State University, Michigan (888-16-67)
- 11:00 *Almost split sequences for Artin algebras over  $\mathbb{Z}_p$ ,  $p$  prime  $r \geq 2$ .*  
(155) **María Alicia Aviñó\***, Instituto Pedagógico, Cuba, and **Raymundo Bautista**, IMATE-UNAM (888-13-176) (Sponsored by Idun Reiten)
- 11:30 *Covering quantum groups.*  
(156) **Edward Green**, Virginia Polytechnic Institute and State University, Blacksburg (888-16-142) (Sponsored by Idun Reiten)

### Special Session on Asymptotic and Numerical Methods in Biology, III

#### 09:00–11:50

- 09:00 *On the number of solitons for the ILW equation.*  
(157) **A. A. Minzoni\***, IIMAS-UNAM, and **Touvia Miloh**, Tel Aviv University, Israel (888-76-106)

- 09:30 *Dynamics of quantitative genetic parameters under stabilizing selection: An analysis of multilocus models with strong selection.*  
(158) **Alan Hastings\*** and **Sergey Gavrillets**, University of California, Davis (888-92-90)
- 10:00 Discussion
- 10:30 *A theory of sustainable harvesting.*  
(159) **Donald Ludwig**, University of British Columbia, Canada (888-92-148) (Sponsored by Carlos Castillo-Chavez)
- 11:00 *Parameter estimation in a model of Chagas disease.*  
(160) **Jorge X. Velasco-Hernández**, UAM-I (888-92-94) (Sponsored by Carlos Castillo-Chavez)
- 11:30 *Social dynamics meets epidemiology: The HIV/AIDS epidemic.*  
(161) **Carlos Castillo-Chavez**, Cornell University, New York (888-92-163)

### Special Session on Holomorphic Systems and Geometry, III

#### 09:00–11:50

- 09:00 *Multiplication of spinors and the Dirac operator.*  
(162) **Francis J. Flaherty**, Oregon State University, Corvallis, Oregon (888-53-19)
- 09:30 *Nilpotent groups and Kahler groups.*  
(163) **James A. Carlson\*** and **Domingo Toledo**, University of Utah, Salt Lake City (888-14-159)
- 10:00 *Chow forms of congruences.*  
(164) **Luis Giraldo\*** and **Ignacio Sols**, Universidad Complutense de Madrid, Spain (888-14-128)
- 10:30 *Rigidity via harmonic maps.* Preliminary report.  
(165) **Luis Hernández**, Ohio State University, Columbus, Ohio (888-53-97)
- 11:00 *Geometry of degenerations of Kummer surfaces.* Preliminary report.  
(166) **Isidro Nieto**, CIMAT (888-14-125)
- 11:30 *A structure theorem for complete Kähler manifolds with bounded geometry and applications to Lefschetz type theorems.*  
(167) **Terrence Napier**, Lehigh University, Pennsylvania, and **Mohan Ramachandran\***, State University of New York, Buffalo (888-32-111)

### Special Session on Geometric Topology in Low Dimensions, IV

#### 09:00–11:50

- 09:00 *Energy of polygonal knots.*  
(168) **Jonathan Simon**, University of Iowa, Iowa City (888-57-144)
- 09:30 *Least area and minimal intersection of immersed surfaces.* Preliminary report.  
(169) **Max Neumann-Coto**, IMATE-UNAM (888-57-150)
- 10:00 *Controlling essential laminations.*  
(170) **Mark W. Brittenham**, University of Texas, Austin (888-57-173)

## Program of the Sessions

- 10:30 Discussion  
11:00 *Homotopic and metric properties of Anosov flows in 3-dimensional manifolds.*  
(171) **Sérgio R. Fenley**, University of California, Berkeley (888-57-184)  
11:30 *Knotting and supercoiling of circular DNA.*  
(172) **De Witt L Sumners**, Florida State University, Tallahassee (888-57-147)

---

### Special Session on Stochastic Analysis, III

---

#### 09:00–11:50

- 09:00 *The fundamental frequency of a drum.*  
(173) **Rodrigo Banaelos\***, Purdue University, West Lafayette, Indiana, and **Tom Carroll**, University College, Cork, Republic of Ireland (888-60-35)  
09:30 *Iterates of Brownian motion.*  
(174) **Davar Khoshnevisan\*** and **Thomas M. Lewis**, Furman University, South Carolina (888-60-82) (Sponsored by Luis G. Gorostiza)  
10:00 *Conditions for integral and other operators to be of trace class.*  
(175) **Richard M. Dudley**, Massachusetts Institute of Technology, Cambridge, and **J. González-Barrios\***, CIMAT, Mexico (888-60-46)  
10:30 Discussion  
11:00 *Decoupling inequalities: A survey and new results.* Preliminary report.  
(176) **Victor H. de la Peña**, Columbia University, New York (888-60-05) (Sponsored by Luis G. Gorostiza)  
11:30 *Stochastic McKean-Vlasov equations.*  
(177) **Peter Kotelenetz**, Case Western Reserve University, Ohio (888-60-78)

---

### Special Session on Non-Commutative Rings, IV

---

#### 09:00–11:20

- 09:00 *A characterization of fully bounded noetherian rings.* Preliminary report.  
(178) **Jaime Castro Perez**, ITESM (888-16-69) (Sponsored by Sergio R. Lopez-Permouth)  
09:30 *On the Picard group of a group graded ring.*  
(179) Preliminary report.  
**Margaret Beattie\***, Mount Allison University, Canada, and **Angel del Rio Mateos**, University of Murcia, Spain (888-16-76) (Sponsored by S. K. Jain)  
10:00 Discussion

- 10:30 *Idempotents in matrices over commutative von Neumann regular rings II.* Preliminary report.  
(180) **Christopher Barrett\***, Imperial College of Science, Technology & Medicine, United Kingdom, and **Victor Camillo**, University of Iowa, Iowa City (888-16-02)  
11:00 *Minimal cogenerators over Osofsky and Camillo rings.*  
(181) **Carl Faith**, Rutgers University, New Brunswick (888-16-77)

---

### Board on Mathematical Sciences–Sociedad Matemática Mexicana Forum

---

#### 10:00–10:50

*Employment of mathematical scientists in business and industry.*

---

### Board of Mathematical Sciences-Sociedad Matemática Mexicana Forum

---

#### 11:00–11:50

*How strategic reports on the mathematical sciences can be used to improve the competitive position of mathematical sciences departments.*

---

### Invited Address

---

#### 12:30–13:30

- (182) *The role of self-similar solutions for solving Euler's equations for fluid flow.*  
**Cathleen S. Morawetz**, Courant Institute of Mathematical Sciences, New York University (888-35-29)

---

### Closing Ceremony

---


#### 13:30–13:40

- 13:30 *Closing Ceremony.*

# Joint Mathematics Meetings, Cincinnati, Ohio

## January 12–15, 1994

*Supplement to announcement in the October Notices*


Please refer to the preliminary announcement for this meeting that begins on page 1030 in the October 1993 issue of the *Notices*. Please note important deadlines below. The forms for Advance Registration/Housing, MAA Minicourses, and the Employment Register are located at the back of this issue. Events that have been planned to celebrate 100 years of AMS Annual Meetings are indicated with this symbol .

### Joint Prize Session


The Association for Women in Mathematics (AWM) is delighted to present their Louise Hay Award for Contributions to Mathematics Education during this session rather than at the AWM business meeting.

### AMS Sessions

**Committee on Education Panel Discussion:** This will take place on Saturday from 8:30 a.m. to 10:00 a.m.

 The title of the panel discussion at 2:15 p.m. on Saturday has been changed to *Future mathematics meetings: is change desirable?*

### Other AMS Events

 The festivities at the AMS Banquet on Saturday evening will be conducted by **De Witt L. Summers**, Florida State University.

### MAA Sessions

**Life after Retirement:** This panel discussion, scheduled on Thursday from 7:00 p.m. to 8:00 p.m., is organized by **Andrew Sterrett, Jr.**, MAA.

### Activities of Other Organizations

The title of the AWM panel discussion on Wednesday afternoon is *Are women getting all the jobs?*

### Mathematical Sciences Employment Register

Applicants and employers planning on participating in the 1994 Employment Register should be aware that this year there will be ten interview periods per session, for a total of forty interview periods. Requests for interviews will be based on the number of sessions you will be available, five requests per session for a total of twenty requests for those available for all four sessions. All participants must turn in their request sheets at the Employment Register Desk before 4:00 p.m. on Wednesday in order to be scheduled for interviews.

### Electronic Advance Registration

The e-MATH GOPHER now has a selection for forms for meetings that may be used to register electronically. It may be accessed either by `gopher e-math.ams.org` if your system has a gopher client, or by selecting #12 from the main menu of the e-MATH login facility. Please note that you may not register for the Employment Register electronically, nor for MAA Minicourses.

### IMPORTANT DEADLINES

AMS Abstracts	
For Consideration for Special Sessions	Expired
Of Contributed Papers	Expired
MAA Abstracts of Contributed Papers	Expired
EARLY Meetings Advance Registration and Housing (Room Lottery)	Expired
ORDINARY Meetings Advance Registration/Housing/Tickets	November 12
Employment Register Advance Registration	November 12
MAA Minicourse Advance Registration	November 12
Hotel Changes and Cancellations with MMSB	December 10
FINAL Employment Register with no Winter List listings	December 13
FINAL Meetings Advance Registration (no housing or tickets)	December 13
Motions for AMS Business Meeting	December 14
Cancellations for all Banquets (50% refund)	December 30
Advance Registration Cancellations (50% refund)	January 9

# Invited Addresses and Special Sessions

## Invited Addresses at AMS Meetings

The individuals listed below have accepted invitations to address the Society at the times and places indicated. For some meetings the list of speakers is incomplete. For full announcements or programs of meetings occurring prior to the first meeting listed below see the table of contents in this issue. Invited addresses at Sectional Meetings are selected by the Section Program Committee, usually twelve to eighteen months in advance of a meeting. Members wishing to nominate candidates for invited addresses should send relevant information to the associate secretary for the section who will forward it to the Section Program Committee.

### Lexington, KY, March 1994

Jack J. Dongarra                      George F. McNulty  
James E. McClure                     David R. Morrison

### Manhattan, KS, March 1994

Marilyn Breen                         David M. Goss  
Michael C. Cranston                 Mei-Chi Shaw

### Brooklyn, NY, April 1994

David Bayer                             Debasis Mitra  
Peter B. Kronheimer                 Nikolai Reshetikhin

### Stillwater, OK, October 1994

V. Lakshmibai                         David J. Wright  
David E. Marker                        Joel Zinn

### Richmond, VA, November 1994

Loren D. Pitt                            Doron Zeilberger  
Cora S. Sadosky

## Organizers and Topics of Special Sessions

The list below contains all the information about special sessions at meetings of the Society available at the time this issue of the *Notices* went to the printer.

### March 1994 Meeting in Lexington, Kentucky

Southeastern Section  
Associate Secretary: Robert J. Daverman  
*Deadline for organizers: Expired*  
*Deadline for consideration: December 7, 1993*

James C. Beidleman and Donald B. Coleman, *Infinite groups and group rings*

Philip L. Bowers, *Geometric group theory and metric geometry*

Russell M. Brown, John L. Lewis, and Zhongwei Shen, *Partial differential equations and minimal smoothness condition*

Karen L. Collins and Ewa M. Kubicka, *Graph theory*

Michael B. Freeman, *Collaborative learning in calculus and precalculus*

Peter D. Hislop and Peter A. Perry, *Inverse spectral problems: theory and computation*

Mark A. Hovey and James E. McClure, *Homotopy theory*

David R. Morrison, *Quantum algebraic geometry*

Serge Ochanine, *Elliptic genera and elliptic cohomology*

Charles H. Romine, *Large-scale matrix computations with applications*

M. Beth Ruskai, *Mathematics of many-body quantum theory*

### March 1994 Meeting in Manhattan, Kansas

Central Section

Associate Secretary: Andy R. Magid

*Deadline for organizers: Expired*

*Deadline for consideration: December 7, 1993*

Andrew G. Bennett and Charles N. Moore, *Harmonic analysis and probability*

Andrew L. Chermak and Albert L. Delgado, *Groups and geometries*

Louis Crane and David N. Yetter, *Quantum topology*

David M. Goss, Michael I. Rosen, and Dinesh Thaker, *Global fields*

Robert A. Gustafson, *Special functions*

A. Alexandrou Himonas and Mei-Chi Shaw, *Several complex variables and partial differential equations*

Lev Kapitanski and Lige Li, *Nonlinear topics and critical phenomena in partial differential equations*

Zongzhu Lin and David B. Surowski, *Representations of algebraic groups and quantum groups*

Gabriel Nagy and Vladimir V. Peller, *Operator theory*

Joseph M. Rosenblatt, *Convergence problems in ergodic theory*

Misha Vishik, *Dynamical systems and fluid dynamics*

Hunan Yang and Qisu Zou, *Computational mathematics and numerical analysis*

### April 1994 Meeting in Brooklyn, New York

Eastern Section

Associate Secretary: Lesley M. Sibner

*Deadline for organizers: Expired*

*Deadline for consideration: January 7, 1994*

## Invited Addresses and Special Sessions

Boris Aronov, *Computational geometry*  
Craig J. Benham, *Mathematical problems in molecular biology*  
Joan S. Birman, Sylvain E. Cappell, and Edward Y. Miller,  
*Invariants of low dimensional manifolds*  
Jozef Dodziuk and Edgar A. Feldman, *Geometric analysis*  
Benjamin Fine, Anthony M. Gaglione, and Kathryn Kuiken,  
*Combinatorial group theory and related topics*  
Frederick P. Gardiner and Yunping Jiang, *Teichmüller theory  
and dynamical systems*  
Dorian Goldfeld, *Analytic number theory*  
Jacob E. Goodman and Erwin Lutwak, *Geometric convexity*  
Pao-sheng Hsu and L. Narisi, *Topological methods; topological  
measure theory*  
Yanyan Li, *Partial differential equations*  
Janos Pach and William Steiger, *Discrete geometry*  
Kurt S. Riedel, *Mathematical methods in plasma physics*  
Robert J. Sibner, *Gauge theory and applications*  
Alan A. Weiss, *Models in telecommunications*

**June 1994 Meeting in Eugene, Oregon**  
Western Section  
Associate Secretary: Lance W. Small  
*Deadline for organizers: Expired*  
*Deadline for consideration: March 14, 1994*

**August 1994 Meeting in Minneapolis, Minnesota**  
Associate Secretary: Lesley M. Sibner  
*Deadline for organizers: November 15, 1993*  
*Deadline for consideration: April 26, 1994*

**October 1994 Meeting in Stillwater, Oklahoma**  
Central Section  
Associate Secretary: Andy R. Magid  
*Deadline for organizers: January 28, 1994*  
*Deadline for consideration: July 13, 1994*

Ara S. Basmajian and Robert R. Miner, *Complex hyperbolic  
geometry and discrete groups*  
Edward T. Cline, *Representations of algebraic groups*  
Bruce C. Crauder and Zhenbo Qin, *Algebraic geometry*  
Benny D. Evans, *The evolving undergraduate mathematics  
curriculum*  
Jerry A. Johnson, *Technology in the classroom*

**November 1994 Meeting in Richmond, Virginia**  
Southeastern Section  
Associate Secretary: Robert J. Daverman  
*Deadline for organizers: February 11, 1994*  
*Deadline for consideration: July 13, 1994*

**January 1995 Meeting in San Francisco, California**  
Associate Secretary: Andy R. Magid  
*Deadline for organizers: April 2, 1994*  
*Deadline for consideration: September 9, 1994*

**March 1995 Meeting in Hartford, Connecticut**  
Eastern Section  
Associate Secretary: Lesley M. Sibner  
*Deadline for organizers: June 3, 1994*  
*Deadline for consideration: To be announced*

**March 1995 Meeting in Orlando, Florida**  
Southeastern Section

Associate Secretary: Robert J. Daverman  
*Deadline for organizers: June 17, 1994*  
*Deadline for consideration: To be announced*

Robert C. Brigham and Richard P. Vitray, *Combinatorics and  
graph theory*  
John R. Cannon, *Inverse and ill-posed problems*  
S. Roy Choudhury, *Nonlinear dynamical systems, chaos, and  
turbulence*  
S. Roy Choudhury and Lokenath Debnath, *Solitons and  
nonlinear waves*  
Xin Li and Ram N. Mohapatra, *Approximation theory and  
special functions*  
Piotr Mikusinski, *New trends in generalized functions*  
Ahmed I. Zayed, *Sampling theory, wavelets, and signal  
processing*

**March 1995 Meeting in Chicago, Illinois**  
Central Section  
Associate Secretary: Andy R. Magid  
*Deadline for organizers: June 24, 1994*  
*Deadline for consideration: To be announced*

**November 1995 Meeting in Kent, Ohio**  
Central Section  
Associate Secretary: Andy R. Magid  
*Deadline for organizers: February 4, 1995*  
*Deadline for consideration: To be announced*

**January 1996 Meeting in Orlando, Florida**  
Associate Secretary: Lance W. Small  
*Deadline for organizers: April 12, 1995*  
*Deadline for consideration: To be announced*

**March 1996 Meeting in Iowa City, Iowa**  
Central Section  
Associate Secretary: Andy R. Magid  
*Deadline for organizers: June 22, 1995*  
*Deadline for consideration: To be announced*  
Daniel D. Anderson, *Commutative ring theory*

**April 1996 Meeting in Baton Rouge, Louisiana**  
Southeastern Section  
Associate Secretary: Robert J. Daverman  
*Deadline for organizers: July 19, 1995*  
*Deadline for consideration: To be announced*

**January 1997 Meeting in San Diego, California**  
Associate Secretary: Lesley M. Sibner  
*Deadline for organizers: April 8, 1996*  
*Deadline for consideration: To be announced*

### Information for Organizers

Potential organizers should refer to the January, February, March, or April issues of the *Notices* for guidelines on organizing a session. Proposals for any of the meetings mentioned in the preceding section should be sent to the cognizant associate secretary by the deadline indicated. No

special sessions can be approved too late to provide adequate advance notice to members who wish to participate.

Western Section

Lance W. Small, Associate Secretary  
Department of Mathematics  
University of California, San Diego  
La Jolla, CA 92093  
E-mail: g\_small@math.ams.org  
Telephone: 619-534-3590

Central Section

Andy R. Magid, Associate Secretary  
Department of Mathematics  
University of Oklahoma  
601 Elm PHSC 423  
Norman, OK 73019  
E-mail: g\_magid@math.ams.org  
Telephone: 405-325-6711

Eastern Section

Lesley M. Sibner, Associate Secretary  
Department of Mathematics  
Polytech University of New York  
Brooklyn, NY 11201-2990  
E-mail: g\_sibner@math.ams.org  
Telephone: 718-260-3505

Southeastern Section

Robert J. Daverman, Associate Secretary  
Department of Mathematics  
University of Tennessee  
Knoxville, TN 37996-1300  
E-mail: g\_daverman@math.ams.org  
Telephone: 615-974-6577

Information on site selection for Sectional Meetings as well as full instructions for submitting abstracts can be found in the January, February, March, and April issues of the *Notices*.

## Translations of Mathematical Monographs

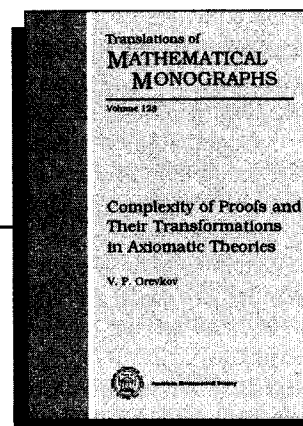
# Complexity of Proofs and Their Transformations in Axiomatic Theories

V. P. Orevkov

### Volume 128

This work develops a tool of logical deduction schemata and uses it to establish upper and lower bounds on the complexity of proofs and their transformations in axiomatized theories. The main results are: establishment of upper bounds on the elongation of deductions in cut eliminations; a proof that the length of a direct deduction of an existence theorem in the predicate calculus cannot be bounded above by an elementary function of the length of an indirect deduction of the same theorem; a complexity version of the existence property of the constructive predicate calculus; and, for certain formal systems of arithmetic, restrictions on the complexity of deductions that guarantee that the deducibility of a formula for all natural numbers in some finite set implies the deducibility of the same formula with a universal quantifier over all sufficiently large numbers.

1991 *Mathematics Subject Classification*: 03  
**ISBN 0-8218-4576-4**, 153 pages (hardcover), September 1993  
**Individual member \$52**, List price \$86, Institutional member \$69  
To order, please specify MMONO/128NA



All prices subject to change. Free shipment by surface; for air delivery, please add \$6.50 per title. *Prepayment required.* Order from: American Mathematical Society, P.O. Box 5904, Boston, MA 02206-5904, or call toll free 800-321-4AMS (321-4267) in the U.S. and Canada to charge with VISA or MasterCard. Residents of Canada, please include 7% GST.

# Joint Summer Research Conferences in the Mathematical Sciences

*Mount Holyoke College, South Hadley, Massachusetts, June 11 to July 15, 1994*

The 1994 Joint Summer Research Conferences in the Mathematical Sciences will be held at Mount Holyoke College, South Hadley, Massachusetts, from June 11 to July 15. It is anticipated that the series of conferences will be supported by grants from the National Science Foundation and other agencies.

There will be six conferences in six different areas of mathematics. The topics and organizers for the conferences were selected by the AMS, the Institute of Mathematical Statistics (IMS), and the Society for Industrial and Applied Mathematics (SIAM) Committee on Joint Summer Research Conferences in the Mathematical Sciences. The selections were based on suggestions made by the members of the committee and individuals submitting proposals. The committee considered it important that the conferences represent diverse areas of mathematical activity, with emphasis on areas currently especially active, and paid careful attention to subjects in which there is important interdisciplinary activity at present.

The Joint Summer Research Conferences are intended to complement the Society's program of annual Summer Institutes and Summer Seminars, which have a larger attendance and are substantially broader in scope. The conferences are research conferences and are not intended to provide an entree to a field in which a participant has not already worked.

It is expected that funding will be available for a limited number of participants in each conference. Others, in addition to those funded, will be welcome, within the limitations of the facilities of the campus. In the spring a brochure of information will be mailed to all who are requesting to attend the conferences. The brochure will include information on room and board rates, the residence and dining hall facilities, travel, local information, and a Residence Housing Form to request on-campus accommodations. Information on off-campus housing will also be included in the brochure. Participants will be responsible for making their own housing and travel arrangements. Each participant will be required to pay a conference fee.

Those interested in attending one of the conferences should send the following information to the Summer Research Conference Coordinator, Conferences Department, American Mathematical Society, Post Office Box 6887, Providence, RI 02940; fax: 401-455-4004; e-mail: [chh@math.ams.org](mailto:chh@math.ams.org).

## **Please type or print the following:**

1. Title and dates of conference desired.
2. Full name.
3. Mailing address.
4. Telephone number and area code for office and home, e-mail address, fax number.
5. A short paragraph describing your scientific background relevant to the topic of the conference.
6. Financial assistance requested; please estimate cost of travel.
7. Indicate if support is not required and if interested in attending even if support is not offered.

**The deadline for receipt of requests for information is March 4, 1994.** Requests to attend will be forwarded to the Organizing Committee for each conference for consideration after the deadline of March 4. All applicants will receive a formal invitation, Brochure of Information, notification of financial assistance, and a tentative scientific program (if the chair has prepared one in advance; otherwise, programs will be distributed at on-site registration) from the AMS by May 1. Funds available for these conferences are limited and individuals who can obtain support from other sources should do so. The allocation of grant funds is administered by the AMS office, and the logistical planning for the conferences is also done by the AMS. However, it is the responsibility of the chair of the Organizing Committee of each conference to determine the amount of support participants will be awarded. This decision is **not** made by the AMS. Women and minorities are encouraged to apply and participate in these conferences.

Any questions concerning the scientific portion of the conference should be directed to the chair or any member of the Organizing Committee.

The Joint Summer Research Conferences in the Mathematical Sciences are under the direction of the AMS-IMS-SIAM Committee on Joint Summer Research Conferences in the Mathematical Sciences. The following committee members chose the topics for the 1994 conferences: Fan R. K. Chung, Leonard Evens, Alan F. Karr, Peter W. K. Li, Bart Ng, Stewart B. Priddy, Robert J. Serfling, Michael Shub, William E. Strawderman, and Sue Whitesides.

***N.B. Lectures begin on Sunday morning and run through Thursday. Check in for housing begins on Saturday. No lectures are held on Saturday.***



**Saturday, June 11, to Friday, June 17***Continuous algorithms and complexity*

J. F. TRAUB (Columbia University), co-chair

J. RENEGAR (Cornell University), co-chair

Continuous computational complexity studies the complexity of continuous mathematical problems. The motivation is that most problems in the physical, biological, and social sciences, and even in finance, have continuous models.

The mathematical problems that arise in this modeling include integral equations, multivariate integration, optimization, ordinary differential equations, partial differential equations, and systems of polynomial equations.

Continuous computational complexity is applied in many disciplines including scientific computation, control theory, and statistics. Invited speakers will cover the foundations of continuous computational complexity, recent results, open problems, and applications.

Continuous computational complexity may be contrasted with discrete computational complexity, that is, the study of the complexity of problems such as scheduling and networking. Much of the research in theoretical computer science over the past twenty-five years has been devoted to discrete complexity.

Continuous computational complexity is a particularly good area for researchers in the mathematical sciences. There is intense international research activity. There are numerous important open problems which, while deep, are solvable. Furthermore, progress requires mathematical tools such as algebra, algebraic geometry, functional analysis, analysis in the large, and measure theory.

Particularly promising new areas include:

**Theoretical topics:** Average case analysis of nonlinear problems, average case complexity, complexity of multidimensional problems, relations between condition numbers and complexity theory, models of parallel computation, noisy data, power and limitations of randomization, and structural computational complexity.

**Applications:** Approximation, computer vision, dynamical systems, control theory, ill-posed problems, integral equations, multivariate integration, nonlinear equations, nonlinear optimization, ordinary differential equations, partial differential equations, prediction and estimation, signal processing, singularity detection, zeros of systems of polynomials, and systems of polynomial equations and inequalities.

Members of the Organizing Committee: Lenore Blum (Mathematical Sciences Research Institute and ICSI) and Henryk Wozniakowski (University of Warsaw and Columbia University).

**Saturday, June 18, to Friday, June 24***Moonshine, the monster, and related topics*

GEOFFREY MASON (University of California, Santa Cruz), chair

CHONGYING DONG (University of California, Santa Cruz), co-chair

JOHN MCKAY (Concordia University), co-chair

1. While a narrow interpretation of "moonshine" would confine it to the study of connections between modular functions (of genus zero) and the monster group  $M$ , experience has shown that much can be learned by viewing it as part of the phenomenology of two-dimensional conformal field theory (CFT). Conversely, intensive study of  $M$  and its attendant Moonshine module has led to progress in CFT itself, and there is currently an extensive and fruitful interplay between the two points of view. These ideas have also provoked advances in elliptic cohomology, which in principle should be both closely related to CFT and be able to clarify the mysteries surrounding  $M$ . The purpose of the conference is to bring together researchers in these different areas, the focal point being the moonshine paradigm in one of the above guises.

2. What follows is a thumbnail sketch of a few of the current ideas on the subject. The famous conjectures of Conway and Norton, who conferred moonshine upon the world, continue to provoke an intensive study of the relation of  $M$  to both modular functions and certain infinite-dimensional Lie algebras. At the hands of Borcherds and Frenkel-Lepowsky-Meurman (FLM), this led to a rigorous and axiomatic approach to CFT via so-called vertex (operator) algebras (VOA). The FLM construction of the VOA  $V^h$  associated to  $M$  is an example of so-called  $Z_2$ -orbifold model, an idea first developed in general by Dixon, Harvey, Vafa, and Witten. Understanding the construction and properties of general orbifolds has become a major theme and is itself part of the larger problem of studying so-called rational conformal field theories.

Thus the physicist Tuite has shown how the generalized Conway-Norton conjectures, which say roughly that the monster orbifold has the genus zero property, follow from standard conjectures of CFT together with the FLM conjecture that  $V^h$  is the only self-dual CFT of central charge  $c = 24$  with no massless particles (i.e., the constant term of the partition function is zero). This is the CFT analogue of Conway's characterization of the Leech lattice. In a similar vein the physicist Schellekens has suggested that there are just 71 distinct self-dual CFTs with  $c = 24$ , which is the CFT analogue of the Niemeier-Venkov classification of even self-dual lattices of rank 24, and its resolution seems to be important for several reasons.

Group theorists continue to influence the subject: after the work of Norton, Ivanov, and others the bimonster ( $M$  wreath  $Z_2$ ) is known to be the quotient of a Coxeter group corresponding to the diagram  $Y_{5,5,5}$ . One wants to understand the role that this set of ideas plays in a wider context. Also, work of Ryba and others strongly suggests that there is a mod  $p$  version of moonshine involving other sporadic simple groups.

In a different direction following work of Smit, Dijkgraaf, and others, the physicist Bantay has studied moonshine in the context of the quantum double and has gone on to consider higher genus moonshine in a similar context. On the other hand, Siegel modular moonshine awaits development.

Many of these ideas conjecturally have analogues and

generalizations in elliptic cohomology. While a geometric description of this theory is still lacking, more formal approaches are proving valuable. Work of Hopkins-Kuhn-Ravenel concerning  $E^*(BG)$  where  $E^*$  is a so-called  $v_n$ -periodic cohomology theory is particularly striking. In the case of elliptic cohomology  $Ell^*$  for example, it relates to pairs of commuting elements of the group  $G$  and hence to  $G$ -orbifold theory. Baker and Thomas have formulated conjectures which directly relate theories similar to  $Ell^*$  with spaces of functions derived from orbifold-like settings and which are analogues of Atiyah's theorem on the K-theory of  $BG$ . Generally one might expect a theory relating  $Ell^*(X)$  to the geometry of the loop space  $\mathcal{L}X$ , where now moonshine is interpreted as the special case  $X = BG$ . Even wilder ideas have been contemplated: cohomology theories taking values in rings of automorphic forms of higher rank and which perhaps are related in some cases to higher genus CFT alluded to above.

Finally, there is the spectre of a monster manifold. If such exists, it would be a spectacular object in which many of these ideas might find their purest expression.

### Saturday, June 25, to Friday, July 1

#### *Multidimensional complex dynamics*

ERIC D. BEDFORD (Indiana University), co-chair

JOHN-ERIK FORNÆSS (University of Michigan, Ann Arbor), co-chair

The subject of this conference derives its impetus from two sources: the dynamics of a function of one complex variable and of real (nonholomorphic) dynamical systems in several dimensions. The study of iterations of analytic functions of a complex variable has seen a vigorous revival during the past decade. The original work in this area was done in the early part of the twentieth century by Fatou and Julia, borrowing heavily from Montel's Theorem and the theory of normal families. In the 1960s the techniques of potential theory were used to study polynomials in the work of Broiln, and quasiconformal mappings have been used by Sullivan, Douady and Hubbard, and others. It would be natural to extend the subject to mappings of several variables, but the techniques of normal families and quasiconformal mappings are not readily available.

The subject of this conference will be centered around the iteration theory of polynomial automorphisms of complex 2-space  $C^2$  and around dynamical properties of holomorphic mappings of complex projective  $n$ -space  $P^n$ . We will approach these subjects from the point of view of several complex variables. Emphasis will be given to the use of pluri-potential theory and methods of positive, closed currents. This will also involve techniques related to invariant metrics.

### Saturday, June 25, to Friday, July 1

#### *Markov chain Monte Carlo methods*

ALAN GELFAND (University of Connecticut), chair

Currently in the statistical community there has been a

considerable increase in interest in the use of Markov chain Monte Carlo algorithms to implement statistical inference for complex models. The objective of the workshop is to assess the current state of the art; to encourage the development of alternative, potentially more efficient sampling algorithms; to discuss practical implementation issues with regard to starting values, parametrizations, convergence assessment; and to clarify the status of software development. Talks will be devoted to general theory and implementation as well as to particular applications and their associated special aspects. The organizing committee is A. Gelfand (Connecticut), C. Geyer (Minnesota), P. J. Green (Bristol), and A. F. M. Smith (Imperial).

### Saturday, July 2, to Friday, July 8

#### *Periodicity and structured homology theories in homotopy theory*

PAUL G. GOERSS (University of Washington), co-chair

HAL SADOFSKY (John Hopkins University), co-chair

PAUL L. SHICK (John Carroll University), co-chair

Since the early 1980s, when Devinatz, Hopkins, and Smith proved various of Ravenel's nilpotence and periodicity conjectures, the notion of periodic phenomena in homotopy theory has become one of the central organizing principles of the field. This conference is intended to examine past progress and future directions in this area. Powerful tools used to great effect by workers in the field are certain extraordinary homology theories that support sufficient extra structure to make them tractable. Progress in understanding these types of homology theories is also to be examined.

### Saturday, July 9, to Friday, July 15

#### *Bergman spaces and the operators that act on them*

STEPHEN D. FISHER (Northwestern University), co-chair

SHELDON AXLER (Michigan State University), co-chair

PETER L. DUREN (University of Michigan), co-chair

The Bergman  $p$ -space on a bounded domain  $D$  in complex  $n$ -space is the Banach space of analytic functions that are  $p$ th power integrable on  $D$  with respect to Lebesgue measure. Bergman spaces differ significantly from the Hardy spaces. The function theory of the latter was developed through the first thirty years of this century by such mathematicians as F. Riesz, M. Riesz, G.H. Hardy, J. Littlewood, V. I. Smirnov, and others. Functional analysis and the analysis of linear operators on Hardy spaces were developed from 1949 onward by A. Beurling, W. Rudin, L. Carleson, H. S. Shapiro, A. L. Shields, S. Ya. Khavinson, and others. Despite superficial similarities between the Hardy and Bergman spaces, the corresponding knowledge of the function theory and the analysis of linear operators in the Bergman spaces seemed for many years not to be accessible. Functions in the Bergman spaces seemed to lack any description analogous to the inner-outer factorization of the Hardy space functions. For instance, in 1974 C. Horowitz

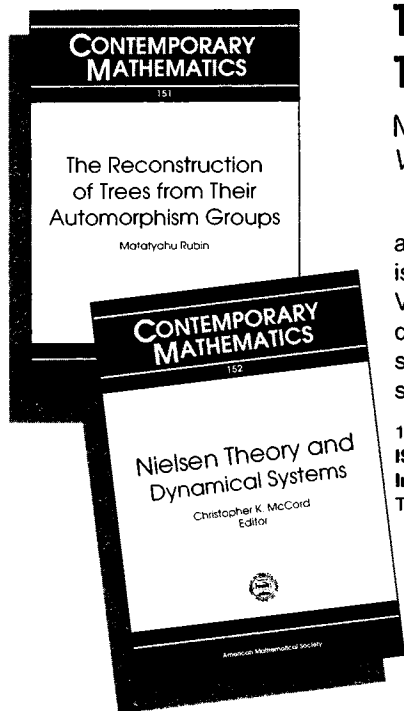
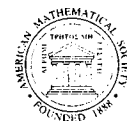
showed that there are no analogues of Blaschke factors, and the zero sets of Bergman functions are more difficult to describe; furthermore, the zero sets of Bergman spaces are different for different values of  $p$ , unlike the case of the Hardy spaces where they are all just the Blaschke sequences. Happily, this state of affairs has turned around in recent years, and significant progress on many open problems has been made.

This conference will focus on the following five topics:

contractive divisors in the Bergman spaces and related topics, Hankel and Toeplitz operators on Bergman spaces in one and several variables, mean polynomial approximation in the plane, sampling and interpolation in Bergman spaces, and composition operators on Hardy and Bergman spaces.

The conference will bring together active participants and interested students to exchange ideas and present recent results.

# CONTEMPORARY MATHEMATICS



## The Reconstruction of Trees from Their Automorphism Groups

Matatyahu Rubin  
*Volume 151*

This book focuses on automorphism groups of trees, providing a nearly complete analysis of when two trees have isomorphic automorphism groups. Special attention is paid to the class of  $\aleph_0$ -categorical trees, and for this class the analysis is complete. Various open problems, mostly in permutation group theory and in model theory, are discussed, and a number of research directions are indicated. Aimed at graduate students and researchers in model theory and permutation group theory, this self-contained book will bring readers to the forefront of research on this topic.

1991 *Mathematics Subject Classification*: 03; 20, 06  
**ISBN 0-8218-5187-X**, 274 pages (softcover), September 1993  
**Individual member \$34**, List price \$56, Institutional member \$45  
 To order, please specify CONM/151NA

## Nielsen Theory and Dynamical Systems

Christopher K. McCord, Editor  
*Volume 152*

This volume contains the proceedings of the AMS-IMS-SIAM Joint Summer Research Conference on Nielsen Theory and Dynamical Systems, held in June 1992 at Mount Holyoke College. Focusing on the interface between Nielsen fixed point theory and dynamical systems, this book provides an almost complete survey of the state of the art of Nielsen theory. Most of the articles are expository and provide references to more technical works, making them accessible to both graduate students and researchers in algebraic topology, fixed point theory, and dynamical systems.

1991 *Mathematics Subject Classification*: 54, 55; 34, 58  
**ISBN 0-8218-5181-0**, 350 pages (softcover), September 1993  
**Individual member \$31**, List price \$52, Institutional member \$42  
 To order, please specify CONM/152NA

All prices subject to change. Free shipment by surface; for air delivery, please add \$6.50 per title. *Prepayment required.* Order from: American Mathematical Society, P.O. Box 5904, Boston, MA 02206-5904, or call toll free 800-321-4AMS (321-4267) in the U.S. and Canada to charge with VISA or MasterCard. Residents of Canada, please include 7% GST.

## Call For Topics For 1995 Conferences

Suggestions are invited from mathematicians, either singly or in groups, for topics for the various conferences that will be organized by the Society in 1995. The deadlines for receipt of these suggestions are given below, as well as some relevant information about each of the conferences. An application form to be used when submitting suggested topic(s) for any of these conferences may be obtained by writing to the Director of Meetings, American Mathematical Society, P. O. Box 6887, Providence, RI 02940; or by telephone: 401-455-4146; fax: 401-455-4004; or e-mail: [meet@math.ams.org](mailto:meet@math.ams.org).

Individuals willing to serve as organizers should be aware that the professional conference coordinators in the Society's Providence office will provide full support and assistance before, during, and after each of these conferences, thereby relieving the organizers of most of the administrative detail. Organizers should also note that for all conferences except Summer Research Conferences it is required that the proceedings be published by the AMS and that proceedings of Summer Research Conferences are frequently published. A member of the Organizing Committee must be willing to serve as editor of the proceedings.

All suggestions must include (1) the names and affiliations of proposed members and the chair of the Organizing Committee; (2) a one- to two-page description addressing the focus of the topic, including the importance and timeliness of the topic and estimated attendance; (3) a list of the recent conferences in the same or closely related areas; (4) a tentative list of names and affiliations of the proposed principal speakers; and (5) a list of likely candidates who would be invited to participate and their current affiliations. Individuals submitting conference suggestions are requested to recommend sites or geographic areas to assist the Meetings staff in their selection of an appropriate site.

### 1995 AMS-SIAM-SMB Symposium on Some Mathematical Questions in Biology

This one-day symposium, sponsored jointly by the AMS, the Society for Industrial and Applied Mathematics (SIAM), and the Society for Mathematical Biology (SMB), is usually held in conjunction with the annual meeting of a biological society closely associated with the topic. Current and recent topics and organizers:

1990—*Neural networks*, **Jack D. Cowan**, University of Chicago.

1991—*Theoretical approaches for predicting spatial effects in ecological systems*, **Robert H. Gardner**, Oak Ridge National Laboratories.

1992—*Cell biology*, **Byron Goldstein**, Los Alamos National Laboratory, and **Carla Wofsy**, University of New Mexico.

1993—*Theories for the evolution of haploid-diploid life cycles*, **Mark Kirkpatrick**, University of Texas, Austin.

Proposals will be considered by the AMS-SIAM-SMB Committee on Mathematics in the Life Sciences. Papers from the symposia are published by the AMS as volumes in the series *Lectures on Mathematics in the Life Sciences*.

**Deadline for Suggestions: December 1, 1993**

### 1995 AMS-IMS-SIAM Joint Summer Research Conferences in the Mathematical Sciences

These conferences, jointly sponsored by the AMS, the Institute for Mathematical Statistics (IMS), and the Society for Industrial and Applied Mathematics (SIAM), emulate the scientific structure of those held at Oberwolfach and represent diverse areas of mathematical activity, with emphasis on areas currently especially active. Careful attention is paid to subjects in which there is important interdisciplinary activity at present. A one-week or two-week conference may be proposed. Topics for the twelfth series of one-week conferences being held in 1993 are *Curvature equations in conformal geometry*; *Multivariable operator theory*; *Spectral geometry*; *Recent developments in the inverse Galois problem*; *Mathematics of superconductivity*; *Distributions with fixed marginals, doubly stochastic measures, and Markov operators*; and *Applications of hypergroups and related measure algebras*.

Proposals will be considered by the AMS-IMS-SIAM Committee on Joint Summer Research Conferences in the Mathematical Sciences. If proceedings are published by the AMS, they appear as volumes in the series *Contemporary Mathematics*.

**Deadline For Suggestions: February 1, 1994**

Submit suggestions to: AMS Director of Meetings, P. O. Box 6887, Providence, RI 02940; fax: 401-455-4004; e-mail: [meet@math.ams.org](mailto:meet@math.ams.org).

# Mathematical Sciences Meetings and Conferences

1993

1993–1994. **Mittag-Leffler Institute's Academic Program for 1993–1994: Topology and Algebraic  $K$ -theory**, Djursholm, Sweden. (Dec. 1992, p. 1274)

Spring 1993. **IMACS Symposium on Mathematical Modelling**, Wiener Neustadt, Germany. (Jan. 1992, p. 54)

1993. **Second IMACS International Conference on Computational Physics**, Univ. of Colorado, Boulder, CO. (Jan. 1992, p. 55)

## November 1993

8–10. **Spectral and Scattering Theory and Related Topics**, Research Institute for Mathematical Sciences, Kyoto University, Kyoto, Japan. (Jul./Aug. 1993, p. 709)

\*8–10. **Advances in Nonlinear Astrodynamics**, University of Minnesota, Minneapolis, MN.

**PROGRAM:** This workshop will highlight new low-energy methods to deliver scientific payloads to the moon, asteroids, Mars, and the sun's gravitational lens. Included in the discussion will be Farquhar's techniques for ISEE-C and missions to comets and asteroids as well as the newly discovered ballistic lunar capture transfer as demonstrated by the Japanese spacecraft *Hiten* in 1991–1992. Applications of these and other methods to small spacecraft will also be addressed. In this industry/lab/academic conference there will also be presentations by experts in celestial mechanics about the mathematical context in which the discoveries and practical orbit computations have been made. Because the workshop will be self-supporting, there is a registration fee of \$325. Very limited support for academic participants may be available. For registered students the registration fee will be waived.

**KEYNOTE SPEAKERS AND TITLES:** R. Farquhar, APL-Johns Hopkins, "The Use of Nonlinear Astrodynamics in Missions to Comets and Asteroids," and L. Friedman, director of the Planetary Society, "Exploration of the Solar System: Celestial Mechanics to the Rescue".

**INVITED SPEAKERS:** E. Belbuno, JPL and The Geometry Center; R. Broucke, U. of Texas; K. Mease, Princeton; and C. Simo, Barcelona.

**INFORMATION:** Organizer, Dr. Edward Belbuno, at The Geometry Center: belbruno@geom.umn.edu or 612-626-1845 or 626-0888; fax: 612-626-7131.

9–12. **Singularities of Holomorphic Vector Fields and Related Topics**, Research Institute

THIS SECTION contains announcements of meetings and conferences of interest to some segment of the mathematical public, including ad hoc, local, or regional meetings, and meetings or symposia devoted to specialized topics, as well as announcements of regularly scheduled meetings of national or international mathematical organizations. A complete listing of meetings of the Society, and of meetings sponsored by the Society, will be found inside the front cover.

AN ANNOUNCEMENT will be published in the *Notices* if it contains a call for papers and specifies the place, date, subject (when applicable), and the speakers; a second announcement will be published only if there are changes or necessary additional information. Once an announcement has appeared, the event will be briefly noted in each issue until it has been held and a reference will be given in parentheses to the month, year, and page of the issue in which the complete information appeared. Asterisks (\*) mark those announcements containing new or revised information.

IN GENERAL, announcements of meetings and conferences held in North America carry only date, title of meeting, place of meeting, names of speakers (or sometimes a general statement on the program), deadlines for abstracts or contributed papers, and source of further information. Meetings held outside the North American area may carry more detailed information. In any case, if there is any application deadline with respect to participation in the meeting, this fact should be noted. All communications on meetings and conferences in the mathematical sciences should be sent to the Editor of the *Notices*, care of the American Mathematical Society in Providence, or electronically to [notices@math.ams.org](mailto:notices@math.ams.org).

DEADLINES for entries in this section are listed on the inside front cover of each issue. In order to allow participants to arrange their travel plans, organizers of meetings are urged to submit information for these listings early enough to allow them to appear in more than one issue of the *Notices* prior to the meeting in question. To achieve this, listings should be received in Providence SIX MONTHS prior to the scheduled date of the meeting.

EFFECTIVE with the 1990 volume of the *Notices*, the complete list of Mathematical Sciences Meetings and Conferences will be published only in the September issue. In all other issues, only meetings and conferences for the twelve-month period following the month of that issue will appear. As new information is received for meetings and conferences that will occur later than the twelve-month period, it will be announced at the end of the listing in the next possible issue. That information will not be repeated until the date of the meeting or conference falls within the twelve-month period.

for Mathematical Sciences, Kyoto University, Kyoto, Japan. (Jul./Aug. 1993, p. 709)

12–13. **Eighth Annual Pi Mu Epsilon Regional Undergraduate Mathematics Conference**, St. Norbert College, De Pere, WI. (Ju./Aug. 1993, p. 709)

12–14. **Twenty-second Midwest Differential Equations Conference**, University of Missouri, Columbia, MO. (Jul./Aug. 1993, p. 709)

13. **New York Graph Theory Day Twenty-six**, Bard College, NY. (Sep. 1993, p. 922)

15–17. **Representation Theory of Finite Groups and Algebras**, Research Institute for Mathematical Sciences, Kyoto University, Kyoto, Japan. (Jul./Aug. 1993, p. 709)

15–19. **IMA Workshop on Random Discrete Structures**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Jan. 1993, p. 63)

15–19. **Systèmes d'Équations Algébriques**, CIRM, Marseille, France. (Jan. 1993, p. 63)

15–19. **Supercomputing '93**, Portland, Oregon. (May/Jun. 1993, p. 513)

17–19. **European Symposium on Numerical Methods in Electromagnetics**, Toulouse, France. (Jul./Aug. 1993, p. 709)

17–19. **Research on Algebraic Combinatorics**, Research Institute for Mathematical Sciences, Kyoto University, Kyoto, Japan. (Jul./Aug. 1993, p. 709)

18–21. **Nineteenth Annual Conference of the American Mathematical Association of Two Year Colleges (AMATYC)**, Boston, MA. (Sep. 1993, p. 923)

21–27. **Mathematische Modelle in der Biologie**, Oberwolfach, Federal Republic of Germany. (Mar. 1992, p. 251)

22–26. **Géométrie Symplectique et Physique Mathématique**, CIRM, Marseille, France. (Jan. 1993, p. 63)

22–26. **Algebraic Combinatorics**, Kyushu University, Fukuoka, Japan. (Sep. 1993, p. 923)

22–27. **Géométrie Symplectique**, Marseille, France. (Feb. 1993, p. 187)

24–26. **Theory and Applications in Computer Algebra**, Research Institute for Math-

ematical Sciences, Kyoto University, Kyoto, Japan. (Jul./Aug. 1993, p. 710)

28–December 4. **Nonlinear Equations in Many-Particle Systems**, Oberwolfach, Federal Republic of Germany. (Mar. 1992, p. 251)

**December 1993**

1–3. **Linear Operators and Inequalities**, Research Institute for Mathematical Sciences, Kyoto University, Kyoto, Japan. (Jul./Aug. 1993, p. 710)

1–4. **Joint Meeting with the Sociedad Matematica Mexicana**, Merida, Yucatan, Mexico.

INFORMATION: W. Drady, AMS, P.O. Box 6887, Providence, RI 02940.

\*2–4. **International Symposium on Special Functions, Approximation, Numerical Quadrature, and Orthogonal Polynomials Celebrating the Sixty-Fifth Birthday of Walter Gautschi**, Purdue University, West Lafayette, IN.

INVITED SPEAKERS: The program is comprised of invited talks on the four main themes of the conference. *One-hour Speakers*: R.A. Askey, E.W. Cheney, G. Dahlquist, G.H. Golub, W.B. Gragg, J. Korevaar, J.N. Lyness, F.W.J. Olver, R.S. Varga; *Half-hour Speakers*: A. Bellen, J.C. Butcher, J.R. Cash, P.J. Davis, C. de Boor, B.D. Flury, D. Gottlieb, M.H. Gutknecht, A. Iserles, W.B. Jones, H.J. Landau, S. Li, G. Mastroianni, C.A. Micchelli, G.V. Milovanovic, G. Monegato, M.E. Muldoon, S.E. Notaris, L. Reichel, W.C. Rheinboldt, T.J. Rivlin, S. Ruscheweyh, E. Saff, F. Stenger, N.M. Temme, J. Wimp, R. Wong, M. Zhang.

INFORMATION: Via anonymous ftp to ftp.iro.umontreal.ca; directory: pub/numerik/Gautschi\_Symposium; filename: Gautschi\_Symposium.

2–5. **First Belgian-French Meeting on PDE**, Han-sur-Lesse, Belgium. (Oct. 1993, p. 1084)

\*3–4. **Advances on Scientific Computing and Modeling**, Eastern Illinois University, Charleston, IL.

CONFERENCE TOPICS: Parallel computation, stiff computation, grid generation, multi-quadratics, finite element methods, fractals and finite differences.

INVITED SPEAKERS: *Partial list*: J. Thompson, D. Lee, K. Gustafson, G. Sod, A. Law (Canada), L. Jodar (Spain), P. Thomsen (Denmark), J. Fleckinger (France), P. Norsett (Norway), and others.

INFORMATION: S.K. Dey, Math. Dept., Eastern Illinois University, Charleston, IL 61920; e-mail: cfskd@eiu.edu.

5–9. **1993 International Symposium on Nonlinear Theory and its Applications (NOLTA**

'93), Hawaii. (Apr. 1993, p. 414)

5–11. **Dynamical Zeta Functions**, Oberwolfach, Federal Republic of Germany. (Feb. 1993, p. 187)

5–11. **Model Selection**, Oberwolfach, Federal Republic of Germany. (Feb. 1993, p. 187)

6–10. **International Congress on Modelling Simulation, 1993**, University of Western Australia, Perth. (Feb. 1993, p. 187)

8–10. **Mathematical Structure of Optimization Theory**, Research Institute for Mathematical Sciences, Kyoto University, Kyoto, Japan. (Jul./Aug. 1993, p. 710)

8–11. **International Conference on Vistas in Modern Applied Mathematics**, Goa University, Goa, India. (Jul./Aug. 1993, p. 710)

\*12–17. **Cornelius Lanczos International Centenary Conference**, North Carolina State University, Raleigh, NC.

PROGRAM: This conference celebrates the 100th anniversary of the birth of Cornelius Lanczos (1893–1974). The conference will reflect the wide interests of Lanczos in computational mathematics, theoretical physics, and astrophysics. The program will include approximately 26 invited plenary speakers and 25 minisymposia. The conference will also include sessions of contributed papers in the form of twelve-minute talks and poster sessions.

PLENARY SPEAKERS: *Computational mathematics*: J.W. Cooley, J.K. Cullum, R.W. Freund, G.H. Golub, A. Greenbaum, M.H. Gutknecht, E.L. Ortiz, C. Paige, B. Parlett, R.J. Plemmons, P. Rozsa, Y. Saad, G.W. Stewart, J. Todd; *Theoretical physics and astrophysics*: V.I. Arnold, J.B. Hartle, C. Isham, J. Marsden, R. Penrose, T. Piran, J.J. Stachel, T. Takahashi, C. Teitelboim, K.S. Thorne, M.S. Turner, J.A. Wheeler, J.W. York.

INFORMATION: Cornelius Lanczos International Centenary Conference, ATTN: Sheehan/Heggie, NCSU/OCE&PD, Box 7401, Raleigh, NC 27695-7401; e-mail: lanczos@math.ncsu.edu.

12–18. **General Principles of Discretization Algorithms, Theory, and Applications**, Oberwolfach, Federal Republic of Germany. (Feb. 1993, p. 187)

12–18. **Methoden und Verfahren der Mathematischen Physik**, Oberwolfach, Federal Republic of Germany. (Feb. 1993, p. 187)

13–15. **Fourth IMA Conference on Cryptography and Coding**, Cirencester, UK. (Jul./Aug. 1993, p. 710)

13–17. **Statistics in Ecology and Environmental Monitoring**, Dunedin, New Zealand. (Sep. 1993, p. 923)

15–17. **Groups and Related Topics**, Research Institute for Mathematical Sciences, Kyoto University, Kyoto, Japan. (July/

August 1993, p. 710)

**January 1994**

January–June 1994. **A Semester at CRM: Bifurcations and the Geometry of Vector Fields**, Université de Montréal. (Jan. 1993, p. 63)

2–5. **Third International Symposium on Artificial Intelligence and Mathematics**, Fort Lauderdale, FL. (Jul./Aug. 1993, p. 710)

2–8. **Modelltheorie**, Oberwolfach, Federal Republic of Germany. (Mar. 1993, p. 285)

\*3–9. **An International Conference on Mathematical Analysis and Signal Processing**, Cairo University, Egypt.

PROGRAM: The focus of the conference is the interaction between mathematical analysis and signal processing.

ORGANIZERS: A. Zayed, U. of Central Florida; Z. Nashed, U. of Delaware; M. Ismail, U. of South Florida.

CONFERENCE TOPICS: Sampling theory in one and several variables, approximation theory, orthogonal polynomials, transform techniques, inverse problems, wavelets, and multiresolution analysis.

INVITED SPEAKERS: P. Butzer, Aachen; S. Cambanis, N. Carolina; C. Chui, Texas A&M; W. Everitt, U. of Birmingham; J. Higgins, Anglia Poly.; C. Kenig, U. of Chicago; P. Nevai, Ohio State; F. Stenger, U. of Utah; A. Tewfik, U. of Minnesota; G. Walter, U. of Wisconsin.

INFORMATION: A. Zayed, Dept. of Math., Univ. of Central Florida, P.O. Box 161364, Orlando, FL 32816-1364; 407-823-5989; fax: 407-823-5156; e-mail: fdzayed@ucf1vm.bitnet.

3–14. **Joint Workshop on Computational Aspects of Geometric Group Theory I**, The Geometry Center of the University of Minnesota, Minneapolis, MN. (Sep. 1993, p. 924)

4–7. **International Symposium on Visco-Elastic Fluids**, Tobago (In the Republic of Trinidad and Tobago). (Feb. 1993, p. 187)

4–8. **International Conference on Harmonic Analysis and Operator Theory**, Caracas, Venezuela. (Jan. 1993, p. 64)

4–9. **An International Conference on Mathematical Analysis and Signal Processing**, Cairo University, Egypt. (Jul./Aug. 1993, p. 710)

5–7. **Semigroup Theory**, Hobart, Tasmania, Australia. (Feb. 1993, p. 187)

5–9. **Twentieth Holiday Mathematics Symposium**, New Mexico State University, Las Cruces, NM. (Sep. 1993, p. 924)

9–15. **Algebraic Combinatorics: Association Schemes and Representation Theory**, Oberwolfach, Federal Republic of Germany. (Mar. 1993, p. 285)

10–12. **Nonlinear Partial Differential Equa-**

tions, Research Institute for Mathematical Sciences, Kyoto University, Kyoto, Japan. (Jul./Aug. 1993, p. 710)

12–15. **Joint Mathematics Meetings**, Cincinnati, OH (including the annual meetings of the AMS, AWM, MAA, and NAM).

INFORMATION: H. Daly, AMS, P.O. Box 6887, Providence, RI 02940.

16–22. **Gruppentheorie (Permutationsgruppen)**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1993, p. 710)

17–19. **Structure and Statistical Law of Turbulence**, Research Institute for Mathematical Sciences, Kyoto University, Kyoto, Japan. (Jul./Aug. 1993, p. 710)

23–25. **Fifth Annual ACM-SIAM Symposium on Discrete Algorithms**, Arlington, VA. (May/Jun. 1993, p. 513)

23–29. **Singulare Integral- und Pseudo-Differential-Operatoren und Ihre Anwendungen**, Oberwolfach, Federal Republic of Germany. (Mar. 1993, p. 285)

24–28. **IMA Workshop on Mathematical Population Genetics**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Jan. 1993, p. 64)

24–28. **Complex Analysis on Hyperbolic 3-manifolds**, Research Institute for Mathematical Sciences, Kyoto University, Kyoto, Japan. (Jul./Aug. 1993, p. 711)

25–29. **Sixth Benin International Conference on Scientific Computing**, University of Benin City, Nigeria. (Sep. 1993, p. 924)

30–February 5. **Nichtstandardanalysis und Anwendungen**, Oberwolfach, Federal Republic of Germany. (Mar. 1993, p. 285)

## February 1994

February 1994. **Workshop on Dynamical Disease**, Laurentian Mountains north of Montréal. (Jan. 1992, p. 64)

\* February–mid-May. **Linear Operators**, Stefan Banach International Mathematical Center, Warsaw, Poland.

ORGANIZERS: J. Janas, F.H. Szafraniec, J. Zemanek.

SUPPORT: The Banach Center covers the living expenses of invited speakers. For other participants, especially for the beginners, a limited number of accommodations at low prices can be provided.

INFORMATION: Banach Center (Linear Operators), ul. Mokotowska 25, 00-950 Warszawa, P.O. Box 137, Poland; banach@impan.impan.gov.pl.

2–4. **IMACS Symposium on Mathematical Modelling**, Vienna, Austria. (Jul./Aug. 1993, p. 711)

\* 6–10. **AMC 94: The Thirtieth Australian**

**Applied Mathematics Conference**, Pokolbin, Hunter Valley, N.S.W.

PROGRAM: The conference provides an interactive forum for presentations of results and discussions on applied problems derived in many scientific fields and amenable to quantitative description and solution. As an incentive to student participation, the T.M. Cherry prize is awarded for the best oral presentation by a student.

INVITED SPEAKERS: N. Dancer, U. of Sydney; D. Dritschel, U. of Cambridge, UK; P. Kloeden, Deakin U., Victoria; A. Mees, U. of Western Australia; T. Roberts, U. of Southern Queensland; N. Barton, CSIRO, Industrial mathematics minisymposium; T. Fackerell, U. of Sydney, Computer algebra minisymposium.

MINISYMPOSIA: Two minisymposia, each lasting one session, will cover industrial mathematics and computer algebra.

INFORMATION: Conference Secretary, 30AMC, School of Mathematics and Statistics, University of Sydney, Sydney, NSW 2006; amc94@maths.su.oz.au.

6–12.  **$C^*$ -Algebren**, Oberwolfach, Federal Republic of Germany. (Mar. 1993, p. 285)

7–11. **Differential Geometry, Hamiltonian Systems, and Operator Theory**, University of the West Indies, Mona, Jamaica. (Jul./Aug. 1993, p. 711)

13–19. **Funktionentheorie**, Oberwolfach, Federal Republic of Germany. (Mar. 1993, p. 285)

\* 14–18. **Workshop on Galois Module Structure**, The Fields Institute, Waterloo, Ontario.

ORGANIZERS: V. Snaith (McMaster University).

PARTICIPANTS: A. Agboola (U. of California at Berkeley), A. Bayad (U. of Augsburg), W. Bley (U. of Augsburg), J. Brinkhuis (Erasmus U.), D. Burns (King's College, London), N. Byott (U. of Exeter), Ph. Cassou-Nogues (U. of Bordeaux I), T. Chinburg (U. of Pennsylvania), B. Erez (U. of Bordeaux I), A. Frohlich (Imperial College, London), C. Greither (U. of Munich), D. Holland (U. of Bristol), U. Jannsen (U. of Cologne), I. Kersten (U. of Bielefeld), L. McCullough (U. of Illinois at Urbana-Champaign), R. Mollin (U. of Calgary), A. Nelson (U. of Sydney), J. Queyruet (U. of Bordeaux I), C. Riehm (McMaster U.), J. Ritter (U. of Augsburg), D. Solomon (U. of Bordeaux I), A. Srivastav (U. of Bordeaux I), M.J. Taylor (U. of Manchester, Institute of Science and Technology), S. Ullom (U. of Illinois at Urbana-Champaign), A. Weiss (U. of Alberta), S.M.J. Wilson (U. of Durham).

INFORMATION: For registration info.: S. Albers, The Fields Institute, 185 Columbia St. West, Waterloo, Ontario, Canada N2L 5Z5;

galois@fields.uwaterloo.ca; fax: 519-725-0704; phone: 519-725-0096.

18–23. **Section A (Mathematics) Sessions at the AAAS Annual Meeting**, San Francisco, CA. (Sep. 1993, p. 924)

20–26. **Harmonische Analyse und Darstellungstheorie Topologischer Gruppen**, Oberwolfach, Federal Republic of Germany. (Mar. 1993, p. 286)

27–March 5. **Mathematical Economics**, Oberwolfach, Federal Republic of Germany. (Mar. 1993, p. 286)

28–March 4. **IMA Workshop on Stochastic Networks**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Jan. 1993, p. 64)

\* 28–March 4. **Workshop on Algebraic K-theory and Arithmetic**, The Fields Institute, Waterloo, Ontario.

ORGANIZERS: M. Kolster (McMaster U.), V. Snaith (McMaster U.).

PARTICIPANTS: G. Banaszak (McMaster U.), W. Bley (U. of Augsburg), S. Bloch (U. of Chicago), J. Browkin (U. of Warsaw), D. Burns (King's College, London), A. Candiotti (Drew U.), V. Fleckinger (U. of Besancon), R. Gillard (U. of Grenoble I), C. Greither (U. of Munich), J. Hurrelbrink (Louisiana State U.), B. Kahn (U. of Paris VII), I. Kersten (U. of Bielefeld), F. Keune (Catholic U., Nijmegen), H. Kisilevsky (Concordia U.), K. Kramer (Queens College, CUNY), M. Kurihara (Tokyo Metropolitan U.), R. C. Laubach (New Mexico State U.), C. Levesque (U. of Laval), B. Magurn (Miami U., Ohio), R. A. Mollin (The U. of Calgary), R. Perrinriou (U. of Paris VII), T. Nguyen Quang Do (U. of Besancon), W. Raskind (U. of Southern California), U. Rehmann (U. of Bielefeld), D. Solomon (U. of Bordeaux I), J. Urbanowicz (Polish Academy of Sciences, Warsaw), A. Weiss (U. of Alberta).

INFORMATION: For registration information: J. Motts, The Fields Institute, 185 Columbia Street West, Waterloo, Ontario, Canada N2L 5Z5; e-mail: k-theory@fields.uwaterloo.ca; fax: 519-725-0704; phone: 519-725-0096.

## March 1994

6–12. **Mathematische Stochastik**, Oberwolfach, Federal Republic of Germany. (Mar. 1993, p. 286)

7–11. **Twenty-fifth Southeastern International Conference on Combinatorics, Graph Theory, and Computing**, Florida Atlantic University, Boca Raton, FL. (Sep. 1993, p. 924)

7–25. **Workshop on Fluid Mechanics**, International Centre for Theoretical Physics, Trieste, Italy. (Jul./Aug. 1993, p. 711)

## Meetings and Conferences

13–17. **The UAB-Georgia Tech International Conference on Differential Equations and Mathematical Physics**, Birmingham, AL. (Oct. 1993, p. 1085)

13–19. **Elementare und Analytische Zahlentheorie**, Oberwolfach, Federal Republic of Germany. (Mar. 1993, p. 286)

17–19. **Seminar on Stochastic Processes 1994**, Texas A&M University, College Station, TX. (Sep. 1993, p. 925)

18–19. **Southeastern Section**, University of Kentucky, Lexington, Kentucky.

INFORMATION: W. Drady, AMS, P.O. Box 6887, Providence, RI 02940.

20–26. **Regelungstheorie**, Oberwolfach, Federal Republic of Germany. (Mar. 1993, p. 286)

21–25. **IMA Period of Concentration: Stochastic Problems for Nonlinear Partial Differential Equations**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (May/June 1993, p. 513)

21–25. **Symplectic Geometry of Moduli Spaces**, CIRM, Marseille/Luminy. (Sep. 1993, p. 925)

\* 21–25. **L-functions Conference**, The Fields Institute, Waterloo, Ontario.

ORGANIZERS: M. Kolster (McMaster U.), V. Snaith (McMaster U.).

PARTICIPANTS: G. Banazak (McMaster U.), W. Bley (U. of Augsburg), S. Bloch (U. of Chicago), T. Chinburg (U. of Pennsylvania), J. Coates (Cambridge U.), J.-L. Colliot-Thelene (U. of Paris-South), C. Deninger (U. of Munster), G. Frey (U. of Essen), A. Goncharov (MIT), D. Goss (Ohio State U.), R. Greenberg (U. of Washington), B. Gross (Harvard U.), M. Harrison (Cambridge U.), D. Hayes (Amherst U.), S. Kim (Korea), H. Kisilevsky (Concordia U.), V. Kolyvagin (Steklov Institute), M. Kurihara (Tokyo Metropolitan U.), W. McCallum (U. of Arizona), G. McConnell (U. of Munster), F. Momose (Chuo U.), E. Nart (U. of Barcelona), T. Nguyen Quang Do (U. of Besancon), N. Nygaard (U. of Chicago), B. Perrin-Riou (U. of Paris VII), B. Ramakrishnan (Mehta Institute), W. Raskind (U. of Southern California), K. Ribet (U. of California at Berkeley), K. Rubin (Ohio State U.), S. Saito (U. of Tokyo), J. Sands (U. of Vermont), P. Schneider (U. of Cologne), C. Schoen (Duke U.), R. Schoof (U. of Trento, Italy), C. Stewart (U. of Waterloo), B. Sury (Tata Institute and U. of Toronto), L. Washington (U. of Maryland), A. Weiss (U. of Alberta), A. Wiles (Princeton U.), H. Zimmer (U. of Saarbrücken).

INFORMATION: For registration information: S. Albers, The Fields Institute, 185 Columbia St. West, Waterloo, Ontario, Canada N2L 5Z5; lmain@fields.uwaterloo.ca;

fax: 519-725-0704; phone: 519-725-0096.

22–24. **The Rhine Workshop on Computer Algebra**, Karlsruhe, Germany. (Sep. 1993, p. 925)

24–26. **Fourth Eugene Lukacs Symposium**, Bowling Green State University, Bowling Green, OH. (Oct. 1993, p. 1085)

\* 24–27. **Joint 1994 Annual Spring Topology Conference and Southeast Dynamical Systems Conference**, Auburn University, Auburn, AL.

PROGRAM: All areas of topology (with an emphasis on geometric topology, general and set-theoretic topology, and continua theory) and dynamical systems will be covered. The dynamical systems portion of the conference will be concentrated in the latter half of the conference.

ORGANIZING COMMITTEE: G. Gruenhage, G. Hetzer, E. Slaminka, and W.R.R. Trantue.

INVITED SPEAKERS: There will be about seven invited hour speakers and approximately 18–20 invited half-hour speakers. Speakers who have accepted invitations so far include J. Bryant, R.D. Edwards, C. Hagopian, Swiatek, S. Todorovic, and J. Xia.

CALL FOR PAPERS: Fifteen minute contributed talks in all branches of topology and dynamical systems are solicited. Send a  $\text{\TeX}$ ,  $\text{\LaTeX}$ , or  $\text{\AMS-TeX}$  file via e-mail or a type-written, camera-ready abstract consisting of 200 words or less to the address below. Deadline: February 21, 1994.

INFORMATION: Organizing Committee for Topology/Dynamical Systems Conference, c/o Dept. of Math., Auburn Univ., AL 36849-5310; e-mail: topdyn@ducvax.auburn.edu.

25–26. **Central Section**, Kansas State University, Manhattan, KS.

INFORMATION: W. Drady, AMS, P.O. Box 6887, Providence, RI 02940.

27–April 2. **Algebraische Gruppen**, Oberwolfach, Federal Republic of Germany. (Mar. 1993, p. 286)

27–April 2. **Endliche Modelltheorie**, Oberwolfach, Federal Republic of Germany. (Mar. 1993, p. 286)

28–30. **Moduli Spaces, Galois Representations, and L-functions**, Research Institute for Mathematical Sciences, Kyoto University, Kyoto, Japan. (Jul./Aug. 1993, p. 711)

28–31. **Twenty-fifth Annual Iranian Mathematics Conference**, Sharif University of Technology, Tehran, Iran. (Jul./Aug. 1993, p. 711)

31–April 2. **Mathematical Approaches to the Study of Nonlinear Materials**, Fayetteville, Arkansas. (Sep. 1993, p. 925)

## April 1994

3–9. **Arbeitsgemeinschaft Mit Aktuellem Thema (wird in den Mitteilungen der DMV Heft 1/1994 Bekanntgegeben)**, Oberwolfach, Federal Republic of Germany. (Mar. 1993, p. 286)

\* 4–10. **Colorado Conference on Iterative Methods**, Breckenridge, CO.

CHAIRMEN: T. Manteuffel and S. McCormick.

SPECIAL FEATURES: Student paper competition, workshops, published proceedings, and a circus.

CONFERENCE TOPICS: Nonsymmetric systems, nonlinear systems, multilevel preconditionings, parallel applications.

CALL FOR PAPERS: Abstract deadline: December 15, 1993.

INFORMATION:

ccim@newton.colorado.edu.

5–9. **MEGA-94, The Third International Symposium on Effective Methods in Algebraic Geometry**, Santander, Spain. (Jul./Aug. 1993, p. 711)

5–11. **Effective Methods in Algebraic Geometry (MEGA '93)**, Santander, Spain. (Mar. 1993, p. 286)

5–15. **Instructional Conference on Harmonic Analysis and Partial Differential Equations**, International Centre for Mathematical Sciences, Edinburgh, Scotland. (Jul./Aug. 1993, p. 711)

\* 7–9. **1994 John H. Barrett Memorial Lectures on Zero-Dimensional Commutative Rings**, University of Tennessee, Knoxville, TN.

PROGRAM: The principal lecturer will give three one-hour talks on recent work on zero-dimensional commutative rings, the hour speakers will each give related talks, and there will be an associated miniconference of 20-minute talks on commutative algebra.

PRINCIPAL SPEAKER: R. Gilmer, Florida State U.

HOURLY SPEAKERS: W. Heinzer, Purdue U.; R. Wiegand, U. of Nebraska.

CALL FOR PAPERS: Submit the title and an abstract for a 20-minute talk by February 1, 1994.

INFORMATION: D.E. Dobbs (dobbs@novell.math.utk.edu), and D.F. Anderson (anderson@novell.math.utk.edu), Math. Dept., Univ. of Tennessee, Knoxville, TN 37996.

8–9. **Mathematical Breakthroughs in the Twentieth Century**, The State University of New York at Farmingdale, NY. (Jul./Aug. 1993, p. 712)



8-10. **Eastern Section**, Polytechnic University, Brooklyn, NY.

INFORMATION: W. Drady, AMS, P.O. Box 6887, Providence, RI 02940.

10-16. **Numerical Linear Algebra with Applications**, Oberwolfach, Federal Republic of Germany. (Mar. 1993, p. 286)

17-22. **International Conference on New Trends in Computer Science I (NETCOMS I)**, University of Ibadan, Nigeria. (Please note date change from Nov. 1992, p. 1121)

17-23. **Designs and Codes**, Oberwolfach, Federal Republic of Germany. (Mar. 1993, p. 286)

18-20. **Conference on Emerging Issues in Mathematics and Computation from the Materials Sciences**, Pittsburgh, PA. (Sep. 1993, p. 925)

\*24-28. **First World Congress on Computational Medicine and Public Health**, University of Texas Center for High Performance Computing, Austin, TX.

PROGRAM: This meeting will bring together a transdisciplinary group of researchers in order to engender discussion of the larger issues of medical computation and its role in the future of the health science disciplines. Mathematical modeling computer simulation and large scale computation are all acceptable areas of participation.

ORGANIZERS: Matthew Witten, Congress chair, University of Texas Center for High Performance Computing, Austin, TX.

CALL FOR PAPERS: Numerous invited and submitted paper sessions.

INFORMATION: CompMed94, UT System CHPC, BRC, 1.154CMS, 10100 Burnet Rd., Austin, TX 78758-4497; 512-471-2472; fax: 512-471-2445; e-mail: compmed94@chpc.utexas.edu; anonymous ftp: ftp.chpc.utexas.edu then cd/pub/compmed94.

24-30. **Geschichte der Mathematik**, Oberwolfach, Federal Republic of Germany. (Mar. 1993, p. 286)

25-29. **Third International Conference on p-adic Functional Analysis**, Clermont-Ferrand, France. (Sep. 1993, p. 925)

### May 1994

1-7. **Gruppentheorie**, Oberwolfach, Federal Republic of Germany. (Mar. 1993, p. 286)

1-7. **Linear Operators and Application**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1993, p. 712)

2-6. **IMA Workshop on Image Models (and Their Speech Model Cousins)**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Jan. 1993, p. 64)

2-6. **International Conference on Topological Vector Spaces, Algebras, and Related Areas**, McMaster University, Hamilton, Ontario, Canada. (Mar. 1993, p. 286)

\*2-6. **Wavelet Analysis as a Tool for Geometric Synthesis and Analysis**, University of Minnesota, Minneapolis, MN.

PROGRAM: Wavelets, and more generally adapted waveform analysis, provide a rich collection of (orthogonal) templates. These can be used for the efficient representation and construction of geometric structures, from fractals to surfaces and images. These methods provide a simple unifying mathematical framework for such tasks as singularity analysis, feature and parameter extraction, as well as data compression. This efficient representation permits faster manipulation of geometric data, providing new fast algorithms for CAD as well as image matching and deformation. Its focus will be on algorithmic/computational techniques. Because of limited staff and computing resources, the number of participants will be limited to about thirty.

INFORMATION: Organizer, R. Coifman at coifman@jules.math.yale.edu, Yale U.

3-14. **The Fourth International School on Differential Equations: Bifurcations and Chaos**, Katsiveli, Crimea, Ukraine. (Sep. 1993, p. 926)

8-14. **Variationsrechnung**, Oberwolfach, Federal Republic of Germany. (Mar. 1993, p. 286)

14-18. **International Congress Henri Poincaré**, Archives-Centre d'Etudes et de Recherche Henri-Poincaré, Nancy, France. (Jul./Aug. 1993, p. 712)

15-21. **Critical Phenomena in Spatial Stochastic Models**, Oberwolfach, Federal Republic of Germany. (Mar. 1993, p. 286)

16-20. **IMA Workshop on Stochastic Models in Geosystems**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Jan. 1993, p. 64)

16-20. **Géométrie Algébrique**, CIRM, Marseille, France. (Jan. 1993, p. 64)

16-27. **Workshop on Commutative Algebra and its Relation to Combinatorics and Computer Algebra**, International Centre for Theoretical Physics, Trieste, Italy. (Jul./Aug. 1993, p. 712)

22-24. **Conference in Honor of E. Dynkin**, MSI, Ithaca, NY. (Jul./Aug. 1993, p. 712)

22-27. **Nonlinear Analysis, Function Spaces, and Applications, V**, Prague, Czech Republic. (Sep. 1993, p. 926)

22-28. **Diskrete Geometrie**, Oberwolfach, Federal Republic of Germany. (Mar. 1993, p. 287)

23-25. **Twenty-sixth Symposium on Theory of Computing (STOC)**, Montreal, Canada.

(September 1993, p. 926)

\*23-25. **The 1994 Scalable High Performance Computing Conference, SHPCC94**, Knoxville, TN.

CONFERENCE TOPICS: Architectures, artificial intelligence, compilers, concurrent languages, fault tolerance, image processing, large-scale applications, C++, load balancing, linear algebra, neural networks, nonnumerical algorithms, operating systems, programming environments, scalable libraries.

INVITED SPEAKERS: G. Blelloch, Carnegie Mellon U.; P. Colella, UC Berkeley; D. Culler, UC Berkeley; M. Lam, Stanford U.; M. Snir, IBM T.J. Watson Res. Ctr.

INFORMATION: walker@msr.epm.ornl.gov

\*23-27. **Elliptic and Parabolic Methods in Geometry**, University of Minnesota, Minneapolis, MN.

PROGRAM: The availability of powerful hardware and software makes it possible to address geometrical questions in low dimensions by numerical simulation and to represent results in a meaningful and flexible visual format. These questions were previously accessible only to the imagination. The majority of mathematicians pursuing these questions in traditional pencil-and-paper ways, however, have no ready access to the intelligent use of computers to attack geometrical problems. At the same time, the best ideas and most fundamental contributions to the understanding of geometrical phenomena have not always been available to the people who are writing software. One goal of this workshop is to bring these two sides together in fruitful ways. It is planned to organize each of the five days, Monday through Friday, into about seven talks or software demonstrations. There will be at least two short courses on useful software packages, with repeated opportunities for workshop participants to see what the program can do, ask questions, propose alternative experiments, or get some hands-on experience in the use of the software. In addition we will allow some time for less formal interaction between participants.

INVITED SPEAKERS: *Tentative*: F. Almgren, S. Altschuler, B. Andrews, S. Angenent, K. Brakke, C. Evans, R. Hamilton, Z.-C. Han, B. Hardt, L. Hsu, G. Huisken, J. Hutchinson, T. Ilmanen, N. Kapouleas, R. Kusner, J. Lee, P. Li, F. Lin, J. Pitts, K. Polthier, J. Rade, R. Schoen, L. Simon, J. Spruck, I. Sterling, M. Struwe, G. Tian, F. Wei, B. White, L.-F. Wu, D. Yang, S.-T. Yau, R. Ye. Also, in addition to the organizers, the following mathematicians will be participating in the workshop: S. Adams, P. Burchard, P. Daskalopoulos, L. Green, C. Leung, J. Nitsche, D. Pollack, Y.

## Meetings and Conferences

Shen, T. Toro, and L. Wang.

INFORMATION: The Organizing Committee, Ben Chow, Bob Gulliver, John Sullivan, Univ. of Minnesota, epmg@geom.umn.edu.

24–27. **Conference on Hermann G. Graßmann (1809–1877)**, Isle of Rügen, Germany. (September 1992, p. 775)

24–28. **International Workshop on Mathematical Methods and Tools in Computer Simulation**, St. Petersburg State University, St. Petersburg, Russia. (Sep. 1993, p. 926)

25–28. **Second Conference on Function Spaces**, Southern Illinois University at Edwardsville, Illinois. (Sep. 1993, p. 926)

\*26–28. **Spatial Stochastic Models in Biology**, The University of Colorado at Colorado Springs.

PROGRAM: The conference will bring together biologists and mathematicians who are interested in applying probability models to biology. Several hour-long presentations by a principal speaker as well as several short communications sessions.

ORGANIZING COMMITTEE: R. Schinazi, schinazi@vision.uccs.edu; G. Morrow, gjmorrow@colospgs.bitnet; Y. Zhang, yzhang@vision.uccs.edu.

INVITED SPEAKERS: *Tentative*: H. Caswell, Woods Hole; T. Cox, Syracuse; R. Durrett, Cornell; B. Gardner, Oak Ridge; D. Griffeth, Madison; L. Gross, Knoxville; S. Levin, Princeton.

INFORMATION: Spatial Stochastic Models in Biology, Dept. of Math., University of Colorado, Colorado Springs, CO 80933; 719-593-3311; fax: 719-593-3588.

26–29. **ICANN '94-International Conference on Artificial Neural Networks**, Sorrento Congress Center, near Naples, Italy. (Jul./Aug. 1993, p. 712)

29–June 3. **International Conference on Real and Complex Algebraic Geometry**, Soesterberg, The Netherlands. (Jul./Aug. 1993, p. 712)

29–June 4. **Singulare Störungsrechnung**, Oberwolfach, Federal Republic of Germany. (Mar. 1993, p. 287)

29–June 4. **Workshop on Harmonic Analysis, Oscillatory Integrals, and Partial Differential Equations**, International Centre for Mathematical Sciences, Edinburgh, Scotland. (Jul./Aug. 1993, p. 713)

30–June 3. **On the Interaction between Functional Analysis, Harmonic Analysis, and Probability**, University of Missouri-Columbia, Columbia, MO. (Jul./Aug. 1993, p. 713)

30–June 9. **Workshop on Group Representation Theory**, Technion, Israel Institute of Technology, Haifa, Israel. (Dec. 1992, p. 1284)

31–June 3. **IMA Minisymposium on Phase Transitions in Catalytic Surface Reaction Models**, Institute for Mathematics and its Ap-

plications, University of Minnesota, Minneapolis, MN. (Jan. 1993, p. 64)

### June 1994

\*1–7. **1994 Barcelona Conference on Algebraic Topology**, Sant Feliu de Guixols (near Barcelona, Spain). (Please note additional information to Jan. 1993, p. 64)

CONFERENCE TOPICS: The conference will focus on new trends in localization and periodicity, although other areas in homotopy theory are not excluded.

INVITED SPEAKERS: Only one-hour invited lectures are planned. The speakers are: J. Berrick, D. Blanc, P. Bousfield, C. Casacuberta, F. Cohen, E. Farjoun, B. Dwyer, J. Hubbuck, R. Kane, L. Langsetmo, R. Levi, H. Miller, J. Moller, D. Notbohm, G. Peschke, D. Ravenal, Y. Xia, S. Zarati. Poster sessions will be organized in order to acknowledge additional communications by participants.

INFORMATION: Updated information about the conference is available by anonymous ftp at node 158.109.0.11, in the directory BCAT94.

5–11. **The Navier-Stokes Equations: Theory and Numerical Methods**, Oberwolfach, Germany. (Jul./Aug. 1993, p. 713)

\*6–10. **Applied and Industrial Mathematics**, University of Linköping, Linköping, Sweden.

PROGRAM: The conference will focus on the use of differential equations for modelling in science and industry as well as on numerical solution techniques for differential and integral equations.

INVITED SPEAKERS: G. Fichera, Rome; I. Babuska, College Park, Maryland; H. Brezis, Paris; B. Engquist, Stockholm; G. Eskin, Los Angeles; I. Gohberg, Tel Aviv; B. Gustafson, Uppsala; J. Haslinger, Prague; B. Haggblad, Vasteras; R. Kleinman, Newark, Delaware; D. Kinderlehrer, Pittsburgh; E. Meister, Darmstadt; S. Prossdorf, Berlin; P.D. Panagiotopoulos, Thessaloniki; R. Temam, Orsay; V. Thomee, Gothenburg; W.L. Wendland, Stuttgart; J. Whiteman, London.

INFORMATION: V. Maz'ya or L.E. Andersson, Dept. of Math., Univ. of Linköping, S-581 183 Linköping, Sweden; tel: Maz'ya +46 13 28 23 73 (national 013-28 23 73), Andersson +46 13 28 14 17 (national 013-28 14 17); fax: +46 13 10 07 46 (national 013-10 07 46); vlmaz@math.liu.se or leand@math.liu.se.

12–18. **Nichtlinearitäten vom Hysterisistyp**, Oberwolfach, Federal Republic of Germany. (Mar. 1993, p. 287)

13–17. **Fifth International Conference on Hyperbolic Problems: Theory, Numerical**

**Methods, and Applications**, Stony Brook, NY. (May/Jun. 1992, p. 497)

13–17. **European Conference on Elliptic and Parabolic Problems**, Pont-à-Mousson, France. (May/Jun. 1993, p. 514)

Summer 1994. **Summer Regional Centers-TRANSIT**, Ohio State University, Columbus, OH. (Oct. 1992, p. 951)

13–17. **IMA Workshop on Classical & Modern Branching Processes**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Jan. 1993, p. 64)

15–18. **Fifth SIAM Conference on Applied Linear Algebra**, Snowbird, Utah. (Sep. 1993, p. 927)

16–18. **Western Section**, University of Oregon, Eugene, Oregon.

INFORMATION: W. Drady, AMS, P.O. Box 6887, Providence, RI 02940.

19–25. **Quantenmechanik von Vielteilchen Systemen**, Oberwolfach, Federal Republic of Germany. (Mar. 1993, p. 287)

19–25. **Integrable Systems from a Quantum Point of View**, Oberwolfach, Federal Republic of Germany. (Mar. 1993, p. 287)

20–24. **Probabilités Quantiques**, CIRM, Marseille, France. (Jan. 1993, p. 64)

20–24. **IMA Workshop on Mathematics in Manufacturing Logistics**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Sep. 1993, p. 927)

22–25. **Seventh SIAM Conference on Discrete Mathematics**, Albuquerque, NM. (Sep. 1993, p. 927)

25–July 2. **Symposium on Diophantine Problems in Honor of Wolfgang Schmidt's 60th Birthday**, Boulder, Colorado. (May/Jun. 1993, p. 514)

26–July 2. **Graphentheorie**, Oberwolfach, Federal Republic of Germany. (Mar. 1993, p. 287)

26–July 2. **Inverse Problems**, Lake St. Wolfgang, Austria. (May/Jun. 1993, p. 514)

\*28–July 1. **Structure in Complexity Theory, Ninth Annual IEEE Conference**, Amsterdam, The Netherlands.

PROGRAM COMMITTEE: U. Schöning (chair), A. Condon, R. Gavalda, J. Hartmanis, U. Hertrampf, N. Immerman, N. Nisan, R. Reischuk, L. Torenvliet.

CONFERENCE TOPICS: All areas of computational complexity including: structure of complexity classes, properties of complete sets, resource-bounded reducibilities, relativizations, circuit complexity, complexity and logic, interactive proof systems, Kolmogorov complexity, cryptographic complexity, structural aspects of distributed and parallel computing.

CALL FOR PAPERS: Send 10 copies of an

extended abstract to the program chair: U. Schöning, Univ. Ulm, Abteilung Theoretische Informatik, D-89069 Ulm, Germany; schoenin@informatik.uni-ulm.de. The deadline for abstracts is December 1, 1993.

INFORMATION: J. Royer, Dept. of Comp. and Inf. Sci., Syracuse U., Syracuse, NY 13244; structures@top.cis.syr.edu.

### July 1994

2-8. **Fourth Conference of the Canadian Number Theory Association**, Dalhousie University, Halifax, Nova Scotia, Canada. (Sep. 1993, p. 927)

3-9. **Analysis und Geometrie Singulärer Räume**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 415)

4-7. **Ninth Annual IEEE Symposium on Logic in Computer Science**, Paris, France. (Oct. 1993, p. 1087)

4-8. **International Conference on Computer Aided Geometric Design (CAGD)**, Penang, Malaysia. (Jul./Aug. 1993, p. 713)

4-8. **Thirty-eighth Annual Meeting of the Australian Mathematical Society**, University of New England in Armidale, Australia. (Oct. 1993, p. 1087)

5-9. **Twenty-fourth National Conference on Geometry and Topology (CNGT 24)**, University of Timișoara, Romania. (Jul./Aug. 1993, p. 713)

5-22. **Conference on Differential and Difference Equations and Recent Developments in Population Biology**, University of Wyoming, Laramie, WY.

PROGRAM: The workshop will be organized around mathematical models, both discrete and continuous, that are used in structured population dynamics, ecology, and related subjects. Mornings will be devoted to lectures by the principal speakers as well as several invited speakers. Invited speakers will also discuss applications to a variety of topics. During the afternoons, participants will have opportunities for projects, informal seminars, and use of computational tools. In addition, there will be group discussions on topics of common interest, including the incorporation of these mathematical topics and biological applications into the undergraduate curriculum. NSF funds to cover living expenses may be available. Women, minorities, and faculty from two- and four-year colleges are especially encouraged to apply.

CONFERENCE TOPICS: 1-D maps, linear and nonlinear matrix equations, the McKendrick partial differential equation, Perron-Frobenius theory, ergodic theorems, bifurcation theory, equilibrium and nonequilibrium dynamics (including aperiodicity

and chaos). Applications will be made to problems in dynamics and ecology.

PRINCIPAL SPEAKERS: J.M. Cuhing, U. of Arizona, and K.M. Crowe, Cornell U.

INFORMATION AND APPLICATION FORMS: A.D. Porter, Math. Dept., P.O. Box 3036, Univ. of Wyoming, Laramie, WY 82071-3036; adporter@corral.uwyo.edu.

5-29. **IMA Summer Program on Molecular Biology**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Apr. 1993, p. 415)

10-16. **Freie Randwertprobleme**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 415)

11-15. **Fourteenth IMACS World Congress on Computational and Applied Mathematics**, Georgia Institute of Technology, Atlanta, GA. (Oct. 1992, p. 951)

14-18. **LFCS'94: Logic at St. Petersburg, a Symposium on Logical Foundations of Computer Science**, St. Petersburg, Russia. (Jul./Aug. 1993, p. 714)

17-23. **Conférence Internationale de Topologie**, CIRM, Marseille, France. (Jan. 1993, p. 64)

17-23. **Algebraische Zahlentheorie**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 415)

17-23. **Workshop on Harmonic Analysis and Elliptic Partial Differential Equations**, International Centre for Mathematical Sciences, Edinburgh, Scotland. (Jul./Aug. 1993, p. 714)

18-22. **Sixth International Conference on Fibonacci Numbers and Their Applications**, Washington State University, Pullman, WA. (Jul./Aug. 1993, p. 714)

18-29. **Fifth Workshop of Stochastic Analysis of Oslo-Silivri**, Silivri, Istanbul, Turkey. (Oct. 1993, p. 1087)

20-30. **Third Souslin Conference**, Saratov, Russia. (Jul./Aug. 1993, p. 714)

24-30. **Complex Geometry: Moduli Problems**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 415)

25-29. **Représentation des Groupes Reductifs  $p$ -adiques**, CIRM, Marseille, France. (Nov. 1992, p. 1122)

25-29. **1994 SIAM Annual Meeting**, San Diego, CA. (Sep. 1993, p. 927)

31-August 6. **Mechanics of Materials**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 415)

### August 1994

1-5. **Third World Congress on Computational Mechanics (WCCM III)**, Chiba, Japan. (May/Jun. 1992, p. 497)

3-11. **The International Congress of Mathe-**

**maticans 1994**, Zürich, Switzerland. (Jul./Aug. 1993, p. 714)

7-13. **Effiziente Algorithmen**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 416)

12-20. **1994 Summer Workshop-Conference on Classical and Quantum Geometry of Homogeneous Spaces**, International Sophus Lie Centre, Moscow. (Oct. 1993, p. 1087)

13-17. **Third Colloquium on Numerical Analysis**, Plovdiv, Bulgaria. (Apr. 1993, p. 416)

14-20. **Nonlinear Evolution Equations**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 416)

\* 14-21. **International Conference on Functional Differential Equations and Applications**, Moscow, Russia.

PROGRAM: The scientific program will consist of invited lectures and short communications. The conference will consider the following fields of FDE: qualitative theory, stability, boundary value problems, calculus of variations, control theory, FDE with partial derivatives, differential equations with nonlocal boundary conditions, operator differential equations, diffusion processes, numerical methods, applications.

ORGANIZERS: Moscow Aviation Institute with the cooperation of the Russian Academy of Sciences and the Moscow Mathematical Society.

CALL FOR PAPERS: Abstract deadline: May 1, 1994.

INFORMATION: A.L. Skubachevskii, Moscow Aviation Institute, Russia, 125871, Moscow, Volokolamskoe shosse 4; fax: (095) 158-29-77; e-mail: aet@tk.mainet.msk.su; telex: 411746 SOKOL SU.

\* 14-27. **NATO Advanced Study Institute on "Finite and Locally Finite Groups"**, Bosphorus University, Istanbul, Turkey.

PROGRAM: The main aim of this conference is to present the current state of knowledge in some areas in which these fields seem particularly to overlap and to explore ways in which they influence each other in the future. Several speakers will present short courses of about three lectures, at a level which is intended to be accessible to senior postgraduate students working in areas related to group theory, as well as being of interest to more experienced workers. There will also be some opportunity for contributed talks.

INVITED SPEAKERS AND TITLES: M.W. Liebeck, J. Saxl, G. Seitz, Finite groups of Lie type and finite permutation groups; J.I. Hall, B. Hartley, R.E. Phillips, A.E. Zalesski, Simple locally finite groups and finitary linear groups; R.M. Bryant, I.M. Isaacs, A. Turull, Topics in representation

theory; A. Shalev,  $p$ -groups; A.V. Borovik, Groups of finite Morley rank; F. Leinen, Existentially closed groups.

INFORMATION: I. Güloğlu, Dept. of Math., Middle East Technical Univ., Ankara 06531, Turkey.

15–17. **Mathfest**, University of Minnesota, Minneapolis, MN (including the summer meetings of the AMS, AWM, MAA, and PME).

INFORMATION: H. Daly, AMS, P.O. Box 6887, Providence, RI 02940.

\* 15–18. **Tenth Summer Conference on General Topology and Applications**, Free University, Amsterdam, The Netherlands.

PROGRAM: The conference is part of the ongoing series of Summer Conferences on General Topology and Applications. It will feature four special sessions devoted to continuum theory and dynamics, infinite dimensional and geometric topology, set theoretic topology, and topology and descriptive set theory. There will also be minicourses on continuum theory and dynamics and topology and descriptive set theory. Participants are invited to present twenty-minute talks. Registration fee is Dfl 270 (US\$150).

PRINCIPAL SPEAKERS: *Opening lectures*: J.W. Milnor, Stony Brook; M.E. Rudin, Madison. *Closing lecture*: I. Moerdijk, Utrecht. *Minicourses*: Ph. L. Boyland, Stony Brook; A.S. Kechris, Pasadena. *Special Sessions*: B. Balcar, Prague; H.S. Becker, Columbia; T. Dobrowolski, Tulsa; A. Dow, Toronto; H. Gladdines, Amsterdam; R.D. Mauldin, Denton; A.W. Miller, Madison; L.G. Oversteegen, Birmingham; J. Pelant, Prague; R. Pol, Warsaw; S.J. van Strien, Amsterdam; F. Takens, Groningen; S. Todorović, Toronto.

INFORMATION: E. Coplakova, Faculty of Technical Mathematics and Informatics, TU Delft, P.O. Box 5031, 2600 GA Delft, The Netherlands; e-mail: info94@dutiaw3.twi.tudelft.nl.

15–19. **Fifteenth International Symposium on Mathematical Programming**, University of Michigan, Ann Arbor, MI. (May/June 1993, p. 515)

15–26. **Advanced Workshop on Algebraic Geometry**, International Centre for Theoretical Physics, Trieste, Italy. (Jul./Aug. 1993, p. 714)

16–20. **ICMI-China Regional Conference on Mathematics Education**, Shanghai, China. (Jul./Aug. 1993, p. 714)

18–23. **Fifth Colloquium on Differential Equations**, Plovdiv, Bulgaria. (Apr. 1993, p. 416)

\* 18–25. **Third International Conference on Group Theory**, Pusan, Republic of Korea.

INVITED SPEAKERS: B. Amberg, Mainz;

C. Campbell, St. Andrews; K. Doerk, Mainz; M.J. Dunwoody, Southampton; D. Garbe, Bielefeld; C. Gupta, Manitoba; N. Gupta, Manitoba; H. Helling, Bielefeld; J. Howie, Heriot-Watt; N. Ito, Meiji; L. Kovacs, Canberra; P. Kropholler, London; T. Maeda, Kansai; J. McCool, Toronto; J.L. Mennicke, Bielefeld; B.H. Neumann, Canberra; W. Neumann, Melbourne; A. Yu O'lsanskii, Moscow; C. Praeger, Netherlands; S. Pride, Glasgow; A. Rhemtulla, Edmonton; E. Robertson, St. Andrews; D. Robinson, Urbana-Champaign; J. Rolfs, Eichstadt; G. Rosenberger, Dortmund; K. Shum, Hong Kong; J.R. Stallings, Berkeley; F. Tang, Waterloo; R. Thomas, Leicester; H. Yamaki, Tohoku; H. Zieschang, Bochum.

INFORMATION: A.C. Kim, Math. Dept., Pusan National Univ., PUSAN 607, Republic of Korea; ackim@hyowon.pusan.ac.kr; or D.L. Johnson, Math. Dept., University Park, Nottingham NG7 2RD, UK; dlj@uk.ac.nott.maths.

20–26. **International Conference on Rings and Radicals**, Shijiazhuang, China. (Mar. 1993, p. 287)

21–27. **Mathematical Models in Phase Transitions**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 416)

22–26. **Sixth Conference on Numerical Methods in Hungary**, Miskolc University, Miskolc, Hungary. (Sep. 1993, p. 928)

28–September 3. **Komplexe Analysis**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 416)

### September 1994

September 1994. **Suslin Jubilee International Conferences**, Suslin Foundation, Russia. (Oct. 1993, p. 1088)

4–10. **Topologie**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 416)

6–8. **International Conference on Parallel Processing: CONPAR 94-VAPP VI**, Linz, Austria. (Oct. 1993, p. 1088)

11–17. **Homotopietheorie**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 416)

15–19. **Fifteenth International Symposium on Mathematical Programming**, University of Michigan, Ann Arbor, MI. (Apr. 1993, p. 416)

18–20. **Teaching of Mathematics for Industry**, Prague. (Jul./Aug. 1993, p. 715)

18–24. **Risk Theory**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 416)

\* 18–24. **DMV-Jahrestagung 1994 (Annual Meeting of the German Mathematical Society)**, Duisberg, Federal Republic of Germany.

INVITED SPEAKERS: Bayer, Columbia; Dahmen, Aachen; Eigen, Göttingen; Foellmer,

Bonn; Majda, Princeton; Manin, Bonn; Moser, Zurich; Mueller, Bonn; Neunzert, Kaiserslautern; Rubin, Ohio State; Sarnak, Princeton; Schneider, Köln; Schoen, Stanford; Seymour, Morristown; Turaev, Strassburg.

CALL FOR PAPERS: Contributed talks of twenty minutes can be submitted for the following sections: 1. industrial mathematics; 2. numerical mathematics; 3. stochastic; 4. function theory, complex analysis, and algebraic geometry; 5. ordinary differential equations; 6. partial differential equations; 7. history of mathematics and mathematics education; 8. number theory; 9. topology and differential geometry; 10. discrete mathematics (graph theory/combinatorics/geometry); 11. computer algebra; 12. scientific computing; 13. algebra; 14. functional analysis and operator algebras; 15. logic and theoretical informatics.

INFORMATION: W. Eberhard or K.W. Wiegmann, Univ. of Duisburg, FB Math., Jahrestagung 1994, Lotharstr. 65, D-47048 Duisburg, Germany; fax: (49 203) 379 3139; eberhard@math.uni-duisburg.de or wiegmann@math.uni-duisburg.de; tel: ex: 855 793 uni du d.

19–23. **3ème Atelier International de Théorie des Ensembles**, CIRM, Marseille, France. (Apr. 1993, p. 416)

\* 21–22. **International Symposium on Object-Oriented Methodologies and Systems**, Palermo, Italy.

CONFERENCE TOPICS: Suggested topics include but are not limited to: active object systems; applications (GIS, medical systems, telecommunications); distributed/parallel object-systems; formal models; integration of object-oriented programming languages with other programming paradigms; multimedia systems; object database systems; object-oriented design methodologies; operating systems; object-oriented integration approaches; object-based knowledge representation models; secure object systems.

CALL FOR PAPERS: The primary focus is on high quality original unpublished research, case studies, and implementation experiences. Also encouraged are submissions of papers of industrial nature discussing product/prototype development or industrial applications. Authors are invited to submit six copies of papers, no more than 15 pages, before February 20, 1994.

INFORMATION: F. Sorbello, Dipt. di Ingegneria Elettrica, Univ. di Palermo, Viale delle Scienze, 90128 Palermo (Italy); tel: +39-91-6566111; fax: +39-91-488452; e-mail: sorbello@vlsipa.cres.it; or E. Ardizzone, tel: +39-91-6566255; fax: +39-91-488452; ardizzone@vlsipa.cres.it.

## Meetings and Conferences

21–23. **Meeting on Matrix Analysis and Its Applications**, Vitoria-Gasteiz, Spain. (Oct. 1993, p. 1088)

25–October 1. **Mathematical Methods in Tomography**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 416)

26–October 1. **First International Workshop on Functional Analysis**, Trier University, near Luxembourg, Germany. (Oct. 1993, p. 1088)

---

### October 1994

2–8. **Randelementmethoden: Anwendungen und Fehleranalysis**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 416)

9–15. **Arbeitsgemeinschaft mit Aktuellem Thema (Wird in den Mitteilungen der DMV Heft 3/1994 Bekanntgegeben)**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 416)

10–28. **School/Workshop on Variational and Local Methods in the Study of Hamiltonian Systems**, International Centre for Theoretical Physics, Trieste, Italy. (Jul./Aug. 1993, p. 715)

\* 12–18. **CARI '94: Second African Conference on Research in Computer Science**, Ouagadougou (Burkina-Faso).

**PROGRAM:** In parallel to the presentation of 120 research papers, a scientific committee has been established with the mandate to: 1. review the existing infrastructure and define the needs for research and advanced training; 2. facilitate the emergence of cooperative projects between the African universities; 3. initiate and coordinate the organization of scientific manifestations. The scientific committee would like to particularly encourage those papers contributing to technological development, to better awareness of the environment, and to the management of natural resources.

**CONFERENCE TOPICS:** Software engineering, parallel computing, scientific computation, architecture, databases, networks, computer vision, artificial intelligence, programming language, operating systems.

**CALL FOR PAPERS:** Authors are invited to submit five copies of the full text of their most recent research results by February 15, 1994.

**INFORMATION:** Secretariat CARI '94, INRIA-BP 105, 78153 Le Chesnay cedex, France; secretariat-cari@orstom.fr.

16–22. **Geometrie**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 416)

23–29. **Wahrscheinlichkeitsmaße auf Gruppen und Verwandten Strukturen**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1993, p. 715)

28–29. **Central Section**, Oklahoma State University, Stillwater, Oklahoma.

**INFORMATION:** W. Drady, AMS, P.O. Box 6887, Providence, RI 02940.

30–November 5. **Finite Volume Methods**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 416)

---

### November 1994

11–13. **Southeastern Section**, University of Richmond, Richmond, VA.

**INFORMATION:** W. Drady, AMS, P.O. Box 6887, Providence, RI 02940.

13–17. **1994 International Symposium on Logic Programming**, MSI, Ithaca, NY. (Jul./Aug. 1993 p. 715)

13–19. **Komplexitätstheorie**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 417)

20–26. **Mathematical Aspects of Computational Fluid Dynamics**, Oberwolfach, Federal Republic of Germany. (Apr. 1993, p. 417)

27–December 3. **Mathematical Models for Infectious Diseases**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1993, p. 715)

---

**The following new announcements will not be repeated until the criteria in the last paragraph in the box at the beginning of this section are met.**

---

### January 1995

4–7. **Joint Mathematics Meetings**, San Francisco, CA (including the annual meetings of the AMS, AWM, MAA, and NAM).

**INFORMATION:** H. Daly, AMS, P.O. Box 6887, Providence, RI 02940.

---

### March 1995

4–5. **Eastern Section**, Hartford, Connecticut.

**INFORMATION:** W.S. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

17–18. **Southeastern Section**, Orlando, Florida.

**INFORMATION:** W.S. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

24–25. **Central Section**, DePaul University, Chicago, IL.

**INFORMATION:** W. Drady, AMS, P.O. Box 6887, Providence, RI 02940.

---

### November 1995

3–4. **Central Section**, Kent State University, Kent, Ohio.

**INFORMATION:** W. Drady, AMS, P.O. Box 6887, Providence, RI 02940.

---

### January 1996

10–13. **Joint Mathematics Meetings**, Orlando, Florida (including the annual meetings of the AMS, AWM, MAA, and NAM).

**INFORMATION:** H. Daly, AMS, P.O. Box 6887, Providence, RI 02940.

---

### March 1996

22–23. **Central Section**, University of Iowa, Iowa City, Iowa.

**INFORMATION:** W. Drady, AMS, P.O. Box 6887, Providence, RI 02940.

---

### April 1996

19–21. **Southeastern Section**, Baton Rouge, Louisiana.

**INFORMATION:** W.S. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

---

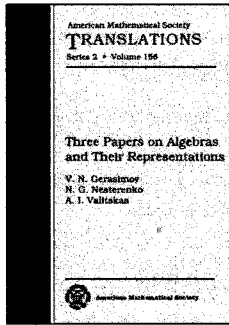
### January 1997

10–13. **Joint Mathematics Meetings**, San Diego, California (including the annual meetings of the AMS, AWM, MAA, and NAM).

**INFORMATION:** H. Daly, AMS, P.O. Box 6887, Providence, RI 02940.

# New Publications Offered by the AMS

## AMERICAN MATHEMATICAL SOCIETY TRANSLATIONS—SERIES 2



### Three Papers on Algebras and Their Representations V. N. Gerasimov, N. G. Nesterenko, and A. I. Valitskas Volume 156

This book contains the doctoral dissertations of three students from Novosibirsk who participated in the seminar of L. A. Bokut'. The dissertation of Gerasimov focuses on Cohn's theory

of noncommutative matrix localizations. Gerasimov presents a construction of matrix localization that is not directly related to (prime) matrix ideals of Cohn, but rather deals with localizations of arbitrary subsets of matrices over a ring. The work of Valitskas applies ideas and constructions of Gerasimov to embeddings of rings into radical rings (in the sense of Jacobson) to develop a theory essentially parallel to Cohn's theory of embeddings of rings into skew fields. Nesterenko's dissertation solves some important problems of Anan'in and Bergman about representations of (infinite-dimensional) algebras and categories in (triangular) matrices over commutative rings.

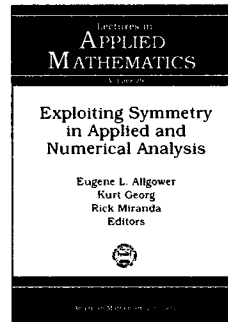
#### Contents

**Part I:** Free associative algebras and inverting homomorphisms of rings; Free algebras and algebras with a single relation; Inverting homomorphisms of rings;  
**Part II:** Representations of algebras by triangular matrices; Representability of triangular categories and graded algebras; Representation of algebras by triangular matrices. Algebras with diagonal; Special representations of nilpotent graded algebras; **Part III:** Embedding rings in radical rings and rational identities of radical algebras; Absence of a finite basis of quasi-identities for the quasi-variety of rings embeddable in radical rings; Examples of noninvertible rings embeddable in a group; Representation of finite-dimensional Lie algebras in radical rings; Rational identities of radical algebras; References.

1991 Mathematics Subject Classification: 16Gxx, 16Nxx  
ISBN 0-8218-7503-5, LC 93-20884, ISSN 0065-9290  
195 pages (hardcover), November 1993

Individual member \$59, List price \$98, Institutional member \$78  
To order, please specify TRANS2/156N

## LECTURES IN APPLIED MATHEMATICS



### Exploiting Symmetry in Applied and Numerical Analysis Eugene L. Allgower, Kurt Georg, and Rick Miranda, Editors Volume 29

Symmetry plays an important role in theoretical physics, applied analysis, classical differential equations, and bifurcation theory. Although numerical

analysis has incorporated aspects of symmetry on an ad hoc basis, there is now a growing collection of numerical analysts who are currently attempting to use symmetry groups and representation theory as fundamental tools in their work. This book contains the proceedings of an AMS-SIAM Summer Seminar in Applied Mathematics, held in 1992 at Colorado State University. The seminar, which drew about 100 scientists from around the world, was intended to stimulate the systematic incorporation of symmetry and group theoretical concepts into numerical methods. The papers in this volume have been refereed and will not be published elsewhere.

#### Contents

**B. Abraham-Shrauner and P. G. L. Leach,** Hidden symmetries of nonlinear ordinary differential equations; **E. Allgower, P. Ashwin, K. Böhmer, and Z. Mei,** Liapunov-Schmidt reduction for a bifurcation problem with periodic boundary conditions on a square domain; **E. Allgower, K. Georg, and R. Miranda,** Exploiting permutation symmetries with fixed points in linear equations; **D. Armbruster and E. Ihrig,** Topological constraints for explicit symmetry breaking; **P. Ashwin, K. Böhmer, and Z. Mei,** A numerical Liapunov-Schmidt method for finitely determined problems; **N. Aubry and W. Lian,** Exploiting and detecting space-time symmetries; **E. Barany,** Lattice periodic solutions with local gauge symmetry; **G. Bluman,** An overview of potential symmetries; **A. Bossavit,** On the computation of strains and stresses in symmetrical articulated structures; **F. H. Busse and R. M. Clever,** Symmetry considerations in the numerical analysis of bifurcation sequences; **P. Chossat and E. Protte,** On the existence of rotating waves in a steady-state bifurcation problem with  $O(3)$  symmetry; **G. Dangelmayr, J. D. Rodriguez, and W. Güttinger,** Dynamics of waves in extended systems; **M. Dellnitz and I. Melbourne,** The equivariant Darboux theorem; **M. J. Englefield,** Invariant boundary conditions for the generalized diffusion equations; **A. Fässler,** The power of the generalized Schur's lemma; **K. Gatermann,** Computation of bifurcation graphs; **Z. Ge,** Caustics in optimal control: An example

Three easy ways to order: 1) call 800-321-4AMS (321-4267) in the U.S. and Canada to use VISA or MasterCard;  
2) use the order form in the back of this issue; or 3) use e-mail via the Internet: [cust-serv@math.ams.org](mailto:cust-serv@math.ams.org).

of bifurcation when the symmetry is broken; **K. Georg and R. Miranda**, Symmetry aspects in numerical linear algebra with applications to boundary element methods; **M. He**, Numerical results on the zeros of Faber polynomials for  $m$ -fold symmetric domains; **W. Hereman**, SYMMGRP.MAX and other symbolic programs for Lie symmetry analysis of partial differential equations; **B. Hong**, A manifold solver with bifurcation and symmetry; **B. L. Keyfitz and M. Lopes-Filho**, How to use symmetry to find models for multidimensional conservation laws; **K. Kirchgässner and K. Lankers**, Semilinear elliptic equations in cylindrical domains—reversibility and its breaking; **G. H. Knightly and D. Sather**, Symmetry in rotating plane Couette-Poiseuille flow; **H.-P. Kruse, J. E. Marsden, and J. Scheurle**, On uniformly rotating fluid drops trapped between two parallel plates; **Pol V.A.J. Lambert**, The symmetry group of the integro-partial differential equations of Poisson-Vlasov; **R. I. McLachlan**, Explicit symplectic splitting methods applied to PDE's; **H. D. Mittelmann**, Symmetric capillary surfaces in a cube Part 2. Near the limit angle; **D. H. Sattinger and J. S. Szmigielski**, Factorization and completely integrable systems; **A. Steindl**, Hopf/Steady-state mode interaction for a fluid conveying elastic tube with  $D_3$ -symmetric support; **E. Stone and M. Kirby**, Dependence of bifurcation structures on the approximation of  $O(2)$  symmetry; **J. Tausch**, A generalization of the discrete Fourier transformation; **E. Van Groesen**, Symmetry methods in symmetry-broken systems; **J. Walker**, Numerical experience with exploiting symmetry groups for boundary element methods; **Z.-Q. Wang**, On the shape of solutions for a nonlinear Neumann problem in symmetric domains; **B. Werner**, The numerical analysis of bifurcation problems with symmetries based on bordered Jacobians.

1991 Mathematics Subject Classification: 20Cxx, 35Qxx; 58F05, 58F14, 58G35, 65H10

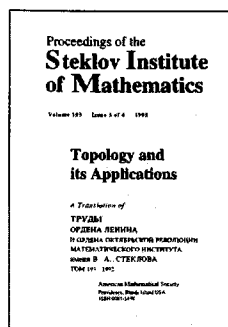
ISBN 0-8218-1134-7, LC 93-30491, ISSN 0075-8485

459 pages (softcover), November 1993

Individual member \$35, List price \$58, Institutional member \$46

To order, please specify LAM/29N

PROCEEDINGS OF THE STEKLOV  
INSTITUTE OF MATHEMATICS



**Topology and Its Applications**  
**S. P. Novikov, Editor**  
Volume 193

This book contains the proceedings of an international topology conference held in the town of Zagulba, near Baku in the former Soviet Union, in October 1987. Sponsored by the Institute of Mathematics and Mechanics of Azerbaijan and the Steklov Mathematical Institute,

the conference was organized by F. G. Maksudov and S. P. Novikov. About 400 mathematicians, including about 100 foreigners, attended the conference. The book covers aspects of general, algebraic, and low-dimensional topology.

**Contents**

**D. P. Adnadzhevich [Adnadzević]**, The  $F$ -ind dimension of  $GF$ -spaces;  
**D. V. Anosov**, Flows on surfaces; **S. Kh. Aranson**, Topology of vector fields, foliations with singularities, and homeomorphisms with invariant foliations on closed surfaces; **V. I. Arnautov and A. V. Mikhalev**, Questions on the possibility of extending the topologies of a ring and of a semigroup to their semigroup ring; **A. V. Arkhangel'skiĭ and Khamdi [Hamdi]** M. M. Genedi. Properties of placement type: relative strong pseudocompactness; **A. A. Babaev**, On the question of equality of morphisms in closed categories; **A. I. Barvinok, A. M. Vershik, and N. E. Mnëv**, The topology of configuration

spaces, convex polytopes, and representations of lattices; **Yu. G. Borisovich**, Topological characteristics of infinite-dimensional mappings and the solvability of nonlinear boundary value problems; **A. N. Varchenko**, Combinatorics of a partial fraction decomposition; **N. V. Velichko**, On the theory of spaces of continuous functions; **A. P. Veselov**, The dynamics of mappings of toric manifolds connected with Lie algebras; **C. Gal'yardi [Gagliardi]**, The regular genus of an  $n$ -dimensional PL manifold: results and problems; **V. M. Gol'dshtein, V. I. Kuz'minov, and I. A. Shvedov**, On a problem of Dodziuk; **M. Golosinskiĭ [Golasiński]**, Rational homotopy type of nilpotent and complete spaces; **S. P. Gul'ko**, On uniform homeomorphisms of spaces of continuous functions; **G. Sh. Guseĭnov**, On the spectral asymptotics of the Laplacian on a fundamental domain in three-dimensional hyperbolic space; **R. Dzh. Daverman [Robert J. Daverman] and D. Repovš [Dušan Repovš]**, Shrinking 1-dimensional cell-like decompositions of 3-manifolds; **D. S. Demariya [D. C. Demaria] and M. Burtsio [M. Burzio]**, Some combinatorial applications of homotopy theory to tournaments; **D. Doĭchinov**, Completeness and completing of quasiuniform spaces; **N. P. Dolbilin, M. A. Shtan'ko, and M. I. Shtogrin**, Quadrillages and parametrizations of lattice cycles; **A. N. Dranishnikov**, On the cohomological dimension of compacta; **L. G. Zambakhidze**, On the realizability of dimension-like functions in special subclasses of the class of Tychonoff spaces; **A. V. Ivanov**, Mixers, functors, and soft mappings; **V. S. Makarov**, On the fundamental polyhedron of a discrete group of motions of Lobachevsky space, its combinatorics and deformation; **V. I. Malykhin**,  $\beta N$  under the negation of  $CH$ ; **A. S. Mishchenko and V. Ya. Pidstrigach**, The cohomological trace of differential operators with parameters; **B. A. Pasynkov**, On openly generated spaces; **A. I. Pluzhnikov**, Topological aspects of the problem of minimizing the Dirichlet functional; **E. G. Pytkeev**, On a property of Fréchet-Urysohn spaces of continuous functions; **E. G. Splyarenko**, Homology and cohomology. Limit passages; **E. E. Skurikhin**, Sheaf cohomology of presheaves of sets and some of its applications; **B. Yu. Sternin and V. E. Shatalov**, On an integral transform of complex-analytic functions; **E. V. Troitskiĭ**, An exact formula for the index of an equivariant  $C^*$ -elliptic operator; **A. A. Tuzhilin**, On the index of minimal surfaces; **A. V. Tyrin**, On the Dirichlet problem for harmonic maps; **V. V. Uspenskii**, Retracts of topological groups, and Dugundji compacta; **V. V. Fedorchuk**, On infinite iterations of metrizable functors; **A. L. Fel'shtyn**, Zeta-functions of Reidemeister and Nielsen; **R. L. Frum-Ketkov**, On closed mappings of infinite-dimensional spaces; **A. Ch. Chigogidze**, The  $n$ -shape functor on the category of compacta; **E. V. Shchepin**, Covering homotopies and analytic mappings.

1991 Mathematics Subject Classification: 58F25, 55P15, 57N12, 54E15, 55M10, 54D35, 55N30

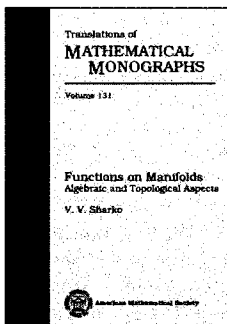
ISBN 0-8218-3151-8, LC 93-6106, ISSN 0081-5438

250 pages (softcover), November 1993

Individual member \$108, List price \$180, Institutional member \$144

To order, please specify STEKLO/193N

TRANSLATIONS OF MATHEMATICAL MONOGRAPHS



**Functions on Manifolds: Algebraic and Topological Aspects**  
V. V. Sharko  
Volume 131

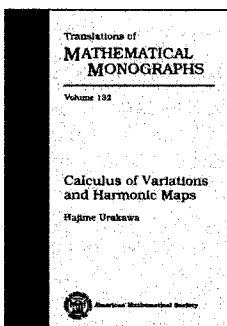
This monograph covers in a unified manner new results on smooth functions on manifolds. A major topic is Morse and Bott functions with a minimal number of singularities on manifolds of dimension greater than five. Sharko computes

obstructions to deformation of one Morse function into another on a simply connected manifold. In addition, a method is developed for constructing minimal chain complexes and homotopical systems in the sense of Whitehead. This leads to conditions under which Morse functions on non-simply-connected manifolds exist. Sharko also describes new homotopical invariants of manifolds, which are used to substantially improve the Morse inequalities. The conditions guaranteeing the existence of minimal round Morse functions are discussed.

**Contents**

*Fréchet manifolds; Minimal Morse functions on simply connected manifolds; Stable algebra; Homotopy of chain complexes; Morse numbers and minimal Morse functions; Elements of the homotopy theory of non-simply-connected CW-complexes; Minimal Morse functions of non-simply-connected manifolds; Minimal round Morse functions; Bibliography.*

1991 *Mathematics Subject Classification*: 57R45, 57R70, 58E05; 57N20, 58B05  
ISBN 0-8218-4578-0, LC 93-25901, ISSN 0065-9282  
193 pages (hardcover), November 1993  
**Individual member \$59**, List price \$98, Institutional member \$78  
To order, please specify MMONO/131N



**Calculus of Variations and Harmonic Maps**  
Hajime Urakawa  
Volume 132

This book provides a wide view of the calculus of variations as it plays an essential role in various areas of mathematics and science. Containing many examples, open problems, and exercises with complete solutions, the book would be suitable as a text for graduate courses

in differential geometry, partial differential equations, and variational methods. The first part of the book is devoted to explaining the notion of (infinite-dimensional) manifolds and contains many examples. An introduction to Morse theory of Banach manifolds is provided, along with a proof of the existence of minimizing functions under the Palais-Smale condition. The second part, which may be read independently of the first, presents the theory of harmonic maps, with a careful calculation of the first and second variations of the energy. Several applications of the second variation and classification theories of harmonic maps are given.

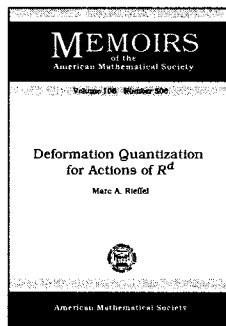
(continued)

**Contents**

*Calculus of variations; Manifolds; Morse theory; Harmonic mappings; The second variation formula and stability; Existence, construction, and classification of harmonic maps; Solutions to exercises; References; Subject index.*

1991 *Mathematics Subject Classification*: 58Exx; 53Cxx, 58Bxx, 58Dxx, 58Gxx, 81Txx  
ISBN 0-8218-4581-0, LC 93-32531, ISSN 0065-9282  
251 pages (hardcover), November 1993  
**Individual member \$59**, List price \$99, Institutional member \$79  
To order, please specify MMONO/132N

MEMOIRS OF THE AMS



**Deformation Quantization for Actions of  $R^d$**   
Marc A. Rieffel  
Volume 106, Number 506

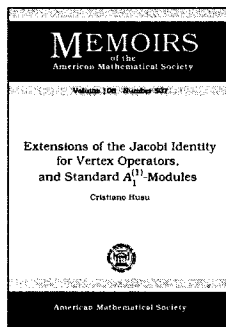
This work describes a general construction of a deformation quantization for any Poisson bracket on a manifold which comes from an action of  $R^d$  on that manifold. These deformation quantizations are strict, in the sense that the deformed product of any two functions is again a

function and that there are corresponding involutions and operator norms. Many of the techniques involved are adapted from the theory of pseudo-differential operators. The construction is shown to have many favorable properties. A number of specific examples are described, ranging from basic ones such as quantum disks, quantum tori, and quantum spheres, to aspects of quantum groups.

**Contents**

*Oscillatory integrals; The deformed product; Function algebras; The algebra of bounded operators; Functoriality for the operator norm; Norms of deformed deformations; Smooth vectors, and exactness; Continuous fields; Strict deformation quantization; Old examples; The quantum Euclidean closed disk and quantum quadrant; The algebraists quantum plane, and quantum groups; References.*

1991 *Mathematics Subject Classification*: 46L87; 35S05, 46L60  
ISBN 0-8218-2575-5, LC 93-6114, ISSN 0065-9266  
93 pages (softcover), November 1993  
**Individual member \$17**, List price \$29, Institutional member \$23  
To order, please specify MEMO/106/506N



**Extensions of the Jacobi Identity for Vertex Operators, and Standard  $A_1^{(1)}$ -Modules**  
Cristiano Husu  
Volume 106, Number 507

This book extends the Jacobi identity, the main axiom for a vertex operator algebra, to multi-operator identities. Based on constructions of Dong and Lepowsky, relative  $Z_2$ -twisted vertex operators are then introduced, and a Jacobi identity for these operators is established. Husu uses these ideas to interpret and recover the



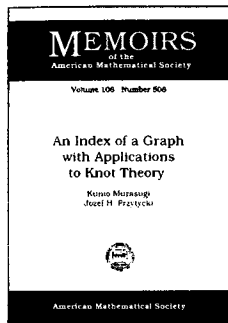
twisted  $Z$ -operators and corresponding generating function identities developed by Lepowsky and Wilson for the construction of the standard  $A_1^{(1)}$ -modules. The point of view of the Jacobi identity also shows the equivalence between these twisted  $Z$ -operator algebras and the (twisted) parafermion algebras constructed by Zamolodchikov and Fadeev. The Lepowsky-Wilson generating function identities correspond to the identities involved in the construction of a basis for the space of  $C$ -disorder fields of such parafermion algebras.

**Contents**

*Introduction; A multi-operator extension of the Jacobi identity; A relative twisted Jacobi identity; Standard representations of the twisted affine Lie algebra  $A_1^{(1)}$ ; References.*

1991 *Mathematics Subject Classification*: 17-XX  
 ISBN 0-8218-2571-2, LC 93-27283, ISSN 0065-9266  
 85 pages (softcover), November 1993

**Individual member \$17**, List price \$28, Institutional member \$22  
 To order, please specify MEMO/106/507N



**An Index of a Graph with Applications to Knot Theory**

Kunio Murasugi and Jozef H. Przytycki  
 Volume 106, Number 508

This book presents a remarkable application of graph theory to knot theory. In knot theory, there are a number of easily defined geometric invariants that are extremely difficult to compute; the

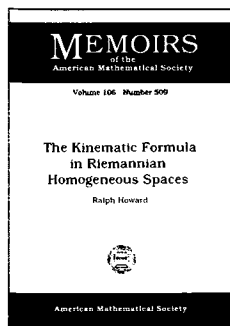
braid index of a knot or link is one example. The authors evaluate the braid index for many knots and links using the generalized Jones polynomial and the index of a graph, a new invariant introduced here. This invariant, which is determined algorithmically, is likely to be of particular interest to computer scientists.

**Contents**

*Index of a graph; Link theory; Braid index of alternating links; Appendix; References.*

1991 *Mathematics Subject Classification*: 05C10, 57M25  
 ISBN 0-8218-2570-4, LC 93-27284, ISSN 0065-9266  
 101 pages (softcover), November 1993

**Individual member \$17**, List price \$29, Institutional member \$23  
 To order, please specify MEMO/106/508N



**The Kinematic Formula in Riemannian Homogeneous Spaces**

Ralph Howard  
 Volume 106, Number 509

This book shows that much of classical integral geometry can be derived from the coarea formula by some elementary techniques. Howard generalizes much of classical integral geometry from spaces of constant sectional curvature to arbitrary

Riemannian homogeneous spaces. To do so, he provides a general definition of an "integral invariant" of a submanifold of the space that is sufficiently general enough to cover most cases that arise in integral geometry. Working in this generality makes it clear that the type of

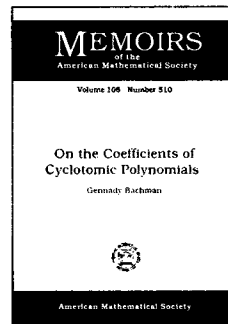
integral geometric formulas that hold in a space does not depend on the full group of isometries, but only on the isotropy subgroup. As a special case, integral geometric formulas that hold in Euclidean space also hold in all the simply connected spaces of constant curvature. Detailed proofs of the results and many examples are included. Requiring background of a one-term course in Riemannian geometry, this book may be used as a textbook in graduate courses on differential and integral geometry.

**Contents**

*Introduction; The basic integral formula for submanifolds of a Lie group; Poincaré's formula in homogeneous spaces; Integral invariants of submanifolds of homogeneous spaces, the kinematic formula, and the transfer principle; The second fundamental form of an intersection; Lemmas and definitions; Proof of the kinematic formula and the transfer principle; Spaces of constant curvature; An algebraic characterization of the polynomials in the Weyl tube formula; The Weyl tube formula and the Chern-Federer kinematic formula; Appendix: Fibre integrals and the smooth coarea formula; References.*

1991 *Mathematics Subject Classification*: 53C65; 53C30  
 ISBN 0-8218-2569-0, LC 93-31294, ISSN 0065-9266  
 69 pages (softcover), November 1993

**Individual member \$16**, List price \$26, Institutional member \$21  
 To order, please specify MEMO/106/509N



**On the Coefficients of Cyclotomic Polynomials**

Gennady Bachman  
 Volume 106, Number 510

This book studies the coefficients of cyclotomic polynomials. Let  $a(m, n)$  be the  $m$ th coefficient of the  $n$ th cyclotomic polynomial  $\Phi_n(z)$ , and let  $a(m) = \max_n |a(m, n)|$ . The principal result is an asymptotic formula for  $\log a(m)$  that improves a recent estimate

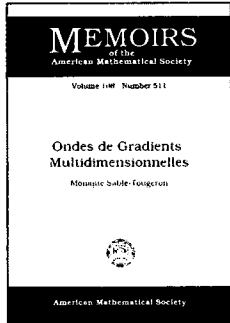
of Montgomery and Vaughan. Bachman also gives similar formulae for the logarithms of the one-sided extrema  $a^*(m) = \max_n a(m, n)$  and  $a_*(m) = \min_n a(m, n)$ . In the course of the proof, estimates are obtained for certain exponential sums which are of independent interest.

**Contents**

*Introduction; Statement of results; Proof of Theorem 0; upper bound; Preliminaries; Proof of Theorem 1; the minor arcs estimate; Proof of Theorem 1; the major arcs estimate; Proof of Theorem 2; preliminaries; Proof of Theorem 2; completion; Proof of Propositions 1 and 2; Proof of Theorem 3; Appendix; References.*

1991 *Mathematics Subject Classification*: 11C08, 11B83, 11N37  
 ISBN 0-8218-2572-0, LC 93-31295, ISSN 0065-9266  
 80 pages (softcover), November 1993

**Individual member \$17**, List price \$28, Institutional member \$22  
 To order, please specify MEMO/106/510N



**Ondes de Gradients  
Multidimensionnelles**  
Monique Sablé-Tougeron  
Volume 106, Number 511

Recent techniques in partial differential equations have led to a solution to the general multidimensional Cauchy problem for nonlinear gradient waves. In a blown-up configuration, Sablé-Tougeron constructs a local solution for a quasilinear hyperbolic system with continuous Cauchy data in

which the first derivatives are discontinuous on a hypersurface. This strong singularity is not so problematic as a rarefaction: the use of Alinhac's para-unknown leads to a tame inequality without loss of derivatives for the iterative scheme.

**Contents**

*Formulation du problème, énoncé du résultat; L'inégalité  $L^2$ ; Espaces et calcul paradifférentiel adaptés; L'inégalité tame: première étape, paralinéarisation; L'inégalité tame, 2<sup>ème</sup> étape: inégalités conormales du modèle paradifférentiel; L'inégalité tame fermée; Les estimations  $L^\infty$ ; Les équations eiconales; Le problème non linéaire; Appendice; Bibliographie.*

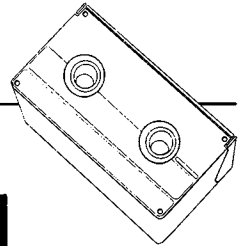
1991 *Mathematics Subject Classification*: 35L60  
ISBN 0-8218-2573-9, LC 93-31686, ISSN 0065-9266  
93 pages (softcover), November 1993

**Individual member \$17**, List price \$29, Institutional member \$23  
To order, please specify MEMO/106/511N



VIDEOTAPE

Interview with  
**I. M. Gelfand**



I. M. Gelfand

In this one-hour interview, I. M. Gelfand, one of the major mathematicians of the century, discusses his mathematics, his inspirations, and his major achievements. He also touches on his work in biology and education, two areas in which he has had an important impact. The interview was held during the Joint Mathematics Meetings in Baltimore in January 1992, not long after Gelfand left the former Soviet Union to take a position at Rutgers University. Providing a personal look at this great mathematician, the interview has particular appeal to students, researchers, and historians in mathematics and science. In addition, because Gelfand avoids discussing technical aspects of his work and focuses on what interests and inspires him as a mathematician, this videotape is accessible to a broad audience.

1991 *Mathematics Subject Classification*: 00, 01  
ISBN 0-8218-8084-5, NTSC format on 1/2" VHS videotape; approx. 60 minutes,  
April 1993

**Individual member \$34.95**, List price \$54.95, Institutional member \$44.95  
To order, please specify VIDEO/87NA



All prices subject to change. Free shipment by surface: for air delivery, please add \$6.50 per title. *Prepayment required.* **Order from:** American Mathematical Society, P.O. Box 5904, Boston, MA 02206-5904, or call toll-free 800-321-4AMS (321-4267) in the U.S. and Canada to charge with VISA or MasterCard. Residents of Canada, please include 7% GST.

## Miscellaneous

### Personals

**Chiu Yeung Chan**, Distinguished Professor of the University of Southwestern Louisiana in 1988, was recently awarded the Pennzoil Endowed Professorship.

**Juergen Jost**, of Ruhr University, was awarded the Leibniz Prize of the German Research Society. This prize carries a research grant worth about US\$1 million distributed over five years.

**Alberto Seeger**, of the University of Avignon, France, has accepted a two-year position at King Fahd University of Petroleum and Minerals in Dhahran,

Saudi Arabia, during the period September 1993–August 1995.

**Patrick Shanahan**, of the College of the Holy Cross, was appointed Professor Emeritus at that institution.

### Deaths

**J. Bruce Crabtree**, of Cranford, New Jersey, died in August 1993. He was born on December 11, 1918, and was a member of the Society for 50 years.

**James E. Desmond**, of Pensacola Junior College, died on August 17, 1993.

He was born on September 24, 1935, and was a member of the Society for 24 years.

**Halsey Royden**, of Stanford University, died on August 22, 1993. He was born on September 26, 1928, and was a member of the Society for 44 years.

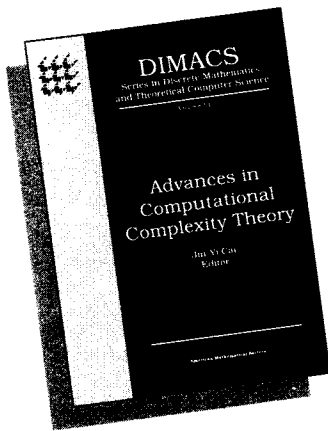
### Erratum

**Alan John Ellis** was incorrectly reported as having died on August 22, 1993. The actual date was August 22, 1992.

DIMACS: Series in Discrete Mathematics and Theoretical Computer Science

# Advances in Computational Complexity Theory

Jin-Yi Cai, Editor  
Volume 13



This collection of recent papers on computational complexity theory grew out of activities during a special year at DIMACS. With contributions by some of the leading experts in the field, this book is of lasting value in this fast-moving field, providing expositions not found elsewhere. Although aimed primarily at researchers in complexity theory and graduate students in mathematics or computer science, the book is accessible to anyone with an undergraduate education in mathematics or computer science. By touching on some of the major topics in complexity theory, this book sheds light on this burgeoning area of research.

1991 *Mathematics Subject Classification*: 68; 05  
ISBN 0-8218-6597-8, 209 pages (hardcover), October 1993  
Individual member \$50, List price \$84, Institutional member \$67  
To order, please specify DIMACS/13NA



All prices subject to change. Free shipment by surface: for air delivery, please add \$6.50 per title. *Prepayment required.*  
Order from: American Mathematical Society, P.O. Box 5904, Boston, MA 02206-5904, or call toll free 800-321-4AMS (321-4267) in the U.S. and Canada to charge with VISA or MasterCard. Residents of Canada, please include 7% GST.

# AMS Reports and Communications

## Bylaws of the American Mathematical Society

### Article I *Officers*

**Section 1.** There shall be a president, a president-elect (during the even-numbered years only), an ex-president (during the odd-numbered years only), three vice-presidents, a secretary, four associate secretaries, a treasurer, and an associate treasurer.

**Section 2.** It shall be a duty of the president to deliver an address before the Society at the close of the term of office or within one year thereafter.

### Article II *Board of Trustees*

**Section 1.** There shall be a Board of Trustees consisting of eight trustees, five trustees elected by the Society in accordance with Article VII, together with the president, the treasurer, and the associate treasurer of the Society *ex officio*. The Board of Trustees shall designate its own presiding officer and secretary.

**Section 2.** The function of the Board of Trustees shall be to receive and administer the funds of the Society, to have full legal control of its investments and properties, to make contracts, and, in general, to conduct all business affairs of the Society.

**Section 3.** The Board of Trustees shall have the power to appoint such assistants and agents as may be necessary or convenient to facilitate the conduct of the affairs of the Society, and to fix the terms and conditions of their employment. The Board may delegate to the officers of the Society duties and powers normally inhering in their respective corporate offices, subject to supervision by the Board. The Board of Trustees may appoint committees to facilitate the conduct of the financial business of the Society and delegate to such committees such powers as may be necessary or convenient for the proper exercise of those powers. Agents appointed, or members of committees designated, by the Board of Trustees need not be members of the Board.

Nothing herein contained shall be construed to empower the Board of Trustees to divest itself of responsibility for, or legal control of, the investments, properties, and contracts of the Society.

### Article III *Committees*

**Section 1.** There shall be nine editorial committees as follows: committees for the *Bulletin*, for the *Proceedings*, for the *Colloquium Publications*, for the *Journal*, for *Mathematical Surveys and Monographs*, for *Mathematical Reviews*; a joint committee for the *Transactions* and the *Memoirs*; a committee consisting of the representatives of the Society on the Board of Editors of the *American Journal of Mathematics*; and a committee for *Mathematics of Computation*.

**Section 2.** There shall be a Science Policy Committee.

**Section 3.** There shall be a communications committee called the Committee to Monitor Problems in Communication.

**Section 4.** The size of each committee shall be determined by the Council.

### Article IV *Council*

**Section 1.** The Council shall consist of fifteen members-at-large and the following *ex officio* members: the officers of the Society specified in Article I, except that it shall include only one associate secretary, the chairman of each of the editorial committees and of the communications committee and of the Science Policy Committee, any former secretary and of the Executive Committee (Article V) who remain on the Council by the operation of Article VII, Section 4.

The chairman of any committee designated as a Council member may name a deputy from the committee as substitute. The associate secretary shall be the one charged with the scientific program of the meeting at which the Council meets except that at a meeting associated with no scientific meeting of the Society the secretary may designate the associate secretary.

**Section 2.** The Council shall formulate and administer the scientific policies of the Society and shall act in an advisory capacity to the Board of Trustees.

**Section 3.** In the absence of the secretary from any meeting of the Council, a member may be designated as acting secretary for the meeting, either by written authorization of the secretary, or, failing that, by the presiding officer.

**Section 4.** All members of the Council shall be voting members. Each member, including deputies and the designated associate secretary, shall have one vote. The method for settling matters before the Council at any meeting shall be by majority vote of the members present. If the result of a vote is challenged, it shall be the duty of the presiding officer to determine the true vote by a roll call. In a roll call vote, each Council member shall vote only once (although possibly a member of the Council in several capacities).

**Section 5.** Any five members of the Council shall constitute a quorum for the transaction of business at any meeting of the Council.

**Section 6.** Between meetings of the Council, business may be transacted by a mail vote. Votes shall be counted as specified in Section 4 of this Article, "members present" being replaced by "members voting." An affirmative vote by mail on any proposal shall be declared if, and only if, (a) more than half of the total number of possible votes is received by the time announced for the closing of the polls, and (b) at least three-quarters of the votes received by then are affirmative. If five or more members request postponement at the time of voting, action on the matter at issue shall be postponed until the next meeting of the Council, unless either (1) at the discretion of the secretary, the question is made the subject of a second vote by mail, in connection with which brief statements of reason, for and against, are circulated; or (2) the Council places the matter at issue before the Executive Committee for action.

**Section 7.** The Council may delegate to the Executive Committee certain of its duties and powers. Between meetings of the Council, the Executive Committee shall act for the Council on such matters and in such ways as the Council may specify. Nothing herein contained shall be construed as empowering the Council to divest itself of responsibility for formulating and administering the scientific policies of the Society.

**Section 8.** The Council shall also have power to speak in the name of the Society with respect to matters affecting the status of mathematics or mathematicians, such as proposed or enacted federal or state legislation; conditions of employment in universities, colleges, or business, research or industrial organizations; regulations, policies, or acts of governmental agencies or instrumentalities; and other items which tend to affect the dignity and effective position of mathematics.

With the exception noted in the next paragraph, a favorable vote of two-thirds of the entire membership of the Council shall be necessary to authorize any statement in the name of the Society with respect to such matters. With the exception noted in the next paragraph, such a vote may be taken only if written notice shall have been given to the secretary by the

proposer of any such resolution not later than one month prior to the Council meeting at which the matter is to be presented; and the vote shall be taken not earlier than one month after the resolution has been discussed by the Council.

If, at a meeting of the Council, there are present twelve members, then the prior notification to the secretary may be waived by unanimous consent. In such a case, a unanimous favorable vote by those present shall empower the Council to speak in the name of the Society.

The Council may also refer the matter to a referendum by mail of the entire membership of the Society, and shall make such reference if a referendum is requested, prior to final action by the Council, by two hundred or more members. The taking of a referendum shall act as a stay upon Council action until the votes have been canvassed, and thereafter no action may be taken by the Council except in accordance with a plurality of the votes cast in the referendum.

## Article V

### *Executive Committee*

**Section 1.** There shall be an Executive Committee of the Council, consisting of four elected members and the following *ex officio* members: the president, the secretary, the president-elect (during even-numbered years), and the ex-president (during odd-numbered years).

**Section 2.** The Executive Committee of the Council shall be empowered to act for the Council on matters which have been delegated to the Executive Committee by the Council. If three members of the Executive Committee request that any matter be referred to the Council, the matter shall be so referred. The Executive Committee shall be responsible to the Council and shall report its actions to the Council. It may consider the agenda for meetings of the Council and may make recommendations to the Council.

**Section 3.** Each member of the Executive Committee shall have one vote. An affirmative vote on any proposal before the Executive Committee shall be declared if, and only if, at least four affirmative votes are cast for the proposal. A vote on any proposal may be determined at a meeting of the Executive Committee, but it shall not be necessary to hold a meeting to determine a vote.

## Article VI

### *Executive Director*

**Section 1.** There shall be an Executive Director who shall be a paid employee of the Society. The Executive Director shall have charge of the central office of the Society, and shall be responsible for the general administration of the affairs of the Society in accordance with the policies that are set by the Board of Trustees and by the Council.

**Section 2.** The Executive Director shall be appointed by the Board of Trustees with the consent of the Council. The terms and conditions of employment shall be fixed by the Board of Trustees.

**Section 3.** The Executive Director shall work under the immediate direction of a committee consisting of the president, the secretary, and the treasurer, of which the president shall be chairman *ex officio*. The Executive Director shall attend meetings of the Board of Trustees, the Council, and the Executive Committee, but shall not be a member of any of these bodies. The Executive Director shall be a voting member of the Committee to Monitor Problems in Communication but shall not be its chairman.

## Article VII

### *Election of Officers and Terms of Office*

**Section 1.** The term of office shall be one year in the case of the president-elect and the ex-president; two years in the case of the president, the secretary, the associate secretaries, the treasurer, and the associate treasurer; three years in the case of vice-presidents and members-at-large of the Council, one vice-president and five members-at-large retiring annually; and five years in the case of the trustees. In the case of members of the editorial committees and appointed members of the communications committees, the term of office shall be determined by the Council. The term of office for elected members of the Executive Committee shall be four years, one of the elected members retiring annually. All terms of office shall begin on February 1 and terminate on January 31 with the exception that the officials specified in Articles I, II, III, IV, and V (excepting the president-elect and ex-president) shall continue to serve until their successors have been duly elected or appointed and qualified.

**Section 2.** The president-elect, the vice-presidents, the trustees, and the members-at-large of the Council shall be elected by written ballot. An official ballot shall be sent to each member of the Society by the secretary on or before October 10, and such ballots, if returned to the secretary in envelopes bearing the name of the voter and received within thirty days, shall be counted. Each ballot shall contain one or more names proposed by the Council for each office to be filled, with blank spaces in which the voter may substitute other names. A plurality of all votes cast shall be necessary for election. In case of failure to secure a plurality for any office, the Council shall choose by written ballot among the members having the highest number of votes. The secretary, the associate secretaries, the treasurer, and the associate treasurer shall be appointed by the Council in a manner designated by the Council. Each committee named in Article III, Section 1 or 3, shall be appointed by the Council in a manner designated by the Council. Each such committee shall elect one of its members as chairman in a manner designated by the Council.

**Section 3.** The president becomes ex-president at the end of the term of office and the president-elect becomes president.

**Section 4.** On or before February 15, the secretary shall send to all members of the Council for a mail vote a ballot containing two names for each place to be filled on the Executive Committee. The nominees shall be chosen by a committee appointed by the president. Members of the Council may vote for persons not nominated. Any member of

the Council who is not an *ex officio* member of the Executive Committee (see Article V, Section 1) shall be eligible for election to the Executive Committee. In case a member is elected to the Executive Committee for a term extending beyond the regular term on the Council, that person shall automatically continue as a member of the Council during the remainder of that term on the Executive Committee.

**Section 5.** The president and vice-presidents shall not be eligible for immediate re-election to their respective offices. A member-at-large or an *ex officio* member of the Council shall not be eligible for immediate election (or re-election) as a member-at-large of the Council.

**Section 6.** If the president of the Society should die or resign while a president-elect is in office, the president-elect shall serve as president for the remainder of the year and thereafter shall serve the regular two-year term. If the president of the Society should die or resign when no president-elect is in office, the Council, with the approval of the Board of Trustees, shall designate one of the vice-presidents to serve as president for the balance of the regular presidential term. If the president-elect of the Society should die or resign before becoming president, the office shall remain vacant until the next regular election of a president-elect, and the Society shall, at the next annual meeting, elect a president for a two-year term. If the ex-president should die or resign before expiration of the term of office, the Council, with the approval of the Board of Trustees, shall designate a former president of the Society to serve as ex-president during the remainder of the regular term of the ex-presidency. Such vacancies as may occur at any time in the group consisting of the vice-presidents, the secretary, the associate secretaries, the treasurer, and the associate treasurer shall be filled by the Council with the approval of the Board of Trustees. If a member of an editorial or communications committee should take temporary leave from duties, the Council shall then appoint a substitute. The Council shall fill from its own membership any vacancy in the elected membership of the Executive Committee.

**Section 7.** If any elected trustee should die while in office or resign, the vacancy thus created shall be filled for the unexpired term by the Board of Trustees.

**Section 8.** If any member-at-large of the Council should die or resign more than one year before the expiration of the term, the vacancy for the unexpired term shall be filled by the Society at the next annual meeting.

**Section 9.** In case any officer should die or decline to serve between the time of election and the time to assume office, the vacancy shall be filled in the same manner as if that officer had served one day of the term.

## Article VIII

### *Members and Their Election*

**Section 1.** Election of members shall be by vote of the Council or of its Executive Committee.

**Section 2.** There shall be four classes of members, namely ordinary, contributing, corporate, and institutional.

**Section 3.** Application for admission to ordinary membership shall be made by the applicant on a blank provided by the secretary. Such applications shall not be acted upon until at least thirty days after their presentation to the Council (at a meeting or by mail), except in the case of members of other societies entering under special action of the Council approved by the Board of Trustees.

**Section 4.** An ordinary member may become a contributing member by paying the dues for such membership. (See Article IX, Section 3.)

**Section 5.** A university or college, or a firm, corporation, or association interested in the support of mathematics may be elected a corporate or an institutional member.

## Article IX

### *Dues and Privileges of Members*

**Section 1.** Any applicant shall be admitted to ordinary membership immediately upon election by the Council (Article VIII) and the discharge within sixty days of election of the first annual dues. Dues may be discharged by payment or by remission when the provision of Section 7 of this Article is applicable. The first annual dues shall apply to the year of election, except that any applicant elected after August 15 of any year may elect to have the first annual dues apply to the following year.

**Section 2.** The annual dues of an ordinary member of the Society shall be established by the Council with the approval of the Trustees. The Council, with the approval of the Trustees, may establish special rates in exceptional cases and for members of an organization with which the Society has a reciprocity agreement.

**Section 3.** The minimum dues for a contributing member shall be three-halves of the dues of an ordinary member per year. Members may, upon their own initiative, pay larger dues.

**Section 4.** The minimum dues of an institutional member shall depend on the scholarly activity of that member. The formula for computing these dues shall be established from time to time by the Council, subject to approval by the Board of Trustees. Institutions may pay larger dues than the computed minimum.

**Section 5.** The privileges of an institutional member shall depend on its dues in a manner to be determined by the Council, subject to approval by the Board of Trustees. These privileges shall be in terms of Society publications to be received by the institution and of the number of persons it may nominate for ordinary membership in the Society.

**Section 6.** Dues and privileges of corporate members of the Society shall be established by the Council subject to approval by the Board of Trustees.

**Section 7.** The dues of an ordinary member of the Society shall be remitted for any years during which that member is the nominee of an institutional member.

**Section 8.** After retirement from active service on account of age or on account of long term disability, any ordinary or contributing member who is not in arrears of dues and with membership extending over at least twenty years may, by

giving proper notification to the secretary, have dues remitted. Such a member shall receive the *Notices* and may request to receive *Bulletin* as privileges of membership during each year until membership ends.

**Section 9.** An ordinary or contributing member shall receive the *Notices* and *Bulletin* as privileges of membership during each year for which dues have been discharged.

**Section 10.** The annual dues of ordinary, contributing, and corporate members shall be due by January 1 of the year to which they apply. The Society shall submit bills for dues. If the annual dues of any member remain undischarged beyond what the Board of Trustees deems to be a reasonable time, the name of that member shall be removed from the list of members after due notice. A member wishing to discontinue membership at any time shall submit a resignation in writing to the Society.

**Section 11.** Any person who has attained the age of 62 and has been a member for at least twenty years may become a life member by making a single payment equal to five times the dues of an ordinary member for the coming year. Insofar as there is more than one level of dues for ordinary membership, it is the highest such dues that shall be used in the calculation, with the exception for members by reciprocity noted in the following paragraph. A life member is subsequently relieved of the obligation of paying dues. The status and privileges are those of ordinary members. (This section does not affect those persons who became life members before October 25, 1941. They remain life members with the status and privileges of ordinary members. When the class of them is empty, this parenthetical remark is to be removed.)

A member of the Society by reciprocity who has reached the age of 62, has been a member for at least 20 years, has been a member by reciprocity for at least 15 of those 20 years and asserts the intention of continuing to be a member by reciprocity may purchase a life membership by a one-time payment of a special rate established by the Council, with the approval of the Trustees.

## Article X

### *Meetings*

**Section 1.** The annual meeting of the Society shall be held between the fifteenth of December and the tenth of February next following. Notice of the time and place of this meeting shall be mailed by the secretary or an associate secretary to the last known post office address of each member of the Society. The times and places of the annual and other meetings of the Society shall be designated by the Council. There shall be a business meeting of the Society at the annual meeting and at the summer meeting. A business meeting of the Society shall take final action only on business accepted by unanimous consent, or business notified to the full membership of the Society in the call for the meeting, except that the business meetings held at either the annual meeting or the summer meeting may take final action on business which has been recommended for consideration by the Council and has been accepted by the vote of four-fifths of the Society present and

voting at such a meeting. Such notification shall be made only when so directed by a previous business meeting of the Society or by the Council.

**Section 2.** Meetings of the Executive Committee may be called by the president. The president shall call a meeting at any time upon the written request of two of its members.

**Section 3.** The Council shall meet at the annual meeting of the Society. Special meetings of the Council may be called by the president. The president shall call a special meeting at any time upon the written request of five of its members. No special meeting of the Council shall be held unless written notice of it shall have been sent to all members of the Council at least ten days before the day set for the meeting.

**Section 4.** The Board of Trustees shall hold at least one meeting in each calendar year. Meetings of the Board of Trustees may be called by the president, the treasurer, or the secretary of the Society upon three-days' notice of such meetings mailed to the last known post office address of each trustee. The secretary of the Society shall call a meeting upon the receipt of a written request of two of the trustees. Meetings may also be held by common consent of all the trustees.

**Section 5.** Papers intended for presentation at any meeting of the Society shall be passed upon in advance by a program committee appointed by or under the authority of the Council; and only such papers shall be presented as shall have been approved by such committee. Papers in form unsuitable for publication, if accepted for presentation, shall be referred to on the program as preliminary communications or reports.

### Article XI *Publications*

**Section 1.** The Society shall publish an official organ called the *Bulletin of the American Mathematical Society*. It shall publish four journals, known as the *Journal of the American Mathematical Society*, the *Transactions of the American Mathematical Society*, the *Proceedings of the American Mathematical Society*, and *Mathematics of Computation*. It shall publish a series of mathematical papers known as the *Memoirs of the American Mathematical Society*. The object of the *Journal*, *Transactions*, *Proceedings*, *Memoirs*, and *Mathematics of Computation* is to make known important mathematical researches. It shall publish a periodical called *Mathematical Reviews*, containing abstracts or reviews of current mathematical literature. It shall publish a series of volumes called *Colloquium Publications* which shall embody in book form new mathematical developments. It shall publish a series of monographs called *Mathematical Surveys and Monographs* which shall furnish expositions of the principal methods and results of particular fields of mathematical research. It shall also cooperate in the conduct of the *American Journal of Mathematics*. It shall publish a news periodical known as the *Notices of the American Mathematical Society*, containing programs of meetings, items of news of particular interest to mathematicians, and such other materials as the Council may direct.

**Section 2.** The editorial management of the publications of the Society listed in Section 1 of this article, with the exception of the *Notices*, and the participation of the Society in the editorial management of the *American Journal of Mathematics* shall be in the charge of the respective editorial committees as provided in Article III, Section 1. The editorial management of the *Notices* shall be in the hands of a committee chosen in a manner established by the Council.

### Article XII *Communications*

The Committee to Monitor Problems in Communication shall perform such tasks in the field of communication of mathematics as are assigned to it by the Council.

### Article XIII *Indemnification*

Any person who at any time serves or has served as a trustee or officer of the Society, or as a member of the Council, or, at the request of the Society, as a director or officer of another corporation, whether for profit or not for profit, shall be indemnified by the Society and be reimbursed against and for expenses actually and necessarily incurred in connection with the defense or reasonable settlement of any action, suit, legal or administrative proceeding, whether civil, criminal, administrative or investigative, threatened, pending or completed, to which that person is made a party by reason of being or having been such trustee, officer or director or Council member, except in relation to matters as to which the person shall be adjudged in such action, suit or proceeding to be liable for negligence or misconduct in the performance of official duties. Such right of indemnification and reimbursement shall also extend to the personal representatives of any such person, and shall be in addition to and not in substitution for any other rights to which such person or personal representatives may now or hereafter be entitled by virtue of the provisions of applicable law or of any other agreement or vote of the Board of Trustees, or otherwise.

### Article XIV *Amendments*

These bylaws may be amended or suspended on recommendation of the Council and with the approval of the membership of the Society, the approval consisting of an affirmative vote by two-thirds of the members present at a business meeting or of two-thirds of the members voting in a mail ballot in which at least ten percent of the members vote, whichever alternative shall have been designated by the Council, and provided notice of the proposed action and of its general nature shall have been given in the call for the meeting or accompanies the ballot in full.

*As amended December 1990*



# AMS Lecturers, Officers, Funds, and Prizes

## Colloquium Lecturers

James Pierpont, 1896  
 Maxime Bôcher, 1896  
 W. F. Osgood, 1898  
 A. G. Webster, 1898  
 Oskar Bolza, 1901  
 E. W. Brown, 1901  
 H. S. White, 1903  
 F. S. Woods, 1903  
 E. B. Van Vleck, 1903  
 E. H. Moore, 1906  
 E. J. Wilczynski, 1906  
 Max Mason, 1906  
 G. A. Bliss, 1909  
 Edward Kasner, 1909  
 L. E. Dickson, 1913  
 W. F. Osgood, 1913  
 G. C. Evans, 1916  
 Oswald Veblen, 1916  
 G. D. Birkhoff, 1920  
 F. R. Moulton, 1920  
 L. P. Eisenhart, 1925  
 Dunham Jackson, 1925  
 E. T. Bell, 1927  
 Anna Pell-Wheeler, 1927  
 A. B. Coble, 1928  
 R. L. Moore, 1929  
 Solomon Lefschetz, 1930  
 Marston Morse, 1931  
 J. F. Ritt, 1932  
 R. E. A. C. Paley, 1934  
 Norbert Wiener, 1934  
 H. S. Vandiver, 1935  
 E. W. Chittenden, 1936  
 John von Neumann, 1937  
 A. A. Albert, 1939  
 M. H. Stone, 1939  
 G. T. Whyburn, 1940  
 Oystein Ore, 1941  
 R. L. Wilder, 1942  
 E. J. McShane, 1943  
 Einar Hille, 1944  
 Tibor Radó, 1945  
 Hassler Whitney, 1946  
 Oscar Zariski, 1947  
 Richard Brauer, 1948  
 G. A. Hedlund, 1949  
 Deane Montgomery, 1951  
 Alfred Tarski, 1952  
 Antoni Zygmund, 1953  
 Nathan Jacobson, 1955  
 Salomon Bochner, 1956  
 N. E. Steenrod, 1957  
 J. L. Doob, 1959  
 S. S. Chern, 1960  
 G. W. Mackey, 1961  
 Saunders Mac Lane, 1963  
 C. B. Morrey, Jr., 1964  
 A. P. Calderón, 1965

Samuel Eilenberg, 1967  
 D. C. Spencer, 1968  
 J. W. Milnor, 1968  
 Raoul H. Bott, 1969  
 Harish-Chandra, 1969  
 R. H. Bing, 1970  
 Lipman Bers, 1971  
 Armand Borel, 1971  
 Stephen Smale, 1972  
 John T. Tate, 1972  
 M. F. Atiyah, 1973  
 E. A. Bishop, 1973  
 F. E. Browder, 1973  
 Louis Nirenberg, 1974  
 John G. Thompson, 1974  
 H. Jerome Keisler, 1975  
 Ellis R. Kolchin, 1975  
 Elias M. Stein, 1975  
 I. M. Singer, 1976  
 Jürgen K. Moser, 1976  
 William Browder, 1977  
 Herbert Federer, 1977  
 Hyman Bass, 1978  
 Philip A. Griffiths, 1979  
 George D. Mostow, 1979  
 Julia B. Robinson, 1980  
 Wolfgang M. Schmidt, 1980  
 Mark Kac, 1981  
 Serge Lang, 1981  
 Dennis Sullivan, 1982  
 Morris W. Hirsch, 1982  
 Charles L. Fefferman, 1983  
 Bertram Kostant, 1983  
 Barry Mazur, 1984  
 Paul H. Rabinowitz, 1984  
 Daniel Gorenstein, 1985  
 Karen K. Uhlenbeck, 1985  
 Shing-Tung Yau, 1986  
 Peter D. Lax, 1987  
 Edward Witten, 1987  
 Victor W. Guillemin, 1988  
 Nicholas Katz, 1989  
 William P. Thurston, 1989  
 Shlomo Sternberg, 1990  
 Robert D. Macpherson, 1991  
 Robert P. Langlands, 1992  
 Luis A. Caffarelli, 1993  
 Sergiu Klainerman, 1993

## Gibbs Lecturers

M. I. Pupin, 1923  
 Robert Henderson, 1924  
 James Pierpont, 1925  
 H. B. Williams, 1926  
 E. W. Brown, 1927  
 G. H. Hardy, 1928  
 Irving Fisher, 1929  
 E. B. Wilson, 1930

P. W. Bridgman, 1931  
 R. C. Tolman, 1932  
 Albert Einstein, 1934  
 Vannevar Bush, 1935  
 H. N. Russell, 1936  
 C. A. Kraus, 1937  
 Theodore von Kármán, 1939  
 Sewall Wright, 1941  
 Harry Bateman, 1943  
 John von Neumann, 1944  
 J. C. Slater, 1945  
 S. Chandrasekhar, 1946  
 P. M. Morse, 1947  
 Hermann Weyl, 1948  
 Norbert Wiener, 1949  
 G. E. Uhlenbeck, 1950  
 Kurt Gödel, 1951  
 Marston Morse, 1952  
 Wassily Leontief, 1953  
 K. O. Friedrichs, 1954  
 J. E. Mayer, 1955  
 M. H. Stone, 1956  
 H. J. Muller, 1958  
 J. M. Burgers, 1959  
 Julian Schwinger, 1960  
 J. J. Stoker, 1961  
 C. N. Yang, 1962  
 C. E. Shannon, 1963  
 Lars Onsager, 1964  
 D. H. Lehmer, 1965  
 Martin Schwarzschild, 1966  
 Mark Kac, 1967  
 E. P. Wigner, 1968  
 R. L. Wilder, 1969  
 W. H. Munk, 1970  
 E. F. F. Hopf, 1971  
 F. J. Dyson, 1972  
 J. K. Moser, 1973  
 Paul A. Samuelson, 1974  
 Fritz John, 1975  
 Arthur S. Wightman, 1976  
 Joseph B. Keller, 1977  
 Donald E. Knuth, 1978  
 Martin D. Kruskal, 1979  
 Kenneth G. Wilson, 1980  
 Cathleen S. Morawetz, 1981  
 Elliott W. Montroll, 1982  
 Samuel Karlin, 1983  
 Herbert A. Simon, 1984  
 Michael O. Rabin, 1985  
 L. E. Scriven, 1986  
 Thomas C. Spencer, 1987  
 David P. Ruelle, 1988  
 Elliott H. Lieb, 1989  
 George B. Dantzig, 1990  
 Michael F. Atiyah, 1991  
 Michael E. Fisher, 1992  
 Charles S. Peskin, 1993

**Presidents**

J. H. Van Amringe, 1889, 1890  
 J. E. McClintock, 1891–1894  
 G. W. Hill, 1895, 1896  
 Simon Newcomb, 1897, 1898  
 R. S. Woodward, 1899, 1900  
 E. H. Moore, 1901, 1902  
 T. S. Fiske, 1903, 1904  
 W. F. Osgood, 1905, 1906  
 H. S. White, 1907, 1908  
 Maxime Bôcher, 1909, 1910  
 H. B. Fine, 1911, 1912  
 E. B. Van Vleck, 1913, 1914  
 E. W. Brown, 1915, 1916  
 L. E. Dickson, 1917, 1918  
 Frank Morley, 1919, 1920  
 G. A. Bliss, 1921, 1922  
 Oswald Veblen, 1923, 1924  
 G. D. Birkhoff, 1925, 1926  
 Virgil Snyder, 1927, 1928  
 E. R. Hedrick, 1929, 1930  
 L. P. Eisenhart, 1931, 1932  
 A. B. Coble, 1933, 1934  
 Solomon Lefschetz, 1935, 1936  
 R. L. Moore, 1937, 1938  
 G. C. Evans, 1939, 1940

Marston Morse, 1941, 1942  
 M. H. Stone, 1943, 1944  
 T. H. Hildebrandt, 1945, 1946  
 Einar Hille, 1947, 1948  
 J. L. Walsh, 1949, 1950  
 John von Neumann, 1951, 1952  
 G. T. Whyburn, 1953, 1954  
 R. L. Wilder, 1955, 1956  
 Richard Brauer, 1957, 1958  
 E. J. McShane, 1959, 1960  
 Deane Montgomery, 1961, 1962  
 J. L. Doob, 1963, 1964  
 A. A. Albert, 1965, 1966  
 C. B. Morrey, Jr., 1967, 1968  
 Oscar Zariski, 1969, 1970  
 Nathan Jacobson, 1971, 1972  
 Saunders Mac Lane, 1973, 1974  
 Lipman Bers, 1975, 1976  
 R. H. Bing, 1977, 1978  
 Peter D. Lax, 1979, 1980  
 Andrew M. Gleason, 1981, 1982  
 Julia B. Robinson, 1983, 1984  
 Irving Kaplansky, 1985, 1986  
 George Daniel Mostow, 1987, 1988  
 William Browder, 1989, 1990  
 Michael Artin, 1991, 1992  
 Ronald L. Graham, 1993, 1994

**Secretaries**

T. S. Fiske, 1888–1895  
 F. N. Cole, 1896–1920  
 R. G. D. Richardson, 1921–1940  
 J. R. Kline, 1941–1950  
 E. G. Begle, 1951–1956  
 J. W. Green, 1957–1966  
 Everett Pitcher, 1967–1988  
 Robert M. Fossum, 1989–

**Treasurers**

T. S. Fiske, 1890, 1891  
 Harold Jacoby, 1892–1894  
 R. S. Woodward, 1895, 1896  
 Harold Jacoby, 1897–1899  
 W. S. Dennett, 1900–1907  
 J. H. Tanner, 1908–1920  
 W. B. Fite, 1921–1929  
 G. W. Mullins, 1930–1936  
 P. A. Smith, 1937  
 B. P. Gill, 1938–1948  
 A. E. Meder, Jr., 1949–1964  
 W. T. Martin, 1965–1973  
 F. P. Peterson, 1973–

**Endowment Fund**

In 1923 an Endowment Fund was collected to meet the greater demands on the publication program of the Society, demands caused by the ever-increasing number of important mathematical memoirs. Of this fund, which amounted to approximately \$94,000 in 1960, a considerable proportion was contributed by members of the Society. In 1961, upon the death of the last legatees under the will of the late Robert Henderson—for many years a Trustee of the Society—the entire principal of the estate was received by the Society, thereby bringing the total of the Endowment Fund to approximately \$648,000.

**Prize Funds****The Bôcher Memorial Prize**

This prize was founded in memory of Professor Maxime Bôcher with an original endowment of \$1,450. It is awarded every five years for a notable research memoir in analysis that has appeared during the past five years in a recognized North American journal. This provision, introduced in 1971 and modified in 1993, is a liberalization of the terms of the award.

**First (preliminary) award, 1923:** To G. D. Birkhoff for his memoir, *Dynamical systems with two degrees of freedom*. Transactions of the American Mathematical Society, volume 18 (1917), pp. 199–300.

**Second award, 1924:** To E. T. Bell for his memoir, *Arithmetical paraphrases*. I, II, Transactions of the American Mathematical Society, volume 22 (1921), pp. 1–30, 198–219; and to Solomon Lefschetz for his memoir, *On certain numerical invariants with applications to Abelian varieties*,

Transactions of the American Mathematical Society, volume 22 (1921), pp. 407–482.

**Third award, 1928:** To J. W. Alexander for his memoir, *Combinatorial analysis situs*, Transactions of the American Mathematical Society, volume 28 (1926), pp. 301–329.

**Fourth award, 1933:** To Marston Morse for his memoir, *The foundations of a theory of the calculus of variations in the large in  $m$ -space*, Transactions of the American Mathematical Society, volume 31 (1929), pp. 379–404; and to Norbert Wiener for his memoir, *Tauberian theorems*, Annals of Mathematics, Series 2, volume 33 (1932), pp. 1–100.

**Fifth award, 1938:** To John von Neumann for his memoir, *Almost periodic functions and groups*. I, II, Transactions of the American Mathematical Society, volume 36 (1934), pp. 445–492, and volume 37 (1935), pp. 21–50.

**Sixth award, 1943:** To Jesse Douglas for his memoirs, *Green's function and the problem of Plateau*, American Journal of Mathematics, volume 61 (1939), pp. 545–589; *The most general form of the problem of Plateau*, American Journal of Mathematics, volume 61 (1939), pp. 590–608; and *Solution of the inverse problem of the calculus of variations*, Proceedings of the National Academy of Sciences, volume 25 (1939), pp. 631–637.

**Seventh award, 1948:** To A. C. Schaeffer and D. C. Spencer for their memoir, *Coefficients of schlicht functions*. I, II, III, IV, Duke Mathematical Journal, volume 10 (1943), pp. 611–635, volume 12 (1945), pp. 107–125, and the Proceedings of the National Academy of Sciences, volume 32 (1946), pp. 111–116, volume 35 (1949), pp. 143–150.

**Eighth award, 1953:** To Norman Levinson for his contributions to the theory of linear, nonlinear, ordinary, and partial differential equations contained in his papers of recent years.

**Ninth award, 1959:** To Louis Nirenberg for his work in partial differential equations.

**Tenth award, 1964:** To Paul J. Cohen for his paper, *On a conjecture of Littlewood and idempotent measures*, American Journal of Mathematics, volume 82 (1960), pp. 191-212.

**Eleventh award, 1969:** To I. M. Singer in recognition of his work on the index problem, especially his share in two joint papers with Michael F. Atiyah, *The index of elliptic operators*. I, III, Annals of Mathematics, Series 2, volume 87 (1968), pp. 484-530, 546-604.

**Twelfth award, 1974:** To Donald S. Ornstein in recognition of his paper, *Bernoulli shifts with the same entropy are isomorphic*, Advances in Mathematics, volume 4 (1970), pp. 337-352.

**Thirteenth award, 1979:** To Alberto P. Calderón in recognition of his fundamental work on the theory of singular integrals and partial differential equations, and in particular for his paper *Cauchy integrals on Lipschitz curves and related operators*, Proceedings of the National Academy of Sciences, USA, volume 74 (1977), pp. 1324-1327.

**Fourteenth award, 1984:** To Luis A. Caffarelli for his deep and fundamental work in nonlinear partial differential equations, in particular his work on free boundary problems, vortex theory and regularity theory.

**Fifteenth award, 1984:** To Richard B. Melrose for his solution of several outstanding problems in diffraction theory and scattering theory and for developing the analytical tools needed for their resolution.

**Sixteenth award, 1989:** To Richard M. Schoen for his work on the application of partial differential equations to differential geometry, in particular his completion of the solution to the Yamabe Problem in *Conformal deformation of a Riemannian metric to constant scalar curvature*, Journal of Differential Geometry, volume 20 (1984), pp. 479-495.

### The Frank Nelson Cole Prize in Algebra

### The Frank Nelson Cole Prize in Number Theory

These prizes were founded in honor of Professor Frank Nelson Cole on the occasion of his retirement as secretary of the American Mathematical Society after twenty-five years of service and as editor-in-chief of the *Bulletin* for twenty-one years. The original fund was donated by Professor Cole from moneys presented to him on his retirement, was augmented by contributions from members of the Society, and was later doubled by his son, Charles A. Cole. The present endowment is \$2,250. The prizes are awarded at five-year intervals for contributions to algebra and the theory of numbers, respectively, under restrictions similar to those for the Bôcher Prize.

**First award, 1928:** To L. E. Dickson for his book *Algebren und ihre Zahlentheorie*, Orell Füssli, Zürich and Leipzig, 1927.

**Second award, 1931:** To H. S. Vandiver for his several papers on Fermat's last theorem published in the Transactions of the American Mathematical Society and in the Annals of Mathematics during the preceding five years, with special reference to a paper entitled *On Fermat's last theorem*, Transactions of the American Mathematical Society, volume 31 (1929), pp. 613-642.

**Third award, 1939:** To A. Adrian Albert for his papers on the construction of Riemann matrices published in the Annals of Mathematics, Series 2, volume 35 (1934) and volume 36 (1935).

**Fourth award, 1941:** To Claude Chevalley for his paper, *La théorie du corps de classes*, Annals of Mathematics, Series 2, volume 41 (1940), pp. 394-418.

**Fifth award, 1944:** To Oscar Zariski for four papers on algebraic varieties published in the American Journal of Mathematics, volumes 61 (1939) and 62 (1940), and in the Annals of Mathematics, Series 2, volumes 40 (1939) and 41 (1940).

**Sixth award, 1946:** To H. B. Mann for his paper, *A proof of the fundamental theorem on the density of sums of sets of positive integers*, Annals of Mathematics, Series 2, volume 43 (1942), pp. 523-527.

**Seventh award, 1949:** To Richard Brauer for his paper, *On Artin's L-series with general group characters*, Annals of Mathematics, Series 2, volume 48 (1947), pp. 502-514.

**Eighth award, 1951:** To Paul Erdős for his many papers in the theory of numbers, and in particular for his paper, *On a new method in elementary number theory which leads to an elementary proof of the prime number theorem*, Proceedings of the National Academy of Sciences, volume 35 (1949), pp. 374-385.

**Ninth award, 1954:** To Harish-Chandra for his papers on representations of semisimple Lie algebras and groups, and particularly for his paper, *On some applications of the universal enveloping algebra of a semisimple Lie algebra*, Transactions of the American Mathematical Society, volume 70 (1951), pp. 28-96.

**Tenth award, 1956:** To John T. Tate for his paper, *The higher dimensional cohomology groups of class field theory*, Annals of Mathematics, Series 2, volume 56 (1952), pp. 294-297.

**Eleventh award, 1960:** To Serge Lang for his paper, *Unramified class field theory over function fields in several variables*, Annals of Mathematics, Series 2, volume 64 (1956), pp. 285-325; and to Maxwell A. Rosenlicht for his papers, *Generalized Jacobian varieties*, Annals of Mathematics, Series 2, volume 59 (1954), pp. 505-530, and *A universal mapping property of generalized Jacobians*, Annals of Mathematics, Series 2, volume 66 (1957), pp. 80-88.

**Twelfth award, 1962:** To Kenkichi Iwasawa for his paper, *Gamma extensions of number fields*, Bulletin of the American Mathematical Society, volume 65 (1959), pp. 183-226; and to Bernard M. Dwork for his paper, *On the rationality of the zeta function of an algebraic variety*, American Journal of Mathematics, volume 82 (1960), pp. 631-648.

**Thirteenth award, 1965:** To Walter Feit and John G. Thompson for their joint paper, *Solvability of groups of odd order*, Pacific Journal of Mathematics, volume 13 (1963), pp. 775-1029.

**Fourteenth award, 1967:** To James B. Ax and Simon B. Kochen for a series of three joint papers, *Diophantine problems over local fields*. I, II, III, American Journal of Mathematics, volume 87 (1965), pp. 605-630, 631-648, and Annals of Mathematics, Series 2, volume 83 (1966), pp. 437-456.

**Fifteenth award, 1970:** To John R. Stallings for his paper, *On torsion-free groups with infinitely many ends*, Annals of Mathematics, Series 2, volume 88 (1968), pp. 312-334; and to Richard G. Swan for his paper, *Groups of cohomological dimension one*, Journal of Algebra, volume 12 (1969), pp. 585-610.

**Sixteenth award, 1972:** To Wolfgang M. Schmidt for the following papers: *On simultaneous approximation of two algebraic numbers by rationals*, Acta Mathematica (Uppsala), volume 119 (1967), pp. 27-50; *T-numbers do exist*, Symposia Mathematica, volume IV, Academic Press, 1970, pp. 1-26; *Simultaneous approximation to algebraic numbers by rationals*, Acta Mathematica (Uppsala), volume 125 (1970), pp. 189-201; *On Mahler's T-numbers*, Proceedings of Symposia in Pure Mathematics, volume 20, American Mathematical Society, 1971, pp. 275-286.

**Seventeenth award, 1975:** To Hyman Bass for his paper, *Unitary algebraic K-theory*, Springer Lecture Notes in Mathematics, volume 343, 1973; and to Daniel G. Quillen for his paper, *Higher algebraic K-theories*, Springer Lecture Notes in Mathematics, volume 341, 1973.

**Eighteenth award, 1977:** To Goro Shimura for his two papers, *Class fields over real quadratic fields and Hecke operators*, Annals of Mathematics, Series 2, volume 95 (1972), pp. 130-190; and *On modular forms of half integral weight*, Annals of Mathematics, Series 2, volume 97 (1973), pp. 440-481.

**Nineteenth award, 1980:** To Michael Aschbacher for his paper, *A characterization of Chevalley groups over fields of odd order*, Annals of Mathematics, Series 2, volume 106 (1977), pp. 353-398; and to Melvin Hochster for his paper *Topics in the homological theory of commutative rings*, CBMS Regional Conference Series in Mathematics, Number 24, American Mathematical Society, 1975.

**Twentieth award, 1982:** To Robert P. Langlands for pioneering work on automorphic forms, Eisenstein series and product formulas, particularly for his paper *Base change for  $GL(2)$* , Annals of Mathematics Studies, volume 96, Princeton Uni-

versity Press, 1980; and to Barry Mazur for outstanding work on elliptic curves and Abelian varieties, especially on rational points of finite order, and his paper *Modular curves and the Eisenstein ideal*, Publications Mathématiques de l'Institut des Hautes Études Scientifiques, volume 47 (1977), pp. 33-186.

**Twenty-First award, 1985:** To George Lusztig for his fundamental work on the representation theory of finite groups of Lie type. In particular for his contributions to the classification of the irreducible representations in characteristic zero of the groups of rational points of reductive groups over finite fields, appearing in *Characters of reductive groups over finite fields*, Annals of Mathematics Studies, volume 107, Princeton University Press, 1984.

**Twenty-Second award, 1987:** To Dorian M. Goldfeld for his paper, *Gauss's class number problem for imaginary quadratic fields*, Bulletin of the American Mathematical Society, volume 13, (1985), pp. 23-37; and to Benedict H. Gross and Don B. Zagier for their paper, *Heegner points and derivatives of L-Series*, Inventiones Mathematicae, volume 84 (1986), pp. 225-320.

**Twenty-Third award, 1990:** To Shigefumi Mori for his outstanding work on the classification of algebraic varieties and, in particular, for his paper *Flip theorem and the existence of minimal models for 3-folds*, Journal of the American Mathematical Society, volume 1 (1988), pp. 117-253.

**Twenty-Fourth award, 1992:** To Karl Rubin for his work in the area of elliptic curves and Iwasawa theory with particular reference to his papers *Tate-Shafarevich groups and L-functions of elliptic curves with complex multiplication* and *The 'main conjectures' of Iwasawa theory for imaginary quadratic fields* and to Paul Vojta for his work on Diophantine problems with particular reference to his paper *Siegel's theorem in the compact case*.

### The Oswald Veblen Prize in Geometry

This prize was established in 1961 in memory of Professor Oswald Veblen through a fund contributed by former students and colleagues. The fund was later doubled by the widow of Professor Veblen, bringing the fund to \$2,000. The first two awards of the prize were made in 1964 and the next in 1966; thereafter, an award has been (and ordinarily is) made every five years for research in geometry or topology under conditions similar to those for the Bôcher Prize.

**First award, 1964:** To C. D. Papakyriakopoulos for his papers, *On solid tori*, Annals of Mathematics, Series 2, volume 66 (1957), pp. 1-26, and *On Dehn's lemma and the asphericity of knots*, Proceedings of the National Academy of Sciences, volume 43 (1957), pp. 169-172.

**Second award, 1964:** To Raoul Bott for his papers, *The space of loops on a Lie group*, Michigan Mathematical Journal, volume 5 (1958), pp. 35-61, and *The stable homotopy of the classical groups*, Annals of Mathematics, Series 2, volume 70 (1959), pp. 313-337.

**Third award, 1966:** To Stephen Smale for his contributions to various aspects of differential topology.

**Fourth award, 1966:** To Morton Brown and Barry Mazur for their work on the generalized Schoenflies theorem.

**Fifth award, 1971:** To Robion C. Kirby for his paper, *Stable homeomorphisms and the annulus conjecture*, *Annals of Mathematics*, Series 2, volume 89 (1969), pp. 575-582.

**Sixth award, 1971:** To Dennis P. Sullivan for his work on the Hauptvermutung summarized in the paper, *On the Hauptvermutung for manifolds*, *Bulletin of the American Mathematical Society*, volume 73 (1967), pp. 598-600.

**Seventh award, 1976:** To William P. Thurston for his work on foliations.

**Eighth award, 1976:** To James Simons for his work on minimal varieties and characteristic forms.

**Ninth award, 1981:** To Mikhael Gromov for his work relating topological and geometric properties of Riemannian manifolds.

**Tenth award, 1981:** To Shing-Tung Yau for his work in nonlinear partial differential equations, his contributions to the topology of differentiable manifolds, and for his work on the complex Monge-Ampère equation on compact complex manifolds.

**Eleventh award, 1986:** To Michael H. Freedman for his work in differential geometry and, in particular, the solution of the four-dimensional Poincaré conjecture.

**Twelfth award, 1991:** To Andrew J. Casson for his work on the topology of low-dimensional manifolds, and to Clifford H. Taubes for his foundational work in Yang-Mills theory.

#### **The George David Birkhoff Prize in Applied Mathematics**

This prize was established in 1967 in honor of Professor George David Birkhoff. The initial endowment of \$2,066 was contributed by the Birkhoff family and there have been subsequent additions by others. It is normally awarded every five years, beginning in 1968, for an outstanding contribution to "applied mathematics in the highest and broadest sense." The award is made jointly by the American Mathematical Society and the Society for Industrial and Applied Mathematics. The recipient must be a member of one of these societies and a resident of the United States, Canada, or Mexico.

**First award, 1968:** To Jürgen K. Moser for his contributions to the theory of Hamiltonian dynamical systems, especially his proof of the stability of periodic solutions of Hamiltonian systems having two degrees of freedom and his specific applications of the ideas in connection with this work.

**Second award, 1973:** To Fritz John for his outstanding work in partial differential equations, in numerical analysis, and, particularly, in nonlinear elasticity theory; the latter work has led to his study of quasi-isometric mappings as well as

functions of bounded mean oscillation, which have had impact in other areas of analysis.

**Third award, 1973:** To James B. Serrin for his fundamental contributions to the theory of nonlinear partial differential equations, especially his work on existence and regularity theory for nonlinear elliptic equations, and applications of his work to the theory of minimal surfaces in higher dimensions.

**Fourth award, 1978:** To Garrett Birkhoff for bringing the methods of algebra and the highest standards of mathematics to scientific applications.

**Fifth award, 1978:** To Mark Kac for his important contributions to statistical mechanics and to probability theory and its applications.

**Sixth award, 1978:** To Clifford A. Truesdell for his outstanding contributions to our understanding of the subjects of rational mechanics and nonlinear materials, for his efforts to give precise mathematical formulation to these classical subjects, for his many contributions to applied mathematics in the fields of acoustic theory, kinetic theory, and nonlinear elastic theory, and the thermodynamics of mixtures, and for his major work in the history of mechanics.

**Seventh award, 1983:** To Paul R. Garabedian for his important contributions to partial differential equations, to the mathematical analysis of problems of transonic flow and airfoil design by the method of complexification, and to the development and application of scientific computing to problems of fluid dynamics and plasma physics.

**Eighth award, 1988:** To Elliott H. Lieb for his profound analysis of problems arising in mathematical physics.

#### **The Norbert Wiener Prize in Applied Mathematics**

This prize was established in 1967 in honor of Professor Norbert Wiener and was endowed by a fund amounting to \$2,000 from the Department of Mathematics of the Massachusetts Institute of Technology. The prize is normally awarded every five years, beginning in 1970, for an outstanding contribution to "applied mathematics in the highest and broadest sense." The award is made jointly by the American Mathematical Society and the Society for Industrial and Applied Mathematics. The recipient must be a member of one of these societies and a resident of the United States, Canada, or Mexico.

**First award, 1970:** To Richard E. Bellman for his pioneering work in the area of dynamic programming, and for his related work on control, stability, and differential-delay equations.

**Second award, 1975:** To Peter D. Lax for his broad contributions to applied mathematics, in particular, for his work on numerical and theoretical aspects of partial differential equations and on scattering theory.

**Third award, 1980:** To Tosio Kato for his distinguished work in the perturbation theory of quantum mechanics.

**Fourth award, 1980:** To Gerald B. Whitham for his broad contributions to the understanding of fluid dynamical

phenomena and his innovative contributions to the methodology through which that understanding can be constructed.

**Fifth award, 1985:** To Clifford S. Gardner for his contributions to applied mathematics in the areas of supersonic aerodynamics, plasma physics and hydromagnetics, and especially for his contributions to the truly remarkable development of inverse scattering theory for the solution of nonlinear partial differential equations.

**Sixth award, 1990:** To Michael Aizenman for his outstanding contribution of original and non-perturbative mathematical methods in statistical mechanics by means of which he was able to solve several long open important problems concerning critical phenomena, phase transitions, and quantum field theory; and to Jerrold E. Marsden for his outstanding contributions to the study of differential equations in mechanics: he proved the existence of chaos in specific classical differential equations; his work on the momentum map, from abstract foundations to detailed applications, has had great impact.

### The Leroy P. Steele Prizes

These prizes were established in 1970 in honor of George David Birkhoff, William Fogg Osgood, and William Caspar Graustein, and are endowed under the terms of a bequest amounting to \$145,000 from Leroy P. Steele. From 1970 to 1976 one or more prizes were awarded each year for outstanding published mathematical research; most favorable consideration was given to papers distinguished for their exposition and covering broad areas of mathematics. In 1977 the Council of the AMS modified the terms under which the prizes are awarded. Since then, up to three prizes have been awarded each year in the following categories: (1) for the cumulative influence of the total mathematical work of the recipient, high level of research over a period of time, particular influence on the development of a field, and influence on mathematics through Ph.D. students; (2) for a book or substantial survey or expository-research paper; (3) for a paper, whether recent or not, that has proved to be of fundamental or lasting importance in its field, or a model of important research. In 1993 the Council formalized the three categories of the prize by naming each of them: (1) The Leroy P. Steele Prize for Lifetime Achievement; (2) The Leroy P. Steele Prize for Mathematical Exposition; and (3) The Leroy P. Steele Prize for Seminal Contribution to Research.

**August 1970:** To Solomon Lefschetz for his paper, *A page of mathematical autobiography*, Bulletin of the American Mathematical Society, volume 74 (1968), pp. 854-879.

**August 1971:** To James B. Carrell for his paper, written jointly with Jean A. Dieudonné, *Invariant theory, old and new*, Advances in Mathematics, volume 4 (1970), pp. 1-80.

**August 1971:** To Jean A. Dieudonné for his paper, *Algebraic geometry*, Advances in Mathematics, volume 3 (1969), pp. 223-321, and for his paper, written jointly with James B. Carrell, *Invariant theory, old and new*, Advances in Mathematics, volume 4 (1970), pp. 1-80.

**August 1971:** To Phillip A. Griffiths for his paper, *Periods of integrals on algebraic manifolds*, Bulletin of the American Mathematical Society, volume 76 (1970), pp. 228-296.

**August 1972:** To Edward B. Curtis for his paper, *Simplicial homotopy theory*, Advances in Mathematics, volume 6 (1971), pp. 107-209.

**August 1972:** To William J. Ellison for his paper, *Waring's problem*, American Mathematical Monthly, volume 78 (1971), pp. 10-36.

**August 1972:** To Lawrence F. Payne for his paper, *Isoperimetric inequalities and their applications*, SIAM Review, volume 9 (1967), pp. 453-488.

**August 1972:** To Dana S. Scott for his paper, *A proof of the independence of the continuum hypothesis*, Mathematical Systems Theory, volume 1 (1967), pp. 89-111.

**January 1975:** To Lipman Bers for his paper, *Uniformization, moduli, and Kleinian groups*, Bulletin of the London Mathematical Society, volume 4 (1972), pp. 257-300.

**January 1975:** To Martin D. Davis for his paper, *Hilbert's tenth problem is unsolvable*, American Mathematical Monthly, volume 80 (1973), pp. 233-269.

**January 1975:** To Joseph L. Taylor for his paper, *Measure algebras*, CBMS Regional Conference Series in Mathematics, Number 16, American Mathematical Society, 1972.

**August 1975:** To George W. Mackey for his paper, *Ergodic theory and its significance for statistical mechanics and probability theory*, Advances in Mathematics, volume 12 (1974), pp. 178-286.

**August 1975:** To H. Blaine Lawson for his paper, *Foliations*, Bulletin of the American Mathematical Society, volume 80 (1974), pp. 369-418.

**1976, 1977, 1978:** No awards were made.

**January 1979:** To Salomon Bochner for his cumulative influence on the fields of probability theory, Fourier analysis, several complex variables, and differential geometry.

**January 1979:** To Hans Lewy for three fundamental papers: *On the local character of the solutions of an atypical linear differential equation in three variables and a related theorem for regular functions of two complex variables*, Annals of Mathematics, Series 2, volume 64 (1956), pp. 514-522; *An example of a smooth linear partial differential equation without solution*, Annals of Mathematics, Series 2, volume 66 (1957), pp. 155-158; *On hulls of holomorphy*, Communications in Pure and Applied Mathematics, volume 13 (1960), pp. 587-591.

**August 1979:** To Antoni Zygmund for his cumulative influence on the theory of Fourier series, real variables, and related areas of analysis.

**August 1979:** To Robin Hartshorne for his expository research article *Equivalence relations on algebraic cycles and subvarieties of small codimension*, Proceedings of Symposia

in *Pure Mathematics*, volume 29, American Mathematical Society, 1975, pp. 129-164; and his book *Algebraic geometry*, Springer-Verlag, Berlin and New York, 1977.

**August 1979:** To Joseph J. Kohn for his fundamental paper: *Harmonic integrals on strongly convex domains*. I, II, *Annals of Mathematics*, Series 2, volume 78 (1963), pp. 112-248 and volume 79 (1964), pp. 450-472.

**August 1980:** To André Weil for the total effect of his work on the general course of twentieth century mathematics, especially in the many areas in which he has made fundamental contributions.

**August 1980:** To Harold M. Edwards for mathematical exposition in his books *Riemann's zeta function*, *Pure and Applied Mathematics*, number 58, Academic Press, New York and London, 1974; and *Fermat's last theorem*, *Graduate Texts in Mathematics*, number 50, Springer-Verlag, New York and Berlin, 1977.

**August 1980:** To Gerhard P. Hochschild for his significant work in homological algebra and its applications.

**August 1981:** To Oscar Zariski for his work in algebraic geometry, especially his fundamental contributions to the algebraic foundations of this subject.

**August 1981:** To Eberhard Hopf for three papers of fundamental and lasting importance: *Abzweigung einer periodischen Lösung von einer stationären Lösung eines Differential systems*, *Berichte über die Verhandlungen der Sächsischen Akademie der Wissenschaften zu Leipzig. Mathematisch-Naturwissenschaftliche Klasse*, volume 95 (1943), pp. 3-22; *A mathematical example displaying features of turbulence*, *Communications on Applied Mathematics*, volume 1 (1948), pp. 303-322; and *The partial differential equation  $u_t + uu_x = \mu u_{xx}$* , *Communications on Pure and Applied Mathematics*, volume 3 (1950), pp. 201-230.

**August 1981:** To Nelson Dunford and Jacob T. Schwartz for their expository book, *Linear operators*, Part I, *General theory*, 1958; Part II, *Spectral theory*, 1963; Part III, *Spectral operators*, 1971, Interscience Publishers, New York.

**August 1982:** To Lars V. Ahlfors for his expository work in *Complex analysis* (McGraw-Hill Book Company, New York, 1953), and in *Lectures on quasiconformal mappings* (D. Van Nostrand Co., Inc., New York, 1966) and *Conformal invariants* (McGraw-Hill Book Company, New York, 1973).

**August 1982:** To Tsit-Yuen Lam for his expository work in his book *Algebraic theory of quadratic forms* (1973), and four of his papers:  *$K_0$  and  $K_1$ —an introduction to algebraic K-theory* (1975), *Ten lectures on quadratic forms over fields* (1977), *Serre's conjecture* (1978), and *The theory of ordered fields* (1980).

**August 1982:** To John W. Milnor for a paper of fundamental and lasting importance, *On manifolds homeomorphic to the 7-sphere*, *Annals of Mathematics* (2) 64 (1956), pp. 399-405.

**August 1982:** To Fritz John for the cumulative influence of his total mathematical work, high level of research over a

period of time, particular influence on the development of a field, and influence on mathematics through Ph.D. students.

**August 1983:** To Paul R. Halmos for his many graduate texts in mathematics and for his articles on how to write, talk and publish mathematics.

**August 1983:** To Steven C. Kleene for three important papers which formed the basis for later developments in generalized recursion theory and descriptive set theory: *Arithmetical predicates and function quantifiers*, *Transactions of the American Mathematical Society* 79 (1955), pp. 312-340; *On the forms of the predicates in the theory of constructive ordinals (second paper)*, *American Journal of Mathematics* 77 (1955), pp. 405-428; and *Hierarchies of number-theoretic predicates*, *Bulletin of the American Mathematical Society* 61 (1955), pp. 193-213.

**August 1983:** To Shiing-Shen Chern for the cumulative influence of his total mathematical work, high level of research over a period of time, particular influence on the development of the field of differential geometry, and influence on mathematics through Ph.D. students.

**August 1984:** To Elias M. Stein for his book, *Singular integrals and the differentiability properties of functions*, Princeton University Press (1970).

**August 1984:** To Lennart Carleson for his papers: *An interpolation problem for bounded analytic functions*, *American Journal of Mathematics*, volume 80 (1958), pp. 921-930; *Interpolation by bounded analytic functions and the Corona problem*, *Annals of Mathematics* (2), volume 76 (1962), pp. 547-559; and *On convergence and growth of partial sums of Fourier series*, *Acta Mathematica* volume 116 (1966), pp. 135-157.

**August 1984:** To Joseph L. Doob for his fundamental work in establishing probability as a branch of mathematics and for his continuing profound influence on its development.

**August 1985:** To Michael Spivak for his five-volume set, *A Comprehensive Introduction to Differential Geometry* (second edition, Publish or Perish, 1979).

**August 1985:** To Robert Steinberg for three papers on various aspects of the theory of algebraic groups: *Representations of algebraic groups*, *Nagoya Mathematical Journal*, volume 22 (1963), pp. 33-56; *Regular elements of semisimple algebraic groups*, *Institut des Hautes Études Scientifiques, Publications Mathématiques*, volume 25 (1965), pp. 49-80; and *Endomorphisms of linear algebraic groups*, *Memoirs of the American Mathematical Society*, volume 80 (1968).

**August 1985:** To Hassler Whitney for his fundamental work on geometric problems, particularly in the general theory of manifolds, in the study of differentiable functions on closed sets, in geometric integration theory, and in the geometry of the tangents to a singular analytic space.

**January 1986:** To Donald E. Knuth for his expository work, *The Art of Computer Programming*, 3 Volumes (1st Edition 1968, 2nd Edition 1973).

**January 1986:** To Rudolf E. Kalman for his two fundamental papers: *A new approach to linear filtering and prediction problems*, Journal of Basic Engineering, volume 82, (1960), pp. 35-45; and *Mathematical description of linear dynamical systems*, SIAM Journal on Control and Optimization, volume 1 (1963), pp. 152-192; and for his contribution to a third paper, (with R. S. Bucy) *New results in linear filtering and prediction theory*, Journal of Basic Engineering, volume 83D (1961), pp. 95-108.

**January 1986:** To Saunders Mac Lane for his many contributions to algebra and algebraic topology, and in particular for his pioneering work in homological and categorical algebra.

**August 1987:** To Martin Gardner for his many books and articles on mathematics and particularly for his column "Mathematical Games" in *Scientific American*.

**August 1987:** To Herbert Federer and Wendell Fleming for their pioneering paper, *Normal and integral currents*, Annals of Mathematics, volume 72 (1960), pp. 458-520.

**August 1987:** To Samuel Eilenberg for his fundamental contributions to topology and algebra, in particular for his classic papers on singular homology and his work on axiomatic homology theory which had a profound influence on the development of algebraic topology.

**August 1988:** To Sigurdur Helgason for his books *Differential Geometry and Symmetric Spaces* (Academic Press, 1962), *Differential Geometry, Lie Groups, and Symmetric Spaces* (Academic Press, 1978); and *Groups and Geometric Analysis* (Academic Press, 1984).

**August 1988:** To Gian-Carlo Rota for his paper *On the foundations of combinatorial theory, I. Theory of Möbius functions*, Zeitschrift für Wahrscheinlichkeitstheorie und Verwandte Gebiete, volume 2 (1964), pp. 340-368.

**August 1988:** To Deane Montgomery for his lasting impact on mathematics, particularly mathematics in America. He is one of the founders of the modern theory of transformation groups and is particularly known for his contributions to the solution of Hilbert's fifth problem.

**August 1989:** To Daniel Gorenstein for his book *Finite Simple Groups, An Introduction to their Classification* (Plenum Press, 1982); and his two survey articles *The Classification of Finite Simple Groups* and *Classifying the Finite Simple Groups*, Bulletin of the American Mathematical Society, volume 1 (1979) pp. 43-199, and volume 14 (1986) pp. 1-98, respectively.

**August 1989:** To Alberto P. Calderón for his paper *Uniqueness in the Cauchy Problem for Partial Differential Equations*, American Journal of Mathematics, volume 80 (1958), pp. 16-36.

**August 1989:** To Irving Kaplansky for his lasting impact on mathematics, particularly mathematics in America. By his energetic example, his enthusiastic exposition, and his overall generosity, he has made striking changes in mathematics and has inspired generations of younger mathematicians.

**August 1990:** To R. D. Richtmyer for his book *Difference Methods for Initial-Value Problems* (Interscience, 1st Edition 1957 and 2nd Edition, with K. Morton, 1967).

**August 1990:** To Bertram Kostant for his paper, *On the existence and irreducibility of certain series of representations*, Lie Groups and their Representations (1975), pp. 231-329.

**August 1990:** To Raoul Bott for having been instrumental in changing the face of geometry and topology, with his incisive contributions to characteristic classes, K-theory, index theory, and many other tools of modern mathematics.

**August 1991:** To Jean-François Trèves for *Pseudodifferential and Fourier Integral Operators*, Volumes 1 and 2 (Plenum Press, 1980).

**August 1991:** To Eugenio Calabi for his fundamental work on global differential geometry, especially complex differential geometry.

**August 1991:** To Armand Borel for his extensive contributions in geometry and topology, the theory of Lie groups, their lattices and representations and the theory of automorphic forms, the theory of algebraic groups and their representations, and extensive organizational and educational efforts to develop and disseminate modern mathematics.

**January 1993:** To Jacques Dixmier for his books *von Neumann Algebras (Algèbres de von Neumann)*, Gauthier-Villars, Paris (1957); *C\*-Algebras (Les C\*-Algèbres et leurs Représentations)*, Gauthier-Villars, Paris (1964); and *Enveloping Algebras (Algèbres Enveloppantes)*, Gauthier-Villars, Paris (1974).

**January 1993:** To James Glimm for his paper, *Solution in the large for nonlinear hyperbolic systems of conservation laws*, Communications on Pure and Applied Mathematics, XVIII (1965), pp. 697-715.

**January 1993:** To Peter D. Lax for his numerous and fundamental contributions to the theory and applications of linear and nonlinear partial differential equations and functional analysis, for his leadership in the development of computational and applied mathematics, and for his extraordinary impact as a teacher.

**August 1993 - Mathematical Exposition:** To Walter Rudin for his books *Principles of Mathematical Analysis*, McGraw-Hill (1953, 1964, and 1976); and *Real and Complex Analysis*, McGraw-Hill (1966, 1974, and 1976).

**August 1993 - Seminal Contribution to Research:** To George Daniel Mostow for his paper *Strong rigidity of locally symmetric spaces*, Annals of Mathematics Studies, number 78, Princeton University Press (1973).

**August 1993 - Lifetime Achievement:** To Eugene B. Dynkin for his foundational contributions to Lie algebras and probability theory over a long period and his production of outstanding research students in both Russia and the United States, countries to whose mathematical life he has contributed so richly.



### The Delbert Ray Fulkerson Fund

Gifts of friends of the late Professor Fulkerson have provided a fund in excess of \$7,000. Part or all of the proceeds is to be used jointly by the Mathematical Programming Society and the American Mathematical Society for the award of one or more prizes in discrete mathematics at regular intervals.

**First award, 1979:** To Richard M. Karp, for *On the computational complexity of combinatorial problems*, Networks, volume 5 (1975), pp. 45-68; to Kenneth Appel and Wolfgang Haken, for *Every planar map is four colorable*, Part I: *Discharging*, Illinois Journal of Mathematics, volume 21 (1977), pp. 429-490; and to Paul D. Seymour, for *The matroids with the max-flow min-cut property*, Journal of Combinatorial Theory, Series B, volume 23 (1977), pp. 189-222.

**Second award, 1982:** To D. B. Judin and A. S. Nemirovskii, for *Informational complexity and effective methods of solution for convex extremal problems*, Ekonomika i Matematicheskie Metody 12 (1976), 357-369, and to L. G. Khachiyan for *A polynomial algorithm in linear programming*, Akademiia Nauk SSSR. Doklady 244 (1979), 1093-1096; to G. P. Egorychev, for *The solution of van der Waerden's problem for permanents*, Akademiia Nauk SSSR. Doklady 258 (1981), 1041-1044, and D. I. Falikman, for *A proof of the van der Waerden conjecture on the permanent of a doubly stochastic matrix*, Matematicheskie Zametki 29 (1981), 931-938; and to M. Grötschel, L. Lovász and A. Schrijver, for *The ellipsoid method and its consequences in combinatorial optimization*, Combinatorica 1 (1981), 169-197.

**Third award, 1985:** To József Beck, for *Roth's estimate of the discrepancy of integer sequences is nearly sharp*, Combinatorica 1 (4), 319-325, (1981); and H. W. Lenstra, Jr., for *Integer programming with a fixed number of variables*, Mathematics of Operations Research 8 (4), 538-548, (1983); and Eugene M. Luks for *Isomorphism of graphs of bounded valence can be tested in polynomial time*, Journal of Computer and System Sciences 25 (1), 42-65, (1982).

**Fourth award, 1988:** To Éva Tardos for *A strongly polynomial minimum cost circulation algorithm*, Combinatorica, volume 5 (1985), pp. 247-256; and to Narendra Karmarkar for *A new polynomial-time algorithm for linear programming*, Combinatorica, volume 4 (1984), pp. 373-395.

**Fifth award, 1991:** To Martin Dyer, Alan Frieze, and Ravi Kannan for *A random polynomial time algorithm for approximating the volume of convex bodies*, Journal of the Association for Computing Machinery, volume 38/1 (1991) pp. 1-17; to Alfred Lehman for *The width-length inequality and degenerate projective planes*, W. Cook and P. D. Seymour (eds.), Polyhedral Combinatorics, DIMACS Series in Discrete Mathematics and Theoretical Computer Science, volume 1, (American Mathematical Society, 1990) pp. 101-105; and to Nikolai E. Mnev for *The universality theorems on the classification problem of configuration varieties and convex polytope varieties*, O. Ya. Viro (ed.), Topology and Geometry-Rohlin Seminar, Lecture Notes in Mathematics 1346 (Springer-Verlag, Berlin, 1988) pp. 527-544.

### The Ruth Lyttle Satter Prize in Mathematics

The prize was established in 1990 using funds donated by Joan S. Birman in memory of her sister, Ruth Lyttle Satter. Professor Birman requested that the prize be established to honor her sister's commitment to research and to encouraging women in science. The prizes are awarded every two years to recognize an outstanding contribution to mathematics research by a woman in the previous five years.

**First award, 1991:** To Dusa McDuff for her outstanding work during the past five years on symplectic geometry.

**Second award, 1993:** To Lai-Sang Young for her leading role in the investigation of the statistical (or ergodic) properties of dynamical systems.

### Award for Distinguished Public Service

To provide encouragement and recognition to those individuals who contribute their time to public service activities in support of mathematics, the Council of the Society established the Award for Distinguished Public Service. The award was established in response to a recommendation by the Society's Committee on Science policy. The award is presented every two years to a research mathematician who has made a distinguished contribution to the mathematics profession during the preceding five years.

**First award, 1990:** Kenneth M. Hoffman

**Second award, 1992:** Harvey B. Keynes

**Third award, 1993:** I. M. Singer

### Citation for Public Service

To provide encouragement and recognition for contributions to public service activities in support of mathematics, the Council of the Society established the Citation for Public Service. The award was established in response to a recommendation by the Society's Committee on Science Policy. One to three citations are presented each year for notable contributions to the mathematics profession through public service.

**First award, 1991:** Andre Z. Manitius

**Second award, 1992:** Marcia P. Sward

## Special Funds

### AMS Centennial Fellowship Fund

This fund was established by the Society in 1973 and provides one-year Research Fellowships awarded each year in March. The number of fellowships granted each year depends on the contributions the Society receives, matched by a contribution from the Society of not more than \$30,000. Through the academic year 1983-1984, this was a postdoctoral fellowship, restricted to persons only a few years past the Ph.D. In the competition of January 1984, it was changed to an early mid-career fellowship, for persons five to ten years past the Ph.D. At the same time, the stipend was substantially increased. For the 1988 award, the name of the fellowship was changed from

AMS Research Fellowship to AMS Centennial Fellowship in honor of the Society's Centennial.

**First award, 1974–1975:** Fred G. Abramson and James Li-Ming Wang.

**Second award, 1975–1976:** Terence J. Gaffney, Paul Nèvai, and George M. Reed.

**Third award, 1976–1977:** Fredric D. Ancel and Joseph A. Sgro.

**Fourth award, 1977–1978:** Steven Kalikow, Charles Patton, Duong-Hong Phong, and David Vogan.

**Fifth award, 1978–1979:** Alan Dankner, David Harbater, Howard Hiller, Steven P. Kerckhoff, and Robert C. McOwen.

**Sixth award, 1979–1980:** Scott W. Brown, Jeffrey E. Hoffstein, Jeffrey N. Kahn, James E. McClure, Rick L. Smith, and Mark Steinberger.

**Seventh award, 1980–1981:** Robert K. Lazarsfeld, Thomas H. Parker, and Robert Sachs.

**Eighth award, 1981–1982:** Lawrence Man-Hou Ein and Mark Williams.

**Ninth award, 1982–1983:** Nicholas J. Kuhn.

**Tenth award, 1983–1984:** Russell David Lyons.

**Eleventh award, 1984–1985:** Richard Timothy Durrett.

**Twelfth award, 1985–1986:** R. Michael Beals.

**Thirteenth award, 1986–1987:** Dinakar Ramakrishnan

**Fourteenth award, 1987–1988:** Richard Hain and Bill Jacob

**Fifteenth award, 1988–1989:** Stephen R. Bell, Don M. Blasius, and David Gabai

**Sixteenth award, 1989–1990:** Isaac Y. Efrat, John M. Lee, and Ralf J. Spatzier

**Seventeenth award, 1990–1991:** Michael Anderson, Carolyn Gordon, Steven Mitchell

**Eighteenth award, 1991–1992:** Daniel Bump, Kari Vilonen

**Nineteenth award, 1992–1993:** Krzysztof Kurdzy, William Menasco, David Morrison

**Twentieth award, 1993–1994:** Jacques Hurtubise, Andre Scedrov, David Webb

#### **The Levi L. Conant Fund**

Levi L. Conant bequeathed a sum of \$9,500 which the Trustees incorporated with the permanent endowments for prize funds.

#### **The Karl Menger Fund**

The family of the late Karl Menger were the major contributors to a fund established at Duke University totalling \$40,000. The majority of the income from this fund is to be used by the Society for annual awards at the International Science and Engineering Fair.

#### **The Eliakim Hastings Moore Fund**

This fund was donated in 1922 in honor of Professor Eliakim Hastings Moore on the occasion of the twenty-fifth anniversary of the Chicago (Western) section of the Society. The fund is \$2,575 and the income from the fund is to be used at the discretion of the Council for the publication of important mathematical books and memoirs and for the award of prizes.

#### **The C. V. Newsom Fund**

In 1990 the Society received a bequest of \$100,000 from the estate of Carroll V. Newsom. The bequest was made to memorialize John von Neumann and his accomplishments. The income from this fund is to be used to support a quadrennial symposium, called the von Neumann Symposium, that will focus on fundamental concepts in the forefront of mathematics.

#### **The Joseph Fels Ritt Memorial Fund**

From the estate of Estelle F. Ritt, the income from a fund of \$22,500 is available for the publication of works in the field of mathematics as shall be determined by the governing bodies of the Society.

#### **The Waldemar J. Trjitzinsky Fund**

A bequest of \$189,000 was received in 1988 from the estate of Barbara G. Trjitzinsky to establish a fund in memory of her husband, Waldemar J. Trjitzinsky. The income from this fund is to be used for needy students studying in the field of mathematics.

#### **Friends of Mathematics Fund**

A Friends of Mathematics Fund has been created to incorporate monetary gifts to the Society of a general nature. The principle of this fund is now \$123,572. The proceeds of the fund are a part of the invested assets of the Society. The following gifts are components of this fund: \$1,000 from the estate of Professor Ernest William Brown; \$1,000 from the estate of Geneva B. Hutchinson; \$3,000 from Solomon A. Joffe; \$650 from the estate of Professor Helen A. Merrill; \$23,600 from the estate of Dean Marion Reilly; \$1,000 from the estate of James K. Whittemore; and \$2,700 from an anonymous donor.

## **Recent Appointments**

Committee members' terms of office on standing committees expire on January 31 following the year given in parentheses after their names, unless otherwise specified.

Upon recommendation of the Editorial Boards Committee, the Council has elected Henri Gillet (1995) as the Society's representative to the *American Journal of Mathematics Editorial Committee*. The continuing member of the committee is M. Salah Baouendi (1995), chair.

Leonard L. Scott (1996) has been appointed chair of the *University Lecture Series Committee* by President Ronald L. Graham. Other members of the committee are Thomas W. Gamelin (1994) and Donald S. Ornstein (1995).

President Ronald L. Graham has appointed Noga Alon, Randolph E. Bank, Robert Osserman, Carl Pomerance, and Herbert S. Wilf to the *Advisory Board for What's Happening*.

John R. Garrett (1995) has been appointed by President Ronald L. Graham to the *Committee on Publication*. Continuing members of the committee are Sheldon Axler (1994), Robert M. Fossum (*ex officio*), John M. Franks (1994), Ronald L. Graham (*ex officio*), William H. Jaco (*ex officio*), Svetlana R. Katok (1993), Elliott H. Lieb (1993), Haynes R. Miller (1994), Richard S. Palais (1995), chair, Frank S. Quinn (1995), Paul J. Sally, Jr. (1993), and Bhama Srinivasan (1993).

Carl C. Cowen (1996), David A. Cox (1996), and Rebecca A. Herb (1996) have been appointed by President Ronald L. Graham; and Maria M. Klawe (1994) has been appointed by John C. Polking, chair of the Board, to the *Committee on Education*. Continuing members of the committee are Jerry L. Bona (1995), Robert M. Fossum (*ex officio*), Ramesh A. Gangolli (1994), chair, Ronald L. Graham (*ex officio*), Deborah Hughes Hallett (1995), William H. Jaco (*ex officio*), Harvey B. Keynes (1995), Judith Roitman (1995), Alan H. Schoenfeld (1995), Alan C. Tucker (1993), and Frank W. Warner III (*ex officio*).

De Witt Summers (1994) has been appointed chair of the *Pi Mu Epsilon Liaison Committee* by President Ronald L. Graham. Other members of the committee are David W. Ballew (1993), Joseph P. Brennan (1995), Mary B. Martin (1994), and Bruce Reznick (1993).

President Ronald L. Graham has appointed M. Salah Baouendi (1994), Ruth M. Charney (1994), Frank L. Gilfeather (1995), Richard J. Griego (1995), Elliott H. Lieb (1996), Joseph Lipman (1996), William A. Massey (1994), Donald E. McClure (1996), Ronald J. Stern (1995), and Steven H. Weintraub (1994); and Roy L. Adler (1995) has been appointed by John C. Polking, chair of the Board, to the *Committee on the Profession*. Robert M. Fossum, Ronald L. Graham, and William H. Jaco will serve *ex officio*. Professor Baouendi will serve as chair.

Robin A. Pemantle (1995), Alice Silverberg (1995), and Kari Vilonen (1995) have been appointed to the *Committee on Centennial Fellowships* by President Ronald L. Graham. Peter Sarnak (1994) has been appointed chair. Continuing members of the committee are H. Jerome Keisler (1994), Birgit Speh (1994), and Lai-Sang Young (1994). Terms expire on June 30 of the listed year.

Barry Mazur (1996), Marina Ratner (1996), and William P. Thurston (1996) have been appointed by President Ronald L. Graham to the *Committee on Steele Prizes*. Eugenio Calabi (1995) has been appointed chair. Continuing members of the committee are Vaughan F. R. Jones (1994), Robert P. Langlands (1995), Paul Rabinowitz (1995), Jane Cronin Scanlon (1994), and Jean E. Taylor (1994). Terms expire on June 30 of the listed year.

Katalin A. Bencsath (AMS, 1997), John R. Stembridge

(AMS, 1997), and Clifford Taubes (AMS, 1997) have been appointed by President Ronald L. Graham to the *AMS-IMS-SIAM Committee on Joint Summer Research Conferences in the Mathematical Sciences*. Continuing members of the committee are Alan F. Karr (AMS, 1996), Stewart B. Priddy (AMS, 1994), Robert J. Serfling (IMS, 1993), Michael Shub (AMS, 1994), Sue Whitesides (AMS, 1996). Terms expire on June 30.

Daniel J. Madden (AMS, 1994) has been appointed by President Ronald L. Graham to the *AMS-MAA Committee on Teaching Assistants and Part-time Instructors (TA/PTI)*. Continuing members of the committee are Reuben C. Drake (MAA, 1994), Deborah Hughes Hallett (AMS, 1993), Timothy L. Lance (AMS, 1994), Suzanne Lenhart (AMS, 1995), Shelba J. Morman (MAA, 1995), Stephen B. Rode (MAA, 1994), and Raymond O. Wells (MAA, 1995).

Presidents Avner Friedman (SIAM) and Ronald L. Graham (AMS) have appointed Michael Aizenman, Thomas G. Kurtz, and Mary Fanett Wheeler to the *AMS-SIAM Committee to Select the Winner of the Birkhoff Prize for 1994*. Professor Kurtz will serve as chair.

Thomas Kailath, Peter D. Lax, and Jerrold E. Marsden have been appointed by Presidents Avner Friedman (SIAM) and Ronald L. Graham (AMS) to the *AMS-SIAM Committee to Select the Winner of the Weiner Prize for 1995*. Professor Kailath will serve as chair.

Jack D. Cowan (1994) has been appointed chair of the *AMS-SIAM-SMB Committee on Mathematics in the Life Sciences* by Presidents Avner Friedman (SIAM), Alan Perelson (SMB), and Ronald L. Graham (AMS). Continuing members of the committee are James W. Curran (1993), Leah Edelstein-Keshet (1994), Eric S. Lander (1993), Michael S. Waterman (1995), and Carla Wofsy (1995).

## The Council Meeting in Washington

The Council of the Society met on the Howard University campus in Washington, DC, on 17 April 1993 at 7:00 p.m. There were twenty-four members present. The meeting was chaired by President Graham.

Introductions of new members were made. The Council then approved the minutes from the January 1993 meeting. It also approved a minute stating that John Franks, member-at-large, had been elected to a four-year term as a member of the Executive Committee.

The Council consented to discharging several committees.

It passed two resolutions, one welcoming the formation of the Palestine Society of Mathematical Sciences and the other congratulating the Hellenic Mathematical Society on the occasion of its seventy-fifth anniversary:

### *Palestine Society of Mathematical Sciences*

The Council of the American Mathematical Society welcomes the formation of the Palestine Society of Mathematical Sciences and extends congratulations on its inaugural meeting. It hopes for many years of

fruitful cooperation between the societies in the furtherance of mathematical research, education, and scientific exchange.

#### *Hellenic Mathematical Society*

The Council of the American Mathematical Society congratulates the Hellenic Mathematical Society on the occasion of the completion of seventy-five years of active scientific contributions to the international and Hellenic mathematical communities.

The Council looks forward to cooperating with the Hellenic Mathematical Society in continuing efforts to attain common goals within the mathematical sciences.

The Council agreed to recommendations from its Editorial Boards Committee by appointing several editors: WILLIAM BROWDER to a regular three-year term on the *Colloquium* Editorial Committee; ROBERT GREENE to a three-year term on the *Mathematical Surveys and Monographs* Editorial Committee; J.-L. LODAY as an extra member until 31 January 1994, then as a regular member for a three-year term beginning 01 February 1994 on the *Mathematical Reviews* Editorial Committee; and LINDA KEEN as Coordinating Editor on the *Proceedings* Editorial Committee.

The Council made nominations for election of officers. These nominations have been reported elsewhere in the *Notices* and will not be repeated here.

During its deliberations and searches for candidates for the elections, the Nominating Committee considered possible candidates who do not reside in North America. Rather than confront the issue of nominating such candidates by actually doing so, the Nominating Committee decided to put the question to the Council. It asked the Council to instruct the Nominating Committee on the question as to whether the Council will consider nominations for election of members of the Society who do not reside in North America. The Council responded by passing the following resolution:

Any member in good standing of the Society is eligible for candidacy and election to office or for membership on committees of the Society. In particular, residence in North America is not a prerequisite for candidacy for nomination for an office in the Society or for membership on committees of the Society.

The executive director, William H. Jaco, gave his annual report to the Council. Vice-president Davis reported as the Society's representative to the Canadian Mathematical Society.

The Council had requested and the president had appointed a special Committee on Guidelines and Procedures for the Committee on Professional Ethics. This committee reported to the January 1993 Council. The guidelines and procedures the committee recommended were adopted by the January 1993 Council subject to review by Society counsel. The Council determined that the part of the procedures concerning election of members to the Committee on Professional Ethics will apply immediately to future committees. The Society counsel

had provided comments that were returned to the special Committee on Guidelines and Procedures for a report to a future Council.

A special committee had been appointed early in 1993 to consider when the Council should meet. The committee considered several questions.

- What portion of a Council member's travel and subsistence should be reimbursed by the Society?
- Should there be any kind of restriction on types of airfares that are reimbursed?
- When and where should the Council meet in January?
- When and where should the Council meet in the spring?
- When and where should the Council meet in the late summer?
- When should the Council meet at the meeting in Vancouver?

Following a report of the committee and some discussion, the Council adopted the following recommendations:

**Reimbursements:** As a temporary policy, in effect until the Society adopts a general reimbursement policy, members attending Council meetings should be reimbursed for airfares not exceeding supersaver fares, not more than \$75 for ground transportation, and one night lodging. Exceptions can be made by requesting approval from the secretary prior to the travel.

All efforts will be made to schedule meetings so that supersaver fares can be used. Reference to supersaver fares will be continued as long as they exist.

**Spring Meetings of the Council.** Meetings of the Council in the spring should be held on a Saturday, beginning in the afternoon. If the agenda cannot be completed before early evening, the meeting should continue on Sunday morning. In the event that there is not a convenient sectional meeting near a transportation center, then this spring Council meeting should be held at or near an airline hub so that members can conveniently arrive at and depart from the meeting.

**Meeting in Vancouver, BC.** The Council will meet on Saturday, 14 August 1993, beginning at 1:00 p.m.

**Meeting in Minneapolis in August 1994.** The Council is scheduled to meet on Sunday, 14 August 1994, from 1:00 p.m. until the evening, with supper included.

**Meeting in Cincinnati:** The Council will meet on Tuesday, 11 January 1994, beginning at 1:00 p.m., in Cincinnati, Ohio.

**Meetings at other Annual Meetings:** The Council will meet on a day of the weekend of an Annual Meeting that is nearest to the first or last day of the meeting. (Under the current timetable for these annual meetings, the Council would meet on a Saturday.)

#### **Special Committee on Ethical Conduct**

A special committee consisting of Chandler Davis, chair; Lee D. Mosher; and Frank S. Quinn was appointed by then

President Artin to make findings and recommendations to the Council on a complaint by Richard K. Skora. The final report of this committee is reproduced elsewhere in this issue of the *Notices*.

The Second International Conference on Approximation and Optimization is being held in Havana, Cuba, in the period 26 September to 01 October 1993. The Council endorsed the following resolution (without dissent).

The Council of the AMS, in accordance with its established practice of supporting the free circulation of scientists, calls upon the U.S. administration to permit all U.S. mathematicians wishing to participate in the "Second International Conference on Approximation and Optimization" (Havana, Cuba, September 26–October 1, 1993) to do so and to authorize them to participate in the same fashion as would be normal were the conference to be held in another country. This includes their right to attend without being "fully hosted".

The Society officers are to approach promptly the appropriate officers of the U.S. State and Treasury Departments (the agencies administering the present U.S. government policy) and to secure the support of the Science Advisor to President Clinton.

These officials, in addition to being made aware of the general issues involved, should be informed that this Conference is sponsored by the Third World Academy of Sciences and by the International Mathematical Union (IMU). The U.S. is represented in the IMU and in it supports the policy of free circulation of scientists. Further, a blanket license to attend should be sought without requiring individuals to apply one by one for permission.

The January 1993 Council adopted the report of the special Committee on Restructuring that suggested that the Council eliminate the Committee to Monitor Problems in Communication. Accordingly, the secretary drafted amendments that eliminated mention of that committee in the Bylaws. The Council substituted the suggested amendment with an amendment that would eliminate the Committee to Monitor Problems in Communication and remove the chair of the Committee on Science Policy from *ex officio* membership on the Council. The amendment then passed. Adoption of the amendment awaits confirmation by the membership in the current election. (Since the amendment has been published in the *Notices*, it will not be repeated here.)

The Council adjourned shortly after 11:00 p.m. local time.

**Robert M. Fossum**  
Secretary  
Urbana, Illinois

### The Council in Vancouver

The Council of the American Mathematical Society met at 1:00 p.m. on Saturday, 14 August 1993, in Fort Camp Lounge,

Walter Gage Complex on the University of British Columbia Campus, Vancouver, BC. There were twenty-one members in attendance. President Graham presided.

The meeting was called to order shortly after 1:00 p.m. local time.

The Minutes of the April 1993 Council were approved as submitted.

The Executive Committee and Board of Trustees (ECBT) met in the period 21–23 May 1993. The minutes of those meetings have been distributed to the members of the Council and are considered to be part of the record of the Council.

(Note: The agenda and minutes of the Council and the ECBT are available on a regular basis by subscription. Copies of the open minutes are available by request from the secretary of the Society. This report is taken from the minutes.)

The Council approved a recommendation by its Executive Committee that the Advisory Board for *What's Happening in the Mathematical Sciences* will be appointed by the President upon consultation with and by recommendations from the Editorial Boards Committee. It also amended the charge to the Library Committee to include the following statement:

Periodically collect and maintain authoritative data on mathematics libraries. Study and articulate the needs of mathematicians with respect to use of print and electronic information. Monitor problems in libraries and foster dialog between mathematicians and librarians on issues that concern the dissemination and preservation of research. Support librarians in their efforts to build and maintain better mathematics libraries and to provide access to information.

The Editorial Boards Committee recommended appointments of several editors, appointments that were considered in executive session. The Council approved the following appointments:

HENRI GILLET to a regular term as representative from the Society to the Editorial Committee of the *American Journal of Mathematics*. (This appointment has been approved by the editor-in-chief of the Editorial Committee of the *American Journal of Mathematics*.)

ROBERT STANTON, E. ZELMANOV, and DANIEL RUDOLPH for full terms on the *Transactions* and *Memoirs* Editorial Committee and PETER SHALEN as managing editor.

BENEDICT H. GROSS for a full term on the *Journal of the AMS* Editorial Committee.

HAYNES R. MILLER to a full term as editor of Research Reports on the *Bulletin of the AMS* Editorial Committee.

Acting on the advice of the Executive Committee, the Council adopted the following policy regarding the role of vice-presidents in the governance and activities of the Society.

#### Vice-presidents

- Under the bylaws, a vice-president may become president in the event that the president dies or resigns when no president-elect is in office. In that case, the Council, with the approval of the Board of Trustees, shall designate one

vice-president to serve the remainder of the term of the president.

- At the discretion of the president, a vice-president (as well as a president-elect, an ex-president or other officer) can represent the Society when the president cannot attend.
- Vice-presidents should not be elected with a portfolio.
- When nominating vice-presidents, the Nominating Committee should take into account that former vice-presidents are considered in the pool of candidates to be nominated as president.
- The Nominating Committee should be instructed about the above roles of the vice-presidents.
- The president should be encouraged to use the vice-presidents in active roles within the Society.

In 1991 then-President Artin appointed a special Committee on Prizes that was requested to report to the ECBT. Following the actions taken by the Executive Committee (EC) and/or the Board of Trustees (BT), the following proposals were put to the Council. The Council approved them all.

Responding to a question about the number of prizes and awards offered by the Society, the Council agreed that:

*Resolution:*

The Society welcomes the creation of new prizes as a result of gifts when the following conditions are met:

1. The gift should be sufficient to fully endow a substantial prize, and
2. any conditions attached to the gift should be acceptable to the Society.

There is a Committee on National Awards and Public Representation that nominates individuals for awards on behalf of the Council. This committee has consisted of the president, the president-elect (or ex-president), the secretary, and a member named by the president. The Council agreed to expand this committee slightly:

*Resolution:*

The Committee on National Awards and Public Representation be reconstituted to be a working committee with more members who are not *ex officio*.

Some members of prize selection committees have expressed concern about restrictions, such as residency, on prizes awarded by the AMS. The Council responded by removing any such restrictions on Society prizes.

*Resolution:*

The Society hereby removes any citizenship, residency, or AMS membership requirements for AMS awards.

There have traditionally been three Steele prizes awarded, usually at summer meetings. The Council formalized this tradition by naming the three Steele prizes:

*Resolution:*

- The Steele prizes will carry the following three names:
- a) The Leroy P. Steele Prize for Seminal Contribution to Research

- b) The Leroy P. Steele Prize for Lifetime Achievement
- c) The Leroy P. Steele Prize for Mathematical Exposition

The Council agreed with its Executive Committee and the Board of Trustees and the special Committee on Prizes about contributions to other prizes by passing the following:

*Resolution:*

The AMS will not contribute funding to awards given by other organizations. It will, however, at the discretion of its governing bodies, consider contributions to awards made jointly by the AMS and another society provided the contributions are equal and the behavior being rewarded is considered sufficiently in line with the mission of the AMS.

The Board of Trustees agreed that all AMS prizes should be a minimum of \$4,000 and that the Satter Prize should be raised to \$4,000. In the future new prizes will not be accepted unless they meet the minimum set by the BT. The BT expects that a concerted effort will be made to raise money to fund AMS prizes and that the Executive Director (ED) will attempt to see if other prizes the AMS cosponsors can be raised to the minimum of \$4,000.

The Council received several reports or was notified where reports were filed.

At its meeting in San Antonio in January 1993 the Council passed the following directive:

The Council directs the Committee on Science Policy (CSP) to prepare a satisfactory procedure for determining sizes of National Science Foundation (NSF) grants and to report this procedure to the Council, and the Council, following approval, propose this procedure to NSF.

The CSP interpreted the Council directive to be a request for a satisfactory procedure for determining sizes of NSF grants in the current funding climate. The Council adopted the following resolution and requested that it be forwarded to all individuals concerned.

**Preamble.**

The quality of mathematics research in the United States is being adversely affected by erosion in the support by the NSF for basic disciplinary mathematical sciences research. Recent levels of constant or reduced funding from NSF have had a direct, uncushioned impact on several fundamental areas of mathematics research for which there is little alternative funding. The overall funding in mathematics has become so tightly stretched that much outstanding research is now either unsupported or inadequately supported. Even more worrisome for the health of the discipline is that this situation is unlikely to improve in the near future. This present state of funding threatens our ability to maintain U.S. world leadership in science research and technological vitality.

**Recommendations.**

The only completely satisfactory procedure is to provide the full funding necessary to maintain the preeminence

of mathematical sciences research in the United States. Unfortunately, this ideal is impossible with the current Division of Mathematical Sciences (DMS) budget because there are far more excellent research activities than can be fully supported.

The operational DMS strategy today, described next, is intended to minimize the damage caused by the present funding constraints.

First, within each program 10%–15% of the number of awards may be made (if appropriate) to support research considered as “high impact”. Such proposals are funded adequately, meaning that reasonable requested support will be fully provided. The support awarded for such research may include up to two months of time in the summer for the investigator(s), postdocs and graduate students, travel, visitors, and publication costs.

Approximately 25% of the number of awards are made to support research proposed by young investigators (up to seven or eight years after the Ph.D.) considered outstanding relative to this group. These proposals are also to be funded adequately, with a somewhat more restricted definition. The support awarded for such research may include up to two months of time in the summer for the investigator(s) and modest funds for travel, visitors, and publications. Graduate student support is rare, and postdocs are not provided.

The remaining awards are made at the discretion of the program directors based on the quality of the proposed science and the availability of funds. Typically the full amount needed to support each project adequately cannot be provided.

The CSP recommends that the award policy for this latter group be based on the following guidelines. If time during the summer is required to perform the research and if support is requested for one month or more, then support for at least one full month for each investigator should be provided to ensure a minimal period of time for sustained attention to the research. Because of the central importance to mathematical research of professional interactions and communication of new results, these awards should also include (when requested) modest amounts for travel, visitors, and publications. Further, differential rates of benefits and overhead should not affect the support awarded directly to a research project. Calculations of benefits and overhead should be made separately once the levels of salary, travel, visitor, and publication support are set.

With the above implementation, the CSP would support current DMS policy as a reasonable interim funding strategy.

We emphasize again that the budgetary constraints imposed on DMS do not allow outstanding U.S. mathematical research to be supported at the level needed both to maintain world leadership in mathematics and to fulfill the crucial enabling roles of mathematics in

science, engineering, applications, and education. The current policy of DMS, even if modified as suggested above, represents a compromise made necessary by the current low level of funding at NSF for the mathematical sciences. This compromise is in many ways unsatisfactory. The only truly satisfactory level of funding is the full support necessary to maintain U.S. leadership in this discipline.

The AMS should pursue all possible avenues necessary to achieve support for mathematics research that reflects its importance in achieving these national priorities. The preparation of a federal policy agenda for the AMS as well as a joint agenda for the Joint Policy Board for Mathematics (JPBM) organizations will be an important step in this process. New mechanisms for liaison with NSF will also be important in view of the demise of the DMS Advisory Committee.

The Council received and acted upon the report of the special Committee to Review Member Publications (CRMP) by adopting the report in its entirety. The conclusions of the report have appeared in the *Notices* and will not be repeated here.

A special Committee on Guidelines and Procedures for the Committee on Professional Ethics (COPE) has reported previously. The procedures were adopted by the January 1993 Council subject to review by Society counsel. The committee recommendations were once again put on the floor and passed by the Council as follows:

#### Membership

COPE shall be a committee of six members representing a broad spectrum of membership of the Society. They shall be appointed by the president with the advice of the Committee on Committees and have three-year staggered terms. The chair of COPE shall be elected by the committee. The committee normally is to conduct business via conference calls, mail, and e-mail (for official business printed e-mail records will be kept.) COPE, however, is encouraged to meet at least once each year (normally at the annual meeting) to review its activities or to conduct on-going business. COPE should prepare a summary of its activities to be presented to the Council at its summer and winter meetings.

Outlined below are recommended procedures for resolution of conflict. The committee may deviate from these procedures as cases warrant and parties agree, but COPE is encouraged to follow standardized procedures in the interest of perceived fairness. Indeed, it is of great importance to the AMS that COPE act impartially—both in fact and in appearance. Modification of these procedures is expected to occur as experience is gained, and the Council shall entertain such suggested modifications.

#### Procedures

1. COPE receives a written inquiry from a member of the Society concerning professional ethics. The

chair of COPE makes an informal inquiry, taking no more than several weeks. The chair reports to the committee, and the committee then determines if the case should be handled by an ombudsperson or proceed directly to an investigation.

2. In case reconciliation seems possible the chair selects a member of the committee to act as ombudsperson for that case. The chair and the ombudsperson shall agree on a time limit for this procedure (this will depend on the parties involved, time of year, and other circumstances). At the end of this period, or any extension mutually agreed upon by the chair and the ombudsperson, the ombudsperson shall report on the solution of the issue to COPE or recommend that the case be investigated formally by COPE.
3. In case a formal investigation is called for, the chair, on the advice of the committee and after consultation with the president of the Society, shall appoint a three-member special committee for the case. Any party to the case may submit to the chair of COPE a written list of Society members whom they wish not to serve on the special committee and reason for the objection. Any party may request certain peer representation on the special committee, e.g., a nontenured member if a party is also nontenured. The chair of COPE shall take these suggestions under advisement and may, but is not required to, act upon them. The members of the special committee shall generally be knowledgeable of the area of conflict. A time limit for the special investigation will be agreed to by all parties, with the chair of COPE making the final determination of reasonable time limit in case of nonagreement of the principal parties. Any party may ask for an extension of the time limit from COPE as the case proceeds, and the chair will grant the extension if the request is justified.
4. The special committee shall gather facts and statements from all interested parties. Committee members conducting interviews will make written summaries of any interviews. Any person interviewed by the committee shall be fully apprised that parties to the conflict shall be aware of their identity and the written summary of their statements. In rare cases the committee might decide it is necessary to obtain confidential material or assure the confidentiality of a source. In these circumstances the material and/or source shall not be used as sole or primary material in rendering any decision. In that case the special committee should tell the source that it will try to protect the confidentiality, but it cannot guarantee it. Minutes or other written records of the special committee's discussions and deliberations, as well as discussions with the chair of COPE, need not be kept. All paper and electronic correspondence shall be kept as part of its records. After any discussions or interview sessions involving parties to the case, all parties, including those interviewed, shall have the opportunity to see and comment on the written summaries.
5. After completing what it determines to be a full investigation and after all parties have been asked to comment on the accuracy and completeness of the record, the special committee shall present a written report to COPE. Such report shall be presented within the allotted time. In case parties disagree on statements of facts contained in the record submitted by the special committee or on the completeness of the report, their written disagreement shall constitute a part of the report.
6. This report shall consist of a copy of the complete record, as determined by the special committee, and the special committee's determination in case of conflicting statements or claims as to factual or other matters. The special committee shall recommend to COPE action to reprimand any party or parties or steps to correct any action or inaction. All parties to the dispute shall be given copies of the special committee report. COPE and any special committee COPE established to investigate any case shall have access to AMS legal counsel for advice. AMS legal staff shall review the final report of any special committee and any final determination and recommendation of any case that goes through a special committee procedure.
7. COPE shall take the special committee's recommendations under advisement and make a recommendation to the AMS Council within a reasonable time. COPE shall take into consideration the precedents for any recommendations. COPE may modify the recommended action or actions of the special committee; however, if COPE intends to modify the recommendations of the special committee, it shall confer with the special committee on the final recommendations.
8. At the earliest opportunity COPE shall issue a summary report and recommendation on any completed case to the Council. The secretary of the Society shall circulate the report to the Council straightaway. Parties to the dispute will receive the COPE recommendations and may offer the Council such written statements as they feel would be helpful to the Council. The Council will act on the COPE recommendation by approving it or returning it to COPE with instructions as to further action. Council action shall be at the next Council meeting after COPE has submitted a report on a case.
9. Appeal of any case shall be made only to the Council. The only grounds for appeal are either procedural errors or substantial new facts. Written notice of intent to appeal shall be made to the



secretary of the Society within three months of the Council's action. The Council shall act on any appeal at its next meeting after receipt of the appeal.

COPE and its special committees shall be indemnified under article XIII of the AMS Bylaws. (This may require amendment of the bylaws and, if so, is part of this Council action).

The Council passed the following resolution concerning travel to a forthcoming meeting in Cuba.

The American Mathematical Society has consistently supported freedom of all mathematicians to travel to scientific meetings. Those traveling to the conference on Approximation and Optimization in Cuba (26 September 1993 to 01 October 1993) risk legal proceedings against them by the U.S. Treasury Department. It is the sense of this meeting that the Society should undertake the defense of these individual mathematicians.

The Council passed the following resolution concerning international meetings.

The Society has the policy that women and minority mathematicians be appropriately represented among invited speakers at its meetings. Clearly this objective should also be pursued at meetings held jointly with other organizations. The secretary is instructed in particular to communicate it to program committees of meetings held jointly with mathematical societies of other countries.

On May 14, 1993, the Commission on Physical Sciences, Mathematics, and Applications (CPSMA), a subcommittee of the National Academy of Sciences (NAS), approved a request from the Board of Mathematical Sciences (BMS) to dissolve the U.S. National Committee for Mathematics (USNCM) and to temporarily assign its responsibilities, functions, and title to the BMS. Only half the members of the USNCM had been chosen by the BMS. The other half had been chosen by the Conference Board on Mathematical Sciences (CBMS) (and ratified by the NAS). In its action the BMS has not only dismissed a committee of professional mathematicians but it also cut out the role of the CBMS. The USNCM is the principal interface between the mathematicians in the U.S. and the International Mathematical Union (IMU). The IMU is that organization which organizes the international mathematical congresses. The Council passed the following resolution related to this.

- [WHEREAS] the primary role of the IMU is to promote the dissemination of the highest levels of research in the mathematical sciences to the international community of mathematicians, and
- [WHEREAS] the professional organizations best represent the active research community in the U.S.,

therefore be it

- [RESOLVED] that the AMS Council charges its president to transmit to the BMS its great dismay at the dissolution of the previously broadly representative

USNCM and its demand that the former USNCM be reinstated immediately.

Further it also charges the Executive Committee to investigate the possibility of replacing the National Academy of Sciences by the AMS or a consortium of professional organizations as the adhering organization of the United States to the International Mathematical Union.

The Council agenda contained many items for information, among them were the following short notes.

Two requests for cosponsorship of meetings were considered by the November 1992 ECBT, approved, and forwarded to the January 1993 Council for action. Cosponsorship of these meetings was approved by the Council.

In each case cosponsorship involved agreement on the part of both organizations that the Society should be able to appoint a member to the program committee of the meeting and that the meeting be listed in several locations in the *Notices* as one that is being cosponsored by the Society.

At one time the Society had a committee that considered these requests. Since there were few requests, that committee recommended, and the Council approved, that it be discharged.

There is still need for a committee to screen such requests and, if the request involves more than the routine as mentioned in the paragraph above, to forward them to the appropriate body for approval. (For example, if cosponsorship would involve any expenditures, approval by the BT would be required.) Since these requests come to the Society at odd times and in a random fashion and since they often must be handled in a timely fashion, the committee that considers them should be one that meets frequently. The committee should also be one that consists of members who are familiar with the meetings program of the Society.

Such a committee already exists, namely the Secretariat, whose members are the associate secretaries and the secretary. This committee is empowered by the EC and the Council to decide on dates and times for meetings. It does meet (by formal mail ballot) once a month.

The EC voted to refer this matter to the new Policy Committee on Meetings and Conferences. The following was approved as an interim procedure until the Policy Committee has a chance to act: The Secretariat is empowered to approve or deny simple requests by other organizations for AMS cosponsorship of meetings (with the provisos that the Society can appoint a member or members to the program or organizing committee and that the Society has the right of first refusal on publication of the proceedings). Requests that are more complicated, such as those that might involve expenditures of funds, should be considered first by the Secretariat, which will make appropriate recommendations to the ECBT (and Council).

Council member Birman has written a letter expressing concern about publications. The letter was referred to the Policy Committee on Publications.

Council member Steven Weintraub proposed the creation of a Committee on Younger Mathematicians. It would identify

and consider issues of particular concern to undergraduates, graduate students, postdocs, and junior faculty members and would represent the point of view of this population on issues facing the Society.

The March 1993 Agenda and Budget Committee (ABC) had recommended that the letter be shared with the Committee on Education (COE), which was meeting prior to the ECBT and planning to form subcommittees on undergraduate and graduate and postdoctoral affairs. It was suspected by the ABC that these subcommittees would be considering a number of the concerns expressed in Weintraub's letter.

The COE met on 25 April 1993 and authorized subcommittees on undergraduate and graduate and postdoctoral affairs. The COE believes these subcommittees will address the educational concerns expressed in the letter from Weintraub. However, the COE acknowledged that there were "professional" concerns that did not come under the charge to COE and its subcommittees; hence, the chair of COE will be writing to the newly formed Committee on the Profession, forwarding it a copy of Weintraub's letter.

The January 1993 Committee on the Publication Program voted to recommend to the ECBT the following change in policy regarding the inclusion of abstracts or summary papers in a proceedings volume:

... that papers in conference proceedings either consist of original material or that they contain substantial expository content so they are still of value to the reader. Abstracts or summary material which are to appear elsewhere do not constitute an appropriate paper in a proceedings volume.

The ECBT approved this recommendation.

The Society received notification that the Last Will and Testament of Israel Berstein left a portion of his estate to the AMS for the purpose of working with young topologists. "The application of the gift shall be supervised by the Topology Group in the math department of Cornell University of Ithaca, New York." Because of a long illness, the estate was left with nothing. Professor Berstein's sister, Gita Fonatov, was beneficiary of Professor Berstein's retirement funds, and she wants to make a donation to the AMS to fulfill his wish. Since the conditions of the will would technically no longer apply, there are several ways to address this matter. However, the ED believes that the wishes of Professor Berstein, as expressed in his will, are that the Topology Group at Cornell administer this fund; therefore the ED recommended, and the BT approved, that he write to Ms. Fonatov suggesting that the monies be awarded to the department of mathematics at Cornell for their administration of the fund in accordance with Professor Berstein's wishes.

The *Notices* has received a letter to the editor supporting the decision to move the January 1995 meeting out of Colorado. The author of the letter included a contribution against the costs of that move and urges other members to do likewise. This letter has been accepted for publication and will appear in the July/August 1993 issue of the *Notices*. The development officer has been advised that the costs

of the cancellation of the Denver meeting (if any) will be accounted for in the general fund. The BT approved accepting the above-mentioned contribution (and future ones restricted in this manner) into the AMS General Fund (as opposed to establishing a separate restricted fund).

The director of publication is considering developing a quarterly newsletter for mathematics department chairs. This newsletter would contain information that is useful for department chairs and their departments, such as updated information on funding trends and opportunities in mathematics and mathematics education and information from the AMS Committees on Science Policy, Education, Rewards, and Resources. It would contain information on AMS activities which are beneficial to mathematicians and mathematics departments as well as general information for department chairs on such things as faculty development, teaching evaluation, assembling a tenure dossier, getting the most resources for the department from the administration, etc. Recently, in discussions with the ED, the director of publication has presented the idea of establishing an association made up of AMS Institutional Members. This Department Chair's Newsletter would be a natural publication for this association.

The Committee on Science Policy (CSP) recommended that the AMS put forth annual policy agendas on issues regarding federal science policy and mathematics. The task was assigned to a special subcommittee of the CSP appointed by the president with the advice of the chair of CSP. The members of the AMS Federal Policy Agenda Subcommittee for 1993 are Hyman Bass, John Bradley, Arthur Jaffe, Linda Keen, John Morgan, John Polking, Margaret Wright, Frank Warner (chair), and Robert Zimmer. The president, Ronald Graham; the ex-president, Michael Artin; the chair of JPBM, Richard Herman; the JPBM Congressional liaison, Lisa Thompson; and the ED are included in the communications and meetings of the committee. The committee met in San Antonio during the Annual Joint Mathematics Meetings and held a two-day meeting in New York at the end of February. The committee had hoped to have a draft policy agenda ready by the end of April 1993; however, their plans are now to have a draft ready for the September 1993 CSP meeting and a final version for the November 1993 ECBT.

Both MAA and SIAM are preparing policy agendas. The MAA has a draft agenda that is circulating within MAA, JPBM, and the AMS Federal Policy Subcommittee. JPBM is expected to draft a common agenda from the individual participating JPBM organizations. This will be in addition to the planned AMS agenda.

The November 1992 ECBT received for information a draft discussion paper on the need for a broad, national program for postdoctorates in the mathematical sciences. The January 1993 Council approved the draft for submission by JPBM to NSF. The AMS proposal was revised by the JPBM chair, Richard Herman, to include suggestions from Avner Friedman (on industrial postdoctorates) and MAA (on educational postdoctorates). On March 31, JPBM submitted a white paper to NSF entitled "Investing in Human Resources in the Mathematical Sciences". It is understood that the white

paper has been favorably received and that DMS has moved it forward to the directorate level at NSF.

The Centennial Fellowship Committee reported its recommendations to the secretary in mid-January 1993. Based on the report, three fellowships in the amount of \$41,500 each, with \$1,350 travel stipends, were awarded to Jacques Hurtebise, McGill University; Andre Scedrov, University of Pennsylvania; and David Webb, Dartmouth College. All awardees have accepted the fellowships.

The ECBT set the stipend for the 1994–1995 Fellowship at \$42,600, with an expense allowance of \$1,400.

In response to the Strategic Plan and other initiatives, methods have been sought to gradually broaden the AMS program at the National Joint Mathematics Meetings to include more activities outside the scientific program. These activities address such issues as federal science policy and its impact on mathematics, connections of mathematics to its uses, education reform, crisis in academic research libraries, employment of mathematicians, national reports, etc. Currently, sessions requiring time on the AMS program must be approved by the Program Committee for National Meetings. This committee has viewed the increasing number of these events with some concern, since it considers its charge limited to consideration of the scientific program only. Recently, however, consideration has been given to ways to better coordinate these activities with the scientific program at National Joint Mathematics Meetings and to provide well-designed, balanced programs that successfully serve as broad a segment of the community as possible.

The ED and the secretary proposed that the ECBT recommend to the Council the establishment of a Meeting Coordinating Committee for each national meeting (annual and summer). The ECBT referred this proposal to the Policy Committee on Meetings and Conferences. There was no objection to appointing these committees immediately on an ad hoc basis.

Beginning in 1994 a new reviewer credit policy for *MR* reviewers will be put into place. The new policy will have a negative impact on reviewers from the fSU, the PRC, and eastern Europe. One feature of the old policy which will no longer be available to reviewers from these countries is the opportunity for three reviewers to band together to receive a highly discounted subscription to *MR*. There were fifty-eight such subscriptions in 1992, including eight in the fSU. *MR* was then made available to all mathematicians affiliated with the subscribers' institutions. With the new policy there is a real danger that most of the mathematicians and their respective libraries will no longer have access to *MR*.

It was expected that by 1994 a program for making AMS publications available at an affordable price to institutions in currency-weak countries would be in place. Unfortunately, primarily due to the sudden and unexpected collapse of the fSU and concentration of aid to the fSU, such a plan has not been developed. There is a plan presently being developed by the Society to provide significant donations of mathematical journals, including *MR*, to various sites in the fSU. However, this will not affect reviewers from the PRC and eastern

Europe. It is anticipated that by 1996 the Society, through a new International Affairs Committee, will have developed an effective program to make AMS publications available at an affordable price (probably free in many cases) to institutions in currency-weak countries.

As an interim measure the ECBT approved the continuation of *MR* subscriptions being sent to the fSU, Eastern Europe, and the PRC as a result of its former reviewer credit policy, as long as it can be ascertained that the *gratis* copies go to libraries. This interim aid will be coordinated with other donations and will terminate when the International Affairs Committee recommends and establishes a discount policy for currency-weak countries.

#### AMS fSU Mathematical Literature Donation Plan

The Subcommittee of the Advisory Committee on fSU Mathematics, chaired by Susan Friedlander, has recommended that the Society support sending all current books and journals to five mathematical libraries within the fSU. These libraries are sites of significant mathematical activity and are *not* covered by the AAAS/AMS journal effort or the AMS support of the Moscow Mathematics Institute. The libraries who would benefit from this AMS support include: The Library of the Moscow Mathematical Society, the Library of the Academy of Sciences in Moscow, the Library of the Steklov Institute in St. Petersburg, the Library of FTINT in Kharkov, and the Library of the Mathematics Institute in Novosibirsk. Attachment No. 35 of the 05/93 ECBT Minutes and the summary accompanying it supply background information as well as specific cost figures. The ECBT approved this proposal.

#### Travel Expense Reimbursement of Volunteers

The ECBT approved policies for reimbursement of members serving on committees and other activities in the Society. Administrative procedures implementing these policies will now be prepared and submitted to the 11/93 ECBT for approval. In addition, recommended levels of reimbursement for volunteer activities will be presented for approval at that time. (This coincides with the usual approval of the upcoming year's committee budgets at the fall ECBT meeting.)

The faculty of the University of Michigan has established an Annual Senate Lecture on Academic and Intellectual Freedom, to be named:

The University of Michigan Senate's Davis, Markert, Nickerson Lecture on Academic and Intellectual Freedom

The resolution reads as follows:

#### *Senate Assembly Resolution*

The faculty of the University of Michigan affirms that academic and intellectual freedom are fundamental values for a university in a free society. They form the foundation of the rights of the free inquiry, free expression, and free dissent that are necessary for the life of the university.

The faculty recognizes that such rights are human creations, the product of both the reasoned actions and the deep-seated commitments of women and men. When such actions and commitments are set in human institutions, people may secure for themselves and for others, in the present and the future, the enjoyment of those rights.

We also recognize that these values and the rights they imply are vulnerable to the fads, fashions, social movements, and mass fears that threaten to still dissent and to censure carriers of unpopular ideas. Such was the case in 1954 when the University of Michigan suspended three faculty members and subsequently dismissed two of them. We deeply regret the failure of the University community to protect the fundamental values of intellectual freedom at that time. It is to guard against a repetition of those events and to protect the fundamental freedoms of those who come after us that we make this resolution today.

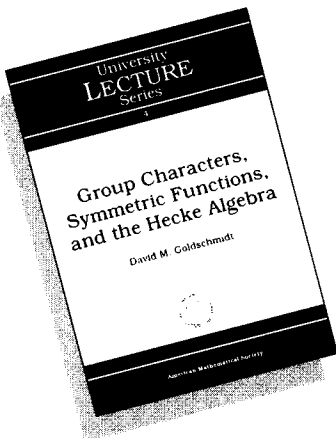
The protection of academic and intellectual freedoms requires a constant reminder of their values and vulnerability. To provide for that reminder the faculty of the University of Michigan hereby resolves to establish an Annual Senate Lecture on Academic and Intellectual Freedom, to be named: *The University of Michigan Senate's Davis, Markert, Nickerson Lecture on Academic and Intellectual Freedom*. November 19, 1990.

William H. Jaco announced to the Board of Trustees on 22 June 1993 that he had accepted an offer from Oklahoma State University of an appointment as Kerr Professor effective 01 September 1993. He will be on leave of absence to continue his duties as executive director at the Society until 31 August 1995.

The Council adjourned at 5:16 p.m., certainly a modern day record.

**Robert M. Fossum**  
Secretary  
Urbana, Illinois

## UNIVERSITY LECTURE SERIES



### Group Characters, Symmetric Functions, and the Hecke Algebra

David Goldschmidt  
*Volume 4*

The book is made up of lecture notes from a course taught by Goldschmidt at the University of California at Berkeley in 1989. The course was organized in three parts. Part I covers, among other things, Burnside's Theorem that groups of order  $p^a q^b$  are solvable, Frobenius's Theorem on the existence of Frobenius kernels, and Brauer's characterization of characters. Part II covers the classical character theory of the symmetric group and includes an algorithm for computing the character table of  $S^n$ ; a construction of the Specht modules; the "determinant form" for the irreducible characters; the hook-length formula of Frame, Robinson, and Thrall; and the Murnaghan-Nakayama formula. Part III covers the ordinary representation theory of the Hecke algebra, the construction of the two-variable Jones polynomial, and a derivation of Ocneanu's "weights" due to T. A. Springer.

1991 *Mathematics Subject Classification*: 20, 57

ISBN 0-8218-7003-3, 73 pages (softcover), June 1993

**Individual member** \$42, List price \$70, Institutional member \$56

To order, please specify ULECT/4NA



All prices subject to change. Free shipment by surface; for air delivery, please add \$6.50 per title. *Prepayment required.* Order from: American Mathematical Society, P.O. Box 5904, Boston, MA 02206-5904, or call toll-free 800-321-4AMS (321-4267) in the U.S. and Canada to charge with VISA or MasterCard. Residents of Canada, please include 7% GST.

# Classified Advertisements

**SUGGESTED USES** for classified advertising are positions available, books or lecture notes for sale, books being sought, exchange or rental of houses, and typing services.

**THE 1993 RATE IS \$65 per inch** on a single column (one-inch minimum), calculated from the top of the type; \$35 for each additional  $\frac{1}{2}$  inch or fraction thereof. No discounts for multiple ads or the same ad in consecutive issues. For an additional \$10 charge, announcements can be placed anonymously. Correspondence will be forwarded.

Advertisements in the "Positions Available" classified section will be set with a minimum one-line headline, consisting of the institution name above body copy, unless additional headline copy is specified by the advertiser. Advertisements in other sections of the classified pages will be set according to the advertisement insertion. Headlines will be centered in boldface at no extra charge. Classified rates are calculated from top of type in headline to bottom of type in body copy, including lines and spaces within. Any fractional text will be charged at the next  $\frac{1}{2}$  inch rate. Ads will appear in the language in which they are submitted.

Prepayment is required of individuals but not of institutions. There are no member discounts for classified ads. Dictation over the telephone will not be accepted for classified advertising.

**DEADLINES** are listed on the inside front cover or may be obtained from the AMS Advertising Department.

**U. S. LAWS PROHIBIT** discrimination in employment on the basis of color, age, sex, race, religion or national origin. "Positions Available" advertisements from institutions outside the U. S. cannot be published unless they are accompanied by a statement that the institution does not discriminate on these grounds whether or not it is subject to U. S. laws. Details and specific wording may be found near the Classified Advertisements in the January and July/August issues of the *Notices*.

**SITUATIONS WANTED ADVERTISEMENTS** from involuntarily unemployed mathematicians are accepted under certain conditions for free publication. Call toll-free 800-321-4AMS (321-4267) in the U.S. and Canada, or 401-455-4084 worldwide, for further information.

**SEND AD AND CHECK TO:** Advertising Department, AMS, P.O. Box 6248, Providence, Rhode Island 02940. AMS location for express delivery packages is 201 Charles Street, Providence, Rhode Island 02904. Individuals are requested to pay in advance, institutions are not required to do so. AMS FAX 401-455-4004.

## POSITIONS AVAILABLE

### ALABAMA

#### THE UNIVERSITY OF ALABAMA AT BIRMINGHAM Department of Mathematics

Applications are invited for a tenure track position at the junior level to begin Jan. 1994. Applicants should have strong research potential as well as a commitment to teaching undergraduate and graduate students. Applicants with postdoctoral experience are especially welcome. Preference will be given to candidates whose research is compatible with that of our current faculty: this includes dynamical systems, differential geometry, mathematical physics, nonlinear analysis, partial differential equations including numerical p.d.e., and topological dynamics. To apply please send a curriculum vitae, selected reprints, and at least three letters of reference. Send applications to the following address:

Search Committee  
Department of Mathematics  
University of Alabama at Birmingham  
Birmingham, AL 35294-1170  
UAB is an AA/EO Employer.

### ARIZONA

#### ARIZONA STATE UNIVERSITY

The Department of Mathematics at Arizona State University invites applications for tenure track/tenured positions at the Assistant Pro-

fessor/Associate Professor level, pending budgetary approval, beginning in the fall semester 1994 or the fall semester 1995. Applicants are required to have a Ph.D. in mathematics and are expected to have a strong commitment to education on all levels and a strong research record. Candidates should show a strong interest in instruction on an introductory level in a large public university environment. Candidates at the Associate Professor level must have a proven record of outstanding achievements in research and teaching. Preference will be given to candidates in the areas of applied analysis, control theory, and functional analysis.

The main campus of Arizona State University has approximately 43,000 students and is located in the rapidly growing metropolitan Phoenix area, which provides a wide variety of recreational and cultural opportunities. The Department of Mathematics currently has 56 full time faculty members. Departmental computing facilities include a networked cluster of high end workstations as well as several graphics computers. In addition access is provided to the university's central computing facilities which include a massively parallel super computer.

Applicants must send their resumé and arrange for at least three letters of recommendation to be sent to Christian Ringhofer, Chair, Department of Mathematics, Box 871804, Arizona State University, Tempe, Arizona 85287-1804. Review of applications will begin December 1, 1993. The application deadline will be extended on a month-to-month basis until positions are filled. AA/EOE.

## CALIFORNIA

### CALIFORNIA STATE UNIVERSITY SAN MARCOS (CSUSM)

California State University San Marcos (CSUSM) invites applications for an entry-level, tenure-track Assistant Professor position starting in August 1994, subject to final administrative authorization.

The first priority for the position is geometry. Any related field of geometry, such as algebraic geometry, analytic geometry, computational geometry, convex and discrete geometry, differential geometry, finite geometry, geometric analysis, is welcome. Applications should be addressed to: Mathematics Geometer Search Committee.

The second priority for the position is for candidates who can offer evidence of their ability to teach graduate statistics and courses in modeling or operations research. Applications should be addressed to: Mathematics General Search Committee.

CSUSM seeks individuals with strong academic preparation who have an interest in teaching undergraduates. Experience with incorporating mathematical software into teaching is strongly desired. An application consists of a statement of interest, a complete resume, a copy of transcript, and at least three letters of reference which should comment on the applicant's credentials in teaching, research, and service. Applications should be addressed as above and sent to: California State University San Marcos, San Marcos, CA 92096-0001. Review of applications will begin February 7 and will continue until the position is filled. CSU San Marcos is an Affirmative Action/Equal Opportunity Employer. The University has a strong commitment to the principle of diversity and seeks a broad spectrum of candidates including women, members of minority groups, and people with disabilities.

### POMONA COLLEGE Claremont, California

Pomona College seeks applicants for a tenure track position at the assistant professor level. Candidates from all fields of mathematics will be considered. The strongest candidates will have postdoctoral experience and be excited about teaching our culturally and intellectually diverse student body, of which about a third of the mathematics majors are women. They should also be committed to continuing a strong research program.

Send application materials to:  
The Search Committee  
Department of Mathematics  
Pomona College  
Claremont, CA 91711-6348

Include a curriculum vitae and 3 letters of recommendation (which include evaluations of teaching), graduate school transcripts, and a description, written for the nonspecialist, of research accomplishments and plans. Applications will be reviewed starting January 7, 1994. Let us know if you will be at the Jan-

## Classified Advertisements

uary AMS meeting. We especially encourage applicants from traditionally underrepresented groups. Pomona College is an AA/EO employer.

---

**STANFORD UNIVERSITY**  
**Department of Mathematics**  
**Assistant Professorships**  
**in Honor of Gabor Szego**

The department expects to make one or more appointments in 1994–1995 for these special two-year positions. Applicants are expected to show outstanding promise in research and clear evidence of achievement. They should have received the Ph.D. prior to the start of the appointment but not before 1992. Stanford is committed to excellence in teaching, and applicants should count this as one of their goals. Candidates should send a letter of application with a curriculum vitae, a list of publications and information concerning teaching experience, and should arrange to have three letters of recommendation sent to Prof. Ralph Cohen, Chairmen, Department of Mathematics, Stanford University, Stanford, CA 94305-2125, by January 1, 1994. Stanford is an Affirmative Action, Equal Opportunity Employer, and welcomes applications from women and minorities.

---

**UNIVERSITY OF CALIFORNIA**  
**AT BERKELEY**  
**Charles B. Morrey Jr.**  
**Assistant Professorship**  
**Department of Mathematics**  
**Berkeley, CA 94720**

We invite applications for these special two-year (nontenure-track) positions effective July 1, 1994. Applicants should have a recent Ph.D. in the areas of algebra, analysis, applied mathematics, foundations, or geometry and topology. Applicants should send a resume, reprints, preprints and/or dissertation abstract, and ask three people to send letters of recommendation to The Vice Chair for Faculty Affairs at the above address. We should receive this material no later than January 15, 1994. Applications received after the deadline will not be considered. The University of California is an Equal Opportunity, Affirmative Action Employer.

---

**UNIVERSITY OF CALIFORNIA**  
**AT BERKELEY**  
**Temporary Postdoctoral Positions**  
**Department of Mathematics**  
**Berkeley, CA 94720**

Several temporary positions beginning in Fall 1994 are anticipated for new and recent Ph.D.s of any age, in the areas of algebra, analysis, and applied mathematics, foundations or geometry and topology. The terms of these appointments may range from one to three years. Applicants for NSF or other postdoctoral fellowships are encouraged to apply for these positions; combined teaching/research appointments may be made for up to three years. Mathematicians whose research interests are close to those of

regular department members will be given some preference. Applicants should send a resume, and reprints, preprints, and/or dissertation abstract, and ask three people to send letters of recommendation to The Vice Chair for Faculty Affairs at the above address. We should receive this material no later than January 15, 1994. Applications received after the deadline will not be considered. The University of California is an Equal Opportunity, Affirmative Action Employer.

---

**UNIVERSITY OF CALIFORNIA**  
**AT BERKELEY**  
**Tenured or Tenure Track Position**  
**Department of Mathematics**  
**Berkeley, CA 94720**

We invite applicants for one or more positions effective July 1, 1994, at either the tenure-track (Assistant Professor) or tenured (Associate or Full Professor) level, subject to budgetary approval, in the areas of algebra, analysis, applied mathematics, foundations or geometry and topology.

*Tenure track applicants* are expected to have demonstrated outstanding research potential, normally including major contributions beyond the doctoral dissertation. Such applicants should send a resume, and reprint or preprints, and/or dissertation abstract, and ask three people to send letters of recommendation to The Vice Chair for Faculty Affairs at the above address.

*Tenure applicants* are expected to demonstrate leadership in research and should send curriculum vitae, list of publications, a few selected reprints or preprints, and the names and addresses of three references to The Vice Chair for Faculty Affairs at the above address.

We should receive this material no later than January 15, 1994. Applications received after the deadline will not be considered. The University of California is an Equal Opportunity, Affirmative Action Employer.

---

**UNIVERSITY OF CALIFORNIA, IRVINE**  
**Department of Mathematics**  
**Irvine, CA 92717-3875**

Applications are invited for 2 regular faculty positions at the Assistant Professor level or above. Priorities will be placed on the following 2 broadly interpreted areas:

1) Geometry—including arithmetic geometry, algebraic geometry, topology, and geometric analysis.

2) Nonlinear Analysis—including mathematical physics and applied mathematics.

Very strong promise in research and teaching is required for the Assistant Professor level. Candidates for the Associate Professor level or above are expected to have an established research and teaching record commensurate to the rank. Applicants should send a resume, reprints, prints, dissertation abstract (in the case of Assistant Professor candidates), and names and addresses of three people to contact for letters of recommendation to: Recruitment Committee, at the above address. The deadline for

application is October 31, 1993, or until the positions are filled. The University of California is an Equal Opportunity/Affirmative Action employer committed to excellence through diversity.

---

**UNIVERSITY OF CALIFORNIA,**  
**LOS ANGELES**  
**Department of Mathematics**

**TEMPORARY POSITIONS**

Subject to availability of resources and administrative approval:

(1) One E. R. Hedrick Assistant Professorship. Applicants must show very strong promise in research and teaching. Salary \$39,600. Three year appointment. Teaching load: four quarter courses per year, which may include one advanced course in the candidate's field. Preference will be given to applications completed by January 1, 1994.

(2) One or two Research Assistant Professorships in Computational and Applied Mathematics. Applicants must show very strong promise in research and teaching. Salary \$39,600. One year appointment, probably renewable up to two times. Teaching load: at most four quarter courses per year, which may include one advanced course in the candidate's field. Preference will be given to applicants completed by January 1, 1994.

(3) One Adjunct Assistant Professorship or Lectureship in the Program in Computing (PIC). (a) Applicants in the first category must show very strong promise in teaching and research, preferably in an area related to computing. Teaching load: four quarter programming courses and an advanced quarter course of the candidate's choice per year. One year appointment, probably renewable once. Salary range \$39,600–\$47,000. (b) Applicants for the Lectureship must show very strong promise in the teaching of programming. M.S. in Computer Science or equivalent degree preferred. Teaching load: six quarter programming courses per year. One-year appointment, probably renewable one or more time, depending on the needs of the program. Salary is based on experience and begins at \$34,248. Preference will be given to applications completed by February 1, 1994.

(4) An Adjunct Assistant Professorship. One year appointment, probably renewable once. Strong research and teaching background required. Salary \$35,900–40,500. Teaching load: five quarter courses per year.

(5) Possibly one or more positions for visitors.

To apply, send electronic mail to search@math.ucla.edu or write to Thomas M. Liggett, Chair, Department of Mathematics, University of California, Los Angeles, CA 90024-1555. Attn: Staff Search. UCLA is an equal opportunity/affirmative action employer.

---

**UNIVERSITY OF CALIFORNIA, RIVERSIDE**  
**Department of Mathematics**  
**Position in Topology**

Applications and nominations are invited for a tenured or tenure track position in Topology beginning July 1, 1994, or later. The position is

## Classified Advertisements

at the Assistant or Associate Professor level. A Ph.D. in Mathematics or related specialization area is required. Demonstrated excellence in research and teaching is essential. Responsibilities include teaching undergraduate and graduate level courses and seminars, conducting scholarly research, and participating in service activities. Established criteria of the University of California determine salary and rank. To assure full consideration, applicants should send their curriculum vita, including a list of publications, and have at least three letters of recommendation sent to:

Professor David Rush  
Topology Hiring Committee  
Department of Mathematics  
University of California  
Riverside, CA 92521-0135

by January 24, 1994. UCR is an Affirmative Action/Equal Opportunity Employer.

---

### UNIVERSITY OF CALIFORNIA, SANTA BARBARA Department of Mathematics

The University of California, Santa Barbara invites applications for the following positions in the Department of Mathematics, beginning fall 1994.

(1) *Ky Fan Assistant Professorship*: Candidates will be considered in the following mathematical areas: linear and nonlinear functional analysis, harmonic analysis, and computational complexity. The Ky Fan assistant professorship is a special two-year nonrenewable position which carries a research stipend. Appointment is effective July 1, 1994, and candidates must possess a Ph.D. by September 1994. Selection will be based primarily on research achievement, but evidence of satisfactory teaching is necessary. Teaching load will consist of 4 one quarter courses per year.

(2) *Tenure track position*: Applications are invited for a tenure-track appointment at the assistant professor level, effective July 1, 1994, in the area of numerical analysis of nonlinear partial differential equations. Candidates should have a command of the field of the numerical analysis of nonlinear partial differential equations, demonstrated excellence in research in associated numerical applied mathematics, and have a command of and interest in the development of associated rigorous mathematical theories. A demonstrated excellence in the design, analysis, and implementation of algorithms for the computation of solutions of nonlinear partial differential equations is highly desirable as is the ability and desire to interact with scientists in applied areas such as engineering and physics. The appointee will also have the potential to provide leadership in the acquisition of new computational facilities, demonstrated the potential to become an effective teacher, and completed the Ph.D. degree by September 1994.

(3) *Special visiting positions*: Subject to availability of funds, one or more special one-year visiting assistant professorships in the research areas mentioned under (1) and (2) above, with possibility of a second year, carrying a teaching load of approximately 5 one quarter

courses per year. Applicants for the Ky Fan and the tenure track positions will automatically be considered for the visiting positions. Excellence in research, potential for interaction with other 94/96 faculty and evidence of good teaching required. Candidates must possess a Ph.D. by September 1994.

Applicants should send a vita, a publication list, a one-page statement of research interests, and arrange to have three letters of recommendation sent to: the Ky Fan Committee for the Ky Fan position, to the Numerical Analysis Committee for the tenure track position, and to the Visiting Appointment Committee for the special visiting positions (but only if not otherwise applying) at the address: Department of Mathematics, University of California, Santa Barbara, CA 93106. Include an e-mail address if available. Applications which are complete by January 15, 1994, will be given full consideration.

UCSB is an affirmative action/equal opportunity employer.

---

### UNIVERSITY OF CALIFORNIA, SANTA CRUZ Mathematics Department Santa Cruz, CA 95064

The Mathematics Department at the UC, Santa Cruz is recruiting for an Assistant Professor Step I-III in Lie groups and representation theory with applications to number theory or arithmetical algebraic geometry effective July 1, 1994, contingent upon availability of funding. Minimum Qualifications: Ph.D. or equivalent degree in mathematics and demonstrated achievements or potential for excellence in research, teaching, and professional service. Step commensurate with experience. Salary range: \$35,900-\$38,800. Deadline: January 15, 1994. Refer to position #278-923. Applicants should send curriculum vitae, summary of research and teaching experience, four letters of recommendation (at least one letter addressing teaching experience and ability) to: Recruitment Committee, Mathematics Department, University of California, Santa Cruz CA 95064, e-mail: mathrcr@cats.ucsc.edu. UCSC is an AA/EEO/IRCA employer.

---

### UNIVERSITY OF CALIFORNIA, SANTA CRUZ Mathematics Department Santa Cruz, CA 95064

The Mathematics Department at the UC, Santa Cruz is recruiting for an Assistant Professor Step I-III in nonlinear partial differential equations or statistical mechanics effective July 1, 1994, contingent upon availability of funding. Minimum Qualifications: Ph.D. (or equivalent degree) in mathematics and demonstrated achievements or potential for excellence in research, teaching, and professional service. Step commensurate with experience. Salary range: \$35,900-\$38,800. Application Deadline: January 15, 1994. Please refer to position #028-923. Applicants should send curriculum vitae, a

summary of their research and teaching experience, four letters of recommendation (at least one letter addressing teaching experience and ability) to: Recruitment Committee, Mathematics Department, University of California, Santa Cruz CA 95064 e-mail: mathrcr@cats.ucsc.edu. UCSC is an AA/EEO/IRCA employer.

---

### UNIVERSITY OF CALIFORNIA, SANTA CRUZ Mathematics Department Santa Cruz, CA 95064

The Department expects to have Visiting Assistant Professorships in Mathematics beginning fall 1994 (subject to availability of funding). Appointees will be expected to teach, pursue their research, and perform some service. These positions are available for periods ranging from one quarter to the full academic year, with a possible extension to a second year. The teaching load is four to five 1-quarter courses per year. Minimum Qualifications: Ph.D. in mathematics and demonstrated achievements or potential for excellence in research, teaching, and professional service. Salary: \$35,900. Deadline: January 15, 1994. Refer to position #T93-12. Send curriculum vitae, a summary of research and teaching experience, three letters of recommendation (at least one letter addressing teaching experience and ability) to: Recruitment Committee, Mathematics Department, University of California, Santa Cruz CA 95064, e-mail: mathrcr@cats.ucsc.edu. UCSC is an AA/EEO/IRCA employer.

---

### UNIVERSITY OF SOUTHERN CALIFORNIA Los Angeles, California

The Department of Mathematics anticipates several tenure-track or possible tenured positions at the Assistant and/or Associate Professor level. Applicants must show strong research promise and possess excellent communications skills for teaching undergraduate mathematics courses. Visiting positions (at all levels) and postdoctoral appointments will also be available.

To apply, please submit the following materials in a single package: letter of application (including your e-mail address and fax number), and a curriculum vitae. Candidates for junior positions should also provide at least three letters of recommendation. Mail application to: Chair of Appointments Committee, Department of Mathematics-DRB 155, University of Southern California, Los Angeles, CA 90089-1113. USC is an Equal Opportunity/Affirmative Action Employer. Women and minorities are especially encouraged to apply.

---

## COLORADO

### UNITED STATES AIR FORCE ACADEMY Faculty Position in Mathematical Sciences

The Department of Mathematical Sciences anticipates the establishment of a new teaching

position at the rank of assistant professor beginning July 1, 1994. The initial appointment will be for three years. Reappointment will be based on qualifications, performance, and vacancies. The Air Force Academy is an undergraduate institution which awards the Bachelor of Science degree as part of its mission to develop and inspire air and space leaders. The successful candidate will have a strong commitment to undergraduate teaching and an interest in the use of computers to enhance mathematics education. Preference will be given to those who have demonstrated potential for excellence and innovation in teaching mathematics to students pursuing nontechnical as well as technical majors. Some consideration will be given to research projects that can involve undergraduates. A Ph.D. (preferably recent) in Mathematics or Applied Mathematics is required. Applicants must be U.S. citizens. Salary and academic rank will be commensurate with qualifications. Send a letter of application; curriculum vitae; transcripts; and the names, addresses, and phone numbers of three references to: US-AFA/DPCS (Attn: Mrs. den Herder, #94-01MS), 8034 Edgerton Drive, Suite 240, U.S. Air Force Academy, CO 80840. Deadline for application is December 15, 1993. The Federal Government is an equal opportunity employer.

## DISTRICT OF COLUMBIA

### HOWARD UNIVERSITY

Mathematics: Assistant Professorships are anticipated for 1994–1995. Ph.D., demonstrated excellence in teaching and active participation in research required. We encourage applicants in statistics and applied mathematics, but other applications are welcome. Send resume and direct three letters of reference to: Chairman, Mathematics Department, Howard University, Washington, DC 20059. Deadline: January 18, 1994. Howard University is an Equal Opportunity Employer.

## FLORIDA

### JACKSONVILLE UNIVERSITY

Jacksonville University is soliciting applications for one and possibly a second tenure-track Assistant Professor position in mathematics. All fields of specialty are welcome, but preference for the first position will be given to a Ph.D. in statistics. Applicants with experience or interest in computer-assisted instruction are particularly desired. Responsibilities include teaching 12 hours per semester, continued scholarly activity (broadly defined), and department/university service. Applications will be accepted until December 15, 1993. Send vita, cover letter addressing qualifications, and three letters of reference to Dr. Charles Lindsey, Chair, Department of Mathematics, Jacksonville University, 2800 University Blvd. N., Jacksonville, FL 32211. Jacksonville University is an AA/EO employer.

## GEORGIA

### EMORY UNIVERSITY Department of Mathematics and Computer Science

The Department of Mathematics and Computer Science, Emory University, invites applications for three anticipated tenure track Assistant Professorships for 1994–1995.

Position 1: A Ph.D. in Mathematics and a promising research program in Algebra are required.

Position 2: A Ph.D. in Mathematics and a promising research program in one of Geometric, Complex, or Functional Analysis are required.

Position 3: A Ph.D. in Computer Science and a promising research program in one or more of Operating Systems, Parallel Processing, Distributed Computing, Computer Networks, and Graphics are required.

As the department offers several undergraduate programs within Emory College, a Ph.D. in Mathematics, and M.S. in Computer Science/Mathematics, applicants are expected to have strong records, or promise, as undergraduate and graduate teachers.

Applications must specify one of Positions 1, 2, or 3 and include CVs (with at least three recommenders' names). Please see that recommendation letters are sent to

Professor Dwight Duffus, Screening Committee  
Department of Mathematics and  
Computer Science  
Emory University  
Atlanta, GA 30322

Screening of applications will begin on 1 January 1994.

Emory University is an Affirmative Action/Equal Opportunity Employer.

### GEORGIA INSTITUTE OF TECHNOLOGY

The School of Mathematics expects to have some visiting and tenure-track positions in several areas, including probability and statistics, at various levels beginning in Fall 1994. Candidates with strong research and teaching records or potential should send a resume, at least three letters of reference, and a summary of future research plans to the Hiring Committee, School of Mathematics, Georgia Institute of Technology, Atlanta, Georgia 30332-0160 U.S.A. Georgia Tech, a member of the University System of Georgia, is an Equal Opportunity/Affirmative Action Employer.

### UNIVERSITY OF GEORGIA Department of Mathematics Athens, GA 30602

Applications are invited for one or more tenure track positions at the assistant professor level for the 1994-95 academic year. For one position the department is particularly interested in candidates in the area of applied probability. The principal qualification is excellence in teaching

and research. Women and minorities are encouraged to apply. Salary will be commensurate with the applicant's abilities and experience.

To apply please send curriculum vitae and four letters of recommendation to John G. Hollingsworth, Head, at the address above. Applications received by Dec. 15, 1993, are assured of consideration. UGA is an Equal Opportunity/Affirmative Action Employer.

### UNIVERSITY OF GEORGIA Department of Mathematics Athens, GA 30602

Applications are invited for a tenure-track position at the associate professor level for the 1994–1995 academic year. The principal qualification is excellence in teaching and research. Women and minorities are encouraged to apply. Salary will be commensurate with the applicant's abilities and experience. To apply please send curriculum vitae and four letters of recommendation to John G. Hollingsworth, Head, at the address above. Applications received by Jan. 15, 1994, are assured of consideration. UGA is an Equal Opportunity/Affirmative Action Employer.

### VALDOSTA STATE UNIVERSITY

Mathematics: The Department of Mathematics and Computer Science of Valdosta State University invites applications for two tenure-track positions at the Assistant or Associate Professor level beginning September 1, 1994. The Ph.D. is preferred; ABD with Master's degree in mathematics or statistics required. The positions are limited to applicants in the areas of statistics, operations research, stochastic processes, and optimization. Applicants should have a commitment to excellence in teaching and continued scholarly activity.

Application deadline is December 15, 1993. A letter of application, a vitae, and three letters of reference should be sent to John W. Schleusner, Head, Department of Mathematics and Computer Science, Valdosta State University, Valdosta, Georgia 31698. VSU is an AA/EOE.

## ILLINOIS

### NORTHWESTERN UNIVERSITY Department of Mathematics 2033 Sheridan Road Evanston, Illinois 60208-2730

Applications are invited for one or more anticipated tenure-track positions starting September 1994. Priority will be given to young, exceptional research mathematicians; however, more senior candidates with very exceptional credentials may be considered for a tenured position. Fields of interest within the department include Algebra, Analysis, Dynamical Systems, Probability, Partial Differential Equations, and Topology. Northwestern is an affirmative action, equal opportunity employer committed to fos-



## Classified Advertisements

tering a diverse faculty; women and minority candidates are especially encouraged to apply. Candidates should arrange that at least three letters of recommendation be sent to Prof. J. Sally, Chair, Personnel Committee, Department of Mathematics, Northwestern University, Evanston, Illinois 60208-2730. Alternatively, applications and supporting documentation can be sent via e-mail to [hirings@math.nwu.edu](mailto:hirings@math.nwu.edu). In order to receive full consideration, applications should be received by January 1, 1994. Hiring is contingent upon eligibility to work in the United States.

### **SOUTHERN ILLINOIS UNIVERSITY AT CARBONDALE Carbondale, Illinois 62901 Numerical Analysis Position Department of Mathematics**

Applications are invited from qualified candidates for a tenure-track position at the assistant professor level beginning on August 16, 1994. Ph.D. in mathematics with specialization in numerical analysis required. Candidates must have demonstrated excellence in research or potential for such. Evidence of teaching effectiveness is required (foreign applicants *must* provide evidence of ability to teach in English effectively). Send letter of application resume and three letters of recommendation to:

Numerical Analysis  
c/o Ronald B. Kirk, Chair  
Department of Mathematics  
Southern Illinois University at  
Carbondale  
Carbondale, Illinois 62901

The closing date for applications is December 10, 1993, or until the position is filled. SIUC IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER. Women and minorities are particularly encouraged to apply.

### **SOUTHERN ILLINOIS UNIVERSITY AT CARBONDALE Carbondale, Illinois 62901 Topology Position Department of Mathematics**

Applications are invited from qualified candidates for a tenure-track position beginning August 16, 1994. The rank will be at the assistant or associate professor level depending on qualifications of the candidate. A Ph.D. in mathematics with specialization in topology—preferably algebraic topology—is required. Candidates must have demonstrated excellence in research or potential for such, and must be qualified to teach graduate level courses in algebraic topology. Evidence of teaching effectiveness is required (foreign applicants must provide evidence of ability to teach in English effectively). Send letter of application, resume, and have three letters of recommendation sent to:

Topology Position  
c/o Ronald B. Kirk, Chair  
Department of Mathematics

Southern Illinois University at  
Carbondale  
Carbondale, Illinois 62901

The closing date for applications is December 10, 1993, or until the position is filled. SIUC IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER. Women and minorities are particularly encouraged to apply.

### **UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN Department of Mathematics**

Applications are invited for one or more junior assistant professor (tenure-track) faculty positions to commence August 1994. We are particularly interested in hiring in the area of applied mathematics, but outstanding candidates in all fields of mathematics are encouraged to apply and will be seriously considered. Salary and teaching load are competitive. Candidates must have received the Ph.D. on or after January 1, 1990, and must have completed the Ph.D. by the time the appointment begins. Candidates should send a letter of application, curriculum vitae and publication list, and arrange to have three letters of reference sent directly to the address below. Area of research should be identified using the 2-digit *Mathematical Reviews* subject classification scheme.

Gerald J. Janusz, Chair  
Department of Mathematics  
University of Illinois at  
Urbana-Champaign  
1409 W. Green St.  
Urbana, Illinois 61801  
tel: 217-333-3352  
e-mail: [search@math.uiuc.edu](mailto:search@math.uiuc.edu)

In order to ensure full consideration, all application materials including letters of reference should be received by December 10, 1993. Interviews may be conducted prior to December 10, but all completed applications received by that date will receive full consideration. Candidates are expected to present evidence of excellence, or potential for excellence, in research and teaching. Applications from women and minority candidates are especially encouraged. The University of Illinois is an Affirmative Action/Equal Opportunity Employer.

## **INDIANA**

### **INDIANA UNIVERSITY-PURDUE UNIVERSITY AT INDIANAPOLIS (IUPUI) Department of Mathematical Sciences**

The Department of Mathematical Sciences at IUPUI is seeking applicants for two or more tenure-track positions to begin in August 1994. Rank is open depending on qualifications. Applicants must have an earned doctorate by the starting date. A strong research record or excellent research potential as well as a commitment to quality graduate and undergraduate teaching are required. Some preference may be given to applicants in scientific computing and applied statistics. However, strong applicants from all

areas of mathematical sciences are encouraged to apply.

IUPUI is a comprehensive urban university with over 28,000 students. The department offers programs of study leading to Purdue University B.S., M.S., and Ph.D. degrees. The university offers competitive salaries and provides excellent fringe benefits. Send resume and three letters of recommendation to Prof. C. D. Alprantis, Acting Chair, Department of Mathematical Sciences, IUPUI, 402 N. Blackford Street, Indianapolis, Indiana 46202-3216. Closing date: January 15, 1994. Late applications will be considered until positions are filled.

IUPUI is an Affirmative Action/Equal Opportunity Employer. Women and minority candidates are encouraged to apply.

### **ROSE-HULMAN INSTITUTE OF TECHNOLOGY Mathematics Chair Search**

Rose-Hulman Institute of Technology is a school of 1350 strong (average SAT averages—680 Math, 540 Verbal) science, engineering, and mathematics students located on a picturesque 130 acre wooded campus with two lakes.

The Department of Mathematics consists of 17 faculty who take teaching seriously. Faculty are active in regional and national professional organizations and are leaders in curriculum efforts to use computers in instruction and to teach innovative curriculum combining science, engineering, and mathematics.

We see a chair to begin in fall 1994.

Send request for more information, inquiries, and applications to: Chair Search Committee, Department of Mathematics, Rose-Hulman Institute of Technology, Terre Haute IN 47803 U.S.A. E-mail: [mathsearch@rose-hulman.edu](mailto:mathsearch@rose-hulman.edu). Phone: 812-877-8391.

A complete application includes a vita; a statement of mathematical, pedagogical, and administrative philosophy; and three letters of recommendation. Evaluation of applications begins 15 December 1993.

## **IOWA**

### **UNIVERSITY OF IOWA**

The Department of Mathematics of the University of Iowa invites applications for the following positions:

1. Tenure-track assistant or beginning associate professorships, starting in August 1994, in the broadly interpreted areas of Analysis, Computational Mathematics, or Geometry. Selection will be based on evidence of outstanding research accomplishments or potential, and teaching ability. A Ph.D. or equivalent training is required.

2. Pending availability of funds, one or more visiting positions for all or part of the 1994–1995 academic year. Selection will be based on research expertise and teaching ability. Preference will be given to applicants whose scholarly activity is of particular interest to members of the current faculty.

## Classified Advertisements

Women and minority candidates are especially urged to apply for the above positions. The University of Iowa welcomes the employment of professional couples on its faculty and staff, permits the appointment of faculty couples within the same department, and permits the sharing of a single appointment by a faculty couple.

Formal screening will begin December 7, 1993; applications will be accepted until the positions are filled. To apply, send a complete vita and have three letters of recommendation sent to:

Professor Richard Randell, Chair  
Department of Mathematics  
University of Iowa  
Iowa City, Iowa 52242

The University of Iowa is an Equal Employment Opportunity and Affirmative Action Employer.

### KANSAS

#### KANSAS STATE UNIVERSITY Department of Mathematics

Subject to budgetary approval, applications are invited for tenure-track and visiting positions commencing August 18, 1994; rank and salary commensurate with qualifications. The Department seeks candidates whose research interests mesh well with current faculty. The Department has research groups in the area of analysis, algebra, geometry/topology, and differential equations. Although all fields will be seriously considered, some preference will be given to candidates in differential equations. Applicants must have strong research credentials and a commitment to excellence in teaching. A Ph.D. in mathematics or a Ph.D. dissertation accepted with only formalities to be completed is required. Letter of application, current vita, description of research, and three letters of recommendation should be sent to:

Department of Mathematics  
Cardwell Hall 137  
Kansas State University  
Manhattan, KS 66506

It is expected that offers will begin on December 14, 1993, but applications for positions will be reviewed until February 1, 1994, or until positions are closed. AA/EOE

#### UNIVERSITY OF KANSAS Department of Mathematics

Applications are invited for a tenure-track position at the assistant professor level and for a visiting position at the assistant professor level (pending funding) beginning August 16, 1994, or as negotiated. For the tenure-track position, preference will be given to candidates first in numerical analysis or stochastic adaptive control, then to candidates whose specialties mesh well with those already represented in the department, then to all other areas of mathematics. For the visiting position, preference will be given to candidates whose research interests mesh well with those of our faculty. Candidates must have a Ph.D. or its requirements completed by

August 15, 1994. Postdoctoral experience for tenure-track position is preferred but optional.

Application, detailed resume with description of research, and three recommendation letters should be sent to C. J. Himmelberg, Chairman, Department of Mathematics, 405 Snow Hall, University of Kansas, Lawrence, KS 66045-2142.

Deadlines: Review of applications will begin on December 1, 1993, and will continue until the positions are filled.

EO/AA Employer.

### KENTUCKY

#### MURRAY STATE UNIVERSITY Department of Mathematics and Statistics

*Position:* Search extended for Asst. Professor. *Starting Date:* August 1, 1994. *Qualifications:* Doctorate in mathematics or mathematics education with at least a master's degree in mathematics, evidence of outstanding teaching, a successful record of scholarly activity or the potential for continuing scholarly activity, and a strong commitment to teacher education. *Responsibilities:* Maximum three course teaching load of a range of courses including content/methods courses for prospective K-12 teachers, continuing research/scholarly activities, and university/departmental service; seek external funding, work in collaboration with public schools to help implement the Kentucky Education Reform Act. *Application deadline:* December 17, 1993. *To Apply:* Send a letter of application, vita, and copies of graduate transcripts to Department of Mathematics and Statistics, Murray State University, Murray, KY 42071. Murray State University is an equal education and employment opportunity, M/F/D, AA employer.

### MARYLAND

#### THE JOHNS HOPKINS UNIVERSITY Department of Mathematical Sciences

Applications are invited for an anticipated faculty position in Statistics.

Substantial capabilities in statistical theory, applications and methodology are required. A broad mathematical and statistical background with an applied statistics specialization is desired. Selection will reflect demonstration and promise of excellence in research, teaching, and innovative applications. A Ph.D. degree is required. Applicants at all levels will be considered.

Minority and women candidates are encouraged to apply. The Johns Hopkins University is an Affirmative Action/Equal Opportunity Employer.

Applicants are requested to send initially only a curriculum vita with a cover letter describing professional interests and aspirations. Recommendation letters, transcripts, preprints and reprints are to be furnished only upon request. Please address applications to: Faculty Search

Committee, Department of Mathematical Sciences, 220 Maryland Hall, The Johns Hopkins University, Baltimore, Maryland 21218-2689

#### THE JOHNS HOPKINS UNIVERSITY Department: Mathematics

Address: Baltimore, MD 21218-2689

Applications are invited for anticipated faculty positions within the general areas of algebra, analysis, geometry, number theory, and topology. Of particular interest is the broad area of analysis. Positions may be filled at any level. Minority and women candidates are encouraged to apply. The Johns Hopkins University is an Affirmative Action/Equal Opportunity Employer. Applicants should submit a curriculum vitae and arrange for letters of recommendation to be sent to: Appointments Committee, Dept. of Mathematics, 404 Krieger Hall, Johns Hopkins University, Baltimore, MD 21218. (Applications in probability, statistics, operations research, and numerical methods will not be considered; applicants in these areas should instead contact the Dept. of Mathematical Sciences in the School of Engineering.)

### MASSACHUSETTS

#### WILLIAMS COLLEGE Department of Mathematics Williamstown, Massachusetts 01267

Anticipated tenure-eligible position in statistics, beginning Fall 1994, probably at the rank of assistant professor; in exceptional cases, however, more advanced appointments may be considered. Excellence in teaching and statistics, including scholarship and consulting, and doctorate required.

Please have a vita and three letters of recommendation on teaching and statistics sent to Statistics Hiring Committee. Evaluation of applications will begin November 15 and continue until the position is filled. As an EEO/AA employer, Williams especially welcomes applications from women and minority candidates.

#### WILLIAMS COLLEGE Department of Mathematics Williamstown, Massachusetts 01267

Anticipated visiting position for the 1994-95 year, probably at the rank of assistant professor; in exceptional cases, however, more advanced appointments may be considered. Excellence in teaching and research, and doctorate expected. Please have a vita and two letters of recommendation on teaching and research sent to Visitor Hiring Committee. Evaluation of applications will begin November 15 and continue until the position is filled. As an EEO/AA employer, Williams especially welcomes applications from women and minority candidates.

**MINNESOTA**

**UNIVERSITY OF MINNESOTA  
School of Mathematics**

Temporary Assistant Professor, Mathematics and Mathematics Education, for recent Ph.D.s interested in working in mathematics education in a major mathematics department. Areas include graduate training, undergraduate curriculum reform, programs for mathematically gifted secondary school students, and networking. 9-month appointment, nontenure track, 2-year initial period, renewable for up to 2 additional years. Work with the University's Talented Youth Mathematics Program (UMTYMP), departmental initiatives, and various networking grants. Projected academic year salary \$31,000-\$33,000. Summer appointments may be available. Responsibilities: Teaching in the UMTYMP calculus component. Work with the Director on K-12 and undergraduate curriculum development, innovative graduate programs and activities, and systemic networking projects. Conduct research with the Director and staff leading to publications. Qualifications: Ph.D. degree in mathematics by beginning of appointment. Teaching experience at the undergraduate level required. Research experience in educationally related programs, especially with undergraduate curriculum development or innovative educational programs for talented secondary school students desirable. Send curriculum vitae, 3 letters of recommendation (including at least one letter on teaching and educational experiences), and statement of interest and background to Dr. Harvey Keynes, School of Mathematics, University of Minnesota, 206 Church Street S.E., 127 Vincent Hall, Minneapolis, MN 55455. The University of Minnesota is an Equal Opportunity Educator and Employer.

**MISSISSIPPI**

**MISSISSIPPI STATE UNIVERSITY  
Search Reopened  
Head**

**Department of Mathematics and Statistics**

Nominations and applications are invited for the position of Head of the Department of Mathematics and Statistics at Mississippi State University. Mississippi State University is a comprehensive land-grant institution and is rated as a Research I Institution by the Carnegie Foundation and a Doctoral I Institution by the Southern Regional Education Board. The department is housed in the College of Arts and Sciences and offers programs for the B.A., B.S., and M.S. in Mathematics, M.S. in Statistics, and the Ph.D. in Mathematical Sciences. The department currently has 35 faculty members, approximately 85 undergraduate majors, and 27 full-time graduate students. Some faculty in the department have cooperative research programs with faculty in the NSF Engineering Research Center. The anticipated retirement of up to six present faculty members over the next five years offers the incoming head a unique

opportunity to shape the department. The applicant should have an earned doctorate in any area of Mathematical Sciences, strong administrative skills, an established record in research, and a commitment to excellence in teaching, research, and other scholarly activities. It is expected that this person will be appointed with the rank of Associate or Full Professor.

Screening of applicants will begin in December 1993 and will continue until the position is filled. The position is available July 1, 1994. Send nominations or applications and resumes, including names, addresses, and telephone numbers of at least three references, to:

Stephen B. Klein, Chair  
Mathematics and Statistics Head  
Search Committee

P.O. Drawer 6161  
Mississippi State University  
Mississippi State, MS 39762

Mississippi State University is an Affirmative Action/Equal Opportunity Employer.

**NEW HAMPSHIRE**

**DARTMOUTH COLLEGE  
John Wesley Young Research  
Instructorship in Mathematics**

The John Wesley Young Research Instructorship is a two year postdoctoral appointment for promising new or recent Ph.D.s whose research interests overlap a department member's. Current departmental interests include areas in algebra, analysis, combinatorics, computer science, differential geometry, logic and set theory, number theory, probability and topology. Teaching duties of four ten-week courses spread over two or three quarters typically include at least one course in the instructor's speciality and include elementary, advanced, and (at instructor's option) graduate courses. Nine-month salary of \$34,000 supplemented by summer (resident) research stipend of \$7,556 (two-ninths). Send letter of application, résumé, graduate transcript, thesis abstract, description of other research activities and intersects if appropriate, and 3 or preferably 4 letters of recommendation (at least one should discuss teaching) to Phyllis A. Bellmore, Mathematics and Computer Science, 6188 Bradley Hall, Hanover, NH 03755-3551. Applications received by Jan. 15 receive first consideration; applications will be accepted until position is filled. Dartmouth College is committed to affirmative action and strongly encourages applications from minorities and women.

**NEW MEXICO**

**NEW MEXICO STATE UNIVERSITY  
Department of Mathematical Sciences**

The department invites applications for tenure-track and visiting positions in pure and applied mathematics and statistics for academic year 1994-1995. New tenure-track positions will be primarily at the assistant professor level; however, appointments at a higher rank may be

possible. Strong commitments to research and teaching are required.

The department has 32 tenure-track positions, and offers B.S., M.S., and Ph.D. degrees. To receive consideration for tenure-track positions, applications must be received by December 15. An application consists of a vita, short research description, and at least three letters of reference, which address both the applicant's research and teaching. The letter of application should identify areas of research and interest in a tenure-track or visiting appointment. Information should be sent to: Hiring Committee, Department of Mathematical Sciences, New Mexico State University, Las Cruces, NM 88003. Applications are kept on file through the hiring period and positions are filled as openings occur.

An Equal Opportunity/Affirmative Action Employer.

**THE UNIVERSITY OF NEW MEXICO  
Albuquerque, New Mexico  
Department of Mathematics and Statistics**

Subject to administrative approval, the Department anticipates that several tenure track positions will be available, beginning in the Fall Semester 1994. We are particularly interested in candidates at the assistant professor level. Candidates must have a strong research record and a commitment to excellence in teaching.

The Department of Mathematics and Statistics currently has 41 faculty members and an active and expanding graduate program. The Department has close research ties with Los Alamos and Sandia National Laboratories, and access to major computing facilities. Joint appointments with other departments are possible.

Review of applications will begin January 3, 1994, and will continue until the positions are filled. All exceptionally strong candidates are urged to apply. Please have curriculum vitae, (including e-mail address if possible) and three letters of reference sent to:

Professor Benjamin Mann, Chair  
Hiring Committee  
Dept. of Mathematics & Statistics  
The University of New Mexico  
Albuquerque, NM 87131

THE UNIVERSITY OF NEW MEXICO IS AN  
EQUAL OPPORTUNITY AND AFFIRMATIVE  
ACTION EMPLOYER

**NEW YORK**

**MATHEMATICAL SCIENCES INSTITUTE**

The Mathematical Sciences Institute of Cornell University and the State University of New York at Stony Brook has positions available for scientific visitors for the year beginning August 1994. For these positions, MSI prefers visitors not more than five years beyond the doctoral degree. Appointments are for the academic year with possible extension to a second year. Salary is \$35,000, plus benefits. Send application, to include a letter of research interests; curriculum vitae with list of publications; and three letters

## Classified Advertisements

of support, one from the thesis advisor, to the attention of the coordinator listed below. Reprints of publications are appreciated. Qualified women and minority applicants are encouraged to apply. Applications are due January 3, 1994.

Appointments may be available in Nonlinear Analysis (attn. J. Glimm), Hybrid Systems (attn. A. Nerode), Symbolic Computation/Computer Algebra/Computational Complexity (attn. M. Sweedler), and Stochastic Analysis (attn. R. Durrett).

Send to:

Mathematical Sciences Institute  
Suite 321, 409 College Avenue  
Ithaca, New York 14850-4697

For information, contact MSI: 607-255-8005, fax: 607-255-9003, or e-mail: deedee@msiadmin.cit.cornell.edu. Appointments are contingent upon continued funding of the above research areas. MSI is partially funded by the U.S. Army Research Office. Cornell University is an Equal Opportunity/Affirmative Action Employer.

### MOUNT SINAI SCHOOL OF MEDICINE OF THE CITY UNIVERSITY OF NEW YORK

Faculty Positions—Department of Biomathematical Sciences at Mount Sinai School of Medicine of the City University of New York. Applications are invited from individuals with research and teaching interests in all areas of the biomathematical sciences for tenured or tenure-track faculty positions. Fields of special interest include molecular sequence analysis, biomolecular structure, mathematical physiology, mathematical neurobiology, imaging, and computational biology. Candidates will be evaluated according to their potential to sustain a nationally recognized, funded research program. Rank and salary will be commensurate with qualifications. Applicants should submit a *curriculum vitae*, a summary of current research, and a brief description of future research plans, and should arrange for three letters of reference to be sent to Craig J. Benham, Department of Biomathematical Sciences, Box 1023, One Gustave L. Levy Place, New York, NY 10029-6574. The deadline for completed application is January 1, 1994. Mount Sinai is an Affirmative Action/Equal Opportunity Employer.

### NORTH CAROLINA

#### WAKE FOREST UNIVERSITY Department of Mathematics and Computer Science

Applications are invited for a position as Instructor or Visiting Assistant Professor in Mathematics. The term is one year, renewable for up to three years. Rank is dependent upon qualifications, and a Master's or Ph.D. degree in Mathematics or Statistics is required. Duties consist only of teaching three courses per semester. A strong interest and preparation for teaching calculus and introductory statistics is desirable. The department has 22 members, offers a B.S. and M.A. in mathematics, and a B.S. and M.S. in computer science.

Send a letter of application and résumé to Richard D. Carmichael, Chairman, Department of Mathematics and Computer Science, Wake Forest University, Box 7388, Winston-Salem, NC 27109. AA/EO employer.

### OHIO

#### THE OHIO STATE UNIVERSITY Department of Mathematics

The Department of Mathematics of The Ohio State University hopes to have available several junior positions, both temporary and tenure track, effective Autumn Quarter 1994. Candidates in all areas of applied and pure mathematics are invited to apply. Significant mathematical research accomplishments or exceptional promise, and evidence of good teaching ability, will be expected of successful applicants.

Please send credentials and have at least three letters of recommendation sent to Professor Dijen Ray-Chaudhuri, Department of Mathematics, The Ohio State University, 231 W. 18th Avenue, Columbus, Ohio 43210. Review of résumés will begin immediately.

The Ohio State University is an Equal Opportunity/Affirmative Action employer. Qualified women and minority candidates are encouraged to apply.

### OKLAHOMA

#### OKLAHOMA STATE UNIVERSITY Department of Mathematics

A small number of postdoctoral and visiting positions are anticipated for fall 1994. Normal duties include research and at most six hours teaching per semester. Minimum qualifications are a Ph.D. in Mathematics or a related field, evidence of research achievement or potential, and a commitment to teaching. For the visiting positions we especially encourage applicants in Algebraic Geometry. Other areas under consideration are Algebraic and Geometric Topology, Functional Analysis and Banach Spaces, Harmonic Analysis, Lie Groups and Representation Theory, Numerical Analysis and Approximation Theory, Number Theory, and Several Complex Variables. For full consideration, send a resume and arrange to have three confidential letters of reference sent by February 15, 1994, to Robert Myers, Appointments Committee Chairman, Department of Mathematics, Oklahoma State University, Stillwater, OK 74078-0613. OSU is an affirmative action equal opportunity employer committed to multicultural diversity.

### PENNSYLVANIA

#### DREXEL UNIVERSITY

*Department Head:* The Department of Mathematics and Computer Science invites qualified candidates to apply. Candidates should have proven ability for academic and administrative leadership and a demonstrated interest in the

continuing development of a multidisciplinary department with cooperative research interests in applied mathematics, computer science, and probability and statistics.

The department, with 30 full-time faculty, has active undergraduate and graduate programs (M.S. and Ph.D.) and a significant service role in engineering and science education. Curriculum reform and development is an important component of the department head's responsibilities.

Evaluation of applications will begin January 15, 1994. Applications will be accepted until the position is filled. Drexel University is an AA/EOE. Send vita and letters of reference to: Dr. Nira Herrmann, Head Search Committee, Department of Mathematics and Computer Science, Drexel University, Philadelphia, PA 19104. Phone: 215-895-2668. e-mail: headsearch@mcs.drexel.edu.

#### GETTYSBURG COLLEGE Computer Science

Gettysburg College invites applications for a tenure-track assistant-professor position in computer science beginning August 1994. A Ph.D. in computer science or a closely related field, promise of excellence in teaching, and a commitment to continued scholarship are essential. Applicants must be qualified to teach both computer science courses and mathematics courses that support the computer science program.

Gettysburg College is a highly selective liberal arts college of about 2000 students in a beautiful and historic area of south-central Pennsylvania. It is conveniently located within an hour and a half drive of the Washington-Baltimore area.

Send letter of application, curriculum vitae, statement of teaching interests and scholarship goals in a liberal-arts environment, and the names of three references (at least one of whom is qualified to address teaching effectiveness) to: James P. Fink, Chair, Department of Mathematics and Computer Science, Gettysburg College, Gettysburg, PA 17325. Please do not send letters of recommendation with your application.

Applications received by December 20, 1993, will receive first consideration; other applications will be accepted until the position is filled. Gettysburg College is an Equal Opportunity/Affirmative Action employer with a Partner Assistance Program. Women and minority candidates are encouraged to apply.

#### LAFAYETTE COLLEGE Department of Mathematics Easton, PA 18042

Tenure track position at the rank of Assistant Professor beginning in late August 1994. Requirements include Ph.D. in mathematics or statistics and strong commitment to undergraduate teaching and continuing professional development. Ability to contribute to the College's general education program is desirable. Teaching load of 5 courses per year. Lafayette offers liberal arts and engineering in a small (2000 students) highly selective private college.

## Classified Advertisements

Please have a vita and 3 letters of recommendation, at least one of which addresses teaching, sent to Mathematics Search Committee. To ensure consideration, all application materials must be received by January 24, 1994. Application materials received after that date may be considered until the position is filled. Lafayette College is an Equal Opportunity Employer and particularly encourages applications from women and minority candidates.

### PENN STATE ERIE, BEHREND COLLEGE

**Mathematics Faculty Position:** A tenure-track assistant professor position for fall 1994. Applicants must have a strong commitment to undergraduate teaching, including topology and algebra, with research interests in areas of applied mathematics, numerical analysis, probability, or partial differential equations to develop an externally funded research program involving undergraduates. Ph.D. required; postdoctoral and teaching experience a plus. Behrend is a 4-year and graduate college offering the B.S. in mathematics within the Penn State system. Application deadline is January 15, 1994. Send resume, transcripts, a brief description of research interests, and arrange that three letters of reference be sent to Dr. Roger Knacke, Division of Science, Department MATH-N, The Pennsylvania State University at Erie, Erie, PA 16563-0203.

An Affirmative Action/Equal Opportunity Employer.

Women and Minorities Encouraged to Apply.

### PUERTO RICO

#### THE UNIVERSITY OF PUERTO RICO AT MAYAGUEZ Department of Mathematics

The Department of Mathematics has a tenure-track opening for an Instructor in the area of applied mathematics (with emphasis in optimal control), with a salary of \$21,000 per year. Fluency in spoken and written Spanish or English, a Master's degree in mathematics, and one year of academic experience are required. The appointee will be expected to teach undergraduate courses and do research.

Send resume and three letters of recommendation to:

Prof. Yuri Rojas-Ramirez  
Acting Chairperson  
Department of Mathematics-UPR  
P.O. Box 5000  
Mayaguez, Puerto Rico 00681-5000  
EEO/AA

#### THE UNIVERSITY OF PUERTO RICO AT MAYAGUEZ Department of Mathematics

The Department of Mathematics has a tenure-track opening for an Assistant Professor in the area of Computational Mathematics (with em-

phasis on high performance computing). The position has a salary of \$27,420 per year. Fluency in spoken and written English or Spanish, a Ph.D. degree in Mathematics (or Computer Science), and one year of academic or industrial/research experience are required. The appointee will be expected to teach graduate and undergraduate courses and do research.

Send resume and three letters of recommendation to:

Prof. Yuri Rojas-Ramirez  
Acting Chairperson  
Department of Mathematics-UPR  
P.O. Box 5000  
Mayaguez, Puerto Rico 00681-5000  
EEO/AA

### TENNESSEE

#### MEMPHIS STATE UNIVERSITY Department of Mathematical Sciences

The Department of Mathematical Sciences is seeking to fill the position of Chair of Excellence (Endowed Chair) in Combinatorics. The Chair will have limited teaching responsibilities but will be expected to maintain an internationally recognized research program, supervise doctoral students, obtain outside funding, provide leadership for the existing graph theory/ combinatorial research group, and attract outstanding faculty and graduate students to the Department.

The Department has excellent in-house library and computing facilities and offers degrees at all levels through the Ph.D. There is substantial support for travel and for hosting visiting collaborators.

Review of applications will begin on December 1, 1993. Applications will continue to be accepted until the position is filled. Women and minorities are strongly urged to apply. Successful candidates must be U.S. citizens or meet the Immigration Reform Act criteria. Applications, including a curriculum vitae, and nominations should be submitted to:

Search Committee  
Chair of Excellence  
Department of Mathematical Sciences  
Memphis State University  
Memphis, TN 38152

An Equal Opportunity/Affirmative Action University

#### UNIVERSITY OF TENNESSEE AT CHATTANOOGA Department Head

The University of Tennessee at Chattanooga invites applications for the Head of the Department of Mathematics. A Ph.D. in a Mathematical Science, at least five years of college mathematics teaching experience, and qualifications commensurate with the rank of Associate Professor or higher are required. Applicants should provide evidence of leadership in curriculum development, teaching, public service, and research/scholarly activities. In this primarily undergraduate institution, the faculty is expected to exhibit excellence in teaching while maintaining a strong commitment to research and

public service. The mathematics department has 23 faculty members including a Chair of Excellence in Applied Mathematics. Located in a very scenic metropolitan area of 400,000, UTC has a student enrollment of 8300. Send applications to Dr. DeWayne S. Nymann; Chair of the Search Committee, Dept. of Mathematics, UTC, Chattanooga, Tn 37403-2598. Screening of applicants' credentials will begin on January 3, 1994, and will continue until the position is filled. Women and minorities are encouraged to apply. UTC is an Equal Opportunity Employment/Affirmative Action/Title IX/Section 504/ADA Institution.

#### UNIVERSITY OF TENNESSEE Department of Mathematics Knoxville, Tennessee

The Mathematics Department of the University of Tennessee, in an effort to significantly improve its research position, seeks to fill a tenure-track assistant or beginning associate professorship in numerical mathematics. A Ph.D. is required. Some postdoctoral experience is preferred. Candidates should be well versed in the core areas of Numerical Analysis with research interests in the numerical solution of differential equations. Preference will be shown to those candidates working in numerical fluid dynamics. Employment begins August 1, 1994. Substantial research promise as well as dedication to teaching are paramount. Interested applicants should arrange to have a vita, three reference letters, and a research statement sent to Professor John B. Conway, Mathematics Search, University of Tennessee, Knoxville, TN 37996-1300; recruit@novell.math.utk.edu. Review of applications will begin December 1 and will continue until the position is filled.

UTK is an EEO/AA/Title IX/Section 504/ADA Employer.

#### VANDERBILT UNIVERSITY Department of Mathematics Nashville, TN 37240

We anticipate three two-year openings at the Assistant Professor level beginning fall 1994. These non-tenure-track positions are intended for recent Ph.D. recipients with demonstrated research potential and strong communication skills who would like to spend time in a department with a vigorous research atmosphere. To apply, send the following materials in a single mailing by 12/15/93 to Professor Constantine Tsinakakis, Chair, at the above address: letter of application (with e-mail address if available), curriculum vitae, and brief research summary. It is essential for candidates to identify in their letter of application **specific** research areas in our department which match their research interests. Additional information, including letters of recommendation, will be requested from selected candidates after an initial screening. Only solicited letters of recommendation will be considered.

VANDERBILT UNIVERSITY IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER

**VANDERBILT UNIVERSITY**  
**Department of Mathematics**  
**Nashville, TN 37240**

We anticipate a tenure track opening at the Assistant Professor level beginning fall 1994. This position carries an initial three-year appointment and requires a Ph.D. in mathematics or computer science. It is intended for a specialist in computer related mathematics, approximation theory, or computer aided design whose primary research involves computing. Outstanding research potential and evidence of effective teaching are required. To apply, send the following materials in a single mailing to Professor Constantine Tsinakis, Chair, at the above address: letter of application (with e-mail address if available), curriculum vitae, and brief research summary. Additional information, including letters of recommendation, will be requested from selected candidates after an initial screening. Only solicited letters of recommendation will be considered.

VANDERBILT UNIVERSITY IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER

**VANDERBILT UNIVERSITY**  
**Department of Mathematics**  
**Nashville, TN 37240**

We anticipate a tenure-track opening at the Assistant Professor level beginning fall 1994. This position carries an initial three-year appointment and requires a Ph.D. in mathematics. It is intended for a specialist in differential equations, operator theory, mathematical biology, or approximation theory. Outstanding research potential and evidence of effective teaching are required. To apply, send the following materials in a single mailing to Professor Constantine Tsinakis, Chair, at the above address: letter of application (with e-mail address if available), curriculum vitae, and brief research summary. Additional information, including letters of recommendation, will be requested from selected candidates after an initial screening. Only solicited letters of recommendation will be considered.

VANDERBILT UNIVERSITY IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER

**TEXAS**

**RICE UNIVERSITY**  
**Griffith Conrad Evans Instructorships**

Postdoctoral appointments for two to three years for promising research mathematicians with research interests in common with the active research areas at Rice, particularly geometric topology, geometric analysis, differential geometry, mathematical physics, and ergodic theory.

Duties will include research and classroom teaching. Applications received by December 31, 1993, will receive full consideration. Rice University is an Equal Opportunity/Affirmative Action Employer and strongly encourages applications from women and minority group members. Inquiries and applications should be mailed to Chair, Evans Committee, Department of Mathematics, Rice University, P.O. Box 1892, Houston, TX 77251-1892.

**SOUTHERN METHODIST UNIVERSITY**

The Department of Mathematics at Southern Methodist University invites applications for two tenure-track assistant professorships, with employment beginning in the Fall semester of 1994. Suitable candidates may be considered for a more senior position. All applicants must have an excellent research record in physical applied mathematics, numerical analysis or scientific computation, and a strong commitment to undergraduate and graduate teaching. The standard teaching load is two courses (six hours) per semester. Applicants who wish to be considered for a senior position must be able to supervise doctoral dissertations and a strong grant record is desirable.

The Department of Mathematics has an active doctoral program in physical applied mathematics, numerical analysis and scientific computation; research interests include asymptotic and perturbation methods, bifurcation theory, dynamical systems, fluid mechanics, mathematical biology, mathematical software, nonlinear waves, and the numerical analysis of differential equations. Fourteen of the seventeen faculty are applied or numerical mathematicians. Senior faculty include W. E. Ferguson (numerical partial differential equations), I. Gladwell (mathematical software), R. Haberman (perturbation theory), M. Melander (computational fluid dynamics), G. W. Reddien (numerical bifurcation theory), D. A. Reinelt (fluid dynamics), and L. F. Shampin (numerical ordinary differential equations). The Department of Mathematics has access to distributed workstations, good Internet connections, and a 20 processor Sequent Symmetry.

Applications will be accepted until January 7, 1994, or until the positions are filled. Send a letter of application and a vita to: Professor I. Gladwell, Chairman, Department of Mathematics, Southern Methodist University, Dallas, Texas 75275-0156. (Tel: 214-692-2506; fax: 214-768-4138). Applicants should arrange for three letters of recommendation to be sent directly to Professor Gladwell.

SMU is an equal opportunity/affirmative action Title IX employer.

I. Gladwell's e-mail addresses: gladwell@sun.cis.smu.edu.

**TEXAS A&M UNIVERSITY**  
**Department of Mathematics**

Applications are invited for tenured faculty positions beginning fall 1994. The long-range plan for the department calls for a major expansion of our programs over the next three years. During

this time period we expect to make a few senior appointments each year. For such a position the applicant should have an outstanding research reputation and be able to fill a leadership role in the department. An established research program, including success in attracting external funding and supervision of graduate students, will be expected and a demonstrated ability, and interest in teaching is required.

Applicants should send a vita, and arrange to have at least four letters of recommendation sent to:

William Rundell, Department of Mathematics, Texas A&M University, College Station, Texas 77843-3368; (hiring@math.tamu.edu). The Department particularly encourages applications from women and minorities.

**TEXAS A&M UNIVERSITY**  
**Department of Mathematics**

We invite applications for tenure-track Assistant Professorships beginning fall 1994. The position requires strong research potential and excellence in teaching at both the undergraduate and graduate level. Contributions beyond the doctoral dissertation will normally be expected. The salary is competitive and the successful applicant will have a start-up package that will include a reduced teaching load and discretionary funds. Preference will be given to applicants whose research area augments our existing strengths.

Application materials, which must include a vita, a statement of research plans, and at least three letters of recommendation, should be sent to:

William Rundell, Department of Mathematics, Texas A&M University, College Station, Texas 77843-3368; (hiring@math.tamu.edu). The Department particularly encourages applications from women and minorities.

**TEXAS A&M UNIVERSITY**  
**Research Instructorships in Mathematics**

The Department expects to have several Research Instructorships available beginning fall 1994. These are two year positions, and are intended for those who have recently received their Ph.D. Candidates must show promise of research excellence in an area of pure or applied mathematics and preference will be given to applicants whose research area is close to those of regular department members.

Application materials must include an application letter, a vita, a statement of research goals, and three letters of recommendation. It is essential that these documents contain evidence of abilities and experience in teaching as well as research. It would be very helpful if the application letter identified members of our faculty with similar research interests.

For full consideration, the complete dossier should be sent by January 1 to:

Hiring Committee  
Department of Mathematics  
Texas A&M University  
College Station, Texas 77843-3368  
(hiring@math.tamu.edu)

## Classified Advertisements

Texas A&M University is an EOE/AA employer and the Department especially encourages applications from women and minorities.

### TEXAS CHRISTIAN UNIVERSITY

One tenure-track position at the assistant professor level beginning August 1994. A Ph.D. in mathematics is required and excellence in both teaching and research is expected. Preference will be given to candidates in (1) index theory/operator algebras/geometry, (2) mathematical physics, (3) modular forms of zeta/L-functions.

A complete application consists of a vita, research abstract, brief statement on teaching experience and philosophy, photocopies of undergraduate and graduate transcripts, and at least three letters of reference, two or more addressing research and one or more addressing teaching.

Review of applications will begin December 15, 1993, and continue until the position is filled. Send correspondence to:

Search Committee  
Department of Mathematics  
Box 32903  
Texas Christian University  
Fort Worth, Texas 76129  
AA/EOE

### TEXAS TECH UNIVERSITY Department of Mathematics

The Department of Mathematics at Texas Tech University anticipates two tenure track appointments at the assistant professor level, beginning fall 1994. For one of these positions, special consideration will be given to applicants in the area of statistics. To qualify, applicants must:

1. have a Ph.D., 2. have a strong dedication to both teaching and research, 3. exhibit research interests that are compatible with ongoing programs in the department, and 4. be willing and able to work with students at both the undergraduate and graduate level.

To apply, please send a resume and have three letters of recommendation sent to Lawrence Schovanec, Chair of the Hiring Committee, Department of Mathematics, Texas Tech University, P. O. Box 41042, Lubbock, TX 79409. EOE/AA

### THE UNIVERSITY OF TEXAS AT AUSTIN Department of Mathematics Austin, Texas 78712

Openings for Fall 1994 will definitely include several at the Instructor level and may include one at the tenure-track/tenure level. Instructorships at The University of Texas at Austin are postdoctoral appointments, renewable for two additional years. It is assumed that applicants for Instructorships will have completed all Ph.D. requirements by August 31, 1994. Preference will go to recent Ph.D. recipients, meaning to those at most one or two years beyond their doctorates. Candidates should show superior research ability and have a strong commitment

to teaching. Consideration will be given only to persons whose research interests have some overlap with those of the permanent faculty. Duties consist of teaching undergraduate or graduate courses and conducting independent research. The projected salary is \$32,500 for the nine-month academic year.

An applicant for a tenure-track or tenured position must present a record of outstanding achievement in her or his research area and must demonstrate a proficiency at teaching. In addition to the duties indicated above for Instructors, such an appointment will typically entail the supervision of M.A. or Ph.D. students. The salary will be commensurate with the level at which the position is filled and the qualifications of the individual who fills it.

Those wishing to apply are asked to send a vita and a brief research summary to the above address, c/o Recruiting Committee. Transmission of the preceding items via e-mail (address: [recruit@math.utexas.edu](mailto:recruit@math.utexas.edu)) is encouraged. Applications must be supported by three or more letters of recommendation, at least one of which speaks to the applicant's teaching credentials. The screening of applicants will begin on December 1, 1993.

The University of Texas at Austin is an equal opportunity employer. Qualified women and minority group members are urged to apply.

### UNIVERSITY OF TEXAS AT EL PASO Department of Mathematical Sciences

The Department of Mathematical Sciences invites applications for a tenure-track Assistant Professor to begin duties in fall 1994. The Department seeks an individual with research interests and expertise in mathematics education and teacher preparation. The Department offers bachelors and masters degrees in Mathematics, Mathematics with an Actuarial Sciences concentration, Applied Mathematics, and Statistics, as well as a bachelor's in mathematics with secondary teaching certification, and a Master of Arts in Teaching with a major in mathematics. Candidates must show strong potential for excellence in teaching and Mathematics Education research and be able to make an immediate contribution to teaching and curriculum reform efforts in entry level and teacher preparation courses. Women and minority candidates are especially encouraged to apply. Send complete Curriculum Vitae (with e-mail address if available) and arrange for three letters of reference to be sent to James E. Nymann, Chairman, Faculty Recruiting Committee, Department of Mathematical Sciences, U.T. El Paso, El Paso, Texas 79968-0514. E-mail inquiries may be made to [mathdept@math.ep.utexas.edu](mailto:mathdept@math.ep.utexas.edu). Consideration of applications will begin December 10, 1993. Applications received after this date may be considered until the position is filled or the search abandoned. The right to leave the position unfilled is reserved. The University of Texas at El Paso does not discriminate on the basis of race, color, national origin, sex, religion, age, or disability in employment or the provision of services.

## UTAH

### UNIVERSITY OF UTAH Department of Mathematics

University of Utah, Department of Mathematics, invites applications for the following positions. Availability of positions is contingent upon funding.

1. Two or more nonrenewable **three-year Instructorships**. Persons of any age receiving Ph.D. degrees in 1993 or 1994 are eligible. Applicants will be selected on the basis of ability and potential in teaching and research. Starting salary will be \$34,000; future cost of living increases are contingent on action by the State Legislature. Duties consist of teaching five courses during the three quarter academic year.

2. One **C. R. Wylie Instructorship**. The term of this instructorship is one year, but it may be renewed for up to three years. It will be awarded either to an incoming Instructor or to one of the Instructors already in residence on the basis of ability and potential in teaching and research. The stipend is \$38,000. Duties consist of teaching four courses during the three quarter academic year.

3. One or more **visiting faculty positions** of one year or less in any of the professorial ranks. Selection will be based on potential contributions to the department's research program and on teaching ability.

It is expected that offers of Instructorships will begin on January 1, 1994, but applications for all positions will be accepted until January 31, 1994, or until all positions are filled.

Applications for any of these positions should include curriculum vitae, bibliography, and three letters of reference. (Instructorship applications should also include an abstract of the thesis and either a list of graduate courses completed or a transcript of graduate work.) Visiting faculty applications should indicate the portion of the three-quarter academic year during which the applicant wishes to visit. Please send your application to Committee on Staffing, Department of Mathematics, 233 JWB, University of Utah, Salt Lake City, Utah 84112. The University of Utah is an Equal Opportunity, Affirmative Action Employer and encourages applications from women and minorities, and provides reasonable accommodation to the known disabilities of applicants and employees.

## VIRGINIA

### UNIVERSITY OF VIRGINIA Assistant Professor

The Department of Applied Mathematics in the School of Engineering & Applied Science at the University of Virginia has a tenure-track opening for an assistant professor in the area Numerical Analysis/Scientific Computing/Mathematical Modeling. We seek candidates who are willing and able to work with colleagues throughout the School of Engineering & Applied Science in applying mathematics to the understanding of real-world phenomena, especially to those problems that arise in modern technology. That

## Classified Advertisements

is, we seek candidates who demonstrate an interest in and potential for mathematical modeling and the development and application of efficient numerical methods for predicting the behavior of such models. Finally, we seek candidates with a strong commitment to the education of both undergraduates and graduates within an environment dedicated to engineering and applied science.

Please send resume and supporting materials to:

Chair of the Search Committee  
Department of Applied Mathematics  
Thornton Hall  
University of Virginia  
Charlottesville, VA 22903-2442

The search will close on December 31, 1993. However, the Department will reopen the search on a month-to-month basis if a suitable candidate cannot be found by this time.

The University of Virginia is an Equal Opportunity/Affirmative Action Employer. Applications from underrepresented minorities are especially encouraged.

---

### WYOMING

#### UNIVERSITY OF WYOMING Department of Mathematics Tenure-Track Position in Algebra

The Department of Mathematics at the University of Wyoming seeks to hire an algebraist in a tenure-track position at the rank of assistant professor. The candidate should have a Ph.D. and an established research record in the representation theory of finite groups and algebras, including Lie algebras, and must have strong teaching credentials. The candidate must also demonstrate an interest in working with our existing research group in algebraic combinatorics. The Department also has active researchers in analysis, applied mathematics, and mathematics education. The availability of this position is subject to administrative approval.

Complete applications consist of a vita, a list of publications, a summary of research interests, and three letters of recommendation sent directly to Professor Myron B. Allen, Chair, Department of Mathematics, University of Wyoming, Laramie, WY 82071-3036. Completed applications received by 1 January 1994 receive first consideration. Women and minorities are encouraged to apply. The University of Wyoming is an affirmative action/equal opportunity employer.

---

#### UNIVERSITY OF WYOMING Department of Mathematics Tenure-Track Position in Analysis

The University of Wyoming Mathematics Department invites applications for a tenure-track position in Analysis at the rank of assistant professor starting August 1994. Applicants must demonstrate strong ability in research, breadth of mathematical knowledge, interest in collaboration with mathematicians in other areas, strong commitment to high quality undergrad-

uate and graduate teaching, and willingness to supervise masters and doctoral students. Preference will be given to researchers with strength in the areas of nonlinear functional analysis and PDE. Outstanding candidates in other areas of analysis are also encouraged to apply. The availability of the position is subject to administrative approval. The Mathematics Department has 25 full-time faculty in applied mathematics, algebra/combinatorics, analysis, and mathematics education.

Complete applications consist of a vita, a list of publications, a summary of research interests, and three letters of recommendation sent directly to Professor Myron B. Allen, Chair, Department of Mathematics, University of Wyoming, Laramie, WY 82071-3036. Completed applications received by 1 January 1994 receive first consideration. Women and minorities are encouraged to apply. The University of Wyoming is an affirmative action/equal opportunity employer.

---

### CANADA

#### UNIVERSITÉ DE MONTRÉAL Professor of Mathematics

The Department of Mathematics and Statistics of the Université de Montréal will have a tenure-track position at all levels in pure mathematics with specialization in algebra, geometry, or algebraic geometry. Qualifications required: Ph.D. in mathematics. Postdoctoral experience desirable. Effective date of appointment: June 1994. Duties include both undergraduate and graduate teaching (in French), research, supervision of graduate students (M.Sc. and Ph.D.), possibility of appointment to the Centre de Recherches Mathématiques (CRM). Salary according to the collective agreement. Closing date for receipt of applications: February 1, 1994. Applications including curriculum vitae, preprints, and three letters of reference should be sent to: Christiane Rousseau, Chair, Department of Mathematics and Statistics, Université de Montréal, P.O. Box 6128, Station A, Montréal (Québec) H3C 3J7. Fax: 514-343-5700. In accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents, men and women.

---

#### UNIVERSITY OF TORONTO Department of Mathematics

The Department solicits applications for a tenure-stream appointment in Geometric Analysis. The position is subject to budgetary approval.

The appointment is at the downtown (St. George) campus at the level of Assistant Professor, to begin July 1, 1994. Candidates are expected to have at least three years experience in teaching and research after the Ph.D., and to be able to demonstrate excellence in each. In particular, a candidate's research should show clearly the ability to make significant original and independent contributions to Mathematics. Salary commensurate with qualifications.

Applicants should send their complete C. V. including a list of publications, a short statement describing their research programme, and all appropriate material about their teaching. They should also arrange to have at least four letters of reference sent directly to Professor K. Murty, Associate Chair, Department of Mathematics, University of Toronto, Toronto, Canada M5S 1A1. At least one letter should be primarily concerned with the candidate's teaching. To insure full consideration, this information should be received by November 30, 1993.

In accordance with Canadian immigration requirements this advertisement is directed to Canadian citizens and permanent residents of Canada. In accordance with its Employment Equity Policy, the University of Toronto encourages applications from qualified women or men, members of visible minorities, aboriginal peoples, and persons with disabilities.

---

#### UNIVERSITY OF TORONTO Department of Mathematics

The Department solicits applications for a tenure-stream appointment in Applied Mathematics. Preference will be given to researchers in the areas of applied probability and nonlinear partial differential equations. The position is subject to budgetary approval.

The appointment is at the downtown (St. George) campus at the level of Assistant Professor, to begin July 1, 1994. Candidates are expected to have at least three years experience in teaching and research after the Ph.D., and to be able to demonstrate excellence in each. In particular, a candidate's research should show clearly the ability to make significant original and independent contributions to Mathematics. Salary commensurate with qualifications.

Applicants should send their complete C. V. including a list of publications, a short statement describing their research programme, and all appropriate material about their teaching. They should also arrange to have at least four letters of reference sent directly to Professor K. Murty, Associate Chair, Department of Mathematics, University of Toronto, Toronto, Canada M5S 1A1. At least one letter should be primarily concerned with the candidate's teaching. To insure full consideration, this information should be received by November 30, 1993.

In accordance with Canadian immigration requirements this advertisement is directed to Canadian citizens and permanent residents of Canada. In accordance with its Employment Equity Policy, the University of Toronto encourages applications from qualified women or men, members of visible minorities, aboriginal peoples, and persons with disabilities.

---

#### UNIVERSITY OF TORONTO Department of Mathematics

The Department solicits applications for a tenure-stream appointment in Geometry. Preference will be given to researchers in the areas of algebraic geometry, arithmetic algebraic geometry, and differential geometry.



## Classified Advertisements

The appointment is at the downtown (St. George) campus at the level of Assistant Professor, to begin July 1, 1994. Candidates are expected to have at least three years experience in teaching and research after the Ph.D., and to be able to demonstrate excellence in each. In particular, a candidate's research should show clearly the ability to make significant original and independent contributions to Mathematics. Salary is commensurate with qualifications.

Applicants should send their complete C. V. including a list of publications, a short statement describing their research programme, and all appropriate material about their teaching. They should also arrange to have at least four letters of reference sent directly to Professor K. Murty, Associate Chair, Department of Mathematics, University of Toronto, Toronto, Canada M5S 1A1. At least one letter should be primarily concerned with the candidate's teaching. To insure full consideration, this information should be received by November 30, 1993.

In accordance with Canadian immigration requirements this advertisement is directed to Canadian citizens and permanent residents of Canada. In accordance with its Employment Equity Policy, the University of Toronto encourages applications from qualified women or men, members of visible minorities, aboriginal peoples, and persons with disabilities.

### UNIVERSITY OF TORONTO Department of Mathematics

The Department solicits applications for limited term Assistant Professorships, which may be at the St. George (downtown) or Erindale campus. The positions are for the three-year period July 1, 1994, to June 30, 1997, and are subject to budgetary approval. Duties consist of teaching and research, and candidates must demonstrate clear strength in both.

Applicants should send their complete C. V. including a list of publications, a short statement describing their research programme, and all appropriate material about their teaching. They should also arrange to have at least four letters of reference sent directly to Professor K. Murty, Associate Chair, Department of Mathematics, University of Toronto, Toronto, Canada M5S 1A1. At least one letter should be primarily concerned with the candidate's teaching. To insure full consideration, this information should be received by November 30, 1993.

In accordance with Canadian immigration requirements this advertisement is directed to Canadian citizens and permanent residents of Canada. In accordance with its Employment Equity Policy, the University of Toronto encourages applications from qualified women or men, members of visible minorities, aboriginal peoples, and persons with disabilities.

### UNIVERSITY OF WATERLOO Department of Pure Mathematics

The Department of Pure Mathematics at the University of Waterloo invites applications for a tenure-track position at the Assistant Professor level starting July 1, 1994. The Department

is particularly interested in candidates whose research interests are related to Algebraic Topology, Differential Geometry, Functional Analysis, or Number Theory. In order to be considered for the position, a Ph.D. is required. An appointment will be offered only to someone with very strong research and teaching qualifications. The University of Waterloo is committed to increasing the number of its female faculty, and therefore applications from women mathematicians are particularly welcome. Duties will include research, and teaching at all levels. Salary will depend on the candidates's qualifications. The closing date for applications is January 15, 1994. An application should contain the curriculum vitae of the candidate plus three letters of reference sent directly from the referees. In accordance with Canadian immigration requirements, this advertisement is directed to Canadian citizens and permanent residents. The University of Waterloo encourages applications from qualified women and men, members of visible minorities, native peoples and persons with disabilities. The availability of this position is subject to budgetary approval. Please send applications to: Dr. J. W. Lawrence, Chair, Department of Pure Mathematics, University of Waterloo, Waterloo, Ontario, Canada N2L 3G1.

## KOREA

### POHANG UNIVERSITY OF SCIENCE AND TECHNOLOGY (POSTECH) Department of Mathematics

We invite applications for positions starting Fall 1994. Preference will be given to statistics (reliability, survival analysis preferred), numerical analysis (numerical pde or ode) and applied mathematics. Outstanding candidates in any field of pure mathematics are also invited.

POSTECH is a small research oriented university with enrollment of about 1200 undergraduate and 800 graduate students. Math department has currently 19 faculty members including two visiting professors, which will eventually be strengthened to 25. Our main research interest includes nonlinear pde, differential geometry, numerical analysis, nonlinear dynamical system, fluid dynamics and computer vision. Regular positions require two journal papers, one year postdoctoral experience and commitment to excellent research and good teaching. Send a resume and a description of planned research and arrange to have three letters of recommendation directly sent to Professor Kyung Whan Kwun, Chairman, Department of Mathematics, POSTECH, P. O. Box 125, Pohang 790-600, Korea. Closing date January 31, 1994, or until positions are filled; phone: 82-562-279-0256; fax: 82-562-279-2799.

## MEXICO

### CENTRO DE INVESTIGACIÓN Y DE ESTUDIOS AVANZADOS DEL IPN Solomon Lefschetz Research Instructorships 1994-1995

The CINVESTAV-IPN Mathematics Department offers the **Solomon Lefschetz Research Instructorships** to young mathematicians with doctorates who show definite promise in research. Appointments are for one year. The salary is equivalent to that of an Assistant Professor in the Mathematics Department. An allowance for moving expenses is provided. Teaching duties generally include one course per semester. Knowledge of Spanish is desirable. Deadline for applications is February 28, 1994. To apply, send curriculum vitae with outline of proposed research plan and arrange for at least three letters of reference to be sent to:

Solomon Lefschetz Instructorship  
Mathematics Department  
CINVESTAV-IPN  
Apartado Postal 14-740  
07000 México, D. F., Mexico  
Phone: (52-5) 754-4466  
Fax: (52-5) 752-6412

## MANUSCRIPTS WANTED

**Sendero Scientific Press**, an author-oriented enterprise with high editorial standards, seeks books of outstanding expository quality accessible to graduate students in math and physics. We offer rapid, courteous service to authors. Most decisions are made within a few weeks. Write Stephen Parrott, 1678 Shattuck Ave. #70, Berkeley, CA 94709.

## PUBLICATIONS FOR SALE

**EXACT ANALYSIS** by Mehran Basti. Please see the ad in the *Notices of the AMS*, Feb. 1993 issue.

**MATH SCI PRESS**, 53 Jordan Rd., Brookline, MA 02146; 617-738-0307. **Lie-Cartan-Ehresmann Theory; Constrained Mechanics and Lie Theory; Geometric Structures in Nonlinear Physics**, by R. Hermann, \$95 each.

**PUBLICATIONS WANTED**

Wanted: Mathematical books, journals, reprints, ephemera. Contact R. K. Dennis, Math. Dept., White Hall, Cornell U., Ithaca, NY 14853-7901. Tel: 607-255-4027, FAX: 607-255-7149. e-mail: dennis@math.cornell.edu

**VIDEOS FOR SALE**

**GROUPS '93 VIDEOS**

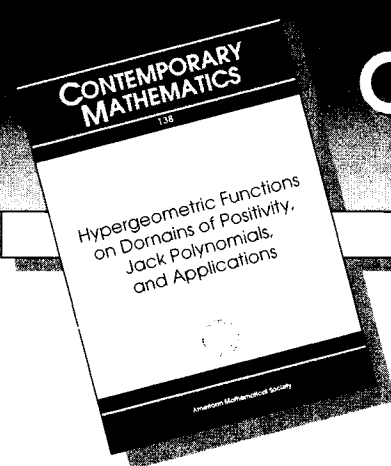
Videos from Groups '93, Galway/St. Andrews, of the lecture courses given by Jon Alperin

("Steinberg representations"). Michel Broué ("Rickard equivalences and block theory"), Peter Kropholler ("Cohomological finiteness conditions"), Alex Lubotzky ("Counting finite index subgroups"), Efim Zel'manov ("Lie methods in group theory") are available. Each video is of approximately 220 minutes duration.

Each tape costs \$52 (individual), \$104 (institution) for NTSC (North American) format and IR£25 (individual), IR£50 (institution) for PAL/Secam (European) format. The whole set is available at \$225 (individual), \$450 (institu-

tion) for NTSC format and IR£110 (individual), IR£230 (institution) for PAL format. The equivalent in other currencies is also acceptable.

Send orders to Groups '93, Department of Mathematics, University College Galway, Ireland (e-mail: mathurley@bodkin.ucg.ie); stating videos required and whether NTSC or PAL format. Prepayment is required for individual orders.



# CONTEMPORARY MATHEMATICS

## Volume 138


### Hypergeometric Functions on Domains of Positivity, Jack Polynomials, and Applications

Donald St. P. Richards, *Editor*

This volume is based largely on lectures presented at a Special Session at the AMS meeting in Tampa, Florida, in March 1991, which was devoted to hypergeometric functions of matrix argument and to fostering communication among representatives of the diverse scientific areas in which these functions are utilized. Accessible to graduate students and others seeking an introduction to the state of the art in this area, this book is a suitable text for advanced graduate seminar courses, as it contains many open problems.

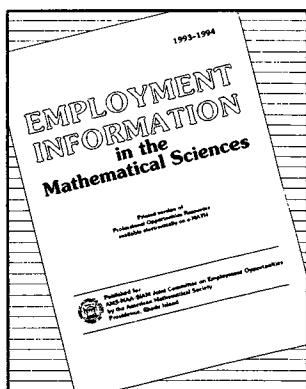
1991 *Mathematics Subject Classification*: 33  
**ISBN 0-8218-5159-4**, 259 pages (softcover), November 1992  
**Individual member \$26**, List price \$44, Institutional member \$35  
 To order, please specify CONM/138NA

All prices subject to change. Free shipment by surface: for air delivery, please add \$6.50 per title. *Prepayment required.* **Order from:** American Mathematical Society, P.O. Box 5904, Boston, MA 02206-5904, or call toll free 800-321-4AMS (321-4267) in the U.S. and Canada to charge with VISA or MasterCard. Residents of Canada, please include 7% GST.



EIMS subscribers: New Information for 1993-1994!  
**Are you looking for a job?**  
**Do you have an open position to fill?**

**Employment Information in the Mathematical Sciences**



The best source for information about open positions for mathematicians is EIMS, published five times per year. Institutions and individuals throughout the world subscribe to EIMS. A one-year subscription offers information on hundreds of open positions for mathematicians with education and experience at levels beyond the bachelor's degree. Graduate students, as well as experienced professionals, rely on EIMS as an essential job-search tool.

**EMPLOYERS:** EIMS gives you access to a wide pool of qualified applicants for your open positions. Listing in EIMS is easy. Your listing can run in one issue or in as many issues as you choose. To list your open positions in EIMS or to get rate and deadline information, call Mike Saitas at 1-800-321-4AMS (321-4267), ext. 4190 (in the United States and Canada), or 1-401-455-4190 (worldwide). You can submit by fax (1-401-331-3842), by e-mail on the Internet (eims-info@

e-math.ams.org), electronically by e-MATH, or by mailing to EIMS, American Mathematical Society, P.O. Box 6248, Providence, RI 02940-6248.

**JOB SEEKERS:** To subscribe, please return the attached order card with payment. As a bonus to your subscription, you will receive three flyers during the summer describing late-breaking opportunities. EIMS is published five times a year; the 1994 subscription year will run from October 1993 to March 1994. You will receive all issues regardless of when you subscribe. Subscriptions in North America are sent first class; all others are sent air mail.

**Electronic bonus!** All job announcements in EIMS are also listed automatically on e-MATH, the AMS electronic resource, at no extra charge. To access e-MATH, type **telnet e-math.ams.org** or **telnet 130.44.1.100**. Login and password are both **e-math** (lower case).

**Subscribing is easy. Call 1-800-321-4AMS (4267);  
1-401-455-4082, worldwide.**

Please enter \_\_\_\_\_ one year subscription(s) to EIMS at the following rate:

Institution Rate of \$160     Individual Rate of \$96     Student or Unemployed Rate of \$40\*

**Prepayment Required**

Residents of Canada, please include 7% GST.

Ordered by: \_\_\_\_\_

Mail to (if different): \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Customer code: \_\_\_\_\_

Check or Money Order enclosed for \$ \_\_\_\_\_     VISA     MasterCard    Card number \_\_\_\_\_

Signature \_\_\_\_\_    Expiration date \_\_\_\_\_

**Send Orders to:** Prepaid orders: American Mathematical Society, P.O. Box 5904, Boston, MA 02206-5904

Charge orders: American Mathematical Society, P.O. Box 6248, Providence, RI 02940-6248

\* To qualify for the Student or Unemployed rate, one of the following statements must accompany the order: "I am currently unemployed and actively seeking employment. My unemployed status is not the result of voluntary resignation or retirement from my last position. I am not enrolled in a graduate study program."  
OR "I am a full-time student enrolled in a program leading to a degree or diploma at: \_\_\_\_\_"

# NEW IN MATHEMATICS

## MORSE HOMOLOGY

M. SCHWARZ, ETH Zentrum Mathematik,  
Zürich, Switzerland

Herein is presented a link between modern analysis and topology. Based upon classical Morse theory this monograph develops the finite dimensional analogue of Floer homology. Morse homology naturally arises from the gradient dynamical system associated with a Morse function. The underlying chain complex, already considered by Thom, Smale, Milnor and Witten, analogously forms the basic ingredient of Floer's homology theory. This concept of relative Morse theory in combination with Conley's continuation principle lends itself to an axiomatic homology functor. The present approach consistently employs analytic methods in strict analogy with the construction of Floer's homology groups. That is a calculus for certain non-linear Fredholm operators on Banach manifolds which here are curve spaces and within which the solution sets form the local moduli spaces. The book offers a systematic and comprehensive presentation of the analysis of these moduli spaces. All theorems within this analytic schedule comprising Fredholm theory, regularity and compactness results, gluing and orientation analysis, together with their proofs and pre-requisite material, are examined in detail.

1993 248 PP. HARDCOVER \$49.50 ISBN 0-8176-2904-1  
PROGRESS IN MATHEMATICS, VOLUME 111

## FUNDAMENTALS OF THE THEORY OF OPERATOR ALGEBRAS

Special Topics

R.V. KADISON, University of Pennsylvania <sup>2</sup>  
J.R. RINGROSE, University of Newcastle (Eds.)

Readers of the highly acclaimed treatise on which these volumes are based will enthusiastically welcome the detailed solutions to the stimulating exercises that appeared in the first two volumes. With clarity, thoroughness, and depth, these solutions supplement the basic theory and provide an invaluable tool for students and researchers in mathematics and theoretical physics and engineering.

**VOLUME IV: Advanced Theory -  
An Exercise Approach**

1992 586 PP. HARDCOVER \$49.50 ISBN 0-8176-3498-3

**VOLUME III: Elementary Theory -  
An Exercise Approach**

"...a fitting companion to the existing volumes and a welcome addition to the literature on functional analysis. The exercises...were carefully designed by the authors to illustrate the results of the text and to expand its scope...the authors' solutions...are models of clarity and efficiency, reflecting their vast experience and insight into the subject."

— MATHEMATICAL REVIEWS

1991 273 PP. HARDCOVER \$34.50 ISBN 0-8176-3497-5

## TOPICS IN COMBINATORIAL GROUP THEORY

G. BAUMSLAG, City College of New York, NY

Combinatorial group theory is a loosely defined subject, with close connections to topology and logic. With surprising frequency, problems in a wide variety of disciplines, including differential equations, automorphic functions and geometry, have been distilled into explicit questions about groups, typically of the following kind: Are the groups in a given class finite (e.g., the Burnside problem)? Finitely generated? Finitely presented? What are the conjugates of a given element in a given group? What are the subgroups of that group? Is there an algorithm for deciding for every pair of groups in a given class whether they are isomorphic or not? The objective of combinatorial group theory is the systematic development of algebraic techniques to settle such questions.

In view of the scope of the subject and the extraordinary variety of groups involved, it is not surprising that no really general theory exists. These notes, bridging the very beginning of the theory to new results and developments, are devoted to a number of topics in combinatorial group theory and serve as an introduction to the subject on the graduate level.

1993 172 PP. SOFTCOVER \$29.50 ISBN 0-8176-2921-1  
LECTURES IN MATHEMATICS

## INTRODUCTION TO THE REGULARITY THEORY FOR NONLINEAR ELLIPTIC SYSTEMS

M. GIAQUINTA, Università di Firenze, Firenze, Italy

These lectures are an introduction to the regularity theory of minimizers of variational integrals in the calculus of variations and of solutions of nonlinear elliptic systems. Topics are presented in simple situations with view to avoiding technical difficulties. They include the Hilbert-space approach to boundary value problems and energy estimates; Schauder-estimates and LP-theory for linear systems, without using potential theory; De Giorgi's regularity theorem and Moser-Harnack inequality in the context of the unifying notion of quasi-minima; and model results of the regularity theory in the vector valued case, including simple theorems concerning the regularity of harmonic maps between Riemannian manifolds.

1993 144 PP. SOFTCOVER \$29.00 ISBN 0-8176-2879-7  
LECTURES IN MATHEMATICS

## RESIDUE CURRENTS AND BEZOUT IDENTITIES

C.A. BERENSTEIN, University of Maryland, College Park, MD.  
R. GAY, University of Bordeaux, France.  
A. VIDRAS, Kyoto University, Japan <sup>2</sup>  
A. YGER, University of Bordeaux, France

The objective of this monograph is to present a coherent picture of the almost mysterious role that analytic methods and, in particular, multidimensional residue have recently played in obtaining effective estimates for problems in commutative algebra. Bezout identities, i. e.,  $f_1g_1 + \dots + f_mg_m = 1$ , appear naturally in many problems, for example in commutative algebra in the Nullstellensatz, and in signal processing in the deconvolution problem. One way to solve them is by using explicit interpolation formulas in  $((xx))$ , and these depend on the theory of multidimensional residues. The authors present this theory in detail, in a form developed by them, and illustrate its applications to the effective Nullstellensatz and to the Fundamental Principle for convolution equations.

1993 168 PP. HARDCOVER \$49.50 ISBN 0-8176-2945-9  
PROGRESS IN MATHEMATICS, VOLUME 114

## COMPUTATIONAL ALGEBRAIC NUMBER THEORY

M.E. POHST, Technische Universität, Berlin, Germany

Computational algebraic number theory has been attracting broad interest in the last few years due to its potential applications in coding theory and cryptography. For this reason, the Deutsche Mathematiker Vereinigung initiated an introductory graduate seminar on this topic in Düsseldorf. The lectures given there by the author served as the basis for this book which allows fast access to the state of the art in this area. Special emphasis has been placed on practical algorithms - all developed in the last five years - for the computation of integral bases, the unit group and the class group of arbitrary algebraic number fields.

1993 104 PP. SOFTCOVER \$26.50 ISBN 0-8176-2913-0  
DEUTSCHE MATHEMATISCHE VEREINIGUNG SEMINAR — DMV 21

## THREE EASY WAYS TO ORDER!

**CALL:** Toll-Free 1-800-777-4643. In NJ please call (201) 348-4033. Your reference number is Y743.  
• **WRITE:** Birkhäuser, Dept. Y743, 44 Harri Way, Secaucus, NJ 07096-2491. • **VISIT:** Your Local Technical Bookstore, or urge your librarian to order for your department. • Payment can be made by check, money order or credit card. Please enclose \$2.50 for shipping & handling for the first book (\$1.00 for each additional book) and add appropriate sales tax if you reside in CA, IL, MA, NJ, NY, PA, TX, VA or VT. Canadian residents please add 7% GST. Prices are valid in North America only, are payable in U.S. currency or its equivalent, and are subject to change without notice. For price and ordering information outside North America contact: Birkhäuser Verlag AG, Klosterberg 23, P.O. Box 133, CH-4010 Basel, Switzerland. FAX 61 271 76 66.

**Birkhäuser**  
Boston · Basel · Berlin



# INSTITUTE FOR MATHEMATICS AND ITS APPLICATIONS

announces a program on

## WAVES AND SCATTERING

ORGANIZING COMMITTEE: INGRID DAUBECHIES, BJORN ENGQUIST, GEORGE PAPANICOLAOU, JEFFREY RAUCH, BARRY SIMON, BILL SYMES

A one-year program with three parts:

Fall: September – December, 1994, Computational Methods and Random Media

Winter: January – March, 1995, Inverse Problems

Spring: April – June, 1995, Geometrical Optics Methods, Singularities & Applications

### POSTDOCTORAL MEMBERSHIPS

All requirements for a doctorate should be completed by September 1, 1994. Applicants must show evidence of mathematical excellence, but they do not need to be specialists in the field. The following materials must be submitted (all material should arrive by January 14, 1994):

- (1) Personal statement of scientific interests, research plans, and reasons for wishing to participate in the Waves and Scattering program. (This is an essential part of the application.)
- (2) Curriculum vitae and a list of publications.
- (3) Three letters of recommendation, to be sent directly to the IMA.

### SENIOR MEMBERSHIPS

Preference will be given to supplementary support for persons with sabbatical leaves, fellowships, or other stipends.

---

### POSTDOCTORATES IN INDUSTRIAL MATHEMATICS

IMA announces at least 4 one-to-two year positions in Industrial Mathematics, effective September 1, 1994. These appointments are in addition to the regular program and are funded jointly by the NSF and participating industries. They are designed to prepare mathematicians for research careers involving industrial interaction. Applicants should have fulfilled all requirements for a Ph.D. in Mathematics or Applied Mathematics by September 1, 1994. Familiarity with pde and/or numerical analysis is desired, but no knowledge in engineering is required. Postdoctorates will spend 50% effort working with industrial scientists on one of the following topics: (1) Signal processing and computational ocean acoustics; (2) Diffractive and nonlinear optics; Maxwell equations in periodic structure; (3) Computational fluid mechanics; (4) Scattering of electromagnetic waves from complex objects; (5) Magneto-optic recording media; the writing process; (6) Semiconductors; (7) Solid state physics & computational chemical physics; (8) Problems in mathematical photography; (9) Air quality modeling; (10) Control theory; (11) Imaging analysis; (12) Micromagnetics; (13) Near-infrared imaging; (14) Applied statistical information theory and data fusion; and 50% effort in the regular IMA program. Requirements and application procedure are the same as for the postdoctoral memberships listed above.

The University of Minnesota is an equal opportunity educator and employer.

---

The application forms are available via anonymous ftp or gopher: [ima.umn.edu](ftp://ima.umn.edu) or call (612) 624-6066.

All correspondence should be sent to either  
VISITING MEMBERSHIP COMMITTEE

or

INDUSTRIAL MATHEMATICS POSTDOCTORATE MEMBERSHIP COMMITTEE

Institute for Mathematics and its Applications

University of Minnesota

514 Vincent Hall

206 Church St. S.E.

Minneapolis, MN 55455-0436

PARTICIPATING INSTITUTIONS: Consiglio Nazionale delle Ricerche, Georgia Institute of Technology, Indiana University, Iowa State University, Kent State University, Michigan State University, Northern Illinois University, Northwestern University, Ohio State University, Pennsylvania State University, Purdue University, University of Chicago, University of Cincinnati, University of Houston, University of Illinois (Chicago), University of Illinois (Urbana), University of Iowa, University of Kentucky, University of Manitoba, University of Maryland, University of Michigan, University of Minnesota, University of Notre Dame, University of Pittsburgh, Wayne State University  
PARTICIPATING CORPORATIONS: Bellcore, Cray Research, Eastman Kodak, Ford, General Motors, Honeywell, IBM, Kao, Motorola, Siemens, 3M, Paramax, UNISYS

**New from Marcel Dekker, Inc.**

**20% Discount  
for AMS Members!**

## **Abstract Algebra with Applications** (in two volumes)

**Vol. I: Vector Spaces and Groups**  
**Vol. II: Rings and Fields**

**KARLHEINZ SPINDLER**

An ideal *primary text* that functions as a single source for all advanced undergraduate and graduate algebra courses. Offers a comprehensive self-contained presentation of all major topics in abstract algebra *and* provides in-depth treatment of the applications of algebraic techniques and the relationship of algebra to other disciplines such as number theory, combinatorics, geometry, topology, differential equations, and Markov chains.

Vol. I: 1993 / 776 pp., illus. / List Price: \$ 75.00  
**AMS Member's Price: \$ 60.00**

Vol. II: 1993 / 552 pp., illus. / List Price: \$ 75.00  
**AMS Member's Price: \$ 60.00**

List Price for both volumes: \$125.00!  
**AMS Member's Price: \$100.00!**

## **Geometric Analysis and Nonlinear Partial Differential Equations**

edited by **ILYA J. BAKELMAN**, Texas A&M University, College Station

Features papers from the *Special Session of the American Mathematical Society Meeting* held in 1990 at the University of North Texas, Denton—discussing and developing research on boundary value problems for nonlinear partial differential equations and related problems.

1993 / 328 pp., illus. / List Price: \$125.00  
**AMS Member's Price: \$100.00**

## **Fundamentals of Pattern Recognition**

**Second Edition, Revised and Expanded**

**MONIQUE PAVEL**, University of Paris V, France

### **About the first edition...**

"...contains a lot of useful and thoughtfully selected known and new information needed for anyone coming into contact with the fundamental problems of pattern recognition."

—*Acta Applicandae Mathematicae*

Revised, updated, and expanded throughout. Addresses the field of pattern recognition (PR) from a basic mathematical viewpoint—treating algebraic, topological, and categorical approaches of PR using concepts from homotopy, shape, and fiber spaces theories as well as computational topology.

1993 / 280 pp., illus. / List Price: \$99.75  
**AMS Member's Price: \$79.80**

## **Conditional Measures and Applications**

**M. M. RAO**, University of California, Riverside

An incomparable *reference for practitioners* applying abstract analysis to problems of practical interest and a valuable *text for all graduate-level courses* in probability, measure theory, and statistical theory. Offers a thorough analysis of conditional expectations and probability measures *and* demonstrates their important uses in real situations.

1993 / 424 pp., illus. / List Price: \$135.00\*  
**AMS Member's Price: \$108.00**

\* Special student adoption price available on orders of five or more copies for classroom use only. Call/write Promotion Dept. at the address below for information.



For Credit Card and Purchase Orders, and Customer Service

**CALL TOLL-FREE 1-800-228-1160**

Mon.-Fri., 8:30 a.m. to 5:45 p.m. (EST)  
or FAX your order to 914-796-1772

**Mail today!** ☒

### **ORDER FORM**

Mail to: **Promotion Dept., MARCEL DEKKER, INC.**  
270 Madison Avenue, New York, N. Y. 10016

Please send me the following books:

Author \_\_\_\_\_ Title \_\_\_\_\_ Quant. \_\_\_\_\_ AMS Price \_\_\_\_\_

I enclose payment in the amount of \$ \_\_\_\_\_ by:

check  money order  Visa

MasterCard (4-digit interbank no. \_\_\_\_\_)  Am.Exp.

Card No. \_\_\_\_\_ Exp. Date \_\_\_\_\_

Please bill my company: P.O. No. \_\_\_\_\_

Signature \_\_\_\_\_  
(must be signed for credit card payment)

**I am a member of the American Mathematical Society.**

**My membership number is:** \_\_\_\_\_

Name \_\_\_\_\_

Address \_\_\_\_\_

City/State/Zip \_\_\_\_\_

Please add \$1.50 for postage and handling per volume, on prepaid orders add only \$.75

N. Y. residents must add appropriate sales tax. Canadian customers add 7% GST. Prices are subject to change without notice.

# THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

## *Department of Mathematics*

The Hong Kong University of Science and Technology is a new publicly-funded research University. Students have been admitted for October 1991 at both undergraduate and postgraduate levels including the doctorate. Enrollment is expected to grow to 7,000 FTE (on full-time equivalent basis) by 1996. The medium of instruction is English. Applications are invited for the following positions:

***Professor***

Minimum US\$107,300 per annum

***Reader***

US\$78,400–US\$104,100 per annum

***Senior Lecturer***

US\$75,100–US\$100,900 per annum

***Lecturer***

US\$48,400–US\$80,800 per annum

The Department will place major emphasis on applications with an appropriate component of pure mathematics to preserve the integrity of the discipline. Research areas will be highly interdisciplinary and will include discrete mathematics, scientific computation, statistics, fluid and solid mechanics, mathematical physics, analysis, algebra, geometry, etc.

Applicants should have a PhD degree in the relevant fields. Appointees at the senior level are expected to have a distinguished record in research and have demonstrated an ability to develop research programs; appointees at Lecturer level are expected to have outstanding potential to develop research in his/her own fields. Responsibilities include undergraduate and postgraduate teaching of not exceeding two courses per semester.

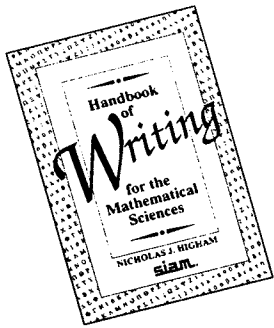
Generous fringe benefits including medical and dental benefits, annual leave, and children's education allowances are provided. Air passages and housing are also provided where applicable. Initial appointments will generally be on a three-year contract; a gratuity of an amount equal to 25% of the total basic salary drawn will be payable upon successful completion of contract. Re-appointment after the initial contract will be subject to mutual agreement. Sabbatical leave if approved will be at full salary.

Applications/nominations should be sent with a complete CV together with the name and address of at least three referees to:

**The Director of Personnel  
The Hong Kong University  
of Science and Technology  
Clear Water Bay  
Kowloon  
Hong Kong  
Fax No: (852) 358-0700**

The search will continue until suitable appointments are made. Applicants interested in positions in the academic year 1994–1995 are however advised to send in their applications before 1 February 1994.





# Applied Mathematics from SIAM

## Handbook of Writing for the Mathematical Sciences

Nicholas J. HIGHAM

Society for Industrial  
and Applied Mathematics

This handy volume provides information on virtually every issue you will face when writing a technical paper or talk.

### Contents

Preface; General Principles; Writer's Tools and Recommended Reading; Mathematical Writing; English Usage; When English is a Foreign Language; Writing a Paper; Revising a Draft; Publishing a Paper; Writing a Talk; Computer Aids for Writing and Research; Appendix A: The Greek Alphabet; Appendix B: Summary of TeX and LaTeX Symbols; Appendix C: GNU Emacs—The Sixty+ Most Useful Commands; Appendix D: Mathematical Organizations; Appendix E: Winners of Prizes for Expository Writing; Glossary; Bibliography; Index.

1993 / xii + 241 pages / Softcover / 0-89871-314-5 / List Price \$21.50 / SIAM Member Price \$17.20  
SIAM Student Member Price \$12.00 / Order Code OT39 / Quantity discounts available for classroom use.

## Russian-English / English-Russian Dictionary on Probability, Statistics, and Combinatorics

K. A. BOROVKOV

This is the only dictionary with current terminology in probability theory, mathematical statistics, combinatorics, and their applications that translates from Russian to English and English to Russian in these subject areas.

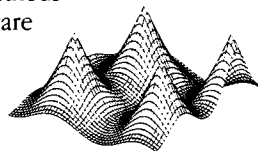
Available December 1993 / Approximately 220 pages / Softcover / ISBN 0-89871-316-1  
List Price \$47.50 / SIAM Member Price \$38.00 / Order Code OT40

## Optimization Software Guide

Jorge J. MORÉ and Stephen J. WRIGHT

Here is a reference tool that includes discussions of optimization theory, including emphasis on large problems and on interior-point methods for linear programming, and presents data sheets of 75 software packages that incorporate the results of theoretical research.

November 1993 / Approximately 152 pages / Softcover / ISBN 0-89871-322-6  
List Price \$24.50 / SIAM Member Price \$19.60 / Order Code FR14



## Mathematical and Computational Techniques for Multilevel Adaptive Methods

Ulrich RÜDE

This monograph presents a unified approach to adaptive methods.

Available October 1993  
Approximately 152 pages / Softcover  
0-89871-320-X / List Price \$23.00  
SIAM Member Price \$18.40  
Order Code FR13

## Transonic Aerodynamics: Problems in Asymptotic Theory

Edited by  
L. Pamela COOK

This invaluable resource presents recent advances in the asymptotic theory of transonic aerodynamics.

1993 / x + 90 pages / Softcover  
0-89871-310-2 / List Price \$26.50  
SIAM Member Price \$21.20  
Order Code FR12

## Interior Point Polynomial Algorithms in Convex Programming

Yurii NESTEROV and  
Arkadii NEMIROVSKII

Here is the first unified theory of polynomial-time interior-point methods.

Available November 1993  
Approximately 400 pages  
Hardcover  
0-89871-319-6  
List Price \$68.50  
SIAM Member  
Price \$54.80  
Order Code AM13

## Ten Lectures on the Probabilistic Method Second Edition

Joel SPENCER

This update of the 1987 title of the same name is an examination of what is currently known about the probabilistic method, written by one of its principal developers. Contains an additional chapter on The Jansen Inequalities.

1993 / 84 pages / Softcover  
0-89871-325-0 / List Price \$18.50  
SIAM/CBMS Member Price \$14.80  
Order Code CB64

## Wavelets: Algorithms & Applications

Yves MEYER; translated and revised by Robert D. RYAN

Presents the mathematical background and the major wavelet applications.

1993 / xi + 133 pages / Softcover / ISBN 0-89871-309-9 / List Price \$19.50 / SIAM Member Price \$15.60  
Order Code OT38

## Algorithms & Architecture: Proceedings of the Second NEC Research Symposium

Edited by T. ISHIGURO

Available October 1993 / Approximately 250 pages / Hardcover / 0-89871-312-9  
List Price \$37.50 / SIAM Member Price \$30.00 / Order Code PR65

**siam**®

Science and Industry  
Advance with Mathematics

### to Order

Use your credit card (AMEX, MasterCard, and VISA): Call toll free in the USA: 800-447-SIAM  
Outside the USA call: 215 382-9800; Fax: 215-386-7999; E-mail: service@siam.org  
Or send check or money order to: SIAM, Dept. BKOP93, P.O. Box 7260, Philadelphia, PA 19101-7260

Shipping and Handling: USA: Add \$2.75 for the first book and \$.50 for each additional book. Canada: Add \$4.50 for the first book and \$1.50 for each additional book. Outside USA/Canada: Add \$4.50 per book. All overseas delivery via airmail.

Payments may be made by wire transfer to SIAM's bank: PNC Bank, 3535 Market Street, Philadelphia, PA 19104; ABA Routing #031000053; Account Name: Society for Industrial and Applied Mathematics; Account Number: 509-704-5.

For a complete table of contents or additional information, access [gopher.siam.org](http://gopher.siam.org)



# ESSENTIAL MATHEMATICS FROM CAMBRIDGE

## Computational Algebraic Geometry and Commutative Algebra

Edited by David Eisenbud and Lorenzo Robbiano  
1993 350 pp. 44218-4 Hardcover \$49.95

## Representations of Solvable Groups

Olaf Manz and Thomas R. Wolf  
London Mathematical Society Lecture Note Series 185  
1993 313 pp. 39739-1 Paper \$39.95

## The Riemann Approach to Integration

Local Geometric Theory  
Washek F. Pfeffer  
Cambridge Tracts in Mathematics 109  
1993 292 pp. 44035-1 Hardcover \$49.95

## Duality and Perturbation Methods in Critical Point Theory

N. Ghoussoub  
Cambridge Tracts in Mathematics 107  
1993 256 pp. 44025-4 Hardcover \$49.95

## Theory of Algebraic Invariants

David Hilbert  
Edited by Bernd Sturmfels  
Reinhard C. Laubenbacher, Translator  
Cambridge Mathematical Library  
1993 200 pp. 44457-8 Hardcover \$39.95  
44903-0 Paper \$12.95

## The Theory of Finite Linear Spaces

Combinatorics of Points and Lines  
Lynn Margaret Batten and Albrecht Beutelspacher  
1993 200 pp. 33317-2 Hardcover \$49.95

Now in paperback...

## Numbers and Functions

Steps to Analysis  
R. P. Burn  
340 pp. 45773-4 Paper \$29.95

## Statistical Analysis of Spherical Data

N. I. Fisher, T. Lewis, and B. J. J. Embleton  
352 pp. 45699-1 Paper \$29.95

Available in bookstores or from

**CAMBRIDGE**  
**UNIVERSITY PRESS**

40 West 20th Street, New York, NY 10011-4211  
Call toll-free 800-872-7423  
MasterCard/VISA accepted. Prices subject to change.

## COMMUNICATIONS on APPLIED NONLINEAR ANALYSIS

An international journal devoted to publish high quality research articles in all areas of nonlinear mathematical sciences (including control theory and optimization), mathematical physics, and their applications-valid mathematical models of importance and significant real world problems with some data analysis-to academic fields as well as to the science and industry.

**HONORARY EDITORIAL BOARD:** C.T.H. Baker (U.K.), A. Friedman (U.S.A.), P.-L. Lions (France), G.-C. Rota (U.S.A.), P.A. Samuelson (U.S.A.), I.E. Segal (U.S.A.), E. Zeidler (Germany)

**EDITORIAL BOARD:** J.P. Albert (U.S.A.), A. Ambrosetti (Italy), H. Berestycki (France), J.M. Borwein (Canada), S.-N. Chow (U.S.A.), T.F. Coleman (U.S.A.), C. Corduneanu (U.S.A.), J. Cronin (U.S.A.), E.N. Dancer (Australia), G. Da Prato (Italy), R. Dautray (France), M.C. Ferris (U.S.A.), B. Fuchssteiner (Germany), J. Henderson (U.S.A.), H. Ishii (Japan), A.G. Kartsatos (U.S.A.), D. Kinderlehrer (U.S.A.), R. Kress (Germany), G. Ladas (U.S.A.), H. Le Dret (France), G. Lieberman (U.S.A.), P.S. Milojevic (U.S.A.), R. Mohapatra (U.S.A.), M.Z. Nashed (U.S.A.), J.-S. Pang (U.S.A.), I.G. Rosen (U.S.A.), M. Slemrod (U.S.A.), J. Spruck (U.S.A.), W.A. Strauss (U.S.A.), M.E. Taylor (U.S.A.), R. Temam (France), R.U. Verma (U.S.A.), M.W. Wong (Canada), H.-K. Xu (China).

Inquiries and orders should be directed to Dr. Ram U. Verma, Managing Editor (CANA), 12046 Coed Drive, Orlando, FL 32826, U.S.A.

NEW JOURNAL FOR 1994 - CALL FOR PAPERS

## SUBSCRIBE NOW:

### PANAMERICAN MATHEMATICAL JOURNAL

A global communication devoted to publish quickly high quality research papers in all areas of mathematical sciences with the best quality of typography that a camera-ready-publication can provide. Papers intended for publication in the journal must meet high standard for clarity as well as mathematical content.

**EDITORIAL BOARD:** Norman Biggs (London School of Economics), Haim Brezis (Universite Paris), George Fix (University of Texas), Robin Harte (Queen's University), A. G. Kartsatos (University of South Florida), W. A. Kirk (University of Iowa), Arthur L. Loeb (Harvard University), S. K. Mitter (M.I.T.), T. Poggio (M.I.T.), Donald Rose (Duke University), Gian-Carlo Rota (M.I.T.), Martin Schechter (University of California), H. M. Srivastava (University of Victoria), R. P. Srivastav (SUNY-Stony Brook), R. P. Tewarson (SUNY-Stony Brook), Samuel C. C. Ting (M.I.T.).

PanAmerican Journal is quarterly, published in January, April, July and October. Annual institutional subscription rate Volume 4 (1994) for North America is U.S. \$100.00; and for all other countries U.S. \$120.00.

Inquiries and orders should be directed to  
Dr. Ram U. Verma, Managing Editor (PMJ), International  
Publications, 12046 Coed Drive, Orlando, FL 32826, U.S.A.

ISSN 1064-9735

# COLBY



## *Carter Professor of Mathematics and Computer Science and Chair of the Department*

Colby invites nominations and applications for Carter Professor of Mathematics and Computer Science and Chair of the Department, effective September 1, 1994. Necessary qualifications include: a Ph.D. in mathematics or computer science; a distinguished record as teacher and scholar; demonstrated departmental and collegial leadership, including the ability to nurture faculty development and research programs; commitment to liberal arts and undergraduate mathematics and computer science education.

Colby is a highly selective college of 1700 students and 165 faculty. Its Department of Mathematics and Computer Science has 9 full-time and 2 part-time faculty members who are active researchers and teach courses in mathematics, computer science, and statistics. Department chairs normally serve 3-year terms, renewable one time. Colby is an AA/EO employer and encourages applications from women and minorities.

Send nominations or applications to **Dale Skrien, Chair, Department of Mathematics and Computer Science, Colby College, Waterville, ME 04901;** ([djskrien@colby.edu](mailto:djskrien@colby.edu)). Review of applications will begin on November 15, 1993, and will continue until the position is filled.

# Advances in SOVIET MATHEMATICS

Volumes 13 & 14

## **Idempotent Analysis**

V. P. Maslov and S. N. Samborskii, *Editors*

The articles in this collection show how idempotent analysis is playing a unifying role in many branches of mathematics related to external phenomena and structures—a role similar to that played by functional analysis in mathematical physics, or numerical methods in partial differential equations. Such a unification necessitates study of the algebraic and analytic structures appearing in spaces of functions with values in idempotent semirings. The papers collected here constitute an advance in this direction.

1991 *Mathematics Subject Classification*: 16, 20, 35, 47, 49, 90; 81  
**ISBN 0-8218-4114-9**, 210 pages (hardcover), December 1992  
Individual member \$65. List price \$108. Institutional member \$86  
To order, please specify ADVSOV/13NA

## **Nonlinear Stokes Phenomena**

Yu. S. Il'yashenko, *Editor*

The nonlinear Stokes phenomenon occurs in the local theory of differential equations and finds application in singularity theory. This book contains a number of papers on this subject, including a survey that begins with Stokes' pioneering works on linear theory, and discusses the work of Voronin.

1991 *Mathematics Subject Classification*: 32, 34, 35, 58; 43  
**ISBN 0-8218-4112-2**, 287 pages (hardcover), February 1993  
Individual member \$70. List price \$116. Institutional member \$93  
To order, please specify ADVSOV/14NA



All prices subject to change. Free shipment by surface; for air delivery, please add \$6.50 per title. *Prepayment required.* Order from: American Mathematical Society, P.O. Box 5904, Boston, MA 02206-5904, or **call toll free 800-321-4AMS** in the U.S. and Canada to charge with VISA or MasterCard. Residents of Canada, please include 7% GST.

## John Conway on the Zometool

*"Zometool helps me make beautiful objects. I love it!"*

John Conway

Call us at (505) 989-4065 for a free sample and info.



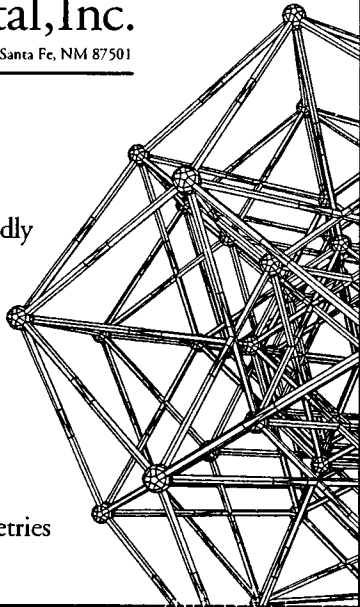
**BioCrystal, Inc.**

605 Calle de San Marcos • Santa Fe, NM 87501

## Zometool

The unique 31 zone construction kit for rapidly creating and visualizing:

- Penrose tiles and quasi-crystals
- N-Dimensional fractal geometries
- Regular polytopes up to 31 dimensions
- 2, 3, and 4D Golden Section geometries



## Announcement & Call for Papers

Fifth Annual

## Ulam Mathematics Conference

March 10-12, 1994

**PALM BEACH ATLANTIC COLLEGE**

West Palm Beach, Florida

**Deadline for Abstracts: Dec. 15, 1993**

**For information, contact:**

Cynthia Smith  
(407) 835-4447

Dr. Piotr Blass  
(407) 835-4353

**PALM BEACH ATLANTIC COLLEGE**

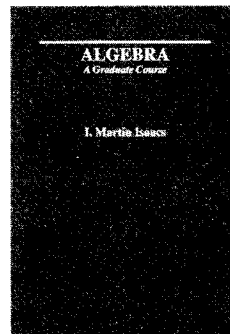
School of Continuing Education

P.O. Box 24708

West Palm Beach, FL 33416-4708

**New for 1994**

**from Brooks/Cole Publishing**



### Algebra: A Graduate Course

by I. Martin Isaacs, University of Wisconsin - Madison  
Approximately 500 pages.  
Casebound. © 1994.  
ISBN: 0-534-19002-2.  
Available October, 1993.

### Accessible and comprehensive

This text begins with a strong presentation of group theory (with an emphasis on finite groups) and goes on to consider modules, rings, and field extensions. Isaacs' balanced coverage of both noncommutative and commutative algebra includes discussion of such specialized topics as Artinian rings, group characters, algebraic number theory, and an introduction to algebraic geometry.

For a complimentary review copy, write on department letterhead to:



Brooks/Cole Publishing Company  
Dept. AMS - Fall  
511 Forest Lodge Road  
Pacific Grove, CA 93950  
(408) 373-0728 / FAX (408) 375-6414



## Translations of MATHEMATICAL MONOGRAPHS

Volume 112

### Introduction to the General Theory of Singular Perturbations

S. A. Lomov

This book is aimed at researchers and students in physics, mathematics, and engineering. It contains the first systematic presentation of a general approach to the integration of singularly perturbed differential equations describing nonuniform transitions, such as the occurrence of a boundary layer, discontinuities, boundary effects, and so on. The method of regularization of singular perturbations presented here can be applied to the asymptotic integration of systems of ordinary and partial differential equations.

1991 Mathematics Subject Classification : 34  
ISBN 0-8218-4569-1, 375 pages (hardcover), Dec. 1992  
Indiv. member \$121, List price \$201, Inst. member \$161  
To order, please specify MMONO/112NA

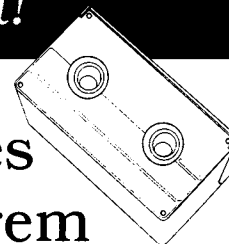


All prices subject to change. Free shipment by surface; for air delivery, please add \$6.50 per title. Prepayment required. Order from: American Mathematical Society, P.O. Box 5904, Boston, MA 02206-5904, or call toll free 800-321-4AMS in the U.S. and Canada to charge with VISA or MasterCard. Residents of Canada, please add 7% GST.

# Wiles Proves Fermat's Last Theorem!

## Modular Elliptic Curves and Fermat's Last Theorem

Kenneth A. Ribet



Andrew Wiles and Kenneth Ribet

In 1637, Pierre de Fermat wrote his legendary marginal comment that  $x^n + y^n = z^n$  has no solution in positive integers when  $n \geq 3$ . Fermat's Last Theorem has eluded proof over the centuries, stimulating a great deal of mathematical development. In 1993, Andrew Wiles announced his proof of this celebrated theorem. Wiles's main result, a special case of the Taniyama Conjecture, relies on a wide range of mathematical tools developed over the past ten years. A crucial link was a 1986 theorem that the Taniyama Conjecture implies Fermat's Last Theorem, proved by Kenneth Ribet, who gives the two lectures on this videotape. Presented just weeks after Wiles's now-historic announcement, these expository lectures describe the main ingredients in Wiles's results. The lectures would be accessible to advanced undergraduates and graduate students with some background in algebra and number theory.

1991 *Mathematics Subject Classification*: 11, 14

ISBN 0-8218-8087-X, NTSC format on 1/2" VHS videotape; approx. 100 minutes, October 1993

**Individual member** \$29.95, List price \$49.95, Institutional member \$39.95

To order, please specify VIDEO/89NA



All prices subject to change. Free shipment by surface: for air delivery, please add \$6.50 per title. *Prepayment required.* Order from: American Mathematical Society, P.O. Box 5904, Boston, MA 02206-5904, or call toll free 800-321-4AMS (321-4267) in the U.S. and Canada to charge with VISA or MasterCard. Residents of Canada, please include 7% GST.



## Membership Categories

Please read the following to determine what membership category you are eligible for, and then indicate below the category for which you are applying.

For **ordinary members** whose annual professional income is below \$45,000, the dues are \$84; for those whose annual professional income is \$45,000 or more, the dues are \$112.

The **CMS cooperative rate** applies to ordinary members of the AMS who are also members of the Canadian Mathematical Society and reside outside of the U.S. For members whose annual professional income is \$45,000 or less, the dues are \$71; for those whose annual professional income is above \$45,000, the dues are \$95.

For a **joint family membership**, one member pays ordinary dues, based on his or her income; the other pays ordinary dues based on his or her income, less \$20. (Only the member paying full dues will receive the Notices and the Bulletin as a privilege of membership, but both members will be accorded all other privileges of membership.)

Minimum dues for **contributing members** are \$168.

For either **students** or **unemployed individuals**, dues are \$28, and annual verification is required.

The annual dues for **reciprocity members** who reside outside the U.S. and Canada are \$56. To be eligible for this classification, members must belong to one of those foreign societies with which the AMS has established a reciprocity agreement, and annual verification is required. Reciprocity members who reside in the U.S. or Canada must pay ordinary member dues (\$84 or \$112).

The annual dues for **category-S members**, those who reside in developing countries, are \$16. Members can choose only one privilege journal. Please indicate your choice below.

Members can purchase a **multi-year membership** by prepaying their current dues rate for either two, three, four or five years. This option is not available to category-S, unemployed, or student members.

### 1994 Dues Schedule (January through December)

For any category of membership where more than one dues level is given, see the above for descriptions of Members' Categories.

Ordinary member	<input type="checkbox"/> \$84 <input type="checkbox"/> \$112
CMS Cooperative rate	<input type="checkbox"/> \$71 <input type="checkbox"/> \$95
Joint family member (full rate)	<input type="checkbox"/> \$84 <input type="checkbox"/> \$112
Joint family member (reduced rate)	<input type="checkbox"/> \$64 <input type="checkbox"/> \$92
Contributing member (minimum \$168)	<input type="checkbox"/>
Student member (please verify) <sup>1</sup>	<input type="checkbox"/> \$28
Unemployed member (please verify) <sup>2</sup>	<input type="checkbox"/> \$28
Reciprocity member (please verify) <sup>3</sup>	<input type="checkbox"/> \$56 <input type="checkbox"/> \$84 <input type="checkbox"/> \$112
Category-S member <sup>4</sup>	<input type="checkbox"/> \$16
Multi-year membership	\$ ..... for ..... years

#### 1 Student Verification (sign below)

I am a full-time student at .....  
..... currently working toward a degree.

**2 Unemployed Verification** (sign below) I am currently unemployed and actively seeking employment. My unemployment status is not a result of voluntary resignation or of retirement from my last position.

**3 Reciprocity Membership Verification** (sign below) I am currently a member of the society indicated on the right and am therefore eligible for reciprocity membership.

4  send NOTICES  send BULLETIN

## Reciprocating Societies

- Allahabad Mathematical Society
- Asociación Matemática Española
- Australian Mathematical Society
- Berliner Mathematische Gesellschaft e.V.
- Calcutta Mathematical Society
- Croatian Mathematical Society
- Dansk Matematisk Forening
- Deutsche Mathematiker-Vereinigung e.V.
- Edinburgh Mathematical Society
- Egyptian Mathematical Society
- Gesellschaft für Angewandte Mathematik und Mechanik
- Glasgow Mathematical Association
- Indian Mathematical Society
- Iranian Mathematical Society
- Irish Mathematical Society
- Íslenzka Staerðfræðafélagið
- Israel Mathematical Union
- János Bolyai Mathematical Society
- Korean Mathematical Society
- London Mathematical Society
- Malaysian Mathematical Society
- Mathematical Society of Japan
- Mathematical Society of the Philippines
- Mathematical Society of the Republic of China
- Nepal Mathematical Society
- New Zealand Mathematical Society
- Nigerian Mathematical Society
- Norsk Matematisk Forening
- Österreichische Mathematische Gesellschaft
- Polskie Towarzystwo Matematyczne
- Punjab Mathematical Society
- Ramanujan Mathematical Society
- Real Sociedad Matemática Española
- Sociedad Colombiana de Matemática
- Sociedad de Matemática de Chile
- Sociedad Matemática de la Republica Dominicana
- Sociedad Matemática Mexicana
- Sociedade Brasileira Matemática
- Sociedade Brasileira de Matemática Aplicada e Computacional
- Sociedade Paranaense de Matemática
- Sociedade Portuguesa de Matemática
- Societat Catalana de Matemàtiques
- Société de Mathématiques Appliquées et Industrielles
- Société Mathématique de Belgique
- Société Mathématique de France
- Société Mathématique Suisse
- Southeast Asian Mathematical Society
- Suomen Matemaattinen Yhdistys
- Svenska Matematikersamfundet
- Union Matemática Argentina
- Union of Bulgarian Mathematicians
- Union of Czechoslovak Mathematicians and Physicists
- Unione Matematica Italiana
- Vijnana Parishad of India
- Wiskundig Genootschap

.....  
Signature

# Order Form

**Ordered by:**

Name \_\_\_\_\_  
 Address \_\_\_\_\_  
 \_\_\_\_\_  
 City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_  
 Country \_\_\_\_\_  
 Code \_\_\_\_\_

**Mail to (if different):**

Name \_\_\_\_\_  
 Address \_\_\_\_\_  
 \_\_\_\_\_  
 City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_  
 Country \_\_\_\_\_  
 Code \_\_\_\_\_

**For orders with remittances:**

American Mathematical Society  
 P. O. Box 5904  
 Boston, MA 02206-5904  
 401-455-4000

**For VISA or MasterCard orders:**

American Mathematical Society  
 P. O. Box 6248  
 Providence, Rhode Island 02940-6248  
 800-321-4AMS (321-4267)

Qty	Code	Title	Price	Total
			\$	\$
		Optional delivery by air to foreign addresses, add \$6.50 per copy.		
		Residents of Canada, please include 7% GST. <span style="float: right;">Total due</span>		\$

Check or Money Order     
  VISA     
  MasterCard

NOTI

Card Number \_\_\_\_\_ Expiration Date \_\_\_\_\_

Signature \_\_\_\_\_

**CHARGE BY PHONE IN THE UNITED STATES AND CANADA 800-321-4AMS (321-4267)**

Customers in these areas should request price information and order directly from the indicated distributors: **EUROPE, MIDDLE EAST, AFRICA:** Oxford University Press, Walton Street, Oxford OX2 6DP England, Tel: 0865 56767, Telefax 0865 56646, Telex 837330 OXPRES G; exclusive distributor of AMS books. **JAPAN:** Maruzen Co. Ltd., P. O. Box 5050, Tokyo International 100-31, Japan. Tel. Tokyo 03-3272-7211, Telex J26516; exclusive distributor of AMS books and journals.

Please send me information about AMS membership

individual membership  
 institutional membership  
 corporate membership  
 institutional associate

**Publications, videotapes, and miscellaneous items** are sent via UPS to U.S. residential addresses, RPS or UPS to U.S. business addresses, and as printed matter elsewhere unless another delivery method is requested. Charges for surface delivery are paid by the AMS. For air delivery outside the U.S., please include an additional \$6.50 per item. **Software** is sent via UPS Second Day Air to U.S. addresses and via U.S. Postal Service air parcel post to addresses outside the United States. Add shipping and handling for software: \$8 per order in the U.S. and Canada; outside the U.S. and Canada \$35 per order (\$15 per order for AMS-TeX and/or AMSFonts only). **Journal back numbers, Mathematical Reviews indexes, and review volumes** are sent via surface mail to any destination unless air delivery is requested. Postage for surface mail is paid by the AMS. Air delivery rates, which will be quoted upon request, must be paid by the purchaser.

Staple here

Fold here



NO POSTAGE  
NECESSARY  
IF MAILED  
IN THE  
UNITED STATES



**BUSINESS REPLY MAIL**  
FIRST-CLASS MAIL PERMIT NO. 554B PROVIDENCE, RI

*POSTAGE WILL BE PAID BY ADDRESSEE*

**Membership and Customer Services**  
**AMERICAN MATHEMATICAL SOCIETY**  
P. O. Box 6248  
Providence, RI 02940-9943



Fold here



## Change of Address

Members of the Society who move or who change positions are urged to notify the Providence Office as soon as possible.

Journal mailing lists must be printed four to six weeks before the issue date. Therefore, in order to avoid disruption of service, members are requested to provide the required notice well in advance.

Besides mailing addresses for members, the Society's records contain information about members' positions and their employers (for publication in the *Combined Membership List*). In addition, the AMS maintains records of members' honors, awards,

and information on Society service. Information of the latter kind appears regularly in *Notices*.

When changing their addresses, members are urged to cooperate by supplying the information requested below. The Society's records are of value only to the extent that they are current and accurate.

If your address has changed or will change within the next two or three months, please fill out this form, supply any other information appropriate for the AMS records, and mail to the address given below.

-----  
Name: \_\_\_\_\_ Customer code: \_\_\_\_\_

Change effective as of: \_\_\_\_\_

Old mailing address: \_\_\_\_\_

NEW mailing address: \_\_\_\_\_

New position: \_\_\_\_\_

If mailing address is not that of your employer, please supply the following information:

New employer: \_\_\_\_\_

Location of employer: \_\_\_\_\_

City

State/Province

Country

Zip Code

Telephone number(s): \_\_\_\_\_

Electronic address(es): \_\_\_\_\_

Recent honors and awards: \_\_\_\_\_

Personal items for publication in *Notices*: \_\_\_\_\_

Mail completed form to:

Customer Services, AMS, P.O. Box 6248, Providence, RI 02940

or send the above information by e-mail to:

[amsmem@math.ams.org](mailto:amsmem@math.ams.org) or [cust-serv@math.ams.org](mailto:cust-serv@math.ams.org)

*Staple here*

*Fold here*

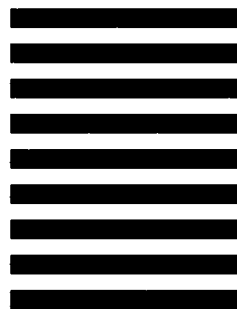


NO POSTAGE  
NECESSARY  
IF MAILED  
IN THE  
UNITED STATES

**BUSINESS REPLY MAIL**  
FIRST-CLASS MAIL PERMIT NO. 554B PROVIDENCE, RI

*POSTAGE WILL BE PAID BY ADDRESSEE*

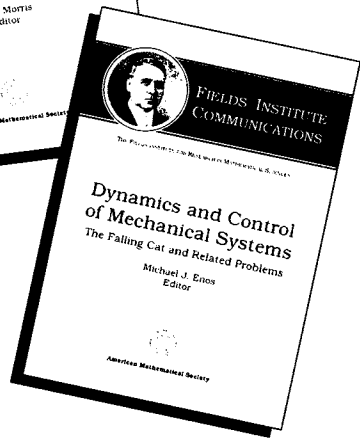
**Membership and Customer Services**  
**AMERICAN MATHEMATICAL SOCIETY**  
P. O. Box 6248  
Providence, RI 02940-9943



*Fold here*



# FIELDS INSTITUTE COMMUNICATIONS



## New Series!

*Fields Institute Communications* series features proceedings and lecture notes growing out of the various activities at the Fields Institute for Research in Mathematical Sciences located in Waterloo, Ontario. The publications evolve from each year's main program. For 1993, the program focused on dynamical systems. For 1994, the main program is *L*-functions. Interdisciplinary titles are featured in areas of mechanical, civil, and aerospace engineering, control theory, and physics.

## Dynamics and Control of Mechanical Systems The Falling Cat and Related Problems

Michael J. Enos, Editor  
*Volume 1*

This book contains a collection of papers presented at the Fields Institute workshop, "The Falling Cat and Related Problems," held in March 1992. The theme of the workshop was the application of methods from geometric mechanics and mathematical control theory to problems in the dynamics and control of freely rotating systems of coupled rigid bodies and related nonholonomic mechanical systems. This book will prove useful in providing insight into this new and exciting area of research.

1991 *Mathematics Subject Classification*: 70, 58, 93, 49  
ISBN 0-8218-9200-2, 280 pages (hardcover), July 1993  
Individual member \$52, List price \$87, Institutional member \$70  
To order, please specify FIC/1NA

## Control of Flexible Structures

K. A. Morris, Editor  
*Volume 2*

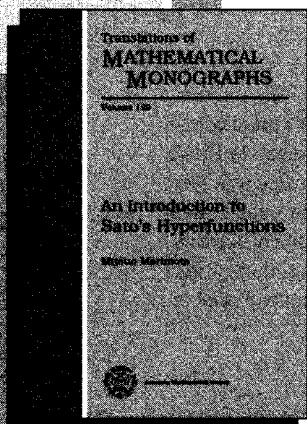
This volume contains papers presented at the workshop "Problems in Sensing, Identification, and Control of Flexible Structures". Topics range from theoretical research on the well-posedness of systems to experimental implementations of various controllers. A number of controller design techniques are discussed and compared, and there are several papers on modelling the complex dynamics of flexible structures. This book is a useful resource to control theorists, engineers, and mathematicians interested in this important field of research.

1991 *Mathematics Subject Classification*: 93, 70  
ISBN 0-8218-9201-0, 243 pages (hardcover), July 1993  
Individual member \$49, List price \$82, Institutional member \$66  
To order, please specify FIC/2NA



All prices subject to change. Free shipment by surface: for air delivery, please add \$6.50 per title. *Prepayment required.* Order from: American Mathematical Society, P.O. Box 5904, Boston, MA 02206-5904, or call toll-free 800-321-4AMS (321-4267) in the U.S. and Canada to charge with VISA or MasterCard. Residents of Canada, please include 7% GST.

## Translations of Mathematical Monographs



### An Introduction to Sato's Hyperfunctions

Mitsuo Morimoto

*Volume 129*

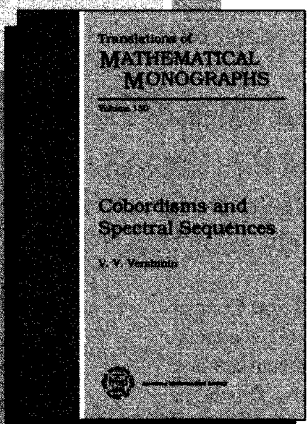
This book is a translation, with corrections and an updated bibliography, of Morimoto's 1976 book on the theory of hyperfunctions originally written in Japanese. Since the time that Sato established the theory of hyperfunctions, there have been many important applications to such areas as pseudodifferential operators and S-matrices. Assuming as little background as possible on the part of the reader, Morimoto covers the basic notions of the theory, from hyperfunctions of one variable to Sato's fundamental theorem. This book provides an excellent introduction to this important field of research.

1991 *Mathematics Subject Classification*: 46; 32, 58

**ISBN 0-8218-4571-3**, 273 pages (hardcover), October 1993

**Individual member** \$52, List price \$87, Institutional member \$70

To order, please specify MMONO/129NA



### Cobordisms and Spectral Sequences

V. V. Vershinin

*Volume 130*

Cobordism is one of the most basic notions of algebraic topology. This book is devoted to spectral sequences related to cobordism theory: the spectral sequence of a singularity, the Adams-Novikov spectral sequence, and applications of these and other sequences to the investigation of cobordism rings.

1991 *Mathematics Subject Classification*: 55

**ISBN 0-8218-4582-9**, 97 pages (hardcover), October 1993

**Individual member** \$37, List price \$62, Institutional member \$50

To order, please specify MMONO/130NA



All prices subject to change. Free shipment by surface: for air delivery, please add \$6.50 per title. *Prepayment required.* Order from: American Mathematical Society, P.O. Box 5904, Boston, MA 02206-5904, or call toll free 800-321-4AMS (321-4267) in the U.S. and Canada to charge with VISA or MasterCard. Residents of Canada, please include 7% GST.

# MAA Minicourse Advance Registration Form, Cincinnati, Ohio

January 12-15, 1994

**NOTE: This is NOT the AMS Short Course Form. Please use the Joint Meetings Advance Registration/Housing Form to register in advance for the AMS Short Course.**

To register for MAA Minicourse(s), please complete **THIS FORM** or a **PHOTOCOPY OF THIS FORM** and return it with your payment to:

Minicourse Coordinator  
Mathematical Association of America  
1529 Eighteenth Street, N.W.  
Washington, DC 20036  
Telephone: 202-387-5200

Telephone: \_\_\_\_\_

(Please print) Surname \_\_\_\_\_ First \_\_\_\_\_ Middle \_\_\_\_\_

Street address \_\_\_\_\_ City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

- Deadline for MAA Minicourse advance registration: November 12, 1993 (After this date, potential participants are encouraged to call the MAA headquarters at 800-331-1622 for availability of Minicourses.).
- Deadline for cancellation in order to receive a 50% refund: December 30, 1993.
- Each participant must fill out a separate Minicourse Advance Registration Form.
- Enrollment is limited to two Minicourses, subject to availability.
- Please complete the following and send both form and payment to the Minicourse Coordinator at the above address:

I would like to attend  1 Minicourse  2 Minicourses

Please enroll me in MAA Minicourse(s): #\_\_\_\_ and #\_\_\_\_

In order of preference, my alternatives are: #\_\_\_\_ and #\_\_\_\_

• **PAYMENT**

Check enclosed: \$ \_\_\_\_\_

Credit card type:  MasterCard  Visa

Credit card # \_\_\_\_\_ Expiration date: \_\_\_\_\_

\_\_\_\_\_  
Your Employing Institution

\_\_\_\_\_  
Signature (as it appears on credit card)

**Minicourse Number and Name**

**Organized by**

**Fee**

1. Organizing an undergraduate research program	Robert O. Robson & Joseph A. Gallian	\$45
2. Inverse problems in the undergraduate classroom	Charles W. Groetsch & Zuhair Nashed	\$45
3. The joy of <i>Mathematica</i> : a point-and-click way to use and learn <i>Mathematica</i>	Alan H. Shuchat & Frederic W. Shultz	\$65
4. How to make effective use of inexpensive pocket computers to develop the concepts and techniques of calculus	Franklin D. Demana & Bert K. Waits	\$45
5. Unifying themes for discrete mathematics	Ralph P. Grimaldi	\$45
6. The mathematics of the perfect shuffle	S. Brent Morris	\$45
7. <i>Theorist</i>	Donald Hartig	\$65
8. Introduction to research in the teaching and learning of undergraduate mathematics: examples in calculus	Joan Ferrini-Mundy & Kathleen Heid	\$45
9. The math modeling/precalculus reform project: using discrete mathematical models to motivate mathematics	Sheldon P. Gordon & B. A. Fusaro	\$45
10. $q$ -dimensional dynamical systems and chaos	Mario U. Martelli	\$45
11. HP48 learning environments for experienced users	Lynn E. Garner	\$45
12. Creating order out of chaos in freshman mathematics	Wade Ellis, Jr.	\$45
13. "Workshop" mathematics: using new pedagogy and technology in introductory mathematics courses	Nancy Hood Baxter & Allan Rossman	\$65
14. Interactive computer graphics laboratories for introductory differential geometry	Thomas F. Banchoff	\$45
15. Designing question-based mathematics courses	Larry Copes & Su Doreé	\$45
16. Calculus: an active approach with projects	Stephen R. Hilbert, John C. Maceli, Diane D. Schwartz, Stanley E. Seltzer, & Eric E. Robinson	\$45
17. Teaching applied math via <i>Maple</i>	Robert J. Lopez	\$65

I plan on registering in advance for the Cincinnati, Ohio meetings **ONLY** in order to attend the MAA Minicourse(s) indicated above. It is my understanding that should the course(s) of my choice be filled a full refund of the Cincinnati meetings advance registration fee will be made.

## Instructions for Applicant and Employer Forms

Applicant forms submitted for the Employment Register by the November 12 deadline will be photographically reproduced in a booklet titled *Winter List of Applicants*.

Employer forms submitted by the November 12 deadline will be photographically reproduced for the *Winter List of Employers*. Employers are encouraged to provide more than one interviewer when they are able to do so, in order to increase the number of interviews which may be scheduled. Please take care to indicate the number of interviewers for whom simultaneous interviews may be scheduled. Please refer to the Employment Register text for specific instructions.

The forms must be carefully typed using a fresh black ribbon. It is important that the keys be clean and make a sharp, clear impression. Do not erase—it causes smudges which reproduce when photographed. Use a correcting typewriter, or correction tape or fluid if necessary. Submit the original typed version only. Copies will not reproduce properly and are not acceptable. **Hand lettered forms will be returned. Do not type outside the box.**

**All forms must be received by the Society by November 12, 1993, in order to appear in the *Winter Lists* and, if attending the meeting, must be accompanied by the Advance Registration/Housing Form printed in the issue.**

### (A) Specialties

AL = Algebra  
 AN = Analysis  
 BI = Biomathematics  
 BS = Biostatistics  
 CB = Combinatorics  
 CN = Control  
 CM = Communication  
 CS = Computer Science  
 CT = Circuits  
 DE = Differential Equations

EC = Economics  
 ED = Mathematics Education  
 FA = Functional Analysis  
 FI = Financial Mathematics  
 FL = Fluid Mechanics  
 GE = Geometry  
 HM = History of Mathematics  
 LO = Logic  
 MB = Mathematical biology  
 ME = Mechanics

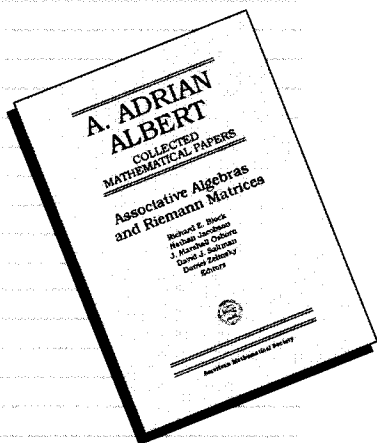
MO = Modelling  
 MP = Mathematical Physics  
 MS = Management Science  
 NA = Numerical Analysis  
 NT = Number Theory  
 OR = Operations Research  
 PR = Probability  
 SA = Systems Analysis  
 ST = Statistics  
 TO = Topology

### (B) (C) Duties and Experience

T = Teaching  
 R = Research  
 S = Supervision  
 C = Consulting

U = Undergraduate  
 G = Graduate  
 A = Administration

IND = Industry  
 GOV = Government  
 DP = Data Processing



## COLLECTED WORKS • Volume 3

# A. ADRIAN ALBERT Collected Mathematical Papers

Richard E. Block, Nathan Jacobson, J. Marshall Osborn,  
 David J. Saltman, and Daniel Zelinsky, Editors

This book contains the collected works of A. Adrian Albert, a leading algebraist of the twentieth century. Albert made many important contributions to the theory of the Brauer group and central simple algebras, Riemann matrices, nonassociative algebras, and other topics. Part 1 focuses on associative algebras and Riemann matrices, and Part 2 on nonassociative algebras and miscellany. Because much of Albert's work remains of vital interest in contemporary research, this volume will interest mathematicians in a variety of areas.

1991 *Mathematics Subject Classification*: 11, 12, 14, 16, 17  
 ISBN (Set) **0-8218-0003-5**; ISBN (Part 1) **0-8218-0005-1**; ISBN (Part 2) **0-8218-0007-8**  
 743 pages (Part 1); 938 pages (Part 2); 1840 pages (Set) (hardcover), January 1993  
 Set: **Individual member** \$124, List price \$206, Institutional member \$165  
 Part 1: **Individual member** \$60, List price \$100, Institutional member \$80  
 Part 2: **Individual member** \$70, List price \$117, Institutional member \$94  
 To order, please specify CWORKS/3NA (Set), CWORKS/3.1NA (Part 1), CWORKS/3.2NA (Part 2)

All prices subject to change. Free shipment by surface; for air delivery, please add \$6.50 per title. *Prepayment required.*  
**Order from:** American Mathematical Society, P.O. Box 5904, Boston, MA 02206-5904, or call toll free 800-321-4AMS (321-4267) in the U.S. and Canada to charge with VISA or MasterCard. Residents of Canada, please include 7% GST.



APPLICANT RÉSUMÉ FORM

MATHEMATICAL SCIENCES EMPLOYMENT REGISTER
JANUARY 12-14, 1994
CINCINNATI, OHIO

- 1. Form must be typed. (Please see instructions on facing page. No other format will be accepted. Use of codes is optional.)
2. This form CANNOT be submitted by electronic mail.
3. Hand lettered forms will be returned. Do not type beyond the box.
4. Please check if Advance Registration/Housing Form previously sent.
5. Return form with payment with your Advance Registration/Housing Form by November 12 to AMS, P.O. Box 6887, Providence, RI 02940, in order to be included in the Winter List of Applicants.

APPLICANT Name
CODE: Mailing Address (include zip code)
E-mail address
Specialties
Career objectives and accomplishments:
ACADEMIC: Research University Teaching College Teaching: 4-year 2-year
Would you be interested in nonacademic employment? yes no
Significant achievements, research, or teaching interests
Paper to be presented at this meeting, or recent publication
Degree Year (expected) Institution
Number of refereed papers accepted/published
PROFESSIONAL EMPLOYMENT HISTORY:
Employer Position Experience Years
1.
2.
3.
DESIRED POSITION:
Duties Available mo./yr.
Significant requirements (or restrictions) which would limit your availability for employment
References (Name and Institution)
Citizenship: (check one) U. S. Citizen Non-U.S. Citizen, Permanent Resident Non-U.S. Citizen, Temporary Resident
AVAILABLE FOR INTERVIEWS:
Session 1 Session 2 Session 3 Session 4
Thurs. AM 8:15-11:40 Thurs. PM 1:00-4:40 Fri. AM 8:15-11:40 Fri. PM 1:00-4:40
I do not plan to attend the Cincinnati meetings.

**EMPLOYER FORM**

**MATHEMATICAL SCIENCES EMPLOYMENT REGISTER  
JANUARY 12-14, 1994  
CINCINNATI, OHIO**

1. Form must be typed. (Please see instructions on page facing Applicant Form. No other format will be accepted. Use of codes is optional.)
2. This form CANNOT be submitted by electronic mail.
3. Hand lettered forms will be returned. Do not type beyond this box.
4. Please check if Advance Registration/Housing Form previously sent.
5. Return form with payment with your Advance Registration/Housing Form by November 12 to AMS, P.O. Box 6887, Providence, RI 02940, in order to be included in the *Winter List of Employers*.

<b>EMPLOYER</b>	
<b>CODE:</b>	Institution _____
	Department _____
	City, State, Zip _____
	E-mail address _____
Name(s) of Interviewer(s) 1. _____	
	2. _____
	3. _____
	4. _____
(A)	Specialties Sought _____
	Title(s) of Position(s) _____
	Number of Positions _____
	Starting Date _____ / _____ Term of Appointment _____
	<small>Month Year</small> <small>Years</small>
	Renewal <input type="checkbox"/> Possible <input type="checkbox"/> Impossible Tenure Track Position <input type="checkbox"/> Yes <input type="checkbox"/> No Teaching Hours per Week _____
	Degree Preferred _____ Degree Accepted _____
(B)	Duties _____
(C)	Experience Preferred _____
	Significant other requirements, needs, or restrictions which will influence hiring decisions _____
	_____
Able to hire for this position : <input type="checkbox"/> U.S. Citizen <input type="checkbox"/> Non-U.S. Citizen, Permanent Resident	
(check all that apply) <input type="checkbox"/> Non-U.S. Citizen, Temporary Resident	
Available for Interviews	<input type="checkbox"/> Session 1 (Thurs. AM, 8:15-11:40) <input type="checkbox"/> Session 2 (Thurs. PM, 1:00-4:40)
	<input type="checkbox"/> Session 3 (Fri. AM, 8:15-11:40) <input type="checkbox"/> Session 4 (Fri. PM, 1:00-4:40)
Number of Interviewers	Session 1: _____ Interviewers Session 2: _____ Interviewers
	Session 3: _____ Interviewers Session 4: _____ Interviewers
<input type="checkbox"/> Not Interviewing	



# Joint Mathematics Meetings Advance Registration/Housing Form, Cincinnati, Ohio

January 12-15, 1994

Please complete this form and return it with your payment to: Mathematics Meetings Service Bureau (MMSB), P.O. Box 6887,  
Providence, Rhode Island 02940; Telephone: (401) 455-4143; Telex: 797192

- DEADLINES:**
- |  |  |
|--|--|
| AMS Short Course, Hotel Reservations (includes Room Lottery Qualification),<br>Joint Meetings (JM) & Employment Register (ER)                | October 29, 1993                               |
| AMS Short Course, Hotel Reservations, JM & ER (includes Tickets, Registration<br>Material Mailed In December, and Inclusion in Winter Lists) | November 12, 1993                              |
| Housing Changes/Cancellations through MMSB   | December 10, 1993                              |
| AMS Short Course, Final JM & ER Registration with no Housing, Tickets,<br>Inclusion in Winter Lists, or Material Mailed                      | December 13, 1993                              |
| 50% Refund on Tickets  | December 30, 1993 (no refunds after this date) |
| 50% Refund Advance Registration/Employment Register/AMS Short Course   | January 9, 1994 (no refunds after this date)   |

(N.B.: A separate form appears in this issue for advance registration for MAA Minicourses.)

**ADVANCE REGISTRATION SECTION:** Please complete this section and the appropriate sections on the reverse.

1) \_\_\_\_\_ Telephone: \_\_\_\_\_  
(Please print) Surname First Middle

2) \_\_\_\_\_  
(Mailing address)

\_\_\_\_\_  
(Mailing address continued) (e-mail address)  
**I do not wish my badge, tickets, program, and/or Employment Register material to be mailed; however, the mailing address for my acknowledgment and room confirmation is given above.**

3) Badge information: Affiliation \_\_\_\_\_  
Names for Guest Badges: \_\_\_\_\_

4) Students: Grad  Undergrad  High School  5) Emeritus member  High School Teacher  Librarian  Unemployed

6) Member of: AMS  CMS  MAA  Nonmember  AWM  NAM  MR Classification # \_\_\_\_\_

7) Joint Meetings fee \$ \_\_\_\_\_ 8) AMS Short Course fee \$ \_\_\_\_\_ 9) Employer fee(s) \$ \_\_\_\_\_ 10) Co-Interviewer fee(s) \$ \_\_\_\_\_

11) Applicant fee \$ \_\_\_\_\_ 12) Posting fee \$ \_\_\_\_\_ 13) Hotel deposit \$ \_\_\_\_\_ (necessary ONLY if paying deposit by check)

14) Tickets: \_\_\_\_\_ AMS 25-Year Banquet @\$25 each = \$ \_\_\_\_\_ Veg. meal  \_\_\_\_\_ MER Banquet @\$36 each = \$ \_\_\_\_\_ Veg. meal   
\_\_\_\_\_ NAM Banquet @\$25 each = \$ \_\_\_\_\_ Veg. meal  \_\_\_\_\_ AWM Workshop Dinner @\$27.50 each = \$ \_\_\_\_\_ Veg. meal   
Students, please check here if you will be attending the MathChats on Tuesday, 1/11/94.

15) TOTAL AMOUNT ENCLOSED FOR 7 through 14 \$ \_\_\_\_\_ NOTE: May be paid by check payable to AMS (Canadian checks must be marked "U.S. Funds"), or VISA or MasterCard credit cards.  original institutional purchase order attached

Credit card type: \_\_\_\_\_ Card number: \_\_\_\_\_ Expiration date: \_\_\_\_\_  
If this is your credit card, please print your name as it appears on the credit card on the line below as well as sign your name.  
If this is not your credit card, please print card holder's name as it appears on the credit card on the line below, and have the card holder sign.

\_\_\_\_\_  
(Printed name)

\_\_\_\_\_  
(Signature)

**REGISTRATION FEES**

<b>JOINT MATHEMATICS MEETINGS</b>		
Member of AMS, CMS, MAA		\$ 125
* Emeritus Member of AMS or MAA		35
Nonmember		194
* Students:		
High School		2
Graduate or Undergraduate		35
* High School Teachers/Librarians/Unemployed Mathematicians		35
<b>AMS SHORT COURSE</b>		
Member/Nonmember		70
* Student, Unemployed, or Emeritus		30
<b>EMPLOYMENT REGISTER</b>		
Employer (1st Interviewer)		150
Employer (2nd/3rd Interviewer)		75
Applicant		35
Posting for job descriptions for noninterviewing employers		50

\* See section on "How to Register in Advance" in the *Notices* or *Focus* for definitions of various registration categories.

For office use only:

Codes	Options	Hotel	Room type
Dates	Hotel Deposit	Total Amount Paid	
Special Remarks			

**HOUSING SECTION:**

ADVANCE REGISTRATION/HOUSING FORM, Cincinnati, Ohio

January 12-15, 1994

I will not require housing.  I am making my own arrangements.  I am staying privately in the local area.  I am requesting a hotel reservation below.

Please rank hotels in order of preference by writing 1, 2, 3, etc., in the spaces at the left on the form and by circling the requested room type and rate. If the rate or hotel requested is no longer available, you will be assigned a room at a ranked or unranked hotel at a comparative rate. Rates listed below are subject to 10% sales/occupancy tax. **GUARANTEE REQUIREMENTS:** \$50 by check **OR** a credit card guarantee with VISA, MasterCard, or American Express. Please supply this information on the reverse.

Order of choice	Distance from Conv. Ctr.	Single	Double 1 bed	Double 2 beds	Triple 2 beds	Triple 2 beds w/cot	Quad 2 beds	Quad 2 beds w/cot	Suites* (starting rates)
<b>Hyatt Regency Cincinnati (Headquarters)</b>	.06 miles	\$ 83	\$ 83	\$ 93	\$ 113	\$ 93	\$ 93	\$ 113	\$360+
Regular									
Student**									
<b>Westin</b>	.20 miles	73	73	73	93	73	73	93	N/A
Regular									
Student**									
<b>Terrace Hilton</b>	.15 miles	82	82	82	97	82	82	97	135+
Regular									
Student**									
<b>Clarion</b>	.06 miles	70	70	70	85	70	70	85	N/A
Regular									
Student**									
<b>Omni Netherland Plaza</b>	.15 miles	80	80	80	110	90	90	110	140
Regular									
Student**									
<b>Holiday Inn Queensgate (downtown)****†</b>	1 mile	79	79	79	109	89	89	109	176+
Regular									
Student**									
<b>Quality Hotel Riverfront†</b>	1 mile	63	63	83	N/A	N/A	103	N/A	205+
Regular									
Student**									
<b>Holiday Inn Riverfront****†</b>	1 mile	49	49	83	N/A	N/A	103	N/A	N/A
Regular									
Student**									
<b>Quality Hotel Riverfront†</b>	1 mile	59	59	59	64	64	69	69	175+
Regular									
Student**									
<b>Holiday Inn Riverfront****†</b>	1 mile	49	49	49	54	54	59	59	N/A
Regular									
Student**									
<b>Quality Hotel Riverfront†</b>	1 mile	55	55	55	65	65	65	65	140+
Regular									
Student**									
<b>Holiday Inn Riverfront****†</b>	1 mile	45	45	45	55	55	45	55	N/A
Regular									
Student**									
<b>Quality Hotel Riverfront†</b>	1 mile	51	51	51	61	61	51	61	N/A
Regular									
Student**									
<b>Quality Hotel Riverfront†</b>	1 mile	41	41	41	51	51	41	51	N/A
Regular									
Student**									

\* Reservations for suites must be made directly with the Service Bureau. The hotel can supply general information only.  
 \*\* Participant must be a certified student or unemployed (as described in the "How to Register in Advance" section of Notices or Focus) to qualify for these rates.  
 \*\*\* Room types available are king sofa and double-double. Please indicate your preference below.  
 † The Holiday Inn Queensgate, Quality Hotel Riverfront, and Holiday Inn Riverfront are not within walking distance. Complimentary shuttle service will be provided to and from these properties.

Special housing requests: \_\_\_\_\_  
 If you are physically challenged and have special needs, please indicate your needs above. If necessary, a staff member will call you for further information to insure that you are placed in a property that is complying with ADA rules and that your stay in Cincinnati is comfortable. Phone number where you can be reached: \_\_\_\_\_  
 I will arrive on (date) \_\_\_\_\_ at \_\_\_\_\_ a.m./p.m., and depart on (date) \_\_\_\_\_ at \_\_\_\_\_ a.m./p.m.  
 Please list other room occupants, indicating their full name, arrival, departure date, and ages of children, and check here if one of the occupants is your spouse

# MATHEMATICS

## JOURNALS

### ANNALS OF PURE AND APPLIED LOGIC

Managing Editors: D. van Dalen, (Co-ordinating Editor), S.N. Artemov, J.-Y. Girard, Y. Gurevich, T. Jech, A. Lachlan, A.R. Meyer, A. Nerode, A. Prestel

The Annals publishes papers and short monographs on topics of current interest in pure and applied logic, the foundations of mathematics and those areas of theoretical computer science and other disciplines which are of direct interest to mathematical logic.

1994: Volumes 66-70 (15 issues)  
Subscription price: Dfl. 1905.00 (US \$ 1030.00)  
ISSN 0168-0072

### APPLIED NUMERICAL MATHEMATICS

An IMACS Journal

Editors-in-Chief: R. Vichnevetsky, J.E. Flaherty

The purpose of the journal is to publish high quality research and tutorial papers in computational mathematics. In addition to the traditional issues and problems in numerical analysis, the journal also publishes papers describing relevant applications in such fields as physics, fluid dynamics, engineering and other branches of applied science.

1994: Volumes 14-16 (12 issues)  
Subscription price: Dfl. 1539.00 (US \$ 832.00)  
ISSN 0168-9274

### DIFFERENTIAL GEOMETRY AND ITS APPLICATIONS

Editor-in-Chief: D. Krupka

This journal publishes original research papers and survey papers in differential geometry and in all interdisciplinary areas in mathematics which use differential geometric methods and investigate geometrical structures.

1994: Volume 4 (4 issues)  
Subscription price: Dfl. 354.00 (US \$ 191.00)  
ISSN 0926-2245

### DISCRETE APPLIED MATHEMATICS

Combinatorial Algorithms, Optimization and Computer Science

Editor-in-Chief: Peter L. Hammer

The aim of this journal is to bring together research papers in different areas of algorithmic and applicable discrete mathematics, as well as applications of combinatorial mathematics to computer science, OR and various areas of science and technology.

1994: Volumes 48-55 (24 issues)  
Subscription price: Dfl. 2576.00 (US \$ 1392.00)  
ISSN 0166-218X

### DISCRETE MATHEMATICS

Editor-in-Chief: Peter L. Hammer

The fields covered by DM include in particular: graph and hypergraph theory, network theory, coding theory, block designs, lattice theory, the theory of partially ordered sets, combinatorial geometries, matroid theory, extremal set theory, logic and automata, matrices, polyhedra, and discrete probability theory.

1994: Volumes 121-133 (39 issues)  
Subscription price: Dfl. 4043.00 (US \$ 2185.00)  
ISSN 0012-365X  
Discrete Applied Mathematics and Discrete Mathematics:  
Combined subscription Dfl. 5776.00 (US \$ 3122.00)

### JOURNAL OF COMPUTATIONAL AND APPLIED MATHEMATICS

Editors in Chief: M.J. Goovaerts, J. Wimp, L. Wuytack, T. Yamamoto

This international journal publishes original research in all areas of applied mathematics. Welcomed are papers describing new computational techniques for solving scientific problems, and carefully-tested algorithms. Survey articles dealing with interactions between different fields of applied mathematics are also published.

1994: Volumes 50-56 (21 issues)  
Subscription price: Dfl. 2457.00 (US \$ 1328.00)  
ISSN 0377-0427

### JOURNAL OF PURE AND APPLIED ALGEBRA

Managing Editors: P.J. Freyd, A. Heller, C.A. Weibel

The Journal of Pure and Applied Algebra concentrates on that part of algebra likely to be of general mathematical interest: algebraic results with immediate applications and the development of algebraic theories of sufficiently general relevance to allow for future applications.

1994: Volumes 91-97 (21 issues)  
Subscription price: Dfl. 2401.00 (US \$ 1298.00)  
ISSN 0022-4049

### TOPOLOGY AND ITS APPLICATIONS

A Journal Devoted to General, Geometric, Set-Theoretic and Algebraic Topology

Managing Editors: R.B. Sher and J.E. Vaughan

Topology and its Applications is primarily concerned with publishing original research papers of moderate length. Subjects include the algebraic, general, geometric, and set-theoretic facets of topology as well as areas of interactions between topology and other mathematical disciplines, e.g. topological algebra, topological dynamics, functional analysis, category theory.

1994: Volumes 55-60 (18 issues)  
Subscription price: Dfl. 2058.00 (US \$ 1112.00)  
ISSN 0166-8641

Prices quoted include postage and handling charges

## ORDER FORM

Send to your regular supplier or to:  
**ELSEVIER SCIENCE PUBLISHERS**  
P.O. Box 211  
1000 AE Amsterdam, The Netherlands  
FAX: (020) 5803-598

Customers in the USA and Canada:  
**ELSEVIER SCIENCE PUBLISHERS**  
P.O. Box 945, Madison Square Station  
New York, NY 10160-0757, USA  
FAX: (212) 633-3680

Please enter my 1994 subscription to the following journal(s):

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Please send me a pro forma invoice

**Payment enclosed:**  
(Bank draft/Eurocheque/International money order/Official Purchase Order Form/Personal cheque/Postal cheque/UNESCO Coupons).

**Please charge my credit card:**  
 Access  American Express  EuroCard  MasterCard  VISA

Card No. \_\_\_\_\_ Valid until: \_\_\_\_\_

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Postal Code \_\_\_\_\_

Country \_\_\_\_\_

VAT registration number \_\_\_\_\_

Signature \_\_\_\_\_ Date \_\_\_\_\_



**ELSEVIER SCIENCE PUBLISHERS**  
IMPRINT: NORTH-HOLLAND

Non VAT registered customers in to the European Community should add the appropriate VAT rate applicable in their country to the price(s). US \$ prices are valid in the Americas only. Dutch Guilder (Dfl.) prices are valid in the rest of the world.

Journals are sent by surface mail to all countries except the following where air delivery via SAL mail is insured at no extra cost to the subscriber: Argentina, Australia, Brazil, Canada, Hong Kong, India, Israel, Japan, Malaysia, Mexico, New Zealand, Pakistan, P.R. of China, Singapore, South Africa, South Korea, Taiwan, Thailand and USA.

PRESENTING SPRINGER-VERLAG'S

# 1993 YELLOW SALE!

Announcing a new Series:

## TEXTS AND MONOGRAPHS IN SYMBOLIC COMPUTATION

Edited by **B. BUCHBERGER** and  
**G.E. COLLINS**

This series publishes research monographs and textbooks by researchers and visiting researchers of the Research Institute for Symbolic Computation at the University of Linz, Austria. According to the basic philosophy of the institute, the emphasis of this series focuses on computer sciences based on mathematics (i.e. logic, formal methods) and on computer-assisted mathematics. An important part of the scope of this series is symbolic computation. Occasionally, proceedings of conferences organized by the institute will also be included in the series.

**B. STURMFELS**, Cornell University,  
Ithaca, NY

## ALGORITHMS IN INVARIANT THEORY

This book is both an easy-to-read text for invariant theory and a challenging research monograph that introduces a new approach to the algorithmic side of invariant theory. The Gröbner bases method is the main tool by which the central problems in invariant theory become amenable to algorithmic solutions. Students will find the book an easy introduction to this "classical and new" area of mathematics. Researchers in mathematics, symbolic computation, and computer science will get access to a wealth of research ideas, hints for applications, outlines and details of algorithms, worked out examples, and research problems.

1993/APP. 300 PP., 5 ILLUS.  
SOFTCOVER/\$39.50  
ISBN 0-387-82445-6  
TEXTS AND MONOGRAPHS IN  
SYMBOLIC COMPUTATION

Save up to 60% on more than 150 Excellent Mathematics Titles!

If you have not received your yellow sale catalog, please call 1-800-SPRINGE(R) ext. 582 to receive your copy today!

### New Release: *MacMath 9.2*

**J. HUBBARD** and **B. WEST**, both of Cornell University, Ithaca, NY

## MACMATH 9.2

*A Dynamical Systems Software Package for the Macintosh*

*MacMath* is a scientific toolkit consisting of twelve interactive graphics programs for the Macintosh computer. It supports mathematical computation and experimentation in dynamical systems, both for differential equations and for iteration. The *MacMath* programs encourage experimentation and vastly increases the number of examples to which a student may be quickly exposed, enhancing the understanding of the mathematics of these topics.

1993/162 PP., 164 ILLUS., PLUS DISKETTE  
SOFTCOVER/\$49.95/ISBN 0-387-94135-5  
\*\* SYSTEM 7 COMPATIBLE  
SITE LICENSES NOW AVAILABLE!  
CALL 1(800)SPRINGE(R) X584

**J.H. SHAPIRO**, Michigan State University,  
East Lansing, MI

## COMPOSITION OPERATORS And Classical Function Theory

The study of composition operators forges links between fundamental properties of linear operators and beautiful results from the classical theory of analytic functions. The book provides a self contained introduction to both the subject and its function-theoretic underpinnings. The development is geometrically motivated, and accessible to anyone who has studied basic graduate level real and complex analysis. The work explores how operator theoretic issues such as boundedness, compactness, and cyclicity evolve - in the setting of composition operators on the Hilbert space  $H^2$  - into questions about subordination, value distribution, angular derivatives, iteration and functional equations. Each of these classical topics are developed fully, and particular attention is paid to their common geometric heritage as descendants of the Schwarz Lemma.

1993/223 PP., 17 ILLUS./SOFTCOVER/\$34.00  
ISBN 0-387-94067-7  
UNIVERSITEXT: TRACTS IN MATHEMATICS

**H. COHEN**, University of Bordeaux, France

## A COURSE IN COMPUTATIONAL ALGEBRAIC NUMBER THEORY

One of the first of a new generation of books in mathematics that show the reader how to do large or complex computations using the power of computer algebra. It contains descriptions of 148 algorithms which are fundamental for number theoretic calculations, in particular, for computations related to algebraic number theory, elliptic curves, primality testing, lattices, and factoring. For each subject a complete theoretical introduction is given. Many of the algorithms are new or appear for the first time in this book and a detailed description of each algorithm is given, allowing for immediate computer implementation. This book also contains a large number of exercises.

1993/534 PP./HARDCOVER/\$49.00  
ISBN 0-387-55640-0  
GRADUATE TEXTS IN MATHEMATICS, VOL. 138

### Third Edition

**D. HUSEMÖLLER**, Haverford College, Haverford, PA

## FIBRE BUNDLES

Fibre bundles play an important role in just about every aspect of modern geometry and topology. Basic properties, homotopy classification, and characteristic classes of fibre bundles have become an essential part of graduate mathematical education for students in geometry and mathematical physics. This third edition includes two new chapters on the gauge group of a bundle and on the differential forms representing characteristic classes of complex vector bundles on manifolds.

1993/APP. 368 PP./HARDCOVER/\$54.00  
ISBN 0-387-94087-1  
GRADUATE TEXTS IN MATHEMATICS, VOL. 20

### Order Today!

**CALL:** Toll-Free 1-800-SPRINGE(R):  
1-800-777-4643. In NJ call 201-348-4033  
(8:30 AM - 5:30 PM EST).

**WRITE:** Send payment plus \$2.50 postage and handling for first book and \$1.00 for each additional book to: Springer Verlag New York Inc., Dept. #S267, PO Box 2485, Secaucus, NJ 07096-2491. (NY, NJ, IL, MA, PA, VA, VT, TX and CA residents add sales tax, Canadian residents add 7% GST.)

**VISIT:** Your local technical bookstore.

**INSTRUCTORS:** Call or Write for information on textbook examination copies!

11/93

S267



Springer-Verlag

NEW YORK