# NOTICES OF THE AMERICAN MATHEMATICAL SOCIETY




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# 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. The meeting dates which fall rather far in the future are subject to change; this is particularly true of meetings to which no numbers have been assigned. *Programs* of the meetings will appear in the issues indicated below. *First* and *supplementary* announcements of the meetings will have appeared in earlier issues. **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. The abstract deadlines listed below should be carefully reviewed since an abstract deadline may expire before publication of a first announcement. Note that the deadline for abstracts for consideration for presentation at special sessions is usually three weeks earlier than that specified below. For additional information, consult the meeting announcements and the list of special sessions.

## Meetings

| Meeting # | | Date | Place | Abstract Deadline | Program Issue |
|---|---|---|---|---|---|
| 878 | * | January 13–16, 1993 (99th Annual Meeting) | San Antonio, Texas | Expired | December |
| 879 | * | March 26–27, 1993 | Knoxville, Tennessee | January 5 | March |
| 880 | * | April 9–10, 1993 | Salt Lake City, Utah | January 29 | April |
| 881 | * | April 17–18, 1993 | Washington, D.C. | January 29 | April |
| 882 | * | May 20–23, 1993 | DeKalb, Illinois | February 26 | May-June |
| 883 | * | August 15–19, 1993 (96th Summer Meeting) (Joint Meeting with the Canadian Mathematical Society) | Vancouver, British Columbia | May 18 | July-August |
| 884 | * | September 18–19, 1993 | Syracuse, New York | May 18 | September |
| 885 | * | October 1–3, 1993 (Joint Meeting with the Deutsche Mathematiker-Vereinigung e.V.) | Heidelberg, Germany | May 18 | September |
| | | October 22–23, 1993 | College Station, Texas | August 4 | October |
| | | January 12–15, 1994 (100th Annual Meeting) | Cincinnati, Ohio | | |
| | | March 18–19, 1994 | Lexington, Kentucky | | |
| | | March 25–26, 1994 | Manhattan, Kansas | | |
| | | June 16–18, 1994 | Eugene, Oregon | | |
| | | October 28-29, 1994 | Stillwater, Oklahoma | | |
| | | January 25–28, 1995 (101st Annual Meeting) | Denver, Colorado | | |
| | | 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 | | |

Please refer to page 1101 for listing of Special Sessions.

## Conferences

November 16–17, 1992: AMS-SIAM-SMB Symposium on Some Mathematical Questions in Biology, Cell Biology, Denver, Colorado.

January 11–12, 1993: AMS Short Course on Wavelets and Applications, San Antonio, Texas.

July 11–30, 1993: AMS Summer Institute on Stochastic Analysis, Cornell University, Ithaca, New York.

July 10–August 6, 1993: Joint Summer Research Conferences in the Mathematical Sciences, University of Washington, Seattle, Washington.

August 9–13, 1993: AMS Symposium on Mathematics of Computation 1943-1933: A Half-Century of Computational Mathematics, University of British Columbia, Vancouver, Canada.

## Other Events Cosponsored by the Society

May 30–June 13,1993: First Caribbean Spring School of Theoretical Physics and Mathematics on Infinite Dimensional Geometry, Noncommutative Geometry, Operator Algebras, and Particle Physics, Pointe à Pitre, Gaudeloupe. Cosponsored by the Société Mathématique de France.

## Deadlines

| | January Issue | February Issue | March Issue | April Issue |
|---|---|---|---|---|
| Classified Ads* | December 10, 1992 | January 7, 1993 | February 4, 1993 | February 24, 1993 |
| News Items | December 2, 1992 | December 24, 1992 | January 22, 1993 | February 19, 1993 |
| Meeting Announcements** | December 2, 1992 | December 24, 1992 | January 26, 1993 | February 22, 1993 |

* 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



## FEATURE COLUMNS



## DEPARTMENTS

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## From the Executive Director . . .

### FUTURE OF NSF

There are tremendous pressures for change at the National Science Foundation (NSF). The NSF, possibly the greatest experiment in public support of basic science, has struggled from its conception by Vannevar Bush in 1945 for sustained federal commitment to basic scientific research. There have often been pressures for the NSF to foster research recognized as being of immediate social utility; and clearly the federal commitment to research and development has been to an extent driven by defense and military needs. Now, with the end of the Cold War, a bleak economic outlook, numerous social problems, and the budget deficit, new and significant pressures are being placed on the NSF for a reexamination of its role.

A new report from Congress (Report of the Task Force on the Health of Research, 1992) calls for a direct link between federally funded research and achievement of social goals. In this *Notices* (page 1021), a message from the Director of the NSF, Walter Massey, calls for a reexamination of the role of the NSF and suggests an expanded portfolio for the agency, closely aligning its support for research with the interest of industry and other government agencies. Massey called for a Commission to define the future of the NSF; this Commission has been established and is expected to report to the National Science Board before the end of November.

There are compelling reasons to enhance links between science and technology, to connect industry and academe, and to bring the success of science to bear on social problems. However, an expanded role for the NSF in the direction of technology transfer has several problematic aspects. Goals that increase the short-term payoff and direct research, while laudable, can work at cross purposes with basic science and the concept that excellence in scientific investigation is the most important criterion to lead to more social benefit. There is always stress between applied research and basic research. Driven by a market economy, applied research will always win out, and we will produce too little basic research. It is necessary that federal and state governments preserve the support of basic research. At the federal level it is the NSF that has this responsibility.

Any policy changes for the NSF must be carefully designed. The mathematics community has been supportive of incremental change and encouraged participation of the Division of Mathematical Sciences (DMS) in new initiatives, such as the FCCSET initiatives. This participation exhibits our current concerns of the expressed new directions for NSF: the results we have seen thus far are zero new funding for undirected research in the DMS programs. The mathematics community has also been open to new experiments that would improve support for research in mathematics. Again, the changes we saw were less than encouraging: this community was presented, somewhat after the fact, with a sweeping demonstration project for flat-funding of individual investigators at the DMS that appeared to have neither broad community input nor careful design. Because of these recent examples, the mathematics community has reasons for concern with the proposed changes.

Recent rhetoric alleges the end of the Vannaver Bush era and the beginning of a new era. We must guard against this. Bush made a fundamental case for basic research as valid today as it was forty-five years ago. We must preserve the "freedom of inquiry" and recognize the value of "free play of free intellects, working on subjects of their own choice, in the manner dictated by their curiosity for explanation of the unknown".

Many of us are convinced that current practices of federal funding are not serving the long-term health of mathematics. There is a need for change and it seems clear there will be change. However, whatever changes occur, a national science policy must adhere to excellence in scientific investigation and maintain the freedom and integrity of the research community.

The leadership of the Society is addressing these issues and expressing views from the mathematics community to the Commission on the Future of NSF and to the administration of the NSF. There is coordination through the Joint Policy Board for Mathematics, which includes the AMS, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics. There are a number of references in this *Notices* to this and related issues of federal science policy.

William Jaco

# Letters to the Editor

### Grant Support as Tenure Criterion

I would like to put before the AMS community what I think is a very unfortunate problem, i.e., the growing impact of funding on tenure decisions, and also suggest a response that the mathematics community might consider making.

Our department recently had a candidate—whom the department had supported unanimously—turned down for tenure. During the appeals process (which was ultimately successful) it became evident that a lack of funding success was one reason for the denial. In fact, during the appeal, one member of the administration (a physicist) bluntly stated in writing that success in funding was a virtual requirement for tenure at some mathematics departments. The response of my colleague was that this statement was almost certainly false, and certainly wasn't true for any department with which our department would be fairly compared. There apparently was a great deal of discussion on this point during the hearing, and eventually letters in support of my colleague's assertion were solicited and these had some impact on the outcome of the case.

The problem is that administrators outside of the discipline are unaware of how low the funding levels are in mathematics. Because we are often associated administratively with departments like physics and computer science, it is assumed that we have access to the same amounts of money, when in fact there is less money, from fewer sources, to be spread among more faculty.

It might be appropriate for the AMS, perhaps in conjunction with SIAM [the Society for Industrial and Applied Mathematics], to consider issuing a statement to the effect that funding levels in mathematics are very low (compared to other disciplines), and that lack of success in obtaining funds should not be a factor in mathematics tenure decisions, especially in minor departments (those outside Groups I and II). An official statement like this would give some credence to the claims of people like my colleague, and perhaps serve to head off more situations like the one he was put through.

James F. Epperson
University of Alabama in Huntsville
(Received August 3, 1991)

### Editing vs. Censoring

We mathematicians value conciseness and economy of argument above all else. A perfect example of this appeared in the Forum in the July/August issue of the *Notices*. At the conclusion of Irwin Kra's two and a half page argument for the proposition that the Editors seek improperly to censor the contents of letters, the Editors offer a two-line proof of their own.

The Editors, we read, "advise anyone considering submitting a letter with a long list of signatures to get approval for the letter before signatures are solicited." QED

Michael Engber
City College, CUNY
(Received August 3, 1992)

### More on the Shafarevich Controversy

I was disturbed by the "Open Letter to Shafarevich" (published in the March, 1992 *Notices*) and I found Irwin Kra's "Sensitive Nerves" (July 1992) to be even more disturbing. While I have not read Shafarevich's "Russophobia", suppose for the moment that we accept the Open Letter's evaluation: Assume "Russophobia" really is an anti-Semitic polemic, espousing a Jewish conspiracy as one of the major forces in recent world history. Let us grant that this article is an embarrassment to all of us, and that it will give aid and comfort to the Powers of Darkness in the world.

There are four possible responses that I can imagine a concerned mathematician making:

(1) Trying to persuade Shafarevich to reconsider his position. This would best be done by a private appeal, and I gather that a number of people have done this.

(2) Trying to counteract the effect Shafarevich may have had on the general public. This would best be done by writing letters to any publications that have paid attention to "Russophobia", pointing out that Shafarevich's political theories are not based on mathematics, and that the majority of mathematicians disagree with him.

(3) Trying to bully Shafarevich into publicly reversing himself. This would best be done by publishing in the mathematical press an open letter with a lot of prominent signatures.

(4) Trying to intimidate other mathematicians with unacceptable political views, so that they will not attempt to publish them. This also would best be done with an open letter in the mathematical press.

While (1) and (2) strike me as constructive and appropriate actions, I find (3) and (4) reprehensible. This is what troubled me about the Open Letter, and why I found Kra's statement "I do not aspire to influence Shafarevich . . . I do want to influence future would be anti-Semites" to be ominous. Read in its full context, this seemed to me to be an admission that (4) was the true goal of the Open Letter.

I believe that Shafarevich—like anyone else—has the right to his political views, however kooky they may be. And if he honestly believes that humanity is threatened by some sinister conspiracy, then by all means he should say so, and

**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 email to notices@math.ams.org, and will be acknowledged on receipt.

say so in public if he wants to. People who disagree with him should stand up and say that, but they have no right to tell Shafarevich to toe the party line.

When I joined the AMS I joined a professional society, not a political party. I see a big difference between on the one hand using the Society's limited influence to publicize the plight of mathematicians who are being treated unfairly, and on the other using the Society's resources to denounce the political views of a colleague. I am troubled that Kra can brush off this difference with "The distinction between political and human rights issues totally escapes me." I hope that the officers of the Society and the editors of the *Notices* will continue to see the distinction between looking out for the rights of mathematicians and attempting to enforce political correctness on them.

Doug Muder
The Mitre Corp.
(Received July 30, 1992)

**Irwin Kra responds:** I am not disturbed by the Muder Letter, though I totally disagree with its contention. Individual society members AND groups have a right, AND perhaps even duty, to express their opinions on matters affecting our lives as scientists.

The purpose of this note is to update the Council as well as the readership of this Journal of progress on the "Shafarevich Affair" (see the article "Sensitive Nerves" that appeared in the July/August 1992 issue of the *Notices*).

1. A translated version of the "Open Letter" (with a note from the Editors but without the signatures) appeared in the Russian newspaper *Nezavizmaya Gazeta* (*Independent Newspaper*). This is perhaps the most influential Moscow newspaper at the moment. In regard to information on this newspaper, I refer the reader to an article in the *New Yorker* magazine of March 23, 1992. It is my belief that the publication of the Open Letter in the March 1992 issue of the *Notices* led directly to its subsequent appearance in the Russian newspaper and, hence, the Society and Council can be rightly proud of the steps they have taken to insure this.

2. The National Academy of Sciences acted very decisively on the Shafarevich matter. In this regard, the readers are referred to *The New York Times* article that appeared in the Wednesday, July 29 issue.

3. In the piece "Sensitive Nerves" I discussed the Shafarevich Affair and the issue of openness in publication in the Society. My article ended with a note that was appended by the Editors of the *Notices*. I was previously requested to confirm that I have no objection to the inclusion of this note in the *Notices*. I, of course, had no objections for it proved precisely the point that I was trying to make. Namely, that the *Notices* Editors are not pursuing the correct editorial policy with regards to communications by members. The policy (as illustrated by the note) tries to inhibit free exchanges and is very mistrustful and disrespectful of the membership of the Society. I suggest that the readers of this letter communicate to both the Editorial Committee of the *Notices* as well as the members of the Council their views regarding this issue.

4. I intend to determine the exact policy of the *Notices* regarding publications of letters and Forum pieces and, if necessary, to introduce motions to the Council to open up these pages to the wide audience that should have access to it.

Irwin Kra
SUNY, Stony Brook
(Received August 13, 1992)

# The Future of the National Science Foundation

*Walter E. Massey, Director*
*National Science Foundation*

The following remarks are based on a presentation made by Massey to the National Science Board (NSB) on August 13 and 14, 1992. The NSB is the policymaking body of the National Science Foundation.

"New products, new industries, and more jobs require continuous additions to knowledge of the laws of nature, and the application of that knowledge to practical purposes."
—Vannevar Bush, *Science: The Endless Frontier*

The National Science Foundation [NSF] is now developing a long-range strategy that will help frame its future activities and strengthen its ability to serve the nation. The new strategic plan will determine the direction of the agency's future evolution in an environment that is very different from the one we were in only five years ago. This plan must be grounded in continued strong support for academic research, but it must also recognize the changing nature of research and the changing context in which research is conducted.

For over forty years NSF has enjoyed the status of being the premier source of federal support for scientific research. During that period the Foundation has undergone a gradual but dramatic evolution. From its first year of full funding in 1952, NSF's budget has increased more than 100-fold in terms of real buying power; and times have changed for NSF in more ways than simple budget growth. NSF has taken on new areas of research and expanded its presence in traditional fields. NSF has achieved an international reputation in mathematics and science education. The Foundation has developed new ways of supporting fundamental research while continuing to serve as the mainstay for the individual investigator. Over the course of the past four decades, NSF has developed into a model for the evaluation, support, and dissemination of research and education.

## New Environment for NSF

The continued strength of NSF and its ability to serve the nation depend not only on remaining flexible and adapting to new circumstances, but also on anticipating change and recognizing opportunities. Many of these opportunities result from changes in the nature of research itself. In recent years the interval between discovery and application has been dramatically shortened. Advances in fundamental science now often have near-term utility in developing and improving products and processes. Incremental gains in fundamental knowledge can provide a comparative advantage in world markets.

This comes as no surprise in fields such as biotechnology, computing, or materials—where rapid innovation is almost cliché. Examples, however, also run the gamut of science: instruments developed to probe the furthermost points in the universe, such as radio and infrared detectors, have proven valuable in more earth-bound pursuits; lasers have progressed from being experimental laboratory devices to being indispensable tools in telecommunications, manufacturing, and medicine; and advances in our understanding of human behavior are now recognized as keys to increasing productivity in manufacturing and services. Furthermore, as the boundaries between "basic" and "applied" research have blurred, the role of feedback loops in the innovation process has been highlighted; scientific advance and technological progress have become ever more dependent on each other.

As these changes are occurring in science, the profound and dramatic changes underway throughout the world require a continuing reassessment of all aspects of science and technology policy. Superpower tensions have declined, and national security based on military strength will no longer be the predominant federal research and development priority. The U.S. economy now competes in a global arena where success is increasingly linked to capitalizing on scientific advances and new technologies.

I think it is imperative that the NSF determine its place in this new order. The continued public support of science requires that science policy both shape and reflect the national temperament. In the postwar years, this temperament was buoyed by an optimism that all problems would yield to scientific inquiry. At the height of the cold war, Americans viewed science as insurance against technological surprise from an adversary. With the rapid decline of the Soviet Union at a time of steady growth of economic power in Asia and Europe, the nation increasingly looks to science as the source of technological advances that are necessary for economic prosperity and an improved quality of life.

## NSF and the Idea-Driven Society

NSF is uniquely charged with fueling the growth of an idea-driven society. It may be time for the Foundation to consider building on its success in supporting research ideas by accepting a major role in fostering the links between research and technology. Peter Eisenberger, Director, Princeton Materials Institute, captured the essence of this idea in a letter to me earlier this year. He said that academic research programs should seek to:

> "horizontally integrate efforts between the disciplines (especially between science and engineering departments) as well as to vertically integrate the research efforts so that industries and government agencies can participate in planning, implementing, and obtaining the knowledge generated for society's benefit."

In an essay in *The Scientist* based on his annual address to the members of the National Academy of Sciences, Academy President Frank Press stated his view that science is entering a new era, one that moves more fully toward the vision expressed in *Science*: *The Endless Frontier*, Vannevar Bush's landmark volume. Press predicts that:

> "... it will be an era in which the boundaries between basic and applied research erode. More than ever, science will drive technology and technology will drive scientific progress ... What I have in mind includes not only fields with obvious applications, like computer science and material science, but others such as astronomy, botany, and mathematics, which we usually think of as being removed from the marketplace. This new reality will entail an increasingly direct connection between fundamental science and engineering and their commercial applications."

The Foundation has already begun to plan for and evolve toward this "new reality". Over the last decade, NSF has expanded its traditional support of science and engineering. The Foundation has reached out to new partners, notably industry and state government. The research centers initiated by the NSF have provided a setting for multidisciplinary research and industry/university cooperation. The Foundation has also supported the development of generic technologies that push the frontiers of science and have great value to the nation.

## Options for NSF

Most scientists would shudder at the thought of tomorrow's research enterprise looking exactly like today's (or even worse, as an impoverished version of the current research environment). In fulfilling its mission in support of science and engineering research, NSF should ensure that its programs progress and adapt to the times.

I believe that three broad options exist for the future of the National Science Foundation. As a first option, the Foundation could revert to its historical roots as a small agency predominantly dedicated to the support of individual investigators and small groups at universities. This would almost certainly mean discontinuing the programs that have sought to connect basic research with the user community—science and technology centers, engineering research centers, supercomputer centers, industry-university cooperative research centers, and other such activities.

A second option for the Foundation is to continue its present path, where the agency builds on its mission as a supporter of academic researchers with marginal and exploratory ventures in other areas, such as centers, initiatives in high performance computing and advanced manufacturing, and programs linking universities and industry. It is very likely that this would be a path of unstable equilibrium, because the importance of these "other areas" on the national agenda will require more than token efforts. It is likely that other agencies, new or existing, will be more than willing to devote serious efforts to such activities.

A third possibility, one that I prefer, is to build on our traditional mission and exercise new leadership across a broader spectrum of research areas. NSF would adopt an expanded portfolio of programs that would be integrated with ongoing activities and closely aligned with industry and other government agencies. While it is difficult now to provide a blueprint for NSF under this option, the agency would reflect some of the following characteristics:

- The intellectual boundaries between disciplines and between types of research would be lowered and made more permeable.
- NSF would encourage increased interaction in areas of national concern between different institutional actors: academia, industry (large and small), federal, state, and local government.
- Human resource development and education would be integrated and expanded into all aspects of research activities and would link industry, colleges and universities, two-year colleges and technical institutes, and precollege students and teachers.
- NSF would articulate and demonstrate in a more comprehensive manner the outcomes and benefits of public investments in research and education.

Increasing the knowledge base of science in ways that can be connected to improvements in the quality of our national life enjoys broad support and provides a compelling rationale for increasing federal investments in basic research. By expanding its function, NSF would have the opportunity to build upon its role as the premier supporter of fundamental research while it assumes further responsibility for forging the links between science and technology. In partnership with the academic community and other agencies, NSF could promote opening research programs to greater participation by nonacademic personnel, making science and engineering education programs more responsive to the needs of industry, and developing stronger working relationships in the pursuit of cutting edge technology.

NSF is uniquely qualified to mobilize such a national effort. The agency's long-standing ties to the academic research community allow it to engage the best minds in the country and capitalize on our national strength in basic science

and engineering. Furthermore, a hallmark of NSF since its inception has been the coupling of research and education. This coupling must be extended to meet the increased science and technology demands of the workplace.

NSF's presence in all fields of the natural and social sciences, mathematics, and engineering positions it to respond to new ideas wherever they arise. This enables the agency to identify and respond to a variety of research challenges in areas of national concern. Already, NSF-supported centers conduct research in twenty of the twenty-two critical technology areas itemized in the Report of the National Critical Technologies Panel.

NSF's criteria for support of research have always been based on excellence, quality, and commitment to innovation. These criteria can become a national resource for undertaking the rigorous evaluations and review essential to assess innovative ideas and programs.

NSF has forged partnerships and cost-sharing programs with industry, academia, and government, and plays a leading role in the FCCSET initiatives, a role much larger than what is suggested by the size of the Foundation. NSF also has developed effective models for industry/university partnerships that keep academic research independent while giving industry access to recent advances in knowledge. One model to be drawn upon is a recent solicitation in cooperation with the chemical industry to study environmentally benign synthesis and processing. It encourages investigators to obtain substantial intellectual input from industry. Of course, any new activities must rest upon a strong and broad base of researchers and educators pursuing knowledge in an open and vital environment. This is the foundation for discovery—and for new opportunities that emerge.

## Next Step

It is too soon to specify in detail what NSF might look like in the next stage of its evolution. The decisions on where, when, and how to make changes must involve the staff, the National Science Board, and the larger community. Several ways to receive input from the external community are now in place, including a request for public comment in the Federal Register. In addition, the Board has established the Special Commission on the Future of the NSF to examine options available to NSF. A broad range of academic, industrial, and government leaders will participate in this endeavor. Their findings will be of crucial importance in helping to identify a vision that can guide the agency for decades to come. NSF's vitality depends on its ability to be as creative and forward-looking in the future as it has been in the past.

# Is It Time for a New GRE Mathematics Test? Would You Like to See Essay Questions on It?

The following article was written by the Committee of Examiners for the GRE (Graduate Record Examination) Mathematics Test. The members of this Committee are Sylvia Bozeman, Robert Gilmer, Samuel Rankin, Paul Sally, Alan Schoenfeld, and William Thurston (chair).

At its most recent meeting, the Committee of Examiners responsible for the GRE Mathematics Subject Test made some preliminary recommendations to the Educational Testing Service (ETS) regarding a complete overhaul of the GRE Mathematics Subject Test. Among other changes, the Committee suggested the inclusion of essay questions on the exam. This committee is convinced that a revised examination that includes essay questions could be more informative and provide more valuable information regarding students' potential to do graduate work in mathematics than does the current examination. It believes the mathematical community will second that judgment—but it will be essential for the community to express its opinion if ETS and the Graduate Record Examinations Board are to be assured of the need for such change.

The reception these recommendations have received from ETS is encouraging. This reception is perhaps not surprising. ETS representatives began discussing the current ferment in mathematics education with leaders of the mathematics community in 1988; the four members of the Committee who were appointed in the summer of 1990 were invited specifically because of their service on committees of MAA/AMS/SIAM that have recommended major changes in American mathematics education; and the possibility of corresponding changes to the GRE Mathematics Test was discussed with each of those four members before they accepted appointment.

Here we outline some of the issues and constraints involved in making the decision to change the exam, and we solicit your comments. We begin with a bit of history. Since test scores are supposed to have constant meaning from year to year, alterations in examination format are made rarely and only when a good case can be made for them. Such changes have happened only twice in the history of the GRE Mathematics Test. From 1939 through 1946, essay questions were included as part of the exam. They were abolished in favor of a multiple-choice format in 1946–1947. While the multiple-choice format was kept, exam content underwent a fairly radical change in the 1960s as the result of efforts spearheaded by Robert Dilworth, Creighton Buck, and Ralph Boas. This group argued (in the words of Chairman Dilworth) that the earlier exam consisted "almost entirely of problems whose solution required only the facts and techniques of the standard underclass mathematics courses. Yet this examination was expected to provide criteria for admission to Graduate School and for graduate Fellowship awards. It is not surprising that, at the time, the exam was not held in high regard in the mathematical community" [**1**]. The revised exam de-emphasized simple content questions and moved toward questions that would identify "students who can exhibit insight, understanding, and ingenuity in approaching mathematical problems" [**1**]. It focused on "questions for which there are at least two avenues of approach, one of which appears obvious, mechanical, computational, and time-consuming, and the other being less obvious, not mechanical, less computational, and quick" [**3**]. In other words, the exam rewarded cleverness, insight, and speed—demanding, among other things, the solution of sixty-six questions in 170 minutes.

The current GRE Mathematics Test Committee believes the time has come to make some significant changes in the examination. In particular, it points to the following three goals for mathematics instruction, taken from the MAA's *Source Book for College Mathematics Teaching* [**2**]:

Mathematics instruction should provide students the opportunity to explore a broad range of problems and problem situations, ranging from exercises to open-ended problems and exploratory situations. It should provide students with a broad range of approaches and techniques (ranging from the straightforward application of the appropriate algorithmic methods to the use of approximation methods, various modeling techniques, and the use of heuristic problem solving strategies) for dealing with such problems.

Mathematics instruction should help students to develop what might be called a "mathematical point of view"—a predilection to analyze and understand, to perceive structure and structural relationships, to see how things fit together. (Note that those connections may be either pure or applied.) It should help students develop their analytical skills and the ability to reason in extended chains of argument.

Mathematics instruction should help students to develop precision in both written and oral presentation. It should help students learn to present their analyses in clear and coherent arguments reflecting the mathematical style and sophistication appropriate to their mathematical levels. Students should learn to communicate with us and with each other, using the language of mathematics.

The Committee values these goals and believes that the mathematical community does; it believes that the GRE examination can be modified to reflect these goals, and that the community will support such a change. In particular, the Committee is prepared to recommend to ETS that the exam be restructured to include essay questions on a range of topics, designed to give students the opportunity to engage with problems for some period of time, to develop reasoned arguments, and to present the results of their work in coherent fashion. We imagine that a revised test might contain three or four questions that qualified students would work on for an average of perhaps twenty minutes per question. Of course, such changes come at some cost. One is consistency: a major change in the exam means that scores on the revised test cannot be compared to scores on the current test. A second is financial. Essay questions are obviously more expensive to grade than multiple-choice questions. In addition to the money factor, there's a question of time and person-power. You need people to do the grading. Do they exist? The committee says yes: we believe that among the readers of this article are a number of mathematicians who think it would be worth getting together with other like-minded colleagues to discuss and grade such questions (for a week, for a modest stipend). We also believe that a significant number of graduate admissions committees—especially some who find the current examination to be irrelevant—will find a revised examination to be useful, and might even consider requesting (for a slight fee, possibly paid either by the department or the student) copies of the essay questions written by applicants to their program.

Will the exam change? To a great extent, that depends on you and on other members of the mathematics community. ETS has authorized some preliminary testing of essay questions on an exploratory basis, so there is a possibility. For any such change to occur, ETS and the GRE Board must be convinced that the mathematics community wants the change and is willing to support it. There are of course other considerations as well, but without the approval of the mathematics community such a change certainly would not occur. Maybe the current exam is just fine as is. If you think so, write and let us know. If you think it should be changed, write and let us know that. More importantly, ETS will be sending a questionnaire to the mathematics department of every four-year college and university in the United States, asking for departmental opinions on this matter; and responses to questions about this kind of change will be critical to whether ETS will further explore our suggested changes. We expect to provide ETS with some essay test questions that illustrate what we have in mind, and those samples will probably be included with the questionnaire. We hope that those of you who are in a position to know when such questionnaires are received will see to it that an appropriate response is made.

Aside from answering the questionnaire, please address any comments or suggestions about our recommendation, and any notes regarding your possible availability as question generator or grader to:

Committee of Examiners for the GRE Mathematics Test
c/o J. R. Jefferson Wadkins
40-P
Educational Testing Service
Princeton, NJ 08540-9885

The Committee will conduct a panel session at the January 1993 annual meeting in San Antonio to report on its recommendation in general, its experience in pilot testing some prototype essay questions, and whatever responses are received in response to this solicitation.

## References

1. Dilworth, Robert, Letter to Richard L. Burns, GRE Program Director, 1969.

2. MAA Committee on the Teaching of Undergraduate Mathematics, *Source Book for College Mathematics Teaching*, ed. Alan Schoenfeld, 1990.

3. Wadkins, J. R. Jefferson, The GRE Advanced Mathematics Test, *American Mathematical Monthly*, Vol. 85, No. 9 (November) 703–719, 1978.

# 1992 Annual AMS-MAA Survey

## (*First Report*)

Report on the 1992 Survey of New Doctorates, *Donald E. McClure*
Salary Survey for New Doctorates
Faculty Salary Survey
Doctoral Degrees Conferred, 1991–1992

This first report on the 1992 Survey includes a report on the 1992 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 1991–1992 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 1991 and June 1992, inclusive. A further questionnaire was distributed in September, concerned with data on fall enrollments, majors, and departmental size. These data will appear in the second report on the 1992 Survey, in a spring 1993 issue of the *Notices*.

The 1992 Annual AMS-MAA Survey represents the thirty-sixth in an annual series begun in 1957 by the Society. The 1992 Survey is under the direction of the AMS-MAA Data Committee whose members are Edward A. Connors, Lincoln K. Durst (consultant), John D. Fulton, James F. Hurley, Charlotte Lin, Don O. Loftsgaarden, David J. Lutzer, James W. Maxwell (ex officio), Donald E. McClure (chair), and Donald C. Rung. 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.[1]
**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.

[1]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 *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 April 1988 *Notices*, pages 532-533.

## Highlights

- U.S. institutions awarded 1050 doctorates in the mathematical sciences from July 1, 1991 to June 30, 1992, a decrease of 2 percent from last year's fall count, but still 17 percent more than the average of the fall counts for the last five years.

- The number of U.S. citizens reported to have received doctorates in the mathematical sciences is 430, which is 7 percent fewer than the number earning doctorates last year. The count remains 19 percent above the record lows reported in 1986–87 and 1987–88.

- The number of non-U.S. citizens receiving doctorates in the mathematical sciences showed a slight decrease (2 percent) for the first time since 1978–79. The 586 non-U.S. citizen recipients is more than twice the number reported ten years earlier.

- Of the 430 U.S. citizen doctoral recipients, 6 are black and 27 are members of other minority groups. In 1990–91, the U.S. citizen doctorates included 10 blacks and 39 other minority members.

- The unemployment rate for new doctorates reached its highest reported level since fall 1975. Among those whose employment status is known, 12.7 percent were unemployed as of late September 1992, up from the corresponding figure of 11.4 percent from last year's fall report. Total employment of new doctorates in the U.S. declined by 8 percent from the level reported in fall 1991.

- While the number of women among U.S. citizen doctorates declined from last year's count, the total number (103) is still the second highest number ever reported, and the percentage of women among U.S. citizen doctorates remains at its all-time high of 24 percent.

- The median starting salary of new doctorates reporting teaching (or teaching and research) was $34,000 for men and $34,900 for women.

- In all but two instances, the mean salary by faculty rank reported for 1992–93 increased less than four percent over the mean for 1991–92.

# Report on the 1992 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, 1991 through June 30, 1992. It includes an analysis of the employment market for 1991–92 doctoral recipients and a demographic profile summarizing characteristics of citizenship status, sex, and racial/ethnic group. Table 1 provides the response rates for the 1992 Survey of New Doctorates (see box on preceding page for description of groups).

**TABLE 1: Response Rates**

| | |
|---|---|
| Group I | 39 of 39 including 1 with 0 degrees |
| Group II | 40 of 43 including 2 with 0 degrees |
| Group III | 77 of 88 including 26 with 0 degrees |
| Group IV | 52 of 75 including 6 with 0 degrees |
| Group Va | 14 of 17 |
| Group Vb | 13 of 33 including 3 with 0 degrees |

Commencing with this thirty-sixth Annual Survey, the survey reports will no longer include data on recipients of doctorates from Canadian mathematics programs. There are two reasons for now changing the populations of departments and doctorates surveyed. First, in order to broaden the information reported about the Canadian mathematical community, the Canadian Mathematical Society (CMS) initiated a separate survey in 1991 including many nondoctorate granting departments . (The first report of the CMS survey appears in *CMS/SMC Notes*, December 1991, pages 14–19.) Second, the employment markets in the U.S. and Canada for new doctorates function quite independently (see 1991 First Report, *Notices*, November 1991, page 1089, Table 3C) and the amalgamation of these analyses results in a distorted interpretation of both markets. For example, the unemployment rate reported in November 1991 for 1990–91 new doctorates was 12.4 percent overall, but this blurred the separate rates of 11.4 percent for U.S. new doctorates and 28.6 percent for Canadian new doctorates.

In the interest of supporting the CMS survey effort, the AMS–MAA Survey continued to collect data from Canadian doctorate granting departments of mathematics in 1992, and the data will be provided to the authors of the CMS report to supplement their own data collection efforts. The names and thesis titles of doctoral recipients from Canadian institutions are listed with the recipients from U.S. institutions.

## Doctorates Granted

The number of new doctorates reported in 1991–92 by U.S. mathematical sciences departments is 1050. 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 1992 Survey, to appear in a spring 1993 issue of the *Notices*.

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

| Fall/Spring 87–88 | Fall/Spring 88–89 | Fall/Spring 89–90 | Fall/Spring 90–91 | Fall/Spring 91–92 |
|---|---|---|---|---|
| 804 828 | 905 919 | 933 950 | 1074 1125 | 1050 * |

* To appear in a spring 1993 issue of the *Notices*.

The fall count of the total number of new doctorates decreased marginally from the fall count of the 1991 Survey. The 2.3 percent decrease in the total follows six years of successive increases. Cumulatively, the total number of new doctorates has increased 43 percent since 1984–85.

Table 2B records the number of new doctorates in the mathematical sciences in the U.S. from the years 1987–88, exclusive of Group Vb. The response rate for Group Vb, which includes departments in engineering and management science, is the lowest of all groups.

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

| | 87–88 | 88–89 | 89–90 | 90–91 | 91–92 |
|---|---|---|---|---|---|
| I-Va | 760 | 854 | 881 | 1034 | 998** |

** 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 1991–92 in a spring 1993 issue of the *Notices*.

The Academic Hiring Survey conducted during the winter of 1991–92 (see *Notices*, April 1992, pages 311–316) projected that the number of new doctorates in mathematics in 1991–92 would be about the same as the 1990–91 count. In fact, the Group I, II, and III departments produced 748 new doctorates in 1991–92 compared to 747 in the 1991 fall count. The fall count of 173 for Group IV (statistics) is also essentially unchanged from last year's count of 170.

## Employment Status of U.S. New Doctorates, 1991–1992

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. For an analysis of the market from the perspective of academic departments recruiting to fill positions, see the Academic Hiring Survey mentioned above..

Table 3A shows the employment status, by type of employer and field of degree, of the 1050 recipients of doctoral degrees conferred by U.S. mathematical sciences departments between July 1, 1991, and June 30, 1992. The names of these individuals are listed with their thesis titles in a later section of this First Report of the 1992 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 648 new doctorates employed in the U.S., a total of 538

## Table 3A: Employment Status of 1991–1992 U.S. New Doctorates in the Mathematical Sciences

| TYPE OF EMPLOYER | FIELD OF THESIS: Algebra/ Number Theory | Real or Complex Analysis | Geometry/ Topology | Logic | Probability/ Statistics | Applied Math | Discr. Math/ Combina-torics | Numerical Analysis | Linear or Nonlinear Optim. | Other | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Group I | 14 | 10 | 22 | 2 | 12 | 27 | 5 | 8 | | | 100 |
| Group II | 6 | 1 | 7 | 1 | 7 | 2 | 1 | 2 | 1 | 1 | 29 |
| Group III | 5 | 2 | 5 | 2 | 5 | 10 | 6 | 6 | 1 | 4 | 46 |
| Group IV | 1 | | | | 22 | | | | | | 23 |
| Group V | | | | | | 4 | | | 1 | 1 | 6 |
| Masters | 16 | 15 | 5 | 3 | 12 | 11 | 9 | 5 | | 2 | 78 |
| Bachelors | 17 | 26 | 25 | 8 | 12 | 15 | 8 | 6 | 2 | 6 | 125 |
| Two-year Colleges | 3 | 1 | 3 | | 2 | 1 | 3 | | | | 13 |
| Other Academic Departments | 1 | 1 | | 2 | 23 | 12 | 3 | 4 | 5 | 8 | 59 |
| Research Institutes | 9 | 4 | 6 | | 26 | 9 | | 3 | | 2 | 59 |
| Government | | | 1 | | 5 | 3 | | 3 | | | 12 |
| Business and Industry | 4 | 5 | 3 | 1 | 43 | 14 | 7 | 6 | 7 | 8 | 98 |
| Foreign, Academic | 19 | 24 | 26 | 5 | 39 | 26 | 4 | 12 | 3 | 3 | 161 |
| Foreign, Nonacademic | 1 | | | 1 | 6 | 2 | | 2 | 2 | | 14 |
| Not seeking employment | 1 | 2 | | | 1 | 2 | | | 1 | | 7 |
| Still seeking employment | 18 | 21 | 20 | 2 | 21 | 21 | 9 | 2 | 5 | 2 | 121 |
| Unknown (U.S.) | 7 | 14 | 8 | 2 | 11 | 14 | 5 | 1 | 2 | 4 | 68 |
| Unknown (non-U.S.)* | 4 | 3 | 3 | 2 | 9 | 4 | 1 | 3 | | 2 | 31 |
| Column Total | 126 | 129 | 134 | 31 | 256 | 177 | 61 | 63 | 30 | 43 | 1050 |
| Column Subtotals: Male | 105 | 108 | 105 | 28 | 189 | 142 | 48 | 51 | 25 | 26 | 827 |
| Column Subtotals: Female | 21 | 21 | 29 | 3 | 67 | 35 | 13 | 12 | 5 | 17 | 223 |

*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 1991–1992 U.S. New Doctorates by type of granting department

| TYPE OF EMPLOYER | TYPE OF DOCTORATE-GRANTING DEPARTMENT: Group I Math | Group II Math | Group III Math | Group IV Statistics | Group V Applied Math/OR | ROW TOTAL | ROW SUBTOTALS: Male | Female |
|---|---|---|---|---|---|---|---|---|
| Group I | 79 | 3 | 4 | 8 | 6 | 100 | 80 | 20 |
| Group II | 12 | 7 | 2 | 4 | 4 | 29 | 23 | 6 |
| Group III | 18 | 7 | 13 | 3 | 5 | 46 | 41 | 5 |
| Group IV | 1 | 2 | 1 | 19 | | 23 | 21 | 2 |
| Group V | 2 | | | | 4 | 6 | 2 | 4 |
| Masters | 25 | 22 | 23 | 6 | 2 | 78 | 63 | 15 |
| Bachelors | 43 | 43 | 25 | 7 | 7 | 125 | 84 | 41 |
| Two-year Colleges | 1 | 5 | 6 | | 1 | 13 | 7 | 6 |
| Other Academic Departments | 5 | 8 | 1 | 18 | 27 | 59 | 48 | 11 |
| Research Institutes | 30 | 4 | | 20 | 5 | 59 | 49 | 10 |
| Government | 3 | 3 | 1 | 3 | 2 | 12 | 8 | 4 |
| Business and Industry | 26 | 12 | 10 | 30 | 20 | 98 | 72 | 26 |
| Foreign, Academic | 78 | 25 | 16 | 27 | 15 | 161 | 130 | 31 |
| Foreign, Nonacademic | 3 | 2 | 2 | 2 | 5 | 14 | 13 | 1 |
| Not seeking employment | 1 | 2 | 2 | | 2 | 7 | 5 | 2 |
| Still seeking employment | 43 | 30 | 20 | 15 | 13 | 121 | 98 | 23 |
| Unknown (U.S.) | 39 | 13 | 5 | 2 | 9 | 68 | 58 | 10 |
| Unknown (non-U.S.)* | 12 | 3 | 5 | 9 | 2 | 31 | 25 | 6 |
| Column Total | 421 | 191 | 136 | 173 | 129 | 1050 | 827 | 223 |
| Column Subtotals: Male | 348 | 153 | 97 | 127 | 102 | 827 | | |
| Column Subtotals: Female | 73 | 38 | 39 | 46 | 27 | 223 | | |

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

(83 percent) hold jobs in academia. For comparison, last year's First Report showed 704 new doctorates employed in the U.S., including 564 (80 percent) in academic positions. Thus total U.S. employment of new doctorates has declined and the concentration of positions in academia has increased. Concomitantly, the number of nonacademic positions in the U.S. for new doctorates has declined by 21 percent to 110, a level that is still comparable to the level of nonacademic employment reported in 1989 and 1990.

The 538 U.S. academic positions this year include a total of 204 in U.S. doctorate-granting departments (Groups I–V). This number is appreciably lower than last year (247 positions in Groups I–V). The number hired by Group I has remained essentially constant at 100 since 1988. For the second consecutive year, the numbers hired by Groups II and III declined; the numbers reported in Table 3A are 37 percent and 27 percent, respectively, below the numbers reported in the 1990 Survey. The number of new doctorates employed by master's and bachelor's degree-granting colleges and universities decreased by only one collectively from the numbers reported last year.

The job market for 1991–92 new doctorates has been equally as difficult as the market for 1990–91 degree recipients. Table 3A shows that among those whose employment status is known, 12.7 percent are unemployed. (The corresponding rate of unemployment for 1990–91 doctoral recipients from U.S. institutions, reported in fall 1991, was 11.4 percent.) The 1992 unemployment level is the second 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. In contrast to the current high unemployment rate, throughout the 1980s the rate reported in the November issue of the *Notices* ranged from a low of 3.7 percent in 1981 to 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 1992 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 1993 issue of the *Notices*. At the time of the Second Report last year, the percentage of 1990–91 new doctorates from U.S. institutions who had reported not finding employment was 4.4 percent (see *Notices*, November 1991, page 1088, and July/August 1992, page 575).

Beyond the unemployment statistics that are explicitly reported in Table 3A, the 1992 Survey reveals other indicators of a difficult job market. For example, 33 new doctorates are reported to hold part-time positions and at least 19 of these individuals are still seeking full-time employment. Forty 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 204 jobs reported in the doctorate-granting departments, 33 positions are held by new doctorates from that same department.

Some information is available from the survey concerning the nature of the academic positions filled. To date, 324 individual responses have been received from new doctorates employed by academic institutions. Fifty percent of these respondents report that their position is not tenure-eligible and the remaining 50 percent report that their position is a tenure-track position. Out of the 163 nontenure-eligible respondents, 37 percent can hold their current position for a maximum of one year and 60 percent can hold their position for up to two years. Thus the incumbents of many nontenure-eligible positions will again be seeking jobs during the current year.

The proportion of the jobs filled that are tenure-eligible varies significantly among survey groups. Among the 324 individual respondents holding jobs in academic institutions, 108 have positions in a doctorate-granting department and 121 have positions in a bachelor's or master's degree-granting department. In the doctorate-granting departments, 73 percent of the positions held by new doctorates are not tenure-eligible, while only 18 percent of the positions in bachelor's and master's granting departments are not tenure-eligible. Similar patterns were reported in the recent Academic Hiring Survey.

Table 3B reveals the dependence of employment patterns on the type of department from which the doctorate is received. There are patterns of compartmentalization and stratification of the job market for new doctorates. For example, Table 3B shows that persons hired for positions in doctorate-granting mathematics departments are drawn predominantly from mathematics doctorates: 83 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, 83 percent of the Group IV jobs went to Group IV degree recipients. Also, 79 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 21.2 percent of the population of new doctorates, but the proportion is not uniform across different types of departments. For example, 15.5 percent of the new doctorates in mathematics are women (110 out of 708) and 26.6 percent of the new doctorates from statistics departments are women (46 out of 173). The proportion of women among new doctorates hired by doctorate-granting mathematics departments (17.7 percent) is slightly higher than their proportion among mathematics doctorates. The proportion of women among hires of new doctorates in bachelor's degree granting departments (33 percent) far exceeds their proportion in the population of new doctorates overall. The proportion of women (27.3 percent) among new doctorates holding nonacademic positions in the U.S. is also greater than the proportion of women among new doctorates overall.

Table 3B shows the different rates of unemployment for doctorate recipients from the five groups. The percentage unemployed, among those whose employment status is known, are: Group I—11.6 percent; Group II—17.1 percent; Group III—15.9 percent; Group IV—9.3 percent; and Group V—11.0 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 1012 of the 1050 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 (11.4 percent). Both of these rates are higher than the ones reported in November 1991 for the 1990–91 new doctorates (see *Notices,* November 1991, page 1090). The percentage of U.S. citizens in U.S. nonacademic jobs is considerably higher than the percentage of noncitizens in the same category (14.4 percent of citizens versus 9.5 percent of noncitizens whose job status is known). The percentages of U.S. and of non-U.S. citizens holding positions in U.S. doctorate-granting departments are identical (21.8 percent), while citizens hold positions in nondoctorate granting U.S. departments in substantially higher proportion than do noncitizens (37.9 percent of citizens compared to 22.4 percent of noncitizens); here all percentages exclude new doctorates whose job status is unknown.

If complete information about 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 32 percent of the non-U.S. citizens.

Nonetheless, the distribution of job categories is reported for 58 noncitizen new doctorates who are known to be permanent U.S. residents. Of those whose employment status is known, 11.5 percent are employed by a doctorate-granting department in the U.S., 42.3 percent are employed by a nondoctorate granting department in the U.S., 25 percent hold a nonacademic position in the U.S., and 11.5 percent are unemployed.

**TABLE 3C: Employment Status of 1991–1992 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 | 88 | 21 | 115 | 20 | 203 | 20 |
| U.S. Academic, non-Ph.D. Department | 153 | 36 | 118 | 20 | 271 | 27 |
| U.S. Research Institute | 33 | 8 | 23 | 4 | 56 | 6 |
| U.S. Nonacademic | 58 | 14 | 50 | 9 | 108 | 11 |
| Foreign Academic | 22 | 5 | 131 | 22 | 153 | 15 |
| Foreign Nonacademic | 3 | 1 | 10 | 2 | 13 | 1 |
| Not seeking employment | 1 | | 6 | 1 | 7 | 1 |
| Still seeking employment | 46 | 11 | 75 | 13 | 121 | 12 |
| Unknown status (U.S. address) | 24 | 6 | 30 | 5 | 54 | 5 |
| Unknown status (foreign address) | | | 26 | 4 | 26 | 3 |
| TOTALS | 428 | 100%** | 584 | 100%** | 1012 | 100%** |

* 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-MAA Survey attempts to provide an accurate appraisal and analysis of various aspects of the academic mathematical scene for the use and benefit of the mathematics 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 for the quality of its information on the conscientious efforts of the dedicated staff members of these departments. On behalf of the AMS-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 1992 Annual AMS-MAA Survey. Monica Foulkes and Elizabeth Foulkes have provided indespensible support and taken many initiatives to facilitate the Data Committee's work. Elizabeth 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, 1991 — June 30, 1992

| 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 | 16 | 2 | 297 | 3 | 318 | 5 | | 77 | 3 | 85 | 403 |
| Black | 6 | | 11 | | 17 | | | 1 | | 1 | 18 |
| American Indian, Eskimo, Aleut | | | | | | 1 | | | | 1 | 1 |
| Mexican American, Puerto Rican, or other Hispanic | 4 | | 25 | | 29 | 1 | | 7 | 1 | 9 | 38 |
| None of the above | 295 | 8 | 128 | 1 | 432 | 96 | 5 | 23 | 1 | 125 | 557 |
| Unknown | 6 | 1 | 1 | 23 | 31 | | | | 2 | 2 | 33 |
| Total | 327 | 11 | 462 | 27 | 827 | 103 | 5 | 108 | 7 | 223 | 1050 |

## Sex, Racial/Ethnic Group, and Citizenship of U.S. New Doctorates, 1991–1992

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 from departments granting the degrees and in some cases from the recipients themselves.

The citizenship status is known for 1016 of the 1050 new doctorates, including 430 U.S. citizens. (Because different surveys 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 6.7 percent smaller than in 1990–91. However, the number of U.S. citizens is still the second highest value since 1983–84, exceeded only by last year's count. Table 5 shows the changes from year to year in the numbers and proportions of U.S. citizens.

This year's *percentage* of U.S. citizens achieves a new all-time low of 42.3 percent. In part, the decline in percentage results from the high number of non-U.S. citizens receiving doctoral degrees. A total of 586 noncitizens were awarded doctorates by U.S. institutions in 1991–92. This represents a decline of 14 individuals (2.3 percent) from last year's count and is the first drop in the number of noncitizens since 1978–79. The 1991–92 count is still 110 percent greater than the number awarded by U.S. institutions ten years ago (279 in 1981–82).

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 1983–86. 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, 6 are black (all male) and 5 are Mexican American, Puerto Rican, or other Hispanic (4 men and 1 woman). Both of these counts are lower than last year's (see *Notices*, November 1991, page 1092).

Women account for 24 percent of the U.S. citizens receiving doctoral degrees in the mathematical sciences from U.S. universities. This remains equal to the highest percentage ever reported. The total number of U.S. citizen women (103) is the second highest number ever reported, exceeded only by the 1990–91 count. See Table 6.

Note that in Table 5 and Table 6 all years prior to 1982–83 include doctorates granted by computer science departments.

**TABLE 4B: Region of Citizenship of 1991–1992 U.S. New Doctorates**

| GEOGRAPHICAL REGION | Number | % Change from 1983–86 Annual Average |
|---|---|---|
| U.S.A. | 428 | +3 |
| Canada | 15 | +36 |
| Central and South America | 31 | –14 |
| Western Europe | 79 | +95 |
| Eastern Europe* | 27 | +151 |
| Middle East | 32 | –21 |
| Southern Asia** | 47 | +21 |
| Far East*** | 314 | +172 |
| Africa | 24 | +13 |
| Australia and Oceania**** | 15 | +25 |
| Unknown country of citizenship | 38 | —— |
| Total | 1050 | +41 |

* Including European Republics of the former Soviet Union. The distinction between "east" and "west" for European countries is determined by the political geography of 1945–91.

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

*** Including Indochina.

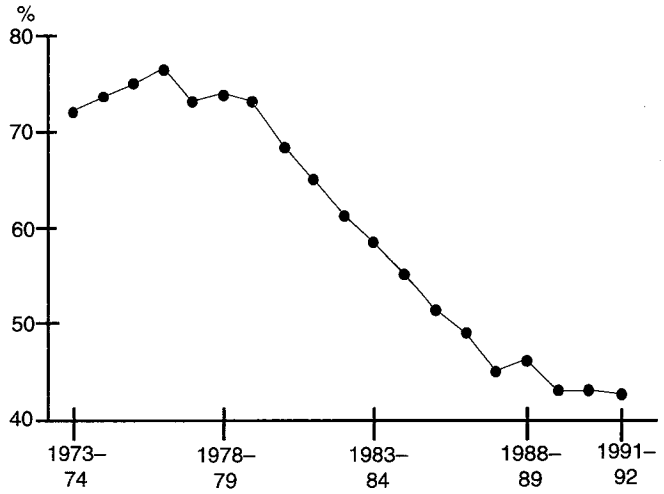
**** Including Central and South Pacific islands, Australia, New Zealand, and the Malay Archipeligo.

**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 |

*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**

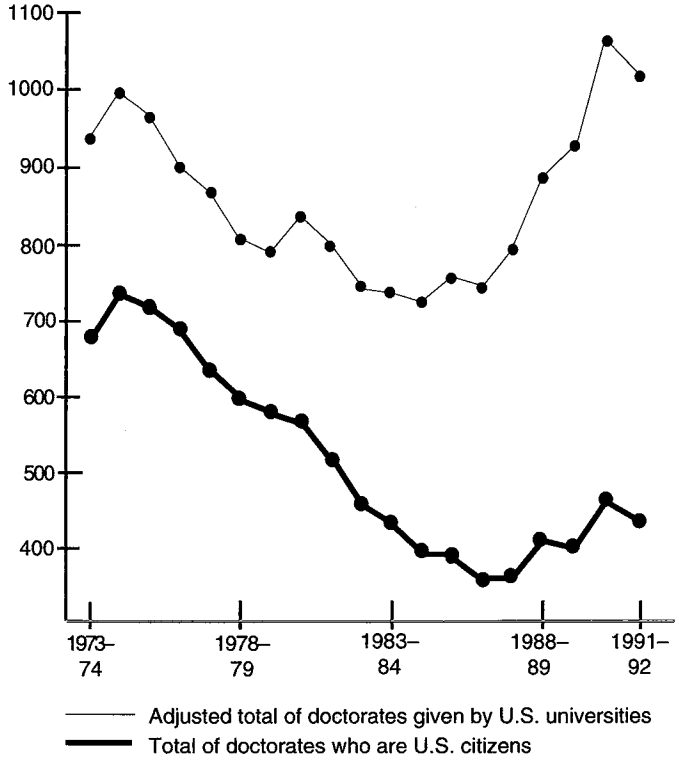



**TABLE 6: U.S. Citizen Doctorates, Male and Female**

| | 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 |

## 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 Sciences 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* 1990*s* (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. CPST, Washington, DC.

———. *Salaries of Scientists, Engineers, and Technicians: A Summary of Salary Surveys,* 15th Ed., Washington, DC, 1991.

———. *Professional Women and Minorities*—1991. Washington, DC, 1991.

———. *Preparing for the* 21*st 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* 1990, *Doctorate Recipients from U. S. Universities,* National Academy Press, Washington, DC, 1991.

———. *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* 1990*s.* 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,* National Science Foundation, Washington, DC, 1990.

———. *Science and Engineering Degrees*: 1966–89, NSF 91-314, Washington, DC, 1991.

———. *Science and Engineering Doctorate Awards*: 1991, NSF 92–309, Selected Data Tables, Washington, DC, 1992.

———. *Science and Engineering Doctorates:* 1960–1989, NSF 90–320, Detailed Statistical Tables, Washington, DC, 1990.

———. *Academic Science and Engineering: Graduate Enrollment and Support*, 1989, NSF 90–324, Detailed Statistical Tables, Washingon, DC, 1991.

———. *Selected Data on Graduate Students and Postdoctorates in Science and Engineering*, Fall 1989. 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.

# Salary Survey for New Recipients of Doctorates, 1991–1992

The figures for 1992 were compiled from questionnaires sent to individuals who received a doctorate in the mathematical sciences during the 1991–92 academic year from universities in the United States.

Questionnaires requesting information on salaries and professional experience were distributed to 986 recipients of degrees using addresses provided by the departments granting the degrees. 422 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 1991 median salary in hundreds of dollars. Values plotted for other years are converted to 1991 dollars using the implicit price deflator prepared annually by the Bureau of Economic Analysis, U.S. Department of Commerce. The 1992 salary data are not shown on the graphs because the deflator is not yet available for this year.

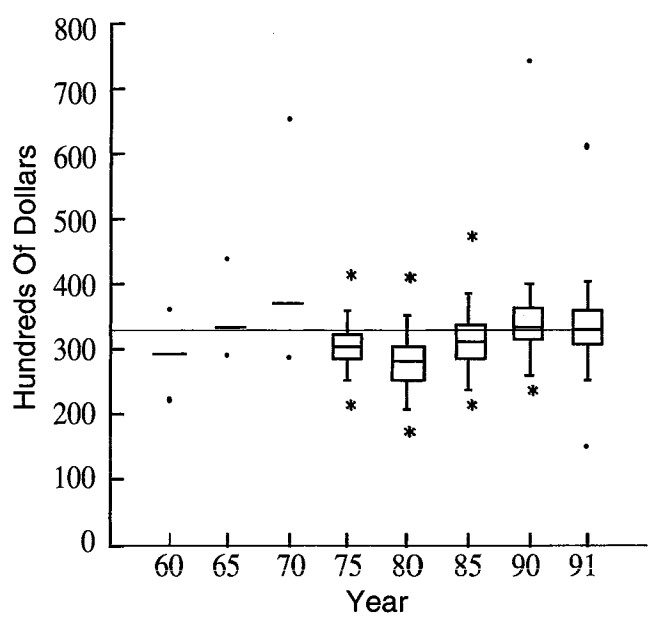
For a given year, the box shows the first and third quartiles and the median salary. (Prior to 1975, the quartiles are not available, and only the median is depicted by the horizontal stroke.) The "whiskers" give additional information about the spread of the data, extending to points that are 1.5 interquartile 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 | $Q_1$ | Median | $Q_3$ | Max | Reported Median in 1991 $ |
|---|---|---|---|---|---|---|
| TEACHING OR TEACHING AND RESEARCH (149 men + 50 women) | | | | | | |
| 1960 | 49 | | 65 | | 80 | 293 |
| 1965 | 70 | | 80 | | 105 | 332 |
| 1970 | 85 | | 110 | | 195 | 368 |
| 1975 | 90 | 120 | 128 | 135 | 173 | 307 |
| 1980 | 105 | 155 | 171 | 185 | 250 | 281 |
| 1985 | 170 | 230 | 250 | 270 | 380 | 312 |
| 1989 | 200 | 290 | 310 | 330 | 478 | 337 |
| 1990 | 230 | 305 | 320 | 350 | 710 | 333 |
| 1991 | 150 | 310 | 330 | 360 | 610 | 330 |
| 1992 | 190 | 320 | 340 | 360 | 520 | — |
| 1989M | 200 | 290 | 305 | 330 | 478 | |
| 1989F | 220 | 295 | 310 | 330 | 470 | |
| 1990M | 230 | 306 | 320 | 350 | 710 | |
| 1990F | 250 | 300 | 325 | 360 | 493 | |
| 1991M | 150 | 310 | 330 | 360 | 610 | |
| 1991F | 260 | 310 | 332 | 360 | 550 | |
| 1992M | 190 | 310 | 340 | 360 | 520 | |
| 1992F | 250 | 330 | 349 | 371 | 500 | |
| One year or less experience (112 men + 31 women) | | | | | | |
| 1992M | 230 | 320 | 340 | 375 | 520 | |
| 1992F | 250 | 340 | 354 | 388 | 500 | |

### Nine-Month Teaching or Teaching and Research



## Nine-Month Salaries

| Ph.D. Year | Min | Median | Max | Reported Median in 1991 $ |
|---|---|---|---|---|
| RESEARCH (4 men + 0 women) | | | | |
| 1960 | 52 | 65 | 80 | 293 |
| 1965 | 71 | 81 | 90 | 336 |
| 1970 | 78 | 105 | 160 | 351 |
| 1975 | 100 | — | 110 | — |
| 1980 | 125 | 137 | 180 | 225 |
| 1985 | 205 | 235 | 250 | 293 |
| 1989 | 235 | 270 | 330 | 293 |
| 1990 | 230 | 300 | 404 | 312 |
| 1991 | 260 | 295 | 470 | 295 |
| 1992 | 160 | 290 | 330 | — |
| 1989M | 235 | 270 | 330 | |
| 1989F | — | — | — | |
| 1990M | 230 | 300 | 404 | |
| 1990F | — | — | — | |
| 1991M | 260 | 290 | 360 | |
| 1991F | — | — | — | |
| 1992M | 160 | 290 | 330 | |
| 1992F | — | — | — | |
| One year or less experience (4 men + 0 women) | | | | |
| 1992M | 160 | 290 | 330 | |
| 1992F | — | — | — | |

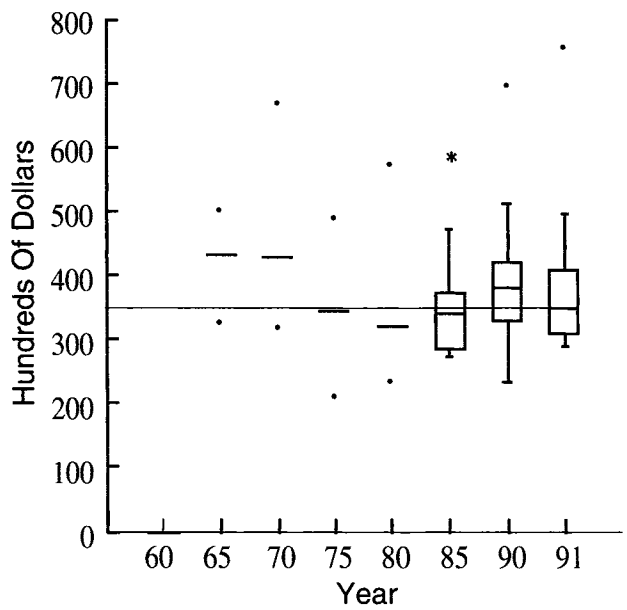
## Nine-Month Research

Graph omitted because sample size too small.

## Twelve-Month Salaries

| Ph.D. Year | Min | $Q_1$ | Median | $Q_3$ | Max | Reported Median in 1991 $ |
|---|---|---|---|---|---|---|
| TEACHING OR TEACHING AND RESEARCH (14 men + 2 women) | | | | | | |
| 1960 | .....No data..... | | | | | |
| 1965 | 78 | | 104 | | 121 | 431 |
| 1970 | 95 | | 128 | | 200 | 428 |
| 1975 | 87 | | 145 | | 204 | 347 |
| 1980 | 143 | | 195 | | 350 | 320 |
| 1985 | 220 | 230 | 273 | 300 | 470 | 341 |
| 1989 | 238 | 290 | 315 | 370 | 620 | 342 |
| 1990 | 225 | 318 | 365 | 404 | 670 | 380 |
| 1991 | 290 | 310 | 350 | 408 | 758 | 350 |
| 1992 | 265 | 325 | 355 | 402 | 1300 | — |
| 1989M | 238 | 295 | 315 | 370 | 620 | |
| 1989F | 275 | 290 | 314 | 380 | 434 | |
| 1990M | 225 | 316 | 360 | 400 | 670 | |
| 1990F | 250 | 320 | 383 | 420 | 425 | |
| 1991M | 290 | 310 | 350 | 400 | 530 | |
| 1991F | 300 | 310 | 472 | 530 | 758 | |
| 1992M | 300 | 330 | 355 | 420 | 1300 | |
| 1992F | — | — | — | — | — | |
| One year or less experience (9 men + 2 women) | | | | | | |
| 1992M | 320 | 330 | 350 | 384 | 1300 | |
| 1992F | — | — | — | — | — | |

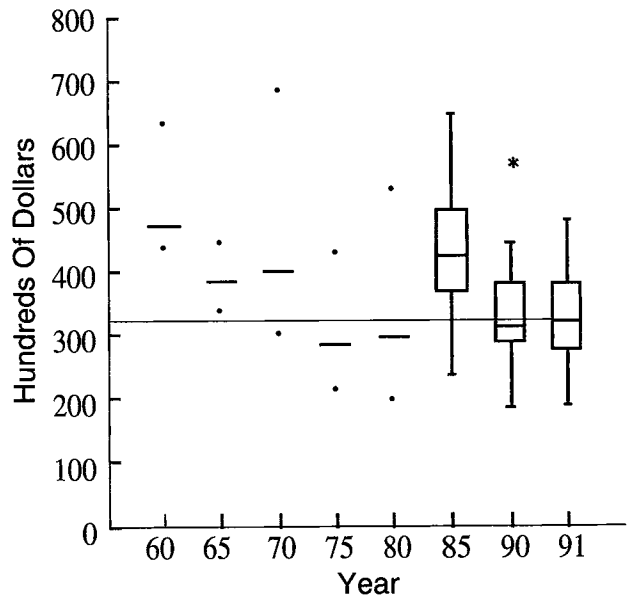
## Twelve-Month Teaching or Teaching and Research



### Twelve-Month Salaries

| Ph.D. Year | Min | $Q_1$ | Median | $Q_3$ | Max | Reported Median in 1991 $ |
|---|---|---|---|---|---|---|
| | | | RESEARCH (19 men + 6 women) | | | |
| 1960 | 97 | | 105 | | 140 | 474 |
| 1965 | 81 | | 93 | | 107 | 386 |
| 1970 | 90 | | 120 | | 205 | 402 |
| 1975 | 90 | | 119 | | 180 | 285 |
| 1980 | 120 | | 180 | | 321 | 296 |
| 1985 | 190 | 295 | 342 | 400 | 520 | 427 |
| 1989 | 180 | 250 | 317 | 385 | 623 | 344 |
| 1990 | 180 | 280 | 300 | 365 | 546 | 312 |
| 1991 | 190 | 277 | 320 | 380 | 480 | 320 |
| 1992 | 186 | 300 | 302 | 360 | 480 | — |
| 1989M | 180 | 250 | 300 | 393 | 623 | |
| 1989F | 200 | 295 | 350 | 373 | 400 | |
| 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 | |
| One year or less experience (19 men + 6 women) | | | | | | |
| 1992M | 210 | 300 | 300 | 358 | 480 | |
| 1992F | 186 | 250 | 370 | 380 | 400 | |

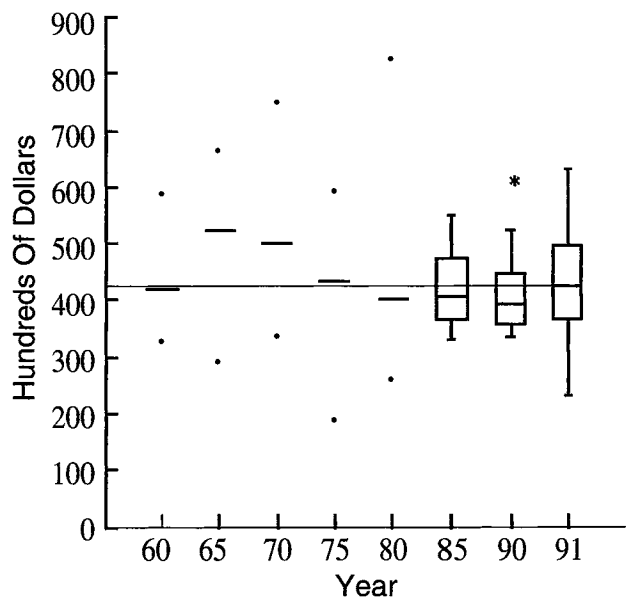
### Twelve-Month Research




### Twelve-Month Salaries

| Ph.D. Year | Min | $Q_1$ | Median | $Q_3$ | Max | Reported Median in 1991 $ |
|---|---|---|---|---|---|---|
| | | | GOVERNMENT (8 men + 3 women) | | | |
| 1960 | 72 | | 93 | | 130 | 420 |
| 1965 | 70 | | 126 | | 160 | 523 |
| 1970 | 100 | | 150 | | 223 | 502 |
| 1975 | 78 | | 182 | | 247 | 436 |
| 1980 | 156 | | 244 | | 501 | 401 |
| 1985 | 263 | 294 | 325 | 381 | 440 | 406 |
| 1989 | 330 | 363 | 378 | 438 | 540 | 410 |
| 1990 | 320 | 345 | 378 | 430 | 587 | 393 |
| 1991 | 230 | 365 | 423 | 497 | 630 | 423 |
| 1992 | 315 | 438 | 530 | 587 | 692 | — |
| 1989M | 330 | 363 | 378 | 438 | 540 | |
| 1989F | — | — | — | — | — | |
| 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 | — | — | — | — | — | |
| One year or less experience (5 men + 1 woman) | | | | | | |
| 1992M | 315 | 402 | 435 | 440 | 675 | |
| 1992F | — | — | — | — | — | |

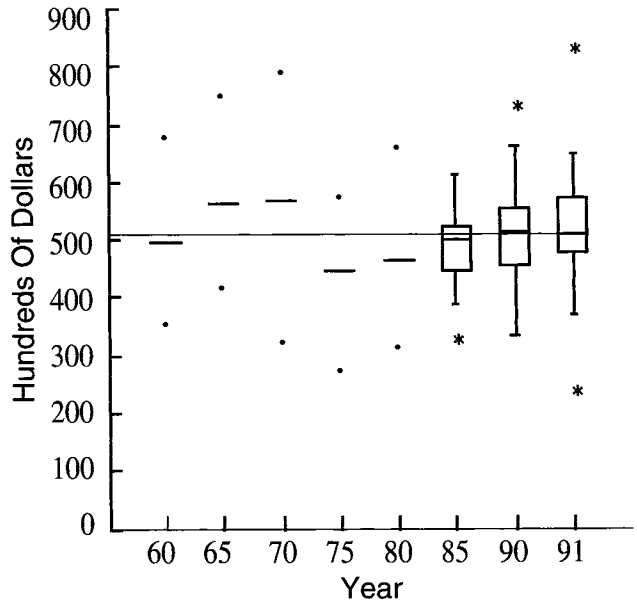
### Twelve-Month Government



**Twelve-Month Salaries**

| Ph.D. Year | Min | $Q_1$ | Median | $Q_3$ | Max | Reported Median in 1991 $ |
|---|---|---|---|---|---|---|
| BUSINESS AND INDUSTRY (31 men + 8 women) | | | | | | |
| 1960 | 78 | | 110 | | 150 | 497 |
| 1965 | 100 | | 136 | | 180 | 564 |
| 1970 | 96 | | 170 | | 235 | 569 |
| 1975 | 114 | | 187 | | 240 | 448 |
| 1980 | 190 | | 284 | | 400 | 467 |
| 1985 | 260 | 360 | 400 | 420 | 493 | 499 |
| 1989 | 250 | 420 | 464 | 505 | 5250 | 504 |
| 1990 | 320 | 438 | 495 | 533 | 700 | 515 |
| 1991 | 235 | 480 | 510 | 573 | 830 | 510 |
| 1992 | 208 | 450 | 530 | 620 | 1000 | — |
| 1989M | 250 | 420 | 464 | 513 | 5250 | |
| 1989F | 375 | 430 | 470 | 500 | 516 | |
| 1990M | 320 | 443 | 490 | 533 | 630 | |
| 1990F | 390 | 440 | 500 | 525 | 700 | |
| 1991M | 330 | 500 | 520 | 587 | 830 | |
| 1991F | 235 | 420 | 481 | 554 | 720 | |
| 1992M | 300 | 440 | 520 | 625 | 1000 | |
| 1992F | 208 | 528 | 549 | 591 | 850 | |
| One year or less experience (12 men + 5 women) | | | | | | |
| 1992M | 300 | 401 | 430 | 565 | 615 | |
| 1992F | 208 | 540 | 558 | 561 | 620 | |

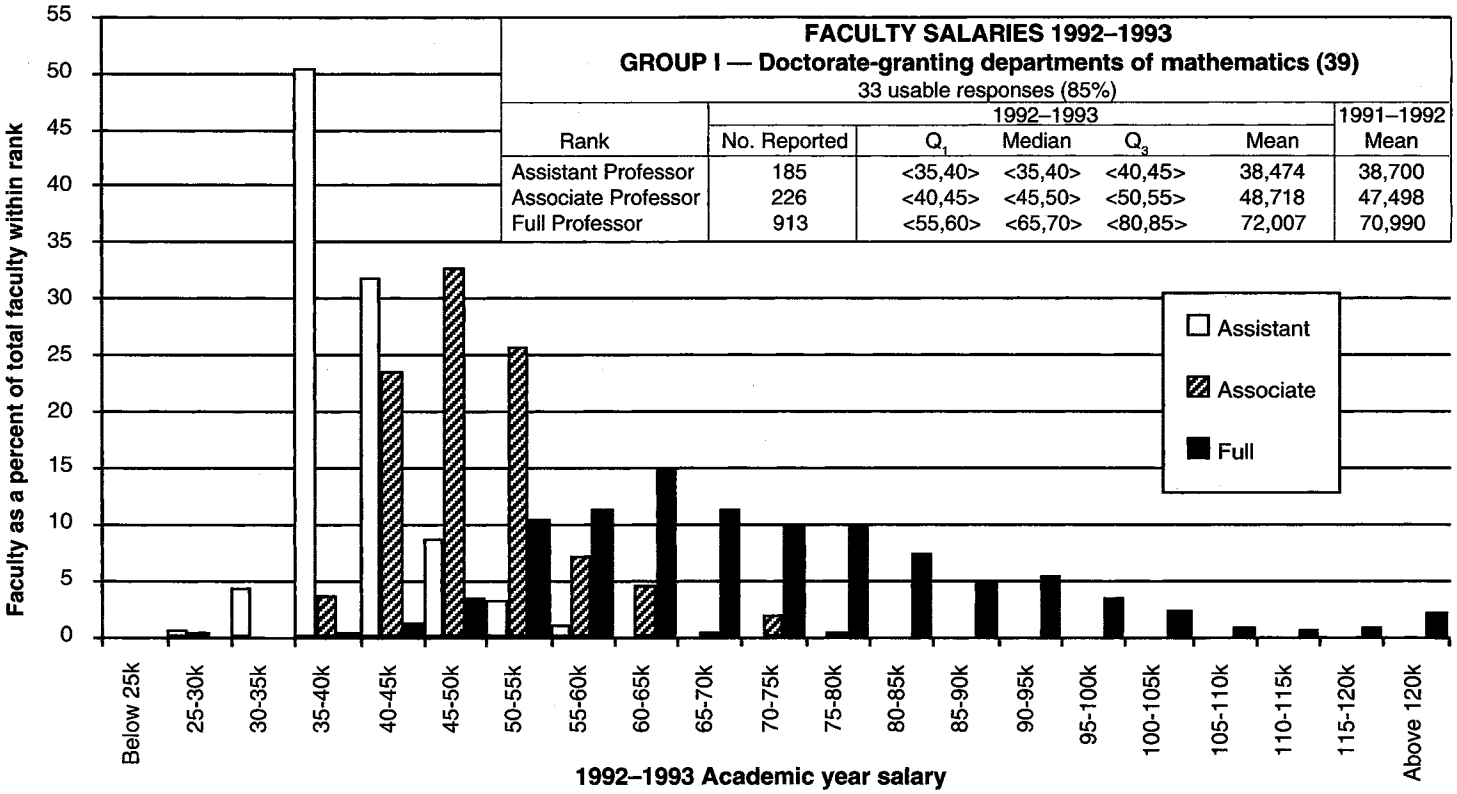
**Twelve-Month Business and Industry**




# Faculty Salary Survey 1992–1993 Salaries

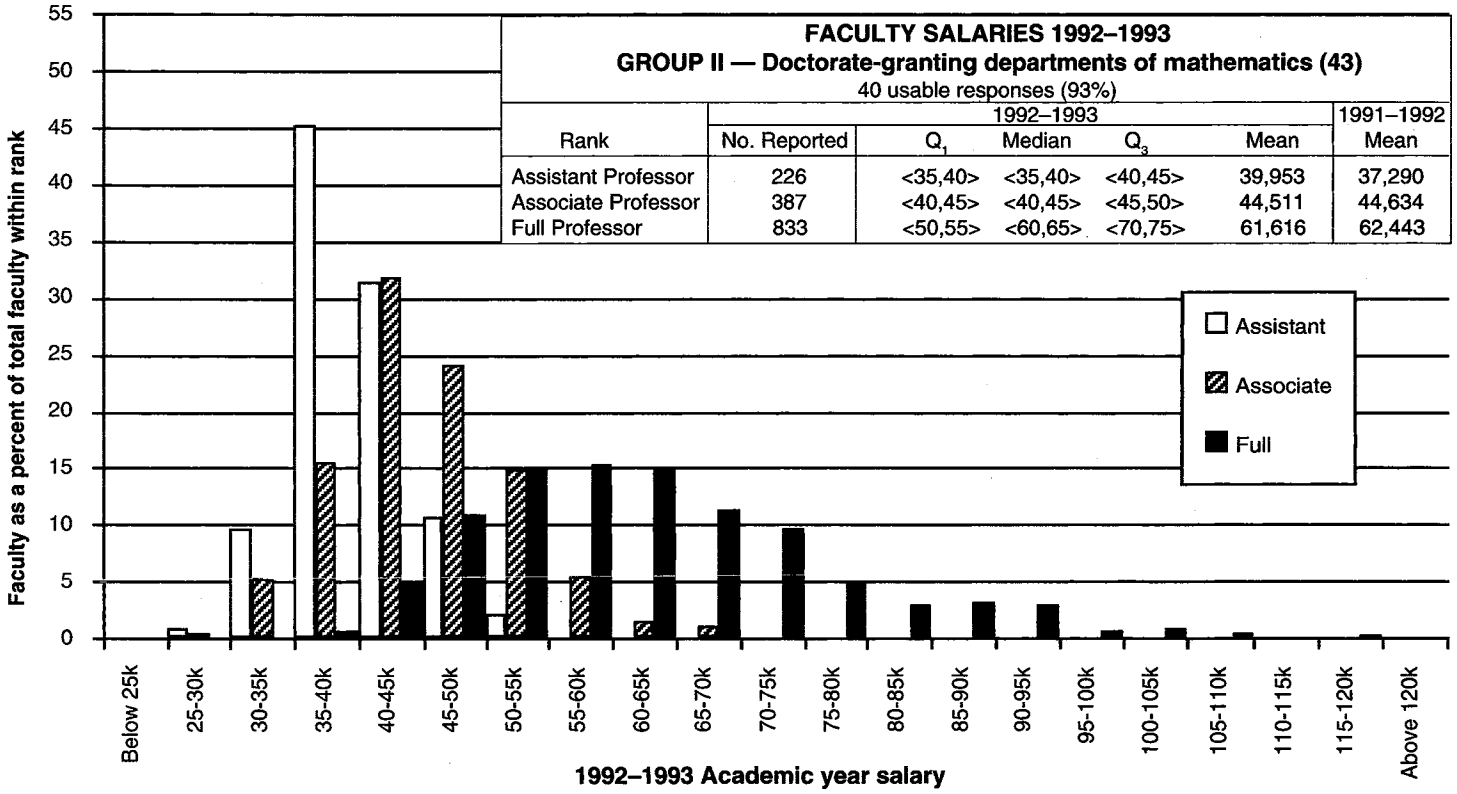
The charts on the following pages display faculty salary data for Groups I–V, M and B: faculty salary distribution by rank, mean salaries by rank, information on quartiles by rank, and the number of usable returns for the group.

Departments were asked to report the number of faculty whose 1992–93 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>.



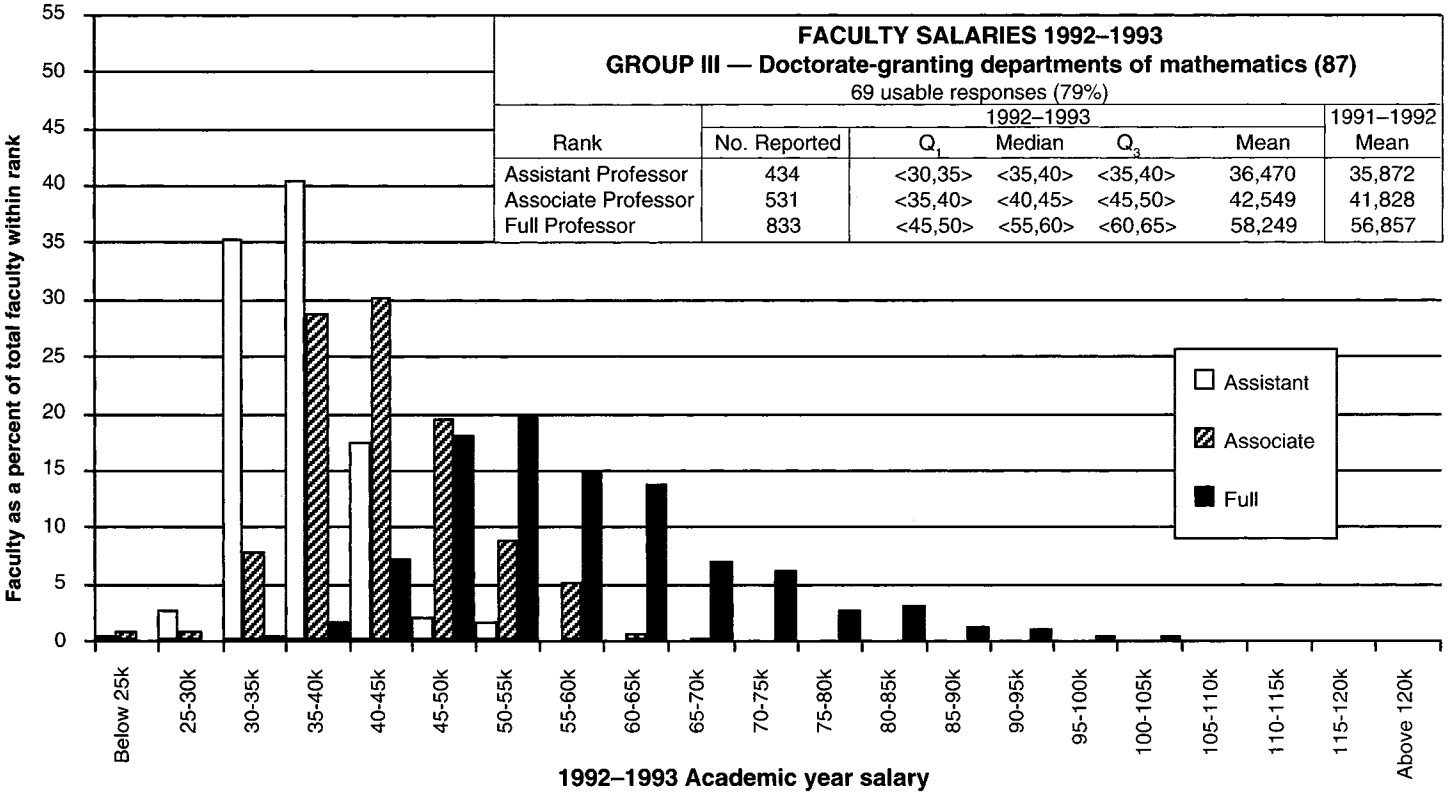

**FACULTY SALARIES 1992–1993**
**GROUP I — Doctorate-granting departments of mathematics (39)**
33 usable responses (85%)

| Rank | 1992–1993 No. Reported | $Q_1$ | Median | $Q_3$ | Mean | 1991–1992 Mean |
|---|---|---|---|---|---|---|
| Assistant Professor | 185 | <35,40> | <35,40> | <40,45> | 38,474 | 38,700 |
| Associate Professor | 226 | <40,45> | <45,50> | <50,55> | 48,718 | 47,498 |
| Full Professor | 913 | <55,60> | <65,70> | <80,85> | 72,007 | 70,990 |



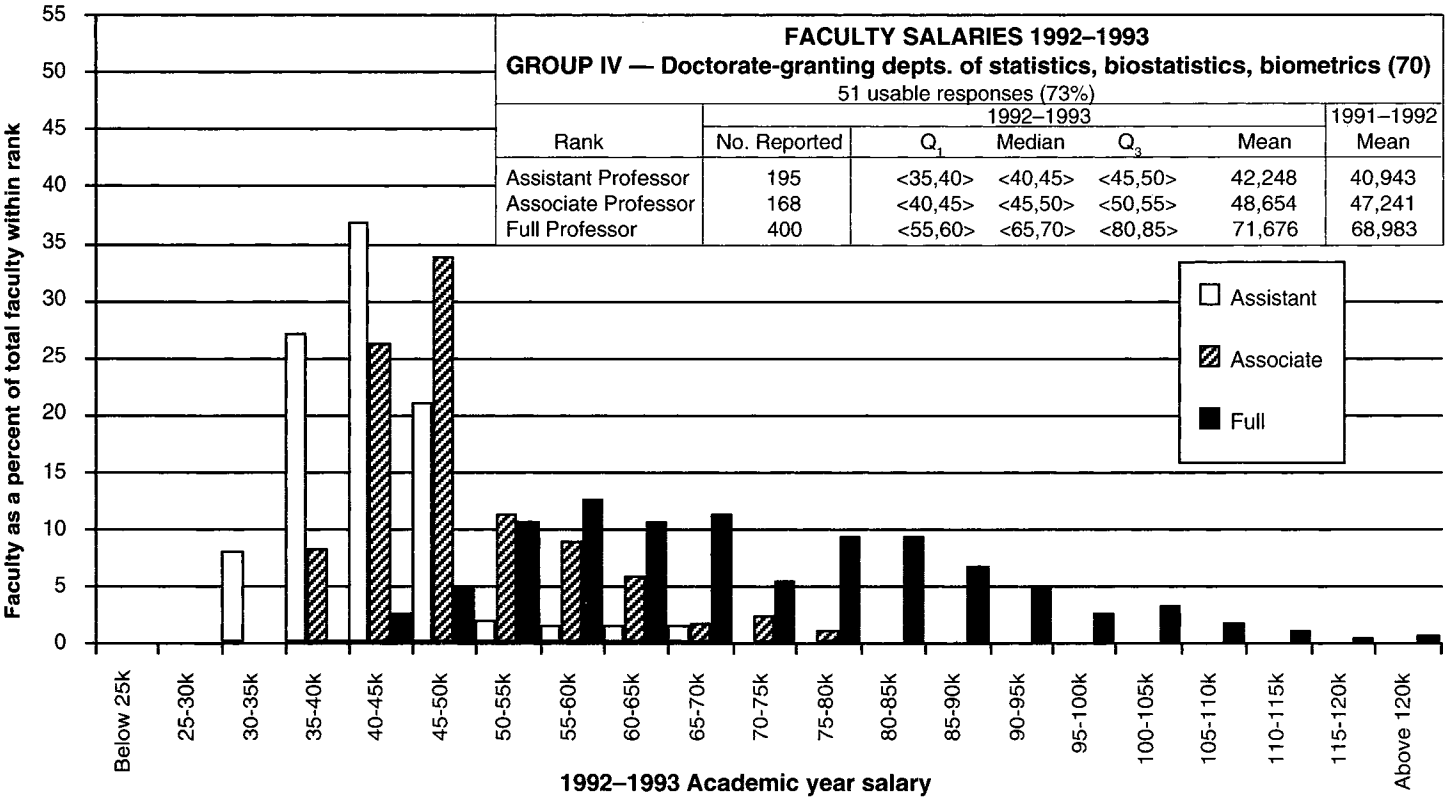

**FACULTY SALARIES 1992–1993**
**GROUP II — Doctorate-granting departments of mathematics (43)**
40 usable responses (93%)

| Rank | 1992–1993 No. Reported | $Q_1$ | Median | $Q_3$ | Mean | 1991–1992 Mean |
|---|---|---|---|---|---|---|
| Assistant Professor | 226 | <35,40> | <35,40> | <40,45> | 39,953 | 37,290 |
| Associate Professor | 387 | <40,45> | <40,45> | <45,50> | 44,511 | 44,634 |
| Full Professor | 833 | <50,55> | <60,65> | <70,75> | 61,616 | 62,443 |



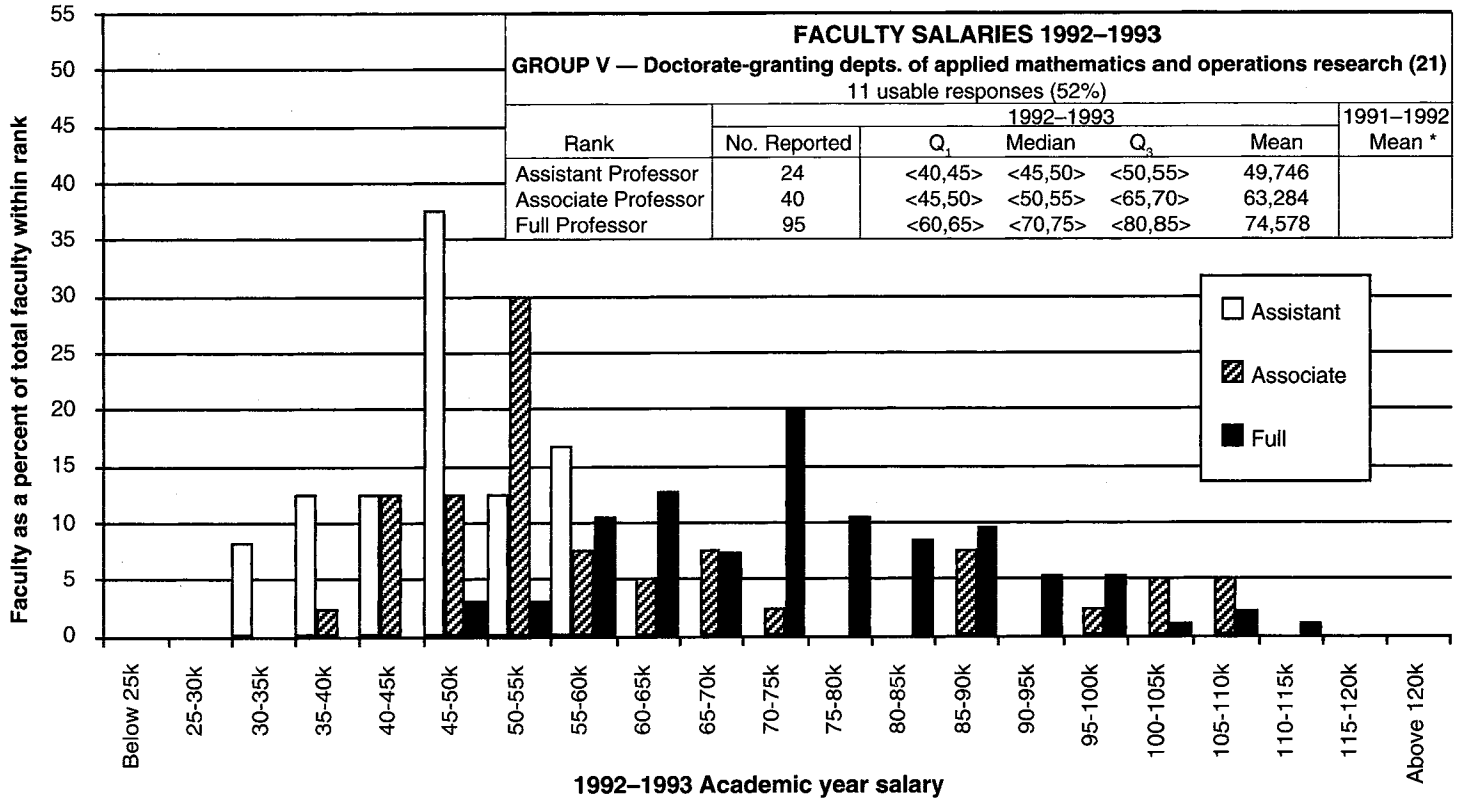

**FACULTY SALARIES 1992–1993**
**GROUP III — Doctorate-granting departments of mathematics (87)**
69 usable responses (79%)

| Rank | 1992–1993 No. Reported | $Q_1$ | Median | $Q_3$ | Mean | 1991–1992 Mean |
|---|---|---|---|---|---|---|
| Assistant Professor | 434 | <30,35> | <35,40> | <35,40> | 36,470 | 35,872 |
| Associate Professor | 531 | <35,40> | <40,45> | <45,50> | 42,549 | 41,828 |
| Full Professor | 833 | <45,50> | <55,60> | <60,65> | 58,249 | 56,857 |




**FACULTY SALARIES 1992–1993**
**GROUP IV — Doctorate-granting depts. of statistics, biostatistics, biometrics (70)**
51 usable responses (73%)

| Rank | 1992–1993 No. Reported | $Q_1$ | Median | $Q_3$ | Mean | 1991–1992 Mean |
|---|---|---|---|---|---|---|
| Assistant Professor | 195 | <35,40> | <40,45> | <45,50> | 42,248 | 40,943 |
| Associate Professor | 168 | <40,45> | <45,50> | <50,55> | 48,654 | 47,241 |
| Full Professor | 400 | <55,60> | <65,70> | <80,85> | 71,676 | 68,983 |



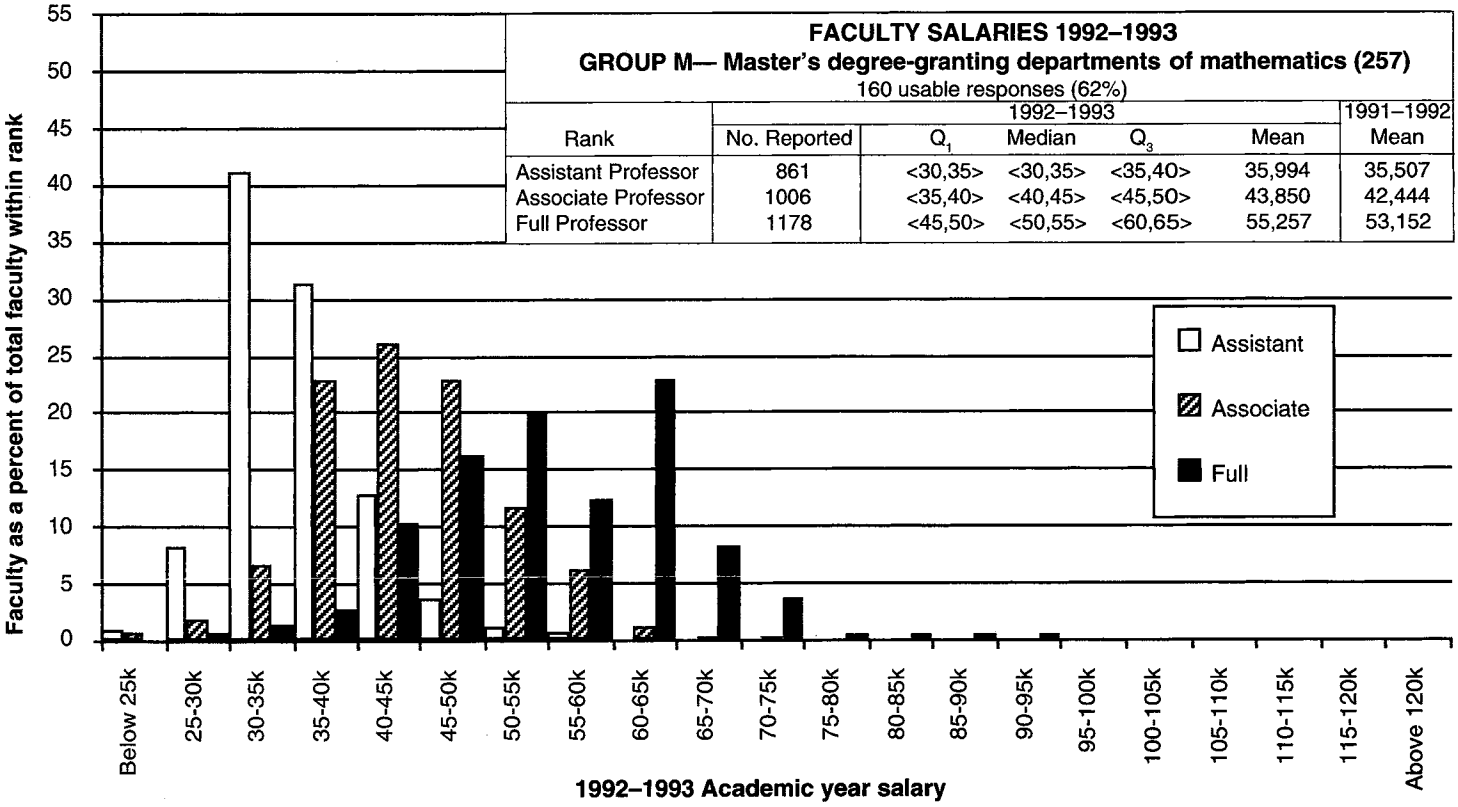

**FACULTY SALARIES 1992–1993**

**GROUP V — Doctorate-granting depts. of applied mathematics and operations research (21)**

11 usable responses (52%)

| Rank | 1992–1993 No. Reported | $Q_1$ | Median | $Q_3$ | Mean | 1991–1992 Mean * |
|---|---|---|---|---|---|---|
| Assistant Professor | 24 | <40,45> | <45,50> | <50,55> | 49,746 | |
| Associate Professor | 40 | <45,50> | <50,55> | <65,70> | 63,284 | |
| Full Professor | 95 | <60,65> | <70,75> | <80,85> | 74,578 | |

* This year's Group V survey population is significantly smaller than last year's, and comparison of means between the two is not valid.

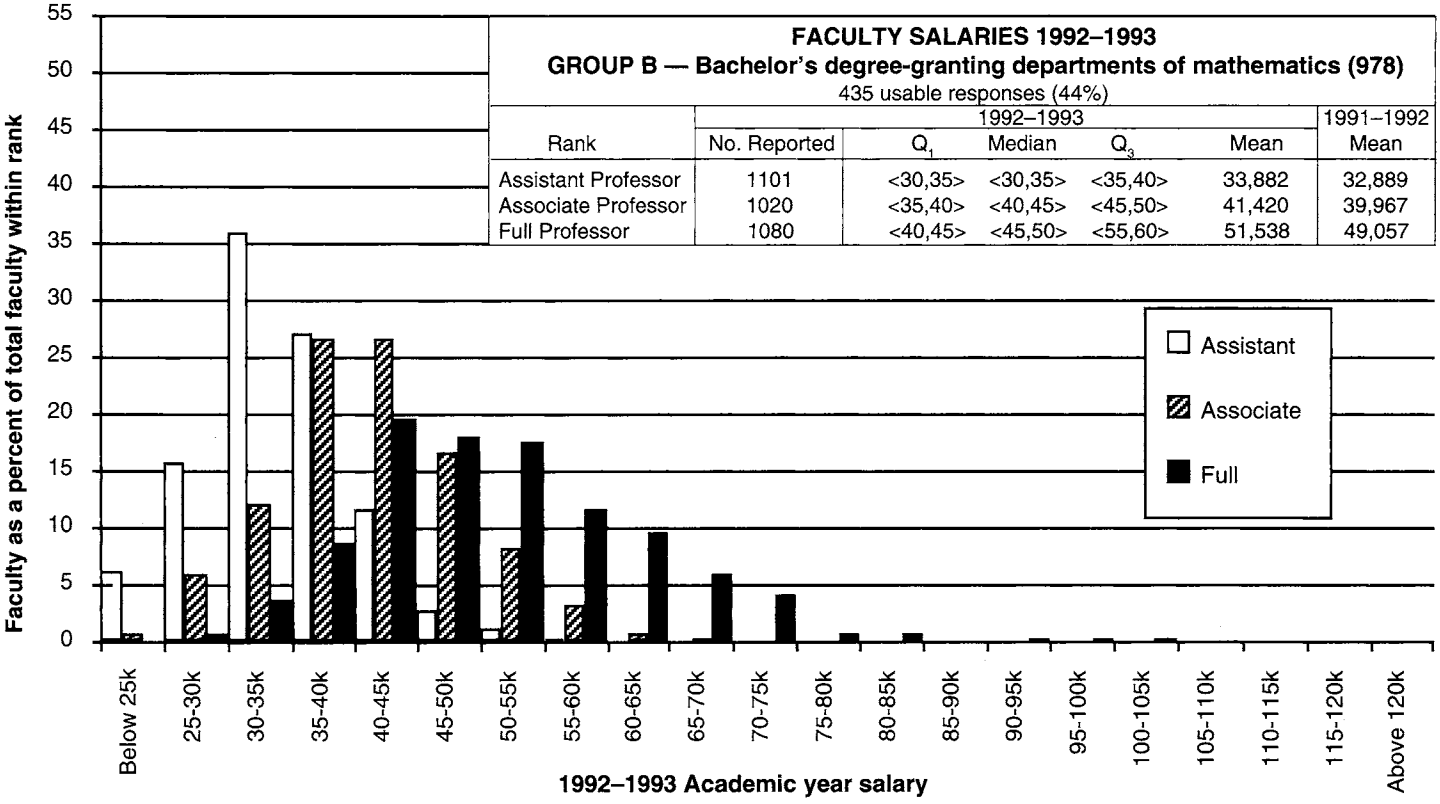



**FACULTY SALARIES 1992–1993**

**GROUP M— Master's degree-granting departments of mathematics (257)**

160 usable responses (62%)

| Rank | 1992–1993 No. Reported | $Q_1$ | Median | $Q_3$ | Mean | 1991–1992 Mean |
|---|---|---|---|---|---|---|
| Assistant Professor | 861 | <30,35> | <30,35> | <35,40> | 35,994 | 35,507 |
| Associate Professor | 1006 | <35,40> | <40,45> | <45,50> | 43,850 | 42,444 |
| Full Professor | 1178 | <45,50> | <50,55> | <60,65> | 55,257 | 53,152 |




**FACULTY SALARIES 1992–1993**
**GROUP B — Bachelor's degree-granting departments of mathematics (978)**
435 usable responses (44%)

| Rank | 1992–1993 No. Reported | $Q_1$ | Median | $Q_3$ | Mean | 1991–1992 Mean |
|---|---|---|---|---|---|---|
| Assistant Professor | 1101 | <30,35> | <30,35> | <35,40> | 33,882 | 32,889 |
| Associate Professor | 1020 | <35,40> | <40,45> | <45,50> | 41,420 | 39,967 |
| Full Professor | 1080 | <40,45> | <45,50> | <55,60> | 51,538 | 49,057 |

# Doctoral Degrees Conferred 1991–1992

The following list contains the names and thesis titles of recipients of doctoral degrees in the mathematical sciences (July 1, 1991 to June 30, 1992) reported in the 1992 Annual AMS-MAA Survey by 231 departments in 166 universities in the United States and Canada. 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 1993 issue of the *Notices*.

## ALABAMA

### Auburn University (4)

ALGEBRA, COMBINATORICS AND ANALYSIS

Gardner, Robert Bentley, *On the zeros of polynomials and Bernstein type inequalities for polynomials and related entire functions.*

Grable, David Alan, *Some applications of the probabilistic method to design.*

FOUNDATIONS, ANALYSIS AND TOPOLOGY

Darji, Udayan Babubhai, *On completely Ramsey sets and limits of differentiable functions.*

Reardon, Patrick, *Classical measure spaces in the Ellentuck and density topologies.*

### University of Alabama, Huntsville (1)

MATHEMATICAL SCIENCES

Ranasinghe, Arjuna Indraraja, *On a linearizing transformation for Burgers equation.*

### University of Alabama, Tuscaloosa (5)

MANAGEMENT SCIENCE AND STATISTICS

Ahire, Sanjay, *Special models for a one-warehouse, N-retailers inventory system.*

Lau, Ronald, *Growth and profitability of the U.S. airline industry: A Markovian analysis.*

Matson, Jack Ernest, *An object-oriented approach to software cost estimation using function point analysis.*

MATHEMATICS

Cho, Gyeong-Mi, *Stability analysis in stochastic multiple objective programming problems.*

Rigsby, Myron, *Sylow p-subgroups of pseudo-complete nilpotent groups.*

## ARIZONA

### Arizona State University (2)

MATHEMATICS

Zhu, Hsiu Rong, *The existence of stable periodic orbits for a system of 3-dimensional differential equations that are competitive.*

Zhu, Xin Jie, *Adaptive control of linear systems.*

### University of Arizona (12)

APPLIED MATHEMATICS

Alameddine, Mona Fouad, *Size structured competition models with periodic coefficients.*

Avila-Murillo, Fernando, *At integrated development of correspondence analysis with applications to environmental data.*

Campini, Marco, *The fluid dynamical limits of the linearized Boltzmann equation.*

Jin, Shan, *The semiclassical limit of the defocusing nonlinear Schroedinger flows.*

Jin, Shi, *Numerical transport in diffusive regimes.*

Pitucco, Anthony P, *Differential-geometric aspects of adapted contact structures.*

Roitner, Heinz, *Applications of the inverse spectral transform to a Korteweg-de Vries equation with a Kuramoto-Sivashinsky-type perturbation.*

Schober, Constance, *Numerical and analytical studies of the discrete nonlinear Schroedinger.*

Tsay, Jhishen, *Wave scattering in random media.*

Varatharajah, Paramanathan, *Propagation of light beams at the interface separating nonlinear diffusive dielectrics.*

MATHEMATICS

Rocha-Martinez, Jose Maria, *Discrete Imperfect repair.*

Tso, Taicheng, *The zero disperion limits of nonlinear wave equations.*

## ARKANSAS

### University of Arkansas (1)

MATHEMATICAL SCIENCES

Yaz, Ilke, *Control of discrete-time infinite dimensional systems.*

## CALIFORNIA

### California Institute of Technology (10)

APPLIED MATHEMATICS

Ammons, Richard L. M., *Mathematical control theory for liquid chromatography.*

Kaper, Tasso Jost, I. *On the structure in separatrix-swept regions of slowly modulated Hamiltonian systems.* II. *On the quantification of mixing in chaotic Stokes' flows: The eccentric journal bearing.*

Lui, Shiu-Hong, I. *Multiple bifurcations.* II. *Parallel homotopy method for the real nonsymmetric eigenvalue problem.*

Melman, Aharon, *Complexity analysis for the Newton modified barrier function method.*

VanPutten, Maurice H. P. M., *MHD in divergence form: A computational method for astrophysical flow.*

MATHEMATICS

Chen, Wei-Feng, *Birkhoff periodic orbit, Aubry-Mather sets, minimal geodesics and Lyapunov exponents.*

Ditzen, Achim, *Definable equivalence relations on Polish spaces.*

Evasius, Dean Matthew, *Carleman inequalities with convex weights.*

Naimi, Ramin, *Constructing essential laminations in some 3-manifolds.*

Qian, Nantian, *Rigidity phenomena of group actions on a class of nilmanifolds and Anosov $\mathbb{R}^n$ actions.*

### Claremont Graduate School (4)

MATHEMATICS

Converse, Cherlyn, *Lower bounds for the maximum number of stable pairings for the general marriage problem based on the latin marriage problem.*

Green, Gregory, *Confidence bounds on functions of parameters with applications to reliability theory.*

Herring, Susan, *Statistical tests for stochastic dominance.*

Wu, Binghui, *Integrated semigroup and its application to inverse problems.*

### Naval Postgraduate School (1)

OPERATIONS RESEARCH

Stephens, James, *An investigation of multivariate adaptive regression splines for modeling and analysis of time series systems.*

### Stanford University (16)

ENGINEERING-ECONOMIC SYSTEMS

Agosta, John Mark, *Probabilistic recognition networks: An application of influence diagrams to visual recognition.*

Einav, David, *Reasoning automation under resource constraints.*

Kim, Choon Shik, *Strategies for new products in fast changing high-technology markets.*

Kim, Sung Kook, *Optimal dynamic hedging and hedger's asset pricing of a state contingent asset.*

Ng, Seok-Hui, *Creating and sustaining competitive advantage: Competing through a skill base approach.*

Robinson, Douglas R., *A framework for determining optimal petroleum leasing.*

Seiver, Adam, *Decision analysis: A framework for critical care decision-making.*

Tao, Yong, *A theory of discount rate for corporate investment decision analysis.*

MATHEMATICS

Gregori, Giovanni, *Regularity estimates for equations and systems of mean curvature types.*

Hewett, Thomas, *Hermitian forms over quaternion algebras, modular invariants and* $H^*(BF_4(q), \mathbb{F}_2)$.

Katznelson, Yonatan, *The number of singular integral matrices in a region.*

Pollack, Daniel, *The extent of nonuniqueness for the Yamabe problem.*

Radunskaya, Ami, *Statistical properties of deterministic Bernoulli flows.*

OPERATIONS RESEARCH

Chan, Nathaniel Yau-Ghi, *Optimal hydraulic aquifer management with reliability constraints.*

DeCroix, Gregory Alan, *Equilibrium warranties and prices.*

Eldersveld, Samuel K., *Large-scale sequential quadratic programming algorithms.*

## University of California, Berkeley (34)

BIOSTATISTICS

Gerson, Jack Richard, *Estimating posterior distributions in the non-linear mixed model using the Gibbs sampler and the metropolis algorithm.*

MATHEMATICS

Abadie, Beatriz, *On the* $K$*-theory of the non-commutative Heisenberg manifolds.*

Bishop, Edward Evrett, *Machines and complexity over the p-adic numbers.*

Carlson, Neil Norton, *Topological defect model of superfluid vortex filaments.*

Cowan, Stuart, *Dynamical systems arising from game theory.*

Crofoot, Robert Bruce, *Multipliers between shift-invariant subspaces.*

Davis, Benjamin Mark, *Positive analytic functions and toeplitz classes.*

Gorodski, Claudio, *Closed minimal hypersurfaces in compact symmetric spaces.*

Hernandez, Alejandro, $\Omega_1$*-saturated models of stable theories.*

Hoffman, Detlev, *Function fields of quadratic forms.*

Jungreis, Douglas, *Braids, Seifert fiber spaces and Anosov flows.*

Kientzle, Timothy Brian, *Categorial generalization of classical monoid theory.*

King-Smith, Oliver Peter, *Some analytic relations between holomorphic compositions operations in* $L_1$ *and* $H_2$.

Kuprat, Andrew Paul, *Creation and annihilation of nodes for the moving finite element method.*

Lu, Tzon-Tzer, *Minimum eigenvalue separation.*

Medina, Herbert, *Hilbert space operators arising from irrational rotations on the circle group.*

Nehaniv, Chrystopher, *Global sequential coordinates on semigroups, automata, and infinite groups.*

Nistor, Victor, *A bivariant Chern-Connes character.*

Pember, Richard Bissel, *Numerical methods for hyperbolic conservation laws with stiff relaxation.*

Peterzil, Ya'acov Amos, *Some definability questions in structures over the reals and in general* $\infty$ *minimal structures.*

Rida, Ahmed-Said, *On subfactors with the generating property and graphs.*

Rowan, William Haynie, *Enveloping ringoids of universal algebras.*

Schaefer, Edward Frank, *Class groups and Selmer groups.*

Schirokauer, Oliver, *On pro-finite groups and on discrete logarithms.*

Starr, Edith N., *Curves in handlebodies.*

Tau, Yu, *Numerical study of Stokes flows with suspended particles.*

Vineberg, Susan Nicolet, *Conditionalization and rational belief change.*

Zeitz, Paul, *Rank-one actions.*

Zidaritz, Adrian, *Composition operators acting on measures.*

STATISTICS

Bajamonde, Alex Catane, *On efficient and robust estimation in semiparametric linear regression models with missing data.*

Bose, Smarajit, *A method for estimating nonlinear class boundaries in the classification problem and comparison with other existing methods.*

Guerra, Rudy, Jr., *Statistical methodology for the estimation of species distances as indicated by DNA-DNA hybridization.*

Nguyen, Trang Diem, *Statistical models and methods in molecular evolution.*

Zhou, Bin, *Analysis of volatile time series, with reference to foreign exchange rates.*

## University of California, Davis (4)

MATHEMATICS

El-Ekhtiar, Ali Ali Ali, *Integral geometry in Minkowski spaces.*

Iseri, Howard, *Least area and minimal annuli with singular boundaries.*

Klebanoff, Aaron, *Chaos in three species food chains.*

Nguyen, Nam Duc, *Decision problems for some tag systems.*

## University of California, Irvine (5)

MATHEMATICS

Acosta, Victor, *Analyticity of the density of states in the Anderson model on the Bethe lattice.*

Ho, Tony, *Derivations of Jordan Banach triples.*

Hudgins, Lonnie H., *Wavelet analysis of atmospheric turbulence.*

Jones, Donald A., *Determining nodes and long time approximations to the Navier-Stokes equations.*

Lao, Norman Yung-Pei, *A numerical approximation on the norms of integral operators.*

## University of California, Los Angeles (27)

BIOSTATISTICS

English, Patricia Ann, *Extreme tail robustness of the* $T$*-statistic.*

Kim, Dong Kee, *Regression models for overdispersed binomial data.*

Sun, Guo-Wen, *Markov renewal proportional hazards models model for longitudinal survival data.*

Wang, Chao, *Nonlinear multivariate analysis of variance with application to event-related potential studies.*

Wang, Yongxiao, *Structural covariance models for longitudinal data with smoothing techniques.*

MATHEMATICS

Borzellino, Joseph Ernest, *Riemannian geometry of orbifolds.*

Burke, Douglas R., *Stationary sets and towers.*

Chang, Shaoping, *Hypersurfaces of constant scalar curvatures in spheres.*

Chang, Yu-chung, *Comparison of finite difference and the pseudo spectral approximation for hyperbolic equations and implementations on the connection machine.*

Chen, Jian-Shen, *Confidence intervals for parametric functions in nonlinear regression.*

Darwin, Sophia Katharine, *Construction and properties of difference sets and related designs.*

Donato, June, *Analysis and design of iterative methods for scalar and systems of elliptic equations.*

Gebelt, Nicholas Watts, *The Bergman kernel on certain weakly pseudoconvex domains.*

Grieser, Daniel, $L^p$ *estimates for eigenfunctions and spectral projections of the Laplacian near concave boundaries.*

Koh, Liang-Khoon, *Geometric quantities and topological structures of Riemannian manifolds.*

Kuang, Weijia, *Resistive instabilities in rapidly rotating fluids.*

Liedahl, Steven, *$Q(i)$-division rings and admissibility.*

Melas, Antonios, *Some properties of eigenfunctions and eigenvalues of the Laplacian.*

Montgomery, Peter Lawrence, *An FFT extension of the elliptic curve method of factorization.*

O'Hara, Paul Patrick, *Gaps in the range of the stable processes.*

Okikiolu, Kate, *The analogue of the strong Szegő limit theorem for the torus and for the three-sphere.*

Reider, Marc B., *Development of higher order numerical methods for two-dimensional incompressible flow with applications to flows around circular cylinders and air foils.*

Schimmerling, Ernest, *Combinatorial principles in the core model for one Woodin cardinal.*

Sinclair, Rodney, *Thermodynamics of quantum and classical Liouville equations.*

St. Pierre, Martin, *On the numerical simulation of rapidly rotating, strong fields dynamos.*

Tong, Boning, *Uniformly high order strictly non-oscillatory numerical schemes for the hyperbolic conservation laws.*

Xu, Geng, *Subvarieties of general hypersurfaces in projective space.*

## University of California, Riverside (5)

MATHEMATICS

Ahn, Sung Hun, *Asymptotic primes and grade functions.*

Allen, Joseph Norbert, *Curvature of intrinsic measures on complex manifolds.*

Ushijima, Kazuchika, *A ring representing a finite projective geometry.*

STATISTICS

Bentley, James, *Change-point estimation in logistic regression.*

Lucas, Thomas William, *Robust Bayesian inference when the data conflicts with the prior.*

## University of California, San Diego (19)

MATHEMATICS

Beaulieu, Raymond Anthony, *Extensions of Noetherian rings: Bounds, Morita contexts, and exact embeddability.*

Benbourenane, Mohamed, *The hierarchical basis multigrid method for convection-diffusion equations.*

Bloom, Laura Anne, *Bijective combinatorial methods in the comparison of optimal algorithms.*

Fierro, Ricardo D., *Collinearity and total least squares.*

Franks, Edwin Samuel, *Polynomially subnormal operator tuples.*

Harland, John Ro, *Nevanlinna-Pick interpolation with topological constraints.*

Hashemi-Asasi, Siamak, *Nevanlinna-Pick interpolation on Sobolev spaces with boundary conditions.*

Hwang, Yoon Sung, *The corestriction of valued division algebras over Henselian fields.*

Jensen, Anders, *Quotient rings and embeddings of Noetherian rings.*

Meylan, Francine, *Reflection principle in complex space for some class of hypersurfaces and mappings.*

Patton, Linda J., *Interpolation of Nevanlinna-Pick type on the boundary of the polydisc.*

Poulos, Steven Christopher, *Graph theoretic and spectral properties of finite upper half planes.*

Santos, Rafael, *Moving space-time finite element methods for convection-diffusion problems.*

Shick, Jonathan Edward, *Quadratic forms over function fields of elliptic and hyperelliptic curves.*

Shimozono, Mark Masami, *Littlewood-Richardson rules for ordinary and projective representations of symmetric groups.*

Tao, David, *A variety associated to an algebra with involution.*

Whitehead, Sara Tamsen, *The computation of Kronecker products and transition matrices.*

Xiao, Bing, *New bounds in cell probe model.*

Yarbrough, Mark G., *The structure of the doubly adjacent gray code for the symmetric group.*

## University of California, Santa Barbara (12)

MATHEMATICS

Bratholdt, James Stuart, *The topology of character varieties of representations into* $SL_2$.

Doll, Helmut Richard, *A generalization of bridge number to links in arbitrary three manifolds.*

Grady, Michael James, *Congruence patterns in subgroup counting functions.*

Keller, Paul Stanley, *Omega-limit sets of various classes of real functions.*

Lorica, Benjamin Tito, *Differential geometry and orbits in mechanical systems.*

Papadopoulos, Caroline Anne, *An alternating iteration method for the solution of certain free boudnary value problems.*

Song, Young-Seop, *On modules of vector-valued functions.*

STATISTICS AND APPLIED PROBABILITY

Gross, Aaron, *Ergodic properties of some stationary infinitely divisible stochastic processes.*

Kozubowski, Tomasz J., *The theory of geometric stable distributions and its use in modeling financial data.*

Liu, Wei, *Sensibility and stability of posterior quantities.*

Panorska, Anna Katarzyna, *Generalized convolutions.*

Wu, Chufang, *The theory of Marshall-Olkin stable laws.*

## University of California, Santa Cruz (4)

MATHEMATICS

Imamoglu, Ozlem, *Theta functions and the Kubota homomorphisms for* $\mathrm{Sp}(2n, O(i))$.

Lou, Shu-xian, *The second order asymptotics of a class of integral operators with discontinuous symbols.*

Tappero, Susan L., *Saddlepoint characterizations of solutions to semilinear operator equations.*

Thorsen, Bobette Hayden, *An asymptotic expansion for the trace of certain integral operators.*

## University of Southern California (5)

MATHEMATICS

Jochner, Michael Paul, *Representations by definite quadratic forms.*

Mao, Chaolin, *An approximation theory for the identification of nonlinear degenerate distributed parameter systems.*

Pei, Xiang, *Flux for incompressible stochastic flows in the plane.*

Quenell, Gregory Tyler, *Trace-formula methods in the spectral theory of graphs.*

Rolke, Wolfgang, *Entropy in probability and statistics.*

# COLORADO

## Colorado School of Mines (1)

MATHEMATICAL AND COMPUTER SCIENCES

Katz, Joseph H., *An algorithm for solving a class of nonlinear, unconstrained, multivariable, signomial optimization problems using geometric programming.*

## Colorado State University (6)

MATHEMATICS

Hasan, Mohammed, *Bifurcation problems in nonlinear programming.*

Oliver, Dale, *Spreads in $PG(3, q)$ admitting $Cq^2 - 1$ and related association schemes.*

Poje, Mia, *Some free cyclic group actions on the 3-sphere.*

Rijavec, Nenad, *A Lagrangian relaxation algorithm for some multidimensional assignment problems.*

STATISTICS

Breidt, F. Jay, *On the structure of innovations for non-Gaussian linear processes.*

Chen, Changhua, *Model selection and missing value estimation in time series analysis.*

### University of Colorado, Boulder (8)

APPLIED MATHEMATICS

Allan, Fathi, *Numerical investigations of the transition to turbulence in the Balsius.*

Nesbitt, Martha, *The dynamics of shooting methods for solving Sturm-Liouville problems.*

MATHEMATICS

Almada, Carlos, *Harmonic reductions in principle fiber bundles.*

Husain, Ali Ojan, *Orthogonal grid generation in three dimensions.*

Hyndman, Jennifer P., *Cover pairs in the lattice of interpretability types of varieties.*

Knill, Emanuel, *Generalized degrees and densities for families of sets.*

Lundy, Thomas, *The inverse of L-matrices.*

McDonald, Brian E., *Towards a meaningfulness and truth: An introduction to variational semantics (a provisional essay).*

### University of Colorado at Denver (2)

MATHEMATICS

King, Hugh, *A method of system identification applied to a simulation of human exercise.*

Otto, James, *Multilevel methods for the solution of advection-dominated elliptic problems on composite grids.*

### University of Northern Colorado (1)

MATHEMATICAL SCIENCES

Chattamvelli, Rajan, *A comparison of selected algorithms for four noncentral statistical distributions.*

## CONNECTICUT

### University of Connecticut (8)

MATHEMATICS

Feng, Yanling, *The study of nonlinear flexings in a floating beam by variational methods.*

LaBarre, Robert, *Computational geometry techniques for 2D and 3D unstructured mesh generation with application to the solution of divergence form partial differential equations.*

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

Pan, Zhidong, *Properties of nest algebras.*

Weber, Frank Peter, *Invariant constructions in the relative r.e. degrees and embeddings into initial segments of the lattice of ideas of r.e. degrees.*

Xiao, Ding, *Numerical analysis of mappings associated with positive definite Toeplitz matrices.*

Yu, Xun, *Investigation of steady state solutions for electrochemical processes.*

STATISTICS

Yiannoutsos, Constantin T., *Sampling based approaches for marginalization, conditioning and propagation of information in dependence networks.*

### Wesleyan University (3)

MATHEMATICS

Johnson, Paul, *Functors of sub-descent type.*

Molitor, Andrew, *Covers of compact Hausdorff spaces via localic methods.*

Zivkovic, Dejan, *Non-probabilistic techniques in circuit complexity.*

### Yale University (8)

MATHEMATICS

Cameron, John Alexander, *The reduction of Einstein's equations on spacetimes with spacelike $U(1)$ isometry groups.*

Epelbaum, Yonathan, *Knottings of orientable surfaces in 1-connected 4-manifolds.*

Mac Manus, Paul Raymond, *Quasi conformal mappings on Ahlfors-David curves.*

Nahmod, Andrea Rica, *Geometry of operators and spectral analysis.*

Walden, Byron Lee, *$L^p$ Integrability of derivatives of Riemann mappings on Ahlfors-David regular curves.*

STATISTICS

Crowley, Evelyn Mary, *Estimation of clustered parameters.*

Mohanty, Surya Prakash, *Detecting bimodality using the minimal spanning tree.*

Riceman, David, *An estimator for the linear model.*

## DELAWARE

### University of Delaware (6)

MATHEMATICAL SCIENCES

Borkowski, John J., Jr., *The evaluation of mixed resolution designs.*

Ju, Huey Lin, *Split plotting and randomization in industrial experiments.*

Mehrotra, Devan, *Circularity diagnostics for repeated measures designs.*

Snikeris, Alfred Christian, *Bioequivalence as a linear structural relationship estimation of formulation intersubject and intrasubject variability and a two-step method for asessing bioequivalence.*

Tong, Zengxiang, *Existence of discontinuous optimal solutions for infinite horizon problems in optimal control and calculus of variations.*

Zhao, Yagu, *Operator theory of the Drazin inverse.*

## DISTRICT OF COLUMBIA

### American University (1)

MATHEMATICS AND STATISTICS

Ellis, Nancy F., *The effect of in-class study groups on achievement and course completion rates in developmental algebra classes.*

## FLORIDA

### Florida Institute of Technology (2)

APPLIED MATHEMATICS

Kiaer, Lynn C., *Discrete optimization strategies for timetabling.*

Koksal, Semen, *Nonuniform boundedness and stability properties of the solutions of the systems of ordinary differential equations.*

### Florida State University (7)

MATHEMATICS

Coulliette, David Lee, *Initiation and development of creeping thermal plumes.*

Edelstein, Eric E., *Singularities in high codimensional decompositions over generalized manifolds.*

STATISTICS

Antoine, Robin, *Identifiability in the autopsy model of reliability theory.*

Kurien, T. V., *Limit theorems for Markov random fields.*

Lee, Sau-Chi, *Estimation and testing of some nonlinear time series biological population models.*

Narasimhan, B., *Optimal search in an ordered array.*

Zhang, Mei-Jie, *Cumulative regression function methods in survival analysis and time series.*

### University of Florida (13)

MATHEMATICS

Basavaraj, Udai, *Screw problems in blocking sets.*

Gu, Xiao-Ping, *Hausdorff dimension of some invariant sets.*

Kitto, Cyrus L., *Some problems in blocking sets.*

Kitto, Wei Z., *An isomorphism theorem between the extended generalized balanced ternary numbers and the p-adic integers.*

Reinke, Edward, *Integration of locally convex valued functions.*

Shihai, Li, *Chaos, recurrence and inverse limit spaces.*

STATISTICS

Baskin, Robert, *Confidence sets for functions of variance components in a mixed linear model.*

Capen, Robert, *Exact testing procedures for unbalanced random and mixed linear models.*

Chung, Daehyun, *Baseline hazard junction in Cox's regression model under order restriction.*

Lang, Joseph, *On model fitting for multivariate polytomous response data.*

Namgung, Yearnok, *The effects of an option-3 measurement scheme in detecting changes in longitudinal data.*

Pikounis, William, *Two-sample problems in survival analysis.*

Sun, Fangshi, *Bayesian approach to the adaptive DPCM for AR(P) and two-dimensional AR(1,1) model.*

### University of South Florida (3)

MATHEMATICS

Budzban, Gregory M., *Weak convergence of convolution iterates of probability measures on topological semigroups.*

He, Xisheng (Matthew), *Weighted polynomial approximation and zeros of Faber polynomials.*

Sun, Jung-Fan, *On some general polynomials over finite fields.*

## GEORGIA

### Emory University (1)

MATHEMATICS AND COMPUTER SCIENCE

Eaton, Nancy, *Some results in graph Ramsey theory and graph representations.*

### Georgia Institute of Technology (7)

MATHEMATICS

Arrieta, Jose M., *Spectral properties of Schrodinger operators under perturbations of the domain.*

Arrigo, Daniel J., *Group properties of a Monge-Ampère type equation.*

Green, Edward L., *Spectral theory of Laplace-Beltrami operators with periodic metrics.*

King, James F., *Dimension characteristics for invariant measures.*

Kuai, Wenming, *Neural networks constructed using families of dense subsets of $L_2(R)$ functions and their capabilities in efficient and flexible training.*

Kwek, Keng-Hut, *On Cahn-Hilliard type equation.*

Van Vleck, Eric S., *Random and numerical aspects of the shadowing lemma.*

### University of Georgia (9)

MATHEMATICS

Lovorn, Renet, *Rigorous, subexponential algorithms for discrete logarithms over finite fields.*

STATISTICS

Bau, Jiin Jonp, *Subset selection procedure with a statistical test.*

Guo, Jiin Huarng, *Causal autoregressive processes on a plane.*

Hwang, Sun Young, *Asymptotic optimal inference for a class of nonlinear time series models.*

Park, You Sung, *Extreme value theory for queueing processes and related discrete valued stochastic processes.*

Sethuraman, Sankar, *Statistical inference for spatial time series with long range dependence.*

Thiruvaiyaru, Dharma, *Some problems of inference for queueing systems and networks.*

Zhang, Hu-Ming, *Developments and applications of the law of the iterated logarithm.*

Zhao, Zhen, *Nonhomogeneous Markov models for the AIDS epidemic.*

## HAWAII

### University of Hawaii (1)

MATHEMATICS

Perry, Patrick Neal, *A covering space approach to (d.K.) constrained codes.*

## IDAHO

### Idaho State University (1)

MATHEMATICS

Woldmedhin, Delelegne, *The Schwarzian derivative in the theory of univalent functions.*

## ILLINOIS

### Illinois Institute of Technology (2)

MATHEMATICS

Feigl, Kathleen A., *Numerical simulation of a KBKZ fluid in a four-to-one axisymmetric contraction domain.*

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

### Illinois State University (3)

MATHEMATICS

Army, Patricia D., *An approach to teaching a college course in trigonometry with applications and graphing calculators.*

Becker, Barbara A., *The concept of function: Misconceptions and remediation at the collegiate level.*

Chumni, Wichai, *A discrete mathematics course for the first two years of study.*

### Northern Illinois University (4)

MATHEMATICAL SCIENCES

Schell, Vicki, *An investigation of the role of symmetry in partitioning tasks.*

Tsutsui, Hiseya, *The structure of rings all of whose ideals are prime.*

Wang, Rongdon, *Absolute stability of nonlinear differential systems.*

Wilkins, David, *Some results on the Mackey dual of a Banach space.*

### Northwestern University (4)

MATHEMATICS

Bauer, John, *Toward a proof that Ashley's matrix is a counterexample to William's conjecture.*

Hetzler, Steven, *An entropy for elements of the rotation set of a lift of a torus homeomorphism.*

Langsetmo, Lisa, *K-theory, $v_1$-periodic homotopy, and localization.*

Ratliff, Thomas, *Congruence subgroups and elliptic cohomology.*

### Southern Illinois University (7)

MATHEMATICS

Bassam, Issa, *An approach to coincidence theory through regular covering spaces.*

Eubanks, David Allen, *Wavelet transforms with translation parameter on* **Z** *and* **R**.

Liu, Hetao, *On a class of partial integro-differential equations and applications in viscoelasticity.*

Park, Mihee, *Permutations for the mixed radix FFT and FHT.*

Schroeder, Marcin, *Dependence systems.*

Van Fleet, Patrick Joe, *Numerical evaluation of multivariant spline functions.*

Zhang, Bo, *Periodic solutions of nonlinear abstract differential equations with infinite delay.*

### University of Chicago (8)

MATHEMATICS

Daskalopoulos, Panagiota, *The Cauchy problem for generalized porous medium equations.*

Fine, Benjamin Lee, *Disconnected equivariant rational homotopy theory and formality of G-Kähler manifolds.*

Goodman, Albert J., *Automorphism groups of graphs: Asymptotic problems.*

Gutschera, Karl Robert, *Ergodic elements for actions of Lie groups.*

Keenan, Philip Thomas, *Thermal simulation of pipeline flow.*

Mildenhall, Stephen J. M., *Cycles in a product of curves.*

Pommersheim, James Erik, *The Todd class of a simplicial toric variety, Dedekind sums, and lattice points in a tetrahedron.*

Seydoux, Guillaume, *Rigidity of ergodic volume-preserving actions of semisimple groups of higher rank on compact manifolds.*

## University of Illinois, Chicago (18)

MATHEMATICS, STATISTICS AND COMPUTER SCIENCE

Abual-Rub, Said Marwan, *Non-linear partial differential equations applied to diffusion problems arising in Mathematical biology.*

Afenya, Kwasi Evans, *Modelling abnormal granulocytopolesis and it's chemotherapy.*

An, Jianbei, *2-weights for finite general linear groups and 2-blocks.*

Chai, Feng-Shun, *On the construction and optimality of linear trend-free and nearly trend-free designs.*

Cirulis, Astrida, *Three prospective elementary teachers' belief and the impact of their mathematics courses.*

Ferreirim, Marie Andre' Isabel, *On varieties and quasivarieties of hoops and their reducts.*

Holland, Kitty, *Geometries associated with strongly minimal theories.*

Jarvis, Dennis J., *Performance and application of multiprocessor systems.*

Kunin, Boris, *A probabilistic model for predicting scatter in brittle fracture.*

Mei, Jing-Dong, *Asymptotic approach to the performance analysis of closed queueing.*

Messmer, Margit, *Groups and fields interpretable in separably closed fields.*

Naimipour, Kumarss, *Numerical convergence for the Bellman equation of stochastic optimal control with quadratic costs and constraints.*

Shi, Niadong, *Construction of stable and omega-stable pseudoplanes.*

Sun, Feng, *Linear separation of stable sets in graphs.*

Tan, Ruby Q., *On Hilbert transforms, cardinal interpolation and Bernstein's inequality.*

Tsai, Han-Ping, *Existence of certain extremal self-dual codes.*

Xu, Huihuang, *Data parallel methods in large scale scientific computations.*

Zabric, Eva, *Hall polynomials for sympletic groups.*

## University of Illinois, Urbana-Champaign (19)

MATHEMATICS

Aldaz, Jesus, *Representations of measures via the standard part map.*

Bachman, Gennady, *On the coefficients of cyclotomic polynomials.*

Blaylock, Richard, *Some results on e-genericity and recursively enumerable weak truth table degrees.*

Bu, Qiyue, *On initial-boundary value problems for the non-linear Schrödinger equation and the Ginzberg-Landau equation.*

DeCastro, Rodrigo, *Combinatorial principles in second order theories of bounded arithmetic.*

Foguel, Tuval, *Finite groups with a special 2-generator property, and order of centralizers in finite groups.*

George, John, *1-factorizations of tensor products of graphs.*

Haputantirige, Sunil Gunaratne, *Generalized Kummer congruences and Iwasawa invariants.*

Kugendran, Thambithura, *Quasiconvex optimization via generalized gradients and symmetric duality.*

Kwon, Ki-Ho, *Growth comparisons for certain Nevannlinna theory functionals.*

Lee, Jinsik Mok, *Geometrical and martingale characterizations of UMD and Hilbert spaces.*

Lichtblau, Daniel, *Invariant proper holomorphic maps between balls.*

Pe, Joseph, *Polynomial time Martin-Löf type theory.*

Pudaite, Paul, *Explicit mathematical models for behavioral science theories.*

Snevily, Hunter, *Combinatorics of finite sets.*

STATISTICS

Amarasinghe, Upali Ananda, *Comparison of several curves in the context of nonparametric regression.*

Chang, Hua-Hua, *Some theoretical and applied results concerning item response theory model estimation.*

Huang, Bidan, *Design, estimation, and prediction of computer experiments with applications of spatial data.*

Park, Jeong Soo, *Tuning complex computer codes to data and optimal designs.*

# INDIANA

## Indiana University (11)

MATHEMATICS

Chen, Min, *Incremental unknown methods.*

Collet, Jean-Francois, *On the existence and regularity of the solutions of a system of conservation equations arising in oil engineering.*

Lee, Chan-Ho, *Iterated random maps and nonlinear autoregressive time series models.*

Mu, Jun, *Regularity of solutions of degenerate variational inequalities.*

Niyikiza, Clet, *Multivariate Behrens-Fisher problems with constraints on the covariance matrices.*

Sun, Shan, *Asymptomatic behavior of the perturbed empirical quantiles and perturbed empirical distribution functions.*

Tarpey, Thaddeus, *Principal points.*

Usadi, Karin M., *On the classification of equivariant surface maps.*

Wachsmuth, Bert, *On the degenerate Monge Ampère equation.*

Wang, Shi-Lin, *Distribution and norm-inequalitie of Littlewood-Paley operators.*

Yan, Jun, *Fixed design nonparametric regression for linear process.*

## Purdue University (32)

INDUSTRIAL ENGINEERING

Bringelson, Liwana, *Group mental model transfer.*

Eneyo, Emmanuel, *An integrated knowledge-based approach to maintenance control systems for automated manufacturing.*

Jahn, Chungen, *Concurrent design for constraint-oriented permanent assembly.*

Kaiser, Mark, *Centers of convex bodies.*

Kim, Chang, *The operation of an automated guided vehicle system in a manufacturing job shop.*

Mooney, Ed, *Tabu search heuristics for resource scheduling with course scheduling applications.*

Ng, Peh, *Leontief flow problems: Integrality properties and strong extended formulations.*

Noble, James, *A framework for the design justification material handling systems.*

Rais, Abdur, *The 2-connected Steiner subgraph problem.*

Veeramani, Dharmaraj, *Physical resource management in large computer-controlled manufacturing systems.*

Ye, Nong, *Development and validation of a cognitive model of human knowledge system: Toward an effective adaptation to differences in cognitive skills.*

MATHEMATICS

Chen, Zhangxin, *On the relationship between mixed and Galerkin finite element methods.*

Cleveland, Bennett W. Jr., *Pre-wavelets and image compression.*

Goonetilleke, Mestiyage Don Lasantha, *Characteristic numbers and equivariant homotopy type.*

Hensley, Jeffrey, *Scattering of Type II Biot waves in inhomogeneous media.*

Jeong, Moonja, *Approximation theorems on mapping properties of the classical kernel functions of complex analysis.*

Keirouz, Malhab Chafic, *Electrostatics and the index of vector fields.*

Kim, Hyoungsoon, *Semicontinuity for unbounded operators affiliated with operator algebras.*

Ma, Peiming, *Local boundary regularity of the Bergman projection in non-pseudoconvex domains.*

Park, Mikeung, *On estimates for the tangential Cauchy-Riemann operator on weakly pseudoconvex CR-manifolds.*

Raghavan, K. N., *Uniform annihilation of local cohomology; powers of ideals generated by quadratic sequences.*

Sadraoui, Houcine, *Hyponormality of Toeplitz operators and composition operators.*

Sheen, Dong-Woo, *Absorbing boundary conditions for wave transmissions.*

Wong, Ngai-ching, *The left quotient of a $C^*$-algebra and its representation through a continuous field of Hilbert spaces.*

Zhang, Yitang, *The Jacobian conjecture and the degree of field extension.*

STATISTICS

Basu, Sanjib, *Robustness of Bayesian and classical inference under distribution bands and shape restricted families.*

Hande, Sayaji Namdeo, *Contributions to nonparametric selection and ranking procedures.*

Hwang, Jinsoo, *Sequential estimation for the proportional hazards model in the presence of nuisance parameters.*

Mueller, Peter, *Numerical integration in Bayesian analysis.*

Pliego, German J., *Curve fitting through orthogonal wavelets.*

Sun, Dongchu, *Bayesian sequential reliability for Weibull and related distributions.*

Zen, Mei-Mei, *Bayesian inference with nonconjugate priors.*

### University of Notre Dame (7)

MATHEMATICS

Besana, Gian Mario, *The geometry of quadric fibrations arising in adjunction theory.*

Chowdhury, Ambar Kumar, *On the number of non-isomorphic models of size $|T|$.*

Chowdhury, Mary, *Rank* I *preserving maps on the unitary Lie ring over a discrete valuation ring.*

Low, Leefong, *Some properties of geometrically simple state theories.*

Olson, Roger, *The coefficient of $t^{-n}$ in the asymptotic expansion of the local trace of the heat kernel for the $\overline{\partial}_b$-Laplacian on $(0,1)$-forms on a compact strictly pseudoconvex CR manifold.*

Spalinski, Jan, *Strong homotopy theory of cyclic sets.*

Wang, Kaining, *The heat equation for a sum of squares of vector fields.*

## IOWA

### Iowa State University (7)

STATISTICS

Lu, Chi-Hsien Joseph, *The use of degradation measures in assessing reliability.*

Medak, Frederick Martin, *Heirarchical testing using the power-divergence family of statistics.*

Robison-Cox, James Franklin, *Order statistics under linear trend.*

Tiro, Muhammad Arif, *Edgeworth expansion and bootstrap approximation for $M$-estimators of linear regression parameters with increasing dimensions.*

Ver Hoef, Jay Michael, *Statistical analysis of spatial pattern in ecological data.*

Wang, Kui-Jang, *Contributions to design of experiments.*

Wang, Morgan Chung-Ching, *Numerical methods for self-validating computation of probabilities and percentiles in selecting distributions using interval analysis.*

### University of Iowa (21)

APPLIED MATHEMATICAL SCIENCES

Chi, Mei-Hsiu, *Linear semi-infinite programming methods for robot trajectory planning problems.*

Suelzer, Michael T., *Analysis of human quantitative judgement: Models of sequential magnitude estimation.*

Zhen, Huang, *Mathematical models and algorithms for distribution system design and operation.*

MATHEMATICS

Chi, Mei-Hsiu, *Linear semiinfinite and nondifferentiable programming methods for robot trajectory planning problems.*

Doucette, Robert, *Boundary integral equation methods for solving Laplace's equation with non-linear boundary conditions on a polygon.*

Gao, Linda, *Disease transmission models with density dependent demographics.*

Ho, Yue-Chan, *Some results on rings generated by semigroups.*

Hu, Zhibao, *Some properties related to the Radon-Nikodým property in Banach spaces.*

Huang, Zhen, *Mathematical models and algorithms for distributions systems design and operation.*

Kim, Donggyun, *Quadratic lifting of supercuspidal representation of* $\mathrm{GL}_2$.

Knopp, Kent, *Ideals generated by powers of elements.*

Lee, Eun Ho, *On the lattice of semigroup whose proper right congruences form a tree.*

Mastrangelo-Puech, Laura, *On radicals of triangular operator algebras.*

Naseer, Muhammad, *Colorings of commutative rings.*

Qiu, Chaoxin, *$K$-theory for triangular operator algebras.*

Radloff, Kathryn, *Properties of arrangement which are related to asphericity.*

Smith, Karen, *Generalized braid arrangements and related quotient spaces.*

Suelzer, Michael, *Analysis of human quantitative judgement: Models of sequential magnitude estimation.*

Teo, Beng-Chong, *On the spherical widths of metric balls in complete Riemannian manifolds.*

Van Ark, James, *Analysis of epidemiological models with heterogeneity.*

Zhang, Wenyao, *Some geometric and topological properties in Banach spaces.*

## KANSAS

### Kansas State University (2)

MATHEMATICS

Li Hung, Peiqing, *Investigation of some ill-posed and inverse problems.*

Taghavi, Mohsen, *Lower bounds for the correlation coefficients of Rudin-Shapiro polynomials.*

### University of Kansas (6)

MATHEMATICS

Chen, Yuanqian, *Lattice-ordered groups.*

LaBerge, Timothy J., *ACRIN spaces, Ostaszewski spaces, and preservation of normality.*

Lin, Shinemin, *Lattice-ordered groups.*

Mooney, Douglas D., *Applications of prime open filters to the theory of $H$-closed extensions.*

Nelson, David George, *Indecomposable root systems and lattice-ordered groups.*

Wu, Hongyou, *Submanifold geometry, nonlinear partial differential equations and Banach loop groups.*

### Wichita State University (2)

MATHEMATICS

Powell, Jeffrey, *Some inverse boundary value problems.*

Sinclair, Paul, *Metrics on bundle spaces and harmonic Gauss maps.*

## KENTUCKY

### University of Kentucky (9)

MATHEMATICS

Bennett, Karin Remington, *Parallel collocation methods for boundary value problems.*

Bigdel, Fariba, *Regular triangulations of convex polytopes and $d$-cubes.*

Fernandes, Ryan Ivan, *Alternating direction implicit finite element methods for solving time dependent problems.*

Hatfield, Barbara, *Gradient estimates for the capillary problems.*

Park, Sangwon, *The Macaulay-Northcott functor.*

Pupplo-Cody, Evelyn, *A structural formula for a class of typically real functions and some consequences.*

Robinson, Mark P., *Numerical solution of Schrödinger equations using finite element methods.*

STATISTICS

Rahman, Mahibbur, *Some contributions to goodness of fit tests and nonparametric estimation of variance.*

Zhong, Jianhua, *Some contributions to the spherical regression model.*

## LOUISIANA

### Louisiana State University (4)

MATHEMATICS

Kingan, Robert, *Tournaments and ideal class groups.*

Lee, Jung Soon, *Fourier transform and heat equation in white noise analysis.*

Moss, James D., *Special polarizations in nilpotent Lie algebras.*

Wargo, Lawrence, *Some results on minors for graph and matroids.*

### Tulane University (2)

MATHEMATICS

Doucet, Julien, *Zigzag continua.*

Lung, Chien-An, *The nuclear cusp condition in spin polarized Thomas-Fermi theory.*

### University of Southwestern Louisiana (9)

MATHEMATICS

El-Kassar, Nasser, *Generalizations of Lehmer's equations, greatest common divisor matrices and Euler's totient for a UFD.*

Fox, Dorene J., *Translatable groups and the Graev operator.*

Jan, Chen-Huan Jack, *Expression parsing and rigorous computation of bounds on all solutions to practical nonlinear systems.*

Ke, Lan, *Nonquenching, quenching, and beyong quenching.*

Prejean, Jennifer Marie, *Point semiuniformities.*

STATISTICS

Elfessi, Abdulaziz, *Some point estimation problems in a decision-theoretic setup.*

Guo, Ying-Yueh, *Decision theoretic point estimation in a multivariate normal distribution.*

Jin, Chun, *Equivariant point and confidence estimation of a multivariate normal mean vector using a normal concomitant vector for covariance adjustment with applications.*

Sapkota, Sijan, *Sensitivity of Klaasen's spread inequality to the choice of prior distribution.*

## MARYLAND

### Johns Hopkins University (13)

BIOSTATISTICS

Bilker, Warren, *Statistical methods for cross-sectional survival data.*

Chang, Yue-Cune, *The trade-off between bias and precision: Some statistical considerations.*

Tsou, Tsung-Shan, *Robust likelihoods.*

MATHEMATICAL SCIENCES

Chan, Onn, *The Grassman manifold and statistics.*

Gabriel, Steven A., *Algorithms for the nonlinear complementarity problem: The NE/SQP method and extensions.*

Merino, Dennis I., *Topics in matrix analysis.*

MATHEMATICS

Abramson, Gabrielle, *A model's theorem for multicategorical realizations.*

Kashiwabara, Takuji, *On the complex cobordism and infinite loop spaces.*

Mao, Yiping, *Poisson kernel on noncompact harmonic manifolds and spherical mean operators.*

Martin, Roland, *Generalized Igusa localization zeta functions associated to enlarged connected Chevalley $K$-groups of type $A_l$, $B_l$, $C_l$, $P_l$, $E_6$, $E_7$, $E_8$, $F_4$, $G_2$, and their functional equations.*

Morishita, Masanori, *Toward non-abelian Kummar theory.*

Nelles, Françoise, *Syzergies among the Plücker relation.*

Soh, Sun Tae, *Formal factorization of prime ideals.*

### University of Maryland, College Park (25)

MATHEMATICS

Carmona, Sara Ianda Correa, *A large deviations principle and wave front propagation for a reaction-diffusion equation.*

Collins, James Patrick, III, *Implicit-explicit Godunov schemes for unsteady gas dynamics.*

Garibay-Bonales, Fernando, *Perturbations of the time one map of an Anosov flow.*

Goldberg, David, *Reducibility of individual representations for classical p-adic groups.*

Graubard, Barry I., *Statistical methods for the analysis of complex survey data with biomedical applications.*

Guo, Xian-Zhong, *Multilevel preconditioners: analysis, performance, enhancements and parallel algorithms.*

Haddad, Kamel N., *Limiting notions of the IP-type in the enveloping semigroup of a compact metric dynamical system.*

Han, Weimin, *Error estimations of mathematical idealizations for elliptic problems with uncertain data.*

Helmreich, James E., *Ultrahomogeneous 2-graphs.*

Huang, Danrun, *Flow equivalence of reducible shifts of finite type, generalized inverses over Banach algebras.*

Lee, Sangyeol, *Testing Gaussianality of time series.*

Lopes, Silvia Regina Costa, *Spectral analysis in frequency modulated models.*

Park, Pil S., *Iterative solution of sparse singular systems of equations arising from queuing networks.*

Park, Young Ho, *Period integrals for* O(4.2) *and values of Langlands L-functions.*

Pavlopoulos, Haralabos, *Statistical inference for optimal thresholds.*

Perry, Elgin S., *Distributional properties of parameters derived from Leslie matrix models.*

Rutman, Elizabeth W., *Computing primary decompositions of modules.*

Searle, Catherine, *Positively curved manifolds with large symmetry groups.*

Sime, Patrick, *On the ideal class group of real biquadratic fields.*

Troendle, James F., *An iterative filtering method of frequency detection in a mixed spectrum model.*

Vidras, Alexos, *Interpolation and division problems in spaces of entire functions with growth conditions and their applications.*

Wilhelm, Frederick H., Jr., *Gromov-Hausdorff distance in the presence of a lower curvature bound.*

Wissman, Joseph, *Material response and inverse problems of incompressible elasticity.*

You, Zhiping, *Numerical study of stable and unstable manifolds of some dynamical systems.*

Zhang, Zhimin, *Solving free boundary problems by the finite element method.*

## MASSACHUSETTS

### Boston University (7)

MATHEMATICS

Alexander, Daniel, *The historical background to the works of Pierre Fatou and Gaston Julia in complex dynamics.*

Cole, Bernard, *A parametric model for performing cost-benefit analysis in the presence of completing risks and multiple failures.*

Copenhafer, Donna, *The robustness of the $F$-test when applied to ordinal scaled data.*

Figueiredo, Ana-Maria, *Differential-delay equations of advanced type and discretization of Kirchoff integral equation.*

Haruta, Mako, *The dynamics of Newton's method on the exponential function.*

Slammert, Lionel, *Differentiability properties of bifurcation phenomena of two parameter families of circle diffeomorphisms.*

Sullivan, Lisa, *Robustness of analysis of covariance applied to data distorted from normality by floor effects and to ordinal scaled data.*

### Brandeis University (5)

MATHEMATICS

Baltuch, Jacob, *On reducible* $(1,2)$*-polarized Abelian surfaces.*

Nappari, Mark, *Nearly holomorphic modular forms.*

Park, Joonsang, *Geometric and analytic characterization of isoparametric submanifolds.*

Park, Seung Kyung, *Enumeration of multipermutations.*

Shipman, Joseph, *Cardinal conditions for strong Fubini theorem.*

## Harvard University (30)

APPLIED SCIENCES

Ariola, Zena M., *An algebraic approach to the compilation and operational semantics of functional languages with I-structures.*

Bestavros, Azer, *Time-constrained reactive automata: A novel development methodology for embedded real-time series.*

Chen, Lilei, *Deriving parallel and systokic programs from data dependence.*

Cochran, Douglas W., *Nonlinear signal compression and reconstruction.*

Ferrier, Nicola J., *Trajectory control of active vision systems.*

Freeman, D. Kent, *Extremely narrow resonances in closed-loop arrays of quantum mechanical and electromagnetic interactions.*

Fuh, Chiou-Shann, *Visual motion analysis: Estimating and interpreting displacement fields.*

Galindo-Legaria, Cesare A., *Algebraic optimization of outerjoin queries.*

Goradia, Tushar M., *Stochastic models for human gene mapping.*

Gordon, Gaile G., *Face recognition from depth and curvature.*

Kilian, Michael F., *Parallel sets: An object-oriented methodology for massively parallel programming.*

Partrigdge, Craig, *Late-binding RPC: A paradigm for distributed computation in a gigabit environment.*

Rak, Edward, *Locl methods for robust matching.*

Shi, Leyuan, *Optimization of discrete event dynamic systems.*

Wang, Shiwei, *A class of new optimized concurrency control protocol for transaction processing systems.*

Zhou, Yuli, *A fix point theory of nonmonotonic functions and its applications to logic programs, deductive databases and production rule systems.*

MATHEMATICS

Azcue, Pablo, *On the dimension of the Chow varieties.*

Chandler, Karen Anne, *Hilbert functions of zero-dimensional schemes in uniform position.*

McQuillan, Michael L., *Division points on semi-Abelian varieties.*

Rosenthal, Jeffrey S., *Rates of convergence for Gibbs sampler and other Markov chains.*

Schwartz, Andrew J., *Functorial smoothing of morphisms in equal characteristic* 0.

Szenes, Andras, *The Verlinde formulas and moduli spaces of vector bundles.*

Voevodsky, Vladimir, *Homology of schemes and covariant motives.*

Wang, Xuesung, *Higher-order characteristic classes in arithmetic geometry.*

Wong, Hon-Wai, *Dolbeault cohomologies and Zuckerman modules associated with finite rank representations.*

STATISTICS

Blyth, Stephen James, *Local regression coefficients and the correlation curve.*

Hwang, Jing-Shiang, *Prototype Bayesian estimation of U.S. state employment and unemployment rates.*

Schafer, Joseph L., *Algorithms for multiple imputation and posterior simulation from incomplete multivariate data with ignorable nonresponse.*

Schmid, Christopher Henry, *Measurement error models for logistic and longitudinal regression.*

Vangel, Mark Geoffrey, *Iterative algorithms for integral equations of the first kind with applications to statistics.*

## Massachusetts Institute of Technology (36)

MATHEMATICS

Ando, Matthew, *Operations in complex-oriented cohomology theories related to subgroups of formal groups.*

Beck, Jonathan, *Representations of quantum groups at even roots of unity.*

Borkovitz, Debra K., *Maximal Hilbert series of quadratic-relator algebras.*

Chan, Clara S., *On shellings and subdivisions of convex polytopes.*

Dhagat, Aditi, *Searching in the presence of errors.*

Dou, Carl C. Z., *Studies of random walks on groups and random graphs.*

Engel, Mark, *Weakly nonlinear surface waves in a ferrofluid.*

Fromm, Stephen B., *Regularity for the Dirichlet problem in convex domains.*

Garnica-Vigil, Eugenio, *On the classification of tempered representations for a group in the Harish-Chandra class.*

Goddard, Wayne D., *Three graphic tales.*

Grojnowski, Ian, *Character sheaves on symmetric spaces.*

Herscovici, David S., *Minimal paths between maximal chains in finite rank semimodular lattices.*

Hoff, Edwin K., *A computer-aided combinatorial analysis of the game of cribbage.*

Jockusch, William, *Perfect matchings and perfect squares.*

Nachtigal, Noel, *A look-ahead variant of the Lanczos algorithm and its application to the quasi-minimal residual method for non-Hermitian linear systems.*

Petters, Arlie O., *Singularities in gravitational microlensing.*

Randall, Ellen, *Resonant interactive effects on systems of hyperbolic equations.*

Reddy, Satish C., *Pseudospectra of operators and discretization matrices and an application to stability of the method of lines.*

Roby, Thomas W., V, *Applications and extensions of Fomin's generalization of the Robinson-Schensted correspondence to differential posets.*

Steingrimsson, Einar, *Permutations statistics of indexed and Poset permutations.*

Tschinkel, Yuri, *Arithmetic of algebraic surfaces.*

Wein, Joel M., *Algorithms for scheduling and network problems.*

Wheeler, Erlan E., II, *Convexity theorems for diametral families of sets.*

Zhao, Ying, *On project pursuit learning.*

Zhuang, Shunhuang Peter, *Formal theory of linear homogeneous Q-difference equations.*

OPERATIONS RESEARCH

Abe, Makoto, *A marketing mix model developed from single source data: A semiparametric approach.*

Athaide, Christopher, *Capacity allocation and safety stocks in manufacturing systems.*

Bai, Sherman Xiewei, *Scheduling manufacturing systems with work-in-process inventory control.*

Chevalier, Philippe, *Two topics in multistage manufacturing systems.*

Hall, Susan, *New directions in queue inference for management implementation.*

Kodialam, Muralidharan, *The O-D shortest path problem and connectivity problems on periodic graphs.*

Ou, Jihong, *Dynamic scheduling of queueing networks.*

Pappu, Suguna, *Production planning with due-date constraints.*

Polychronopoulos, George H., *Stochastic and dynamic shortest distance problems.*

Talluri, Kalyan T., *Issues in the design and analysis of survivable networks.*

Vranas, Peter B., *The multi-airport ground-housing problem in air traffic control.*

## Northeastern University (3)

MATHEMATICS

Bonias, Ioannis, *T-colorings of complete groups.*

Cohen, Daniel C., *Cohomology and intersection cohomology of complex hyperplane arrangements.*

Tang, Junjie, *Prescribing curvature on manifolds with singularities.*

### Tufts University (1)

MATHEMATICS

Ching, Kenny, *Graphs of small girth which are locally projective spaces.*

### University of Massachusetts, Amherst (4)

MATHEMATICS AND STATISTICS

Li, Gong-qin, *Some problems for Helmholtz equations in regions containing an interface.*

Pillen, Cornelius, *Tensor products and injectives for groups of Lie type.*

Wei, Fusheng, *The existence and topology of properly embedded minimal surfaces in* $\mathbb{R}^3$.

Yang, Chengda, *Stochastic methods for image restoration.*

## MICHIGAN

### Michigan State University (5)

MATHEMATICS

Deng, Shangrong, *Variational problems on contact manifolds.*

Li, Kuiyuan, *Homotopy methods and algorithms for real symmetric eigenproblems.*

Zeng, Zhonggang, *Homotopy-determinant method for matrix eigenvalue problems and its parallelizations.*

STATISTICS AND PROBABILITY

Farshidi, Jamshidi, *Autoregressive expansion of linear predictor for stationary stochastic processes.*

Noble, William, *First order allocations.*

### University of Michigan, Ann Arbor (34)

BIOSTATISTICS

Bagin, Robert G., *The estimation of marginal dose-response from joint toxicity information.*

Balagtas, Cecile C., *Marginal models for the analysis of crossover experiments with a categorical response.*

Cheng, Joanna C., *Some aspects of mixture and response surface designs.*

Coelho, Carlos A., *Generalized canonical analysis.*

Olson, Jane M., *Log-linear analysis of survival data with a censored covariate.*

Ten Have, Thomas R., *Exchangeable log-linear models.*

Young, Martin R., *Estimating optimal transformations for multivariate data.*

INDUSTRIAL ENGINEERING AND OPERATIONS RESEARCH

Beck, Douglas, *Human factors of posture entry into ergonomics analysis systems.*

Byun, Seong-Nam, *A computer simulation using a multivariate biomechanical posture prediction model for manual materials handling tasks.*

Chang, Sung-Ho, *Statistical evaluation and analysis of form and profile errors based on discrete measurement data.*

Chen, Lin-Lin, *Visibility algorithms for mold and die design.*

Chou, Shuo-Yan, *Circular and parabolic visibility and their applications.*

Hughes, Richard E., *Empirical evaluation of optimization based lumbar muscle force prediction models.*

Karabakal, Nejat, *The capital rationing replacement problem.*

Park, Joon Young, *Mash generation with quasi-equilateral triangulation.*

Ting, Jame-John, *An object oriented distributed approach to the development of integrated manufacturing systems.*

MATHEMATICS

Auckly, David R., *Computing secondary and spectral invariants.*

Bagchi, Atish, *Topoi satisfying De Morgan's law and related identities.*

Cunningham, Robin J., *Univalent functions which map onto regions of prescribed transfinite diameter.*

Darrow, Dale S., *Some properties of a higher-order coboundary operator.*

Godinho, H-mar, *A pair of additive quartic forms.*

Goh, Say Song, *The two-functional conjecture for univalent functions.*

Kim, Yonggu, *On normal quintic Enriques surfaces.*

Leung, Man Chun, *Harmonic maps between asymptotically hyperbolic spaces.*

Needham, Roger E., *Term rewriting and the word problem for certain infinite presentations.*

Octavio, Alfredo, *Dual algebras generated by commuting contractions.*

Richardson, Thomas M., *Local subgroups of the Monster and odd code loops.*

Ryu, Jeong Seog, *Development mapping on CR-manifolds and the manifolds with constant holomorphic sectional curvature.*

Ryu, KiWon, *Properties of John disks.*

Sankey, Alyssa D., *Regular weights on strongly regular graphs.*

Yang, Shanshuang, *Quasiextremal distance domains and quasiconformal reflections.*

STATISTICS

Eisele, Jeffrey, *An adaptive biased coin design for the Behrens-Fisher problem.*

Hwang, Chang-Ha, *Model selection methods in discriminant analysis.*

Melfi, Vincent, *A nonlinear renewal theorem with statistical applications.*

### Western Michigan University (4)

MATHEMATICS AND STATISTICS

Chen, Hang, *Common moment sets of graphs and their compliments.*

Li, Hung-Ir, *On rank procedures for the logistic models.*

Liu, Jiuqiang, *Maximal and maximum independent sets in graphs.*

Yahya, Hilmi, *A progressive disease model for doubly-censored bivariate survival data that accommodates covariate information.*

## MINNESOTA

### University of Minnesota, Minneapolis (18)

BIOSTATISTICS

Anderson, Jon E., *Time dependent association measures for bivariate survival distributions.*

MATHEMATICS

Catalano, Michael, *Stable splittings for classifying spaces of groups of order thirty-two.*

Chen, Xinfu, *Phase transition and free boundary problems.*

Doyle, Philip Wendell, *Differential geometric Poisson bivectors and quasilinear systems in one space variable.*

Gui, Changfeng, *on semi-linear elliptic and parabolic equations in entire space.*

Hou, Suchung, *A finite element method for conservation laws: multi-dimensional case.*

Lin, Hwei-Ting, *On the dynamic of a model in the propagation of genes.*

Liu, Wenxiong, *Blowup problems of semilinear heat equations.*

Ma, Jin, *Topics on singular stochastic control and related stochastic differential equations.*

Romero, Cristina, *Potential theory for the Kohn Laplacian on the Heisenberg group.*

Seo, Jin Keun, *Regularity for solutions of transmission problems across internal Lipschitz boundaries.*

Shin, Heayong, *An investigation of the singularities of harmonic maps.*

Spiro, Andrea, *Studies of the geometry of infinite dimensional Lie groups.*

Triandaf, Ioana-Alexandra, *A numerical method for semi-conductor device equations.*

Zhou, Qing, *Some topics in the computable analysis of* $R^n$.

Zhou, Xiaoming, *On the decomposition map of Grothendieck groups.*

STATISTICS

Hsu, Ching, *Admissibility of formal Bayes decision rules.*

Weng, Shipei, *Sequential allocation to maximize the probability of achieving a number of successes.*

## MISSOURI

### University of Missouri, Columbia (3)

STATISTICS

Ibrahim, Moh'd, *Towards a better understanding of Bayesian methods.*

Lei, Xingye (Cherry), *A test of homogeneity with a simply ordered alternative based on dependent observations.*

Qu, Shankang, *Optimal design and parameter estimation for the Langmuir models.*

### University of Missouri-Rolla (2)

MATHEMATICS AND STATISTICS

Natsis, Dimitrios, *Convergence of Fourier series and representations of Fourier and Stieltjes coefficients.*

Worth, Fredrick E., *Concerning the expansive property and shift homeomorphisms of inverse limits.*

### Washington University (11)

MATHEMATICS

Candel, Alberto, *Uniformization of foliations by surfaces.*

Fontana, Luigi, *Sharp borderline Sobolev estimates for functions on compact Riemannian manifolds.*

Freudenburg, Gene, *On the automorphism group of the polynomial ring in three variables.*

Kelly, Susan Elaine, *Pointwise convergence for wavelet expansions.*

Nowak, Krzysztof, *Toeplitz operators and commutators based on the Calderón reproducing formula.*

Ouyang, He, *On isospectral deformations on two-step nilmanifolds.*

Paluszynski, Maciej, *Characterization of Lipschitz spaces via the commutator operator of Coifman, Rochberg and Weiss; A multiplier theorem for a semigroup of contractions.*

Zhao, Hesheng, *Hardy spaces on rank one symmetric spaces of noncompact type.*

SYSTEMS SCIENCE AND MATHEMATICS

Ramakrishna, Viswanath, *Symmetry in nonlinear design with applications towards singularities in geometric control.*

Sturtz, Kirk Edward, *Polynomial solution of continuous-time linear programming problems.*

Wu, Yaw-Tyng, *Estimating three-dimensional motion parameters from feature-based image sequence: A perspective-system approach.*

## MONTANA

### Montana State University (1)

MATHEMATICAL SCIENCE

Schwartz, Susan Pamela, *Some planar embeddings of chainable continua can be expressed as inverse limit spaces.*

## NEBRASKA

### University of Nebraska-Lincoln (3)

MATHEMATICS AND STATISTICS

Ahn, Byung Moo, *Path integrals, Fourier transforms and Feynman's operational calculus.*

Fosnaugh, Linda, *Tilings with the neighborhood property and tiling lattice points with blocks.*

Wu, Qiu-Rong, *On properties and constructions of t-designs, $\lambda$-designs and perpendicular arrays.*

## NEW HAMPSHIRE

### Dartmouth College (4)

MATHEMATICS

Albert, Jeanne, *Biproducts in the rational cohomology of biformal spaces.*

DeStefano, Alisa, *Discrete observability of the wave equation.*

Tiu, Philip, *A new class of binary linear codes.*

Welch, George, *Computing bounds for the Hausdorff dimension of the residual set of the Apollonian packing.*

### University of New Hampshire (1)

MATHEMATICS

Rector, Judy, *Beliefs, autonomy and mathematical knowledge.*

## NEW JERSEY

### Princeton University (10)

MATHEMATICS

Bar-Natan, Dror, *Perturbative aspects of the Chern-Simons topological quantum field theory.*

Ferenbaugh, Charles, *On the modular functions involved in "monstrous moonshine".*

Lindenstrauss, Ayelet E., *On cyclic homology and topological Hochschild homology of global rings and of extensions of $Z/pZ$.*

Margolin, Richard, *Integral representations of Mathieu groups.*

Mochizuki, Shin, *The geometry of the compactification of the Hurwitz scheme.*

Mostad, Petter, *Bounded $K$-theory of the Bruhat-Tits building for the special linear group over the $P$-adics with application to the assembly map.*

Niziol, Wieslawa, *On a cohomological functor associated to crystalline representations.*

Ramakrishna, Ravi K., *On a variation of Mazur's deformation functor.*

Sutor, Robert, *The calculation of some geometric monodromy groups.*

Zhao, Yude, *Certain zeta functions attached to automorphic forms over imaginary quadratic fields.*

### Rutgers University (14)

MATHEMATICS

Aboufadel, Edward F., *A priori bounds for solutions of singularly-perturbed ordinary differential equations.*

Alessandrini, Stephen, *Some two-dimensional plate models: derivation, asymptotic properties, and numerical approximation.*

Barr von Oehsen, James, *Level $N$ elliptic genera and Jacobi polynomials.*

Bohus, Geza, *On some combinatorial problems in discrepancy and geometry.*

Cai, Da-Mu, *Reduced continuity finite element methods for hyperbolic equations.*

Comezana, Gustavo Raul, *Bordism of layered cycles and generalized intersection homology theory.*

Francsics, Gabor, *Microlocal homotopy formulas in the tangential Cauchy-Riemann complex of higher codimension.*

Latka, Brenda, *Finitely constrained classes of homogeneous directed graphs and well quasi-ordered families of tournaments.*

Pitt, Nigel J. E., *Convolutions of automorphic $L$-series.*

Rosengarten, Richard, *Aleph-zero stable Lie algebras.*

To, Tze-Ming, *Asymptotic expansions of Whittaker functions at irregular singularities.*

Xie, Xianwen, *Uniqueness and stability of slowly oscillating periodic solutions of differential delay equations.*

Xu, Jian-Ming, *An analysis of the dynamical equations of elastic rods and their numerical approximation.*

Xu, Xiaoping, *Untwisted and twisted gluing techniques for constructing self-dual lattices.*

## NEW MEXICO

### New Mexico State University (2)

MATHEMATICAL SCIENCES

Hughes, Lorenz, *Results of the theory of valuated p-groups.*

Masaedeh, Basem, *Limiting inclusions for classes of weight functions.*

### University of New Mexico (8)

MATHEMATICS AND STATISTICS

Barr, Joseph, *Maximum bipartite subgraphs, maximum $K$-colorable subgraphs and Nordhaus-Gaddsen type theorems.*

Crawford, Thomas Arleigh, *Full holomorphic maps from the Riemann sphere to complex projective space.*

Fisher, Robin, *Essentially non-parametric Bayes empirical Bayes procedures.*

Hellmer, Ronald, *Random splitting times for ergodic processes.*

Hembree, Barry, *Adaptive hierarchical Bayes Kalman filtering with application to quantity control.*

Kim, Joo-Hwan, *Discrimination of objects with Poisson signals: Theory and application.*

Stoecker, Michael, *Admissible boundary conditions for a linearized model of slightly compressible viscous flow.*

Torres, Joseph D., *Differentiation and multiplication operators and the product rule.*

## NEW YORK

### Clarkson University (1)

MATHEMATICS AND COMPUTER SCIENCE

Hyun, Kio Chung, *Consistency checking mechanism using ATMs in a distributed knowledge based system.*

### Columbia University (7)

MATHEMATICS

Bertolini, Massimo, *Iwasawa theory, L-functions and Heegner points.*

Feehan, Paul Matthew Niall, *Geometry of the moduli space of self-dual connections on the four-sphere.*

Li, Wei-Ping, *Moduli space of stable bundles over ruled surfaces and computation of Donaldson polynomials.*

Pappas, Georgios, *Arithmetic models for Hilbert-Blumenthal modular varieties.*

Pinson, Haru Tsuii, *Toward an intrinsic characterization of the minimal models.*

Yang, Hongjie, *Transition functions and a blow up formula for Donaldson polynomials.*

STATISTICS

Cvitanic, Jaksa, *Convex duality in constrained portfolio optimization.*

### Cornell University (25)

APPLIED MATHEMATICS

Adler, Frederic Russell, *Models of structured populations.*

Berkooz, Gal, *Turbulence, coherent structures and low dimensional models.*

Chen, Dingju, *Algorithm restructuring for parallelism and data locality in scientific computing.*

Critchlow, Carol Maria, *The inherent cost of achieving casual consistency.*

Guo, Baining, *Modeling arbitrary smooth objects with algebraic surfaces.*

Hanisch, Mark Robert, *Multigrid preconditioning for mixed finite element methods.*

Mahalov, Alex Semyon, *Attractors, bifurcations and resonances in two problems of fluid dynamics.*

Swart, Pieter Johan, *The dynamical creation of microstructure in material phase transitions.*

Wynters, Erik Lanny, *Optimal motion planning for multiple point robots in the plane.*

BIOMETRICS

Bekele, Isaac, *Sequential procedures for estimation of the time of attainment of a threshold value.*

Frongillo, Edward A., Jr., *Combining information using hierarchical models.*

Umbach, David M., *Methodologies for testing separate families of hypotheses: An odyssey.*

MATHEMATICS

Acosta, Ernesto, *On the essential self-adjointness of Dirichlet operators on non-linear path space.*

Anderson, Bruce Bernard, *Sign sequences and Rolle's restrictions: why not all real differentiable functions and polynomials satisfying Rolle's theorem are constructible.*

Bridson, Martin Robert, *Geodesics and curvature in metric simplicial complexes.*

Chern, Shuh-Jye, *Mathematical theory of the barotropic model in geophysical fluid dynamics.*

Delman, Charles Ira, *Essential laminations in knot complements.*

Hermiller, Susan Marie, *Rewriting systems for Coxeter groups.*

Kautz, Steven M., *Degrees of random sets.*

Meier, John Edward, *Endomorphisms of negatively curved polygonal groups.*

Setti, Alberto Giulio, *Eigenvalue and heat kernel estimates for the weighted Laplacian on a Riemannian manifold.*

Song, Li Min, *Special values of L-functions of curves over finite fields.*

Stein, Melanie Ida, *Groups of piecewise linear homeomorphisms.*

STATISTICS

He, Kun, *Some ancillarity paradoxes in estimation.*

Huwang, Longcheen, *Good coverage probability confidence sets in linear errors-in-variable models.*

### CUNY, Graduate Center (3)

MATHEMATICS

Finz, Harold R., *Studies in computational group theory.*

Jeong, Dal Young, *Polytopal graphs and arrangements of curves.*

McGowan, Jeffrey, *The p-spectrum of the Laplacian on compact hyperbolic three manifolds.*

### New York University, Courant Institute (17)

MATHEMATICS

Fannjiang, Chyunjia Albert, *Convection enhanced diffusions.*

Fechter, Ronald, *Sholem functions, Hibert's $\varepsilon$ symbol and the lambda calculus.*

Fontes, Luiz Renato, *Results of the phase diagram of continuum $1/R2$ Ising models.*

Guevara Jordan, Juan Manuel, *A numerical method for the two-phase flow in a Hill Shaw cell.*

Isopi, Marco, *The triangle law for products of large random matrices.*

Kamvissis, Spyridon, *On the long time behavior of the doubly infinite toda lattice under shock initial data.*

Klapper, Isaac, *Chaotic fast dynamics.*

Li, Tong, *On the Riemann problem and the initiation problem for a combustion model.*

Miller, David, *Non-characteristic embeddings of the $n$-dimensional Torus in the $(n+2)$ dimensional form.*

Olson, Tamara, *Overall properties of granular Piezolectrics: Bounds and effective medium approximations.*

Pietruska-Paluba, Katarzyna, *The Lifschitz singularity for the Brownian motion on the Sierpinski gasket.*

Singer, Stephanie, *The geometry of the full Toda lattice.*

Tian, Feiran, *Oscillations of the zero dispersion limit of the Korteweg-de Vries equation.*

Wetton, Brian, *Convergence of numerical approximations for the Navier-Stokes equations with boundaries: Vorticity and primitive formulations.*

Yang, Yahan, *Solution of functional equations of Peskin Cochlea method and some results of model equations on incompressible fluid flow.*

Zeng, Yanni, *Asymptotic behavior of nonlinear viscoelastic model with fading memory and compressible, isentropic, viscous 1-D flow.*

Zhang, Xuejun, *Studies in domain decomposition: Multi-level methods and the biharmonic Dirichlet problem.*

### Polytechnic University (4)

MATHEMATICS

Chan, Eva, *Bootstrapping a repeated measurement on endocrinology data.*

Connell, Roy, *Lattice measures and associated topological spaces.*

Hajallie, Kamal, *Lattice measures and separation.*

Ragland, Frank, *General problem of Zenodorus.*

### SUNY at Albany (4)

MATHEMATICS

Adams, Terrence M., *Uniform sweeping out.*

Al-Grouz, Ibrahim M., *Functionals on univalent functions and univalent polynomial approximation.*

Burke, Kevin, *Duality of the Bergman spaces on some weakly pseudoconvex domains.*

Lawrence, Deborah A., *Constructions and properties of transitive dynamical systems.*

### SUNY at Binghamton (1)

MATHEMATICAL SCIENCES

Ries, Heather D., *On torsion free Abelian groups which are almost finitely generated.*

### SUNY at Buffalo (3)

MATHEMATICS

Chang, Yi-Hua, *An asymptotic symmetry of the rapidly forced pendulum.*

Liu, Bing, *The complete asymptotic expansion of a duck-solution of a van der Pol-like oscillator with application to a pair of coupled oscillators.*

Liu, Xiaosong, *Some analyses of the Navier-Stokes equations and the Kuramoto-Sivashinsky equation.*

### SUNY at Stony Brook (12)

APPLIED MATHEMATICS AND STATISTICS

Kim, Sunyoung, *Quasi-Newton algorithms for solving large systems of algebraic equations.*

Li, Jian-Hua, *Stress analysis of Griffith cracks in nonhomogeneous elastic solids.*

Shinde, Madhvi, *Stochastic models in inventories and games.*

Zhang, Zhuo, *Subadditive functions and integer programming polyhedra.*

MATHEMATICS

Anderson, James Wyatt, *Mixing elements into Kleinian groups.*

Kim, Jongsu, *On a class of a 4-dimensional minimum energy metrics and hyperbolic geometry.*

Lüttecke, Francisco, *Summability of subsequences.*

Lee, Mei-Man, *Solution 6 Hamiltonian structure for quasi-geostropic flow.*

Paternain, Gabriel, *Geometric and topological properties of manifolds with completely integrable geodesic flow.*

Slome, Susan, *On the Lefschetz fixed point theorem and some of its extensions.*

Sorin, Dragomir, *CR maps between strictly pseudoconvex CR manifolds, interpolation manifolds and CR foliations.*

Yu, Guoliang, *K-theoretic indices of Dirac type operators on complete manifolds.*

### Syracuse University (3)

MATHEMATICS

Agarwal, Amita, *Asymptotic properties of regression estimates for invariate and multivariate normal distribution under type* I *censoring.*

Habre, Samer, *Second-order linear elliptic systems on the complex plane.*

Ranganathan, Murali K., *Endomorphism rings of nonfree, stably free ideals.*

### University of Rochester (1)

STATISTICS

Guang-Qin, Ma, *Two problems associated with ROC Curves.*

## NORTH CAROLINA

### Duke University (7)

MATHEMATICS

Bourgeois, Alfred James, *Validity of the quasigeostrophic model for large-scale flow in the atmosphere and ocean.*

Ferrari, Andrew B., *On the blow-up of solutions of the 3-D Euler equations in a bounded domain.*

Mueller, William Joseph, *Relative computability and abstract degree structures.*

Nailor, Jeanne Marie, *Behavior of equilibria in quasi-thermodynamic chemical reaction networks with mass-action kinetics.*

Porter-Locklear, Freda, *A numerical study of propagation of singularities in semilinear hyperbolic systems.*

Vuono, Charles Michael, *The Kodaira embedding theorem for Kähler varieties with isolated singularities.*

Yu, Yunliang, *Minimal hypersurfaces in $S^4$ with second fundamental form of constant length.*

### North Carolina State University, Raleigh (14)

MATHEMATICS

Chen, Hong-Wei, *Blow-up of solutions for nonlinear parabolic boundary value problems.*

Ferng, Ruennhwa, *Lanczos-based condition estimation in signal processing and optimization.*

Hwang, Dongming, *Convergence of Broyden's method in Banach spaces.*

Jang, Ho-Jong, *The equilibrium equation: Substructing and the force method.*

Mathews, David McCoy, *Valuations defined by Ostrowski nets.*

Mukundan, Lakshmi, *Convergence analysis of the harmonic balance method.*

Nagy, James Gerard, *Toeplitz least squares computations.*

Sumner, Suzanne, *Dynamical systems associated with pioneer-climax models.*

Vallin, Robert William, *Shell porosity in metric spaces.*

Yang, Yadong, *Explicit solutions of a class of riemann problems of mixed type.*

STATISTICS

Lamb, Ronnie Hartwell, *Testing for treatment effects on variance in designed experiments.*

Liu, Chia-yee Jerry, *Parameter estimation of continuous time point process: Serial dependence and neural applications.*

O'Connell, Michael Anthony, *Contingency table models for estimation of the size of a partitioned population.*

Wheeless, Sara Cabe, *Some inference problems in least absolute values regression.*

### University of North Carolina, Chapel Hill (10)

BIOSTATISTICS

Bennett, Leah, *Covariate analysis of bivariate survival data.*

Koch, Matthew, *Precision, bias, and the cost in the $2 \times 2$ crossover with baselines.*

Legault, Claudine, *Analyzing multiple endpoints with a two-stage group sequential design in clinical trials.*

Lesser, Virginia, *A comparison of periodic survey designs employing multi-stage-sampling.*

Pekow, Penelope, *A mixed model analysis of tracking for inconsistently-timed longitudinal data.*

Smith, Fraser, *Mixed model analyses of censored normal distributions via the Em algorithm.*

Tudor, Gail, *Survival analysis using primary and surrogate endpoints.*

MATHEMATICS

Nawrocki, David, *Propagation and spreading of singularities for semilinear hyperbolic mixed problems with general boundary conditions.*

OPERATIONS RESEARCH

Bonazzi, Alberto, *Modeling intransitive preferences among objects with transitively.*

Hariharan, Rema, *Routing and scheduling and queueing networks.*

## OHIO

### Bowling Green State University (5)

MATHEMATICS AND STATISTICS

Boukaabar, Kaddour, *The median problem on the lattice of partitions.*

Hewage, Thilan, *Policy functions of optimal growth models.*

Moore, Philip, *Conjugating extensions of lattice-ordered groups.*

Oluyede, Broderick, *Dependence of bivariate random variables and testing dependency in ordinal contingency tables.*

Wojciechowski, Piotr, *Orderpotent rings.*

### Case Western Reserve University (4)

EPIDEMIOLOGY AND BIOSTATISTICS

Soegiatso, Restuti, *A covariate model in finite mixture survival distributions.*

OPERATIONS RESEARCH

Fuh, Du-Shean, *Hierarchical workforce scheduling with limited substitution as well as full-time and part-time workforce mix.*

Li, Anlong, *Three essays on contingent claim pricing.*

Reddy, Chandupatla Surender, *The impact of product group forcing on individual item forecast accuracy.*

### Kent State University (4)

MATHEMATICS AND COMPUTER SCIENCE

Fellah, Abdelaziz, *Alternating finite automata and related problems.*

Lacruz, Miguel, *Four aspects of modern analysis.*

Shih, Chih-Ming (Jimmy), *Adding fault-tolerance to the cube-connected cycles network.*

Trevisan, Vilmar, *Univariate polynomial factorization.*

### Ohio University (1)

MATHEMATICS

Schommer, John Joseph, *Nearly realcompact and nearly pseudocompact spaces.*

### The Ohio State University (13)

MATHEMATICS

Brozovic, Douglas, *On length of chains in Lie type groups in characteristics* 3.

Cao, Jianzhong, *Viscoelastic jets and fibers with torsion.*

Craighead, Robert Lincoln, *Hypergroups and semiproper functions.*

Donahue, Michael, *The angle between null spaces of the radon and related transforms.*

Kim, Jeongjin, *Mandatory representation designs.*

Ling, Tianwen, *Borel diagonalization theorems and second-order arithmetics.*

Nemethi, Andras, *The zeta function and the spectrum of the hypersurface singularities.*

O'Ryan, Manuel, *Trace forms of higher degree.*

Randby, Scott, *Embedding* $K_5$ *4-connected graphs.*

Reinhold-Larsson, Karin, *Almost everywhere convergence of weighted averages.*

Reyes, Noli, *An asymptotic formula in best approximations.*

Xiong, Chuyu, *Low modes truncation method on Sine-Gordon equation.*

Zhang, Qing, *Multiple recurrence and mixing properties for actions of amenable groups.*

### University of Cincinnati (3)

MATHEMATICAL SCIENCES

Oh, Sei-Qwon, *Primitive ideals in algebras of functions on certain quantum spaces.*

MATHEMATICAL SCIENCES

Hinestroza, Doris, *Numerical identification of transmissivity coefficients in elliptic and parabolic equations by mollification techniques.*

Kim, Seong A., *Convexity criteria and the hyperbolic density.*

## OKLAHOMA

### Oklahoma State University (3)

MATHEMATICS

Farmer, David Wayne, *Mean value of Dirichlet series associated with cusp forms.*

Noel, Linda Hand, *The fundamental theorem of algebra: A survey of history and proofs.*

STATISTICS

Payton, Mark E., *An examination of sequential procedures for the testing of three hypotheses.*

### University of Oklahoma (2)

MATHEMATICS

Hong, Sung Bok, *Myrberg-Agard density points and groups of divergence type.*

Shin, Joonkook, *Isometry groups of three-dimensional Lie groups.*

## OREGON

### Oregon State University (5)

MATHEMATICS

Goulet, Marc Robert, *One-dependence and* $K$*-block factors.*

Hagelberg, Carl Richard, *Existence of a solution to a variational data assimilation method in two-dimensional hydrodynamics.*

Hart, Dianne Ruth, *Building concept images-supercalculators and students' use of multiple representations in calculus.*

Jubran, Isa Sabri, *A chaotic embedding of the Whitehead continuum.*

STATISTICS

Lin, Lie-Fen, *Uses of Bayesian posterior modes in solving complex estimation problems in statistics.*

### University of Oregon (7)

MATHEMATICS

Boardman, Michael, *Relative spectra in complete locally multiplicatively-convex algebras with applications.*

Harlander, Jens, *Groups with cyclic relation module.*

Kangas, Steven, *The nonextendability of the Jones representation for mapping class groups.*

Kotlar, Daniel, *Some induced characters of finite groups of Lie type.*

Lei, Junjiang, *Approximation by multi-integer translates of functions having global support.*

O'Connor, Christopher, *Seminormalizations of coordinate rings of unions of hyperplanes.*

Wu, Sheng L., *Classification of torsion-free self-dual LCA groups.*

## PENNSYLVANIA

### Bryn Mawr College (1)

MATHEMATICS

Heath, Sister Ann M., *Rational period functions, Dirichlet series with functional equations and arithmetical identities.*

### Carnegie Mellon University (13)

MATHEMATICS

Antonić, Nenad, *Memory effects in homeogenization and propagation of singularities.*

Blair, Louis Frederic, *The displacement response of an elastic-perfectly plastic oscillator to a periodic external force.*

Bridge, David S., *Finite fuel singular stochastic control of an* $n$*-dimensional infinite horizon discounted problem.*

Chiou, Sea-Mean, *Theory of connections.*

Issar, Sunil, *Operational issues in automated theorem proving using matings.*

Tronci, Enrico, *Equational programming in lambda calculus via* $SL$*-systems.*

Wang, Keming, *Uniqueness theorems for ordinary differential equations with applications in mechanics.*

Wu, Xiaonan, *Analysis and applications of the covolume method for the Navier-Stokes equations.*

STATISTICS

Erkanli, Alaattin, *Laplace approximations for posterior expectations and marginal densities when the mode is on the boundary of the parameter space.*

Short, Thomas H., *Algorithms for simultaneous image restoration and segmentation.*

Slate, Elizabeth H., *Reparameterization of statistical models.*

Stangl, Dalene, *Modeling heterogeneity in multi-center clinical trials using Bayesian hierarchical survival models.*

Vaidyanathan, Suresh K., *Stochastic control of sequential manufacturing processes.*

### Drexel University (1)

MATHEMATICS AND COMPUTER SCIENCE

DeSesa, Blaise Phillip, *Sieved orthogonal polynomials.*

### Pennsylvania State University (14)

MATHEMATICS

Draghicescu, Cristina I., *Efficient algorithms for particle methods.*

Konieczny, Janusz, *Semigroups of binary relations.*

Mabizela, Sizwe Gladwell, *Parametric approximation.*

Mitsuma, Kunio, *Profinite semigroups and related topics.*

Okamoto, Shingo, *Invariants for subfactors arising from coexter graphs.*

Rukimbira, Philippe, *Some properties of almost contact flows.*

Shann, Wei Chang, *Finite element methods for Maxwell's equations with stationary magnetic field and Galerkin-wavelets methods for two-point boundary value problems.*

Sun, Wenzhi, *Stationary ideals and stationary cardinals.*

STATISTICS

Basu, Ayanendranath, *Minimum disparity estimation in the continuous case: Efficiency, distributions, robustness, and algorithms.*

Coakley, Clint, *Advances in the study of breakdown and resistance.*

Lee, Myung Hwi, *Robust M-estimation under type* 1.5 *censoring and its application to accelerated life testing.*

Mazumdar, Madhuchhanda, *A combination of tests and publication bias in meta-analysis.*

Torbeyns, Anne, *Some goodness-of-fit tests for regression with censored data.*

Zheng, Hongjie, *The conditional approach to multiple time series modeling.*

## Temple University (9)

MATHEMATICS

Jiang, Yiping, *Some results for the domain of attraction of* $H_{3,0}(x)$.

Johnston, Clifford Andrew, *On the solvability of nonlinear second order degenerate elliptic partial differential equations with large zeroth order coefficient.*

STATISTICS

Cheung, Albert, *Bivariate extension of Wang-Ryzin smoothing procedures in discrete density estimation.*

Kouassi, Alex, *Semi-parametric approach to hazard estimation with randomly right censored observations.*

Saranadasa, Hewa, *Discriminant analysis based on some concepts of experimental design.*

Schultz, Delray, *Topics in nonadaptive group testing.*

Vargas, Jose, *Detection of outliers in censored exponential samples.*

## University of Pennsylvania (3)

MATHEMATICS

Blute, Richard, *Linear logic, coherence and dinaturality.*

Markman, Eyal, *Spectral curves and integrable systems.*

STATISTICS

Liu, Wanyun, *Variable selection in observational studies.*

## University of Pittsburgh (7)

BIOSTATISTICS

Damaraju, Chandrasekharro Vinkata, *Ordinal regression models in longitudinal studies.*

Kardatzke, David, *Hypothesis testing and signal detection theory: ROC curves for comparing test statistics.*

Kuntoro, *Designing a breast cancer registry in Indonesia with a built-in statistical quality control component.*

MATHEMATICS AND STATISTICS

Chen, Zhibo, *On polynomial representations of functions over integer residue class rings and over finite fields.*

Harris, Melaine Jeanne, *Linearly stratifiable spaces.*

Mi, Jie, *Optimal burn-in.*

Santmyer, Joseph, *Discordant permutations, Rook polynomials and factorization domains.*

# RHODE ISLAND

## Brown University (14)

APPLIED MATHEMATICS

Black, Kelly, *A parallel multi-domain approximation for parabolic equations using Chebyshev polynomials and the penalty method.*

Chang, Eugene Jen-Ming, *Accelerated motion of rigid spheres in unsteady flows at low to moderate Reynolds numbers.*

Hilgers, Michael Gene, *A different kind of nonuniqueness of solutions of certain hyperbolic systems of conservation laws with spatial dimension greater than one.*

Katz, Richard Alan, *Transitions to turbulence: Determinism in nature.*

Kehagias, Athanasios, *Approximation of stochastic processes by hidden Markov models.*

Mallier, Roland, *Weakly nonlinear waves in mixing layers.*

Mello, David, *The stability of oscillatory flow in a circular pipe.*

Rovelli, Todd Anthony, *Simultaneous estimation of isotope intensity and attenuation coefficients in single photon emission tomography.*

Ruetsch, Gregory Roland, *The structure and dynamics of the vorticity and passive scalar fields at small scales in homogeneous isotropic turbulence.*

Solomonoff, Alex Leonard, *Spectral methods for discontinuous problems.*

Zhu, Hang, *Dynamical programming and variational inequalities in singularly stochastic control.*

MATHEMATICS

Crannell, Annalisa, *The existence of many periodic non-travelling solutions to the Boussinesq equation.*

Lieman, Daniel Bennett, *Automorphic forms and cubic twists of elliptic curves.*

Shu, Linghsueh, *Cyclotomic type theorems over global function fields.*

# SOUTH CAROLINA

## Clemson University (6)

MATHEMATICAL SCIENCES

Boland, James W., *Inclusive connectivity, a local graph connectivity parameter.*

Ebiefung, Aniekan A., *The generalized linear complementarity problem and its applications.*

Grabbe, Michael Thomas, *Optimal control of robot manipulators.*

King, Belinda B., *Modeling and control of multiple component structures.*

Majumdar, Aniket, *Neighborhood hypergraphs: A framework for covering and packing parameters in graphs.*

McIntyre, Dale L., *Time invariance and stability of stochastic linear hereditary systems as characterized by their covariance functions.*

## Medical University of South Carolina (3)

BIOMETRY, EPIDEMIOLOGY, AND SYSTEM SCIENCE

Chen, Qulu, *Compton scattering connection in the qualifications of single photon emission computer tomogram.*

Denslow, Stewart, *Numerical characterization of fiber directionality in digital confocal images of embryonic heart.*

Torsella, Joni, *A method for determining the critical number of bindings sites in biological transduction phenomena.*

## University of South Carolina (8)

MATHEMATICS

Chen, Hsinjun, *Compact convex sets and the barycenter in* $L_0^+$.

Hong, Weihu, *Interpolation of function spaces.*

Kammoun, Jamel, *Products with a* $K$-*metrizable factor.*

Li, Kuo-Ming, $L_0$-*type spaces.*

Liu, Derfen, *Graph homomorphisms and the Channel assignment problem.*

Sun, Christine H.-W., *Binomial determinants with applications.*

Zhao, Shiying, *Square area integral estimates for subharmonic functions in NTA domains.*

STATISTICS

Gulati, Sneh, *Smooth nonparametric function estimation from record breaking data.*

## TENNESSEE

### Memphis State University (3)

MATHEMATICAL SCIENCES

Bedrossian, Pascal, *Forbidden subgraph and minimum degree conditions for hamiltonicity.*

Chen, Guantao, *Hamiltonian graphs and graphs with cycles of length divisible by three.*

Ko, Youn Hee, *Some refinements of asymptotic stability, uniform asymptotic stability, and instability for functional differential equations.*

### University of Tennessee (4)

MATHEMATICS

Davis, Reid, *Covers, q-binomial series and q-lattices.*

Drake, John Bryant, *Convection in the melt.*

Lee, Hyun Young, *Galerkin/Runge-Kutta discretization for the nonlinear Schrödinger.*

Sidani, Mohammad Majed, *A parallel algorithm for the non-symmetric eigenvalue problem.*

### Vanderbilt University (6)

MATHEMATICS

Brewer, Lora Lee, *A study of the motion of zeros of the Epstein zeta function associated to* $m^2 + y^2 + n^2$ *as* $y$ *varies from* 1 *to* $\sqrt{6}$.

Haynes, Todd Michael, *The isomorphism problem for two-generator, one-relator groups with relator of length ten or less.*

Jipsen, Peter, *Computer aided investigations of relation algebras.*

Pinter, Michael Raymond, *W-2 graphs and strongly well-covered graphs; two well-covered graph subclasses.*

Rossa, Bernd Erich, *Asynchronous exponential growth of linear* $C_0$*-semigroups and a new tumor cell population model.*

Shirley, Kevin Lynn, *A scalar-valued analytic model for a class of subnormal operators.*

## TEXAS

### Southern Methodist University (5)

MATHEMATICS

Barrett, Andrew Victor, *The numerical solution of boundary value problems for differential algebraic equations.*

STATISTICAL SCIENCE

Daniel, David, *A locally weighted least squares approach to nonparametric regression.*

Ford, Cindy, *The Gegenbauer and Gegenbauer auto-regressive moving average long-memory time series models.*

Kalkomey, Cindy, *Modeling quasi-periodic and seasonal long memory processes.*

Moon, Myung-Sang, *Polynomial measurement error modeling.*

### Texas A&M University (6)

STATISTICS

Alvarez, Marta, *Parameter estimation for compartmental mixture models.*

Baek, Jangsun, *Kernel estimation for nonparametric additive models.*

Karunaratne, Baladarage (Mahinda), *Estimating the odds ration under double sampling.*

Sepanski, Jungsywan Hwang, *Semiparametric quasilikelihood and variance function estimation in measurement error models.*

Yang, Sheng-Nah (Christine), *A matrix exponential and bootstrap analysis of nonlinear least squares estimation for compartmental models.*

Yeh, Chyon-Hwa, *Solving classification problems with the partial least squares method and classification trees.*

### Texas Tech University (3)

MATHEMATICS

Li, Zhu, *An inverse problem for linear dynamic systems with noise.*

Martinez-Morales, Manuel, *Adaptive premium control in an insurance risk process.*

Stamp, Mark S., *A generalized linear complexity.*

### University of Houston (2)

MATHEMATICS

Cardan, David, *Concerning hypernormal approximation of doubly stochastic matrices.*

Chu, Che Chen (Peter), *Finite dimensional representations of function algebras.*

### University of Texas, Austin (13)

MATHEMATICS

Glosup, Jeffrey Glenn, *Nonparametric regression and its uses in checking model fit.*

Gong, Linguo, *Sensitivity and stability analysis of problems in chance constrained programming.*

Harms, Eerik Thomas, *Three level forms in* $S^4$.

Huang, Zhimin, *Vector extremal approaches to competitive models in economics and business activities.*

Huang, Pi-Hsiang, *Balanced factorial structure with the hypercubic association scheme.*

Liau, Pen Hwang, *Fractional factorial designs.*

Lu, Wang-shu, *Empirical and hierarchical Bayes estimation of several means in the natural exponential family.*

Rade, Johan, *On the Yang-Mills heat equation in two and three dimensions.*

Serio, Frank Jr., *Uppers to* (0) *in intersections of prime ideals in polynomial rings.*

Shah, Chandni, *Integral uppers.*

Sullivan, Michael, *The prime decomposition of knotted periodic orbits in dynamical systems.*

Westmoreland, Michael, *Extension and contraction properties of Dubrovin valuation rings.*

Zhang, Dagan, *Optimization of pursuit and reliability on discrete graphs.*

### University of Texas at Dallas (4)

MATHEMATICAL SCIENCES

Qin, Mingqian, *The asymptotic properties of Bayesian nonparametric estimates for tolerance curves.*

Ribera, Leslie Ann, *Robust regression for non-Gaussian models.*

Sang, Ding, *Performance analysis of music method for DOA estimation.*

Xu, Zhigang, *Input-output linearization.*

## UTAH

### University of Utah (6)

MATHEMATICS

Candia, Mario Ricardo, *Analytic completion of highest weight modules.*

Conner, Gregory Ralph, *Metrics on groups.*

Corti, Alessio, *3-dimensional Del Pezzo fiberings.*

Eyre, David Jay, *Dynamics of patterns for two phase separation equations.*

White, Paula Denise, *Nonsolvable Hall subgroups of the general linear group.*

Yin, Guangyan, *Sinc solution of Navier-Stokes equations.*

### Utah State University (2)

MATHEMATICS AND STATISTICS

Lee, Sang-Gu, *Inequalities for generalized matrix functions.*

Lee, Yoon-Mee, *An implicit free boundary problem for the differential equation.*

## VIRGINIA

### George Mason University (1)

OPERATIONS RESEARCH AND APPLIED STATISTICS

Xie, Jennifer, *Cyclic service systems with limited service disciplines.*

### University of Virginia (9)

APPLIED MATHEMATICS

Horn, Mary Ann, *Exact controllability and uniform stabilization of the Euler-Bernoulli and Kirchoff plate equations with boundary feedback acting via bending moments only.*

Senning, Jonathan Reed, *Parallel methods for elliptic finite element problems on a shared memory vector multiprocessor.*

Straughan, Robert Ashby, *The parallel solution of three-dimensional positive definite finite element problems.*

Tataru, Daniel Ioan, *A-priori pseudoconvexity energy estimates in domains with boundary and applications to exact boundary controllability for conservative P. D. E.*

MATHEMATICS

Housworth, Elizabeth, *Escape rates for a conditioned 2-dimensional Brownian motion.*

Hu, Xiaoyu, *Measure properties of random fractals.*

Krason, Piotr, *On the category of unstable modules modulo its nilpotents.*

Szajda, Douglas, *Spectral theory of a class of unitary pseudo-differential operators.*

Wang, Daoyi, *Prediction problems for random fields.*

## Virginia Commonwealth University (7)

BIOSTATISTICS

Cao, Lihong, *CDF estimation from data with measurement errors.*

Guo, Ji-Yang, *Partial weighting for inference with the mixed MANOVA-GMANOVA model.*

Myers, William R, *Optimal experimental designs for fitting the logistics regression model.*

Pacheco, Miriam (Annett), *Representation and asymptotic properties of the thin plate smoothing spline.*

Sullivan, Esau Kenneth, *Determining Therapeutic synergism in a nonparametric regression setting.*

Symanowski, Sharon, *Kendall's tau as a multiple correlation coefficient for censored data.*

Weller, Edie A., *A multivariate rank test under ordered alternatives.*

## Virginia Polytechnic Institute and State University (5)

MATHEMATICS

Carpenter, Lonnie, *Cascade analysis and synthesis of transfer functions of infinite dimensional linear systems.*

Ferry, John, *Rational and harmonic approximation on F.P.A. sets.*

Gokhale, Dhananjay Ra, *Resolutions mod I, Golod pairs.*

Rondoni, L., *A stochastic treatment of reaction and diffusion.*

Yordanov, Russi Georg, *On the Cauchy problem for the linearized GPkdv and gauge transformations for a quadratic pencil and AKns system.*

# WASHINGTON

## University of Washington (11)

APPLIED MATHEMATICS

Bun, Yeng, *Evolution of three dimensional disturbances in a mixing layer.*

Gates, Kevin E., *Divide and conquer methods for the symmetric tridiagonal eigenvalue problem.*

Greenough, Jeffrey, *A weakly nonlinear theory of confined supersonic instability modes.*

MATHEMATICS

De Angelis, Valerio, *Polynomial beta functions and positivity of polynomials.*

Guo, Li, *On a generalization of Tate dualities with application to Iwasawa theory of arithmetic of elliptic curves.*

Lawrence, Mark G., *Polynomial hulls and geometric function theory of several complex variables.*

Long, Bing, *On the stable splitting of the smash products of some mapping cones.*

Praggastis, Brenda, *Markov partitions for hyperbolic toral automorphisms.*

Wan, Daqing, *p-adic properties of generalized zeta functions.*

Yang, Jun, *Hain-MacPherson high logarithms and algebraic K-groups of number fields.*

STATISTICS

Praestgaard, Jens Thomas, *General-weight bootstrap of the empirical process.*

# WISCONSIN

## University of Wisconsin, Madison (31)

MATHEMATICS

Brandt, Keith A., *A combinatorial study of the module of derivations of an arrangement of hyperplanes.*

Chavey, Keith L., *Combinatorial methods in the study of matrices and matrix spaces.*

Choi, Jeongwhan, *Contribution to the theory of capillary-gravity internal waves in a two layer fluid over an obstruction.*

Daniel, Timothy Lee, *Normality in box products and $\Sigma$-products.*

Fishback, Paul E., *Homomorphic functions that map continuous nonanalytic functions into the disc algebra, and nicely placed subsets of the real line.*

Gravner, Janko, *Mathematical aspects of excitable media.*

Hart, Evelyn L., *An algebraic study of Nielsen fixed point theory.*

Jin, Renling, *Independence relative to nonstandard analysis.*

Jung, Hyung Chan, *Some contributions to the combinatorial theory of partially ordered sets.*

Kaptanoglu, Hakki Turgay, *Möbius-invariant spaces and algebras in polydiscs.*

Kunkle, Thomas J., *A multivariate interpolant with nth derivatives not much larger than necessary.*

Lamb, David A., *Pseudocompact and densely compact spaces in products.*

Lazarevic, Zorana, *Some shrinking spaces.*

Lewis, Thomas M., *A law of the iterated logarithm for random walk in random scenery.*

Linton, Thomas J., *Partial isomorphisms and continuous reductions with games.*

Mekias, Hocine, *Flow due to a singularity beneath a free surface.*

Muchlis, Ahmad, *Some combinatorial properties of polytopes of symmetric, nonnegative matrices with prescribed line-sums.*

Norton-Odenthal, Brigitte E., *A product formula of generalized Lefschetz number.*

Schuette, Paul H., *Large deviations for trajectories of sums of random variables.*

Son, Geum Sug, *Contributions to combinatorial matrix theory and coding.*

Tuckey, Curtis D., *Nonstandard methods in the calculus of variations.*

Turbek, Peter S., *On compact Riemann surfaces with a maximal number of automorphisms.*

Yung, Siu Pang, *Results on infinite dimensional Hamilton-Jacobi equations.*

STATISTICS

Ahn, Hongshik, *Survival modeling through regression trees.*

Chen, Youyi, *On quasi-likelihood estimation.*

Colosimo, Enrico A., *Some issues related to the stratified proportional hazards model.*

Lee, Eric, *Regression analysis for correlated failure time data.*

Lin, Jin-Sying, *Linear regression analysis for multivariate failure time observations.*

Mouhab, Abderrahmaine, *A new Bayesian decision theory approach to screening and classification with large sample results.*

Wendelberger, Joanne, *Impact identification and estimation of sources of transmitted variation.*

Yao, Tzy-Jyun, *Random effects models for clustered proportions.*

## University of Wisconsin, Milwaukee (4)

MATHEMATICAL SCIENCES

Letellier, Julie Ann, *Orthogonal plolynomials in statistical estimation.*

O'Neill, Bruce Edward, *Applications of function theory to interpolation of the differential operator and to distributional solutions of dilation equations.*

Stafford, Keith, *Malcev-Neumann group rings and their generalizations.*

Vachuska, Peter, *Applications of the T-full socle.*

## WYOMING

### University of Wyoming (2)

MATHEMATICS

Samandra-Marakkala, S. Ananda, *Inverse eigenvalue problems for Sturm-Liouville differential equations.*

Smith, Stanley S., *Finite-strip and finite-layer methods: Analysis and applications to groundwater flow modeling.*

## CANADA

### McGill University (2)

MATHEMATICS AND STATISTICS

Gannon, Terry, *Lattices and theta functions.*

Van Rooyen, Marchand, *Stable parametric optimization.*

### Queen's University (6)

MATHEMATICS AND STATISTICS

Dillon, Douglas A., *A proposed curriculum and its implementation for OAC algebra and geometry.*

Dzieciolowski, Krzysztof S., *Methods of inference and analysis of influence in multiresponse nonlinear regression.*

Grinnell, Raymond, *Lorentz-improving measures on compact abelian groups.*

Huang, Jay J., *Tail probability of noncentral indefinite Gaussian quadratic form with applications to trellis coded MDPSK studies.*

Jaworski, Wojciech, *Poisson and Furstenberg boundaries of random walks.*

Ngai, Hung Man (James), *Simultaneous estimation of Poisson means–a hierarchical Bayes approach.*

### Simon Fraser University (5)

MATHEMATICS AND STATISTICS

Chen, Ge Mai, *Empirical processes based on regression residuals theory and applications.*

Das, Salil, *Parameter estimation in oceanographic flows driven by density gradient.*

Hare, Donovan, *The block-intersection graph of pairwise balanced designs.*

Ren, Yuhe, *Theory and computation of moving mesh methods for solving time-dependent partial differential equations.*

Zhang, Shuhua, *Mal'cev products and related topics on the lattice of completely regular semigroups varieties.*

### Université de Montréal (5)

MATHÉMATIQUES ET STATISTIQUE

Adjengue, Luc Désiré, *Estimation pour des processus spatiaux définis sur un treillis triangulaire.*

Benlahcene, Moussa, *Représentations poids maximal des algèbres de Kac-Moody affines, engendrées par l'action d'une sous-algèbre de Heisenberg.*

Houde, Louis, *Estimation de densité pour données groupées.*

Nekka, Fahima, *Equations fonctionnelles en géométrie fractale, courbes et surfaces irrégulariéres.*

Yezza, Abdelwahab, *Optimisation des systèmes gouvernés par des équations intégrales.*

### Université de Sherbrooke (3)

DÉPARTEMENT DE MATHÉMATIQUES ET D'INFORMATIQUE

Hadjou, Brahim, *Théorèmes de décomposition en théorie de la mesure non-commutative.*

Mansouri, Abdelatif, *Méthodes de pénalités mixtes à un et deux paramètres: Extrapolation et convergence asymptotique superlinéaire en deux étapes.*

Saadi-Drissi, Khadija, *Solutions presque périodiques d'équation différentielle du type pendule forcé.*

### University of Alberta (8)

MATHEMATICS

Fabbri, Marc, *Generalized Heisenberg algebras and their vertex operator representations.*

Kim, Pansoo, *Groups with permutable subgroups and infinite metabelian groups.*

Liu, Keqin, *The quantum Witt algebra and quantizations of some modules over the Witt algebra.*

McLaughlin, David, *Smoothness and decompositions in Banach spaces.*

Shi, Zhiyong, *Graded groups and toroidal groups.*

Vanderwerff, Jon, *Renormings and smoothness in Banach spaces.*

Yang, Feng, *A study of mathematical models for a chemostat with periodic input and for a cyclostat.*

STATISTICS AND APPLIED PROBABILITY

Yang, Zhen Lin, *Inference following box-Cox transformation.*

### University of British Columbia (3)

MATHEMATICS

Chang, Huaxiong, *Incompressible viscous flow in tubes with partial occlusions.*

Chiarolla, Maria, *Geometric approach to monotone stochastic control.*

Lisle, Ian, *Equivalence transformations for classes of differential equations.*

### University of Regina (1)

MATHEMATICS AND STATISTICS

Wang, Hong, *Zero-one laws for extreme order statistics.*

### University of Toronto (9)

MATHEMATICS

Ahia, Francis, *Singular perturbation theory for Schrödinger eigenvalue problem. Interaction between discrete and continuous spectra.*

Gorelic, Isaac, *Set-theoretic forcing and Lindelöf topological spaces.*

Leung, Allen Yuklun, *Integral formulae in differential geometry via mixed exterior algebra.*

Livshits, Leonid, *Generalized Schur product for matrices with operator entries.*

STATISTICS

Brimacombe, Michael Bruce, *On a conditional approach to nonlinear regression: Confidence regions and second order.*

Rahman, Sheikh Mukhlesur, *On assessing, comparing and combining probability forecasts.*

Stafford, James Edmond, *Symbolic computation and the comparison of traditional and robust test statistics.*

Wu, Yanhong, *Some contributions to on-line quality control.*

Zhu, Yiliang, *Generalized information measures and asymptotic efficiency.*

### University of Waterloo (10)

COMBINATORICS AND OPTIMIZATION

Gitler, Isidoro, *Delta-Wye-Delta transformations algorithms and applications.*

Martin, William Joseph, III, *Completely regular subsets.*

Mongeau, Marcel, *Discontinuous piecewise differentiable optimization.*

PURE MATHEMATICS

Atkins, Richard, *Equivalence: Invariance, normal forms and symmetry.*

STATISTICS AND ACTUARIAL SCIENCE

Doray, Louis G., *Prediction of INBR events with generalized regression time series and compound Poisson model.*

Ebong, Ephraim O., *Prepayment and pricing of mortgage-backed securities.*

El-Haddad, John N., *Outliers and time series modelling.*

Long, David L., *Estimating function methods for spatial binary data.*

Meester, Steven G., *Methods for clustered categorical data.*

Ravindran, Kannoo, *Generalized secretary problems.*

### University of Western Ontario (4)

APPLIED MATHEMATICS

Ahmady, Mohammad Reza, *Electroweak calculations in the presence of nonperturbative QCD effects.*

Li, Ninghua, *Strong asymptotics of Padé polynomials.*

MATHEMATICS

Bryden, John Milton, *Exterior power operations in representation theory.*

Li, Zaiquing, *Hopf algebras and cohomology operations.*

### University of Windsor (2)

MATHEMATICS AND STATISTICS

Qin, Yu, *Flow and stability studies in porous media based on some non-Darcian models.*

Sun, Weiwei, *Adaptive boundary element method.*

## Doctoral Degrees Conferred 1987–1988
*Supplementary List*

The following list supplements the list of thesis titles published in the November 1988 *Notices*, pages 1314–1342, the April 1989 *Notices*, pages 383–384, and the November 1989 *Notices*, page 1188.

## CANADA

### University of Alberta (1)

MATHEMATICS

Kuang, Yang, *Limit cycles in Gauss-type predator-prey systems.*

## Doctoral Degrees Conferred 1989–1990
*Supplementary List*

The following list supplements the list of thesis titles published in the November 1990 *Notices*, pages 1231–1250, the May/June 1991 *Notices*, page 419, and the November 1991 *Notices*, pages 1121–1122.

## CANADA

### University of Alberta (4)

MATHEMATICS

Huang, Yin Xi, *Positive global solutions of nonlinear elliptic equations.*

Latif, Raja, *Semi-open sets and mappings in topological spaces.*

Skantharajah, Mahatheva, *Amenable hypergroups.*

Yip, Lee Wah, *On Carmichael type problems for the Schemmel totients and some related questions.*

## Doctoral Degrees Conferred 1990–1991
*Supplementary List*

The following list supplements the list of thesis titles published in the November 1991 *Notices*, pages 1103–1121 and the May/June 1992 *Notices*, pages 422–423.

## KENTUCKY

### University of Kentucky (3)

MATHEMATICS

Akatsa, Victor, *Flat envelopes and negative torsion functors.*

Lilly, Glenn M., *The $C_\ell$ generalization of Bailey's transform and Bailey's lemma.*

Stenerson, Jon C., *Space curves as set-theoretic complete intersections.*

## MINNESOTA

### University of Minnesota (1)

STATISTICS

Johnson, Bradford, *On the admissibility of improper Bayes inferences in fair Bayes decision problems.*

## WASHINGTON

### University of Washington (1)

BIOSTATISTICS

Anderson, Kevin, *Efficient deconvolution of episodic hormone data.*

# Postdoctoral Positions
# Research or Research/Teaching 1992–1993

Information on the number of postdoctoral positions (either research or a combination of research and teaching) that were available in academic departments for 1992–1993 is given below. The information was supplied by departments responding to the 1992 Annual AMS-MAA Survey. The list is not a complete list of postdoctorates available for 1992–1993, but is provided as a reference tool for those interested in the availability of such positions. The first number is the total number of postdoctoral positions in the department; the second number following the colon is the number that were available for 1992–1993. An asterisk indicates that no number was supplied by the department.

## Arizona

Univ of Arizona
- Applied Mathematics 2:2

## California

Univ of California, Berkeley
- Mathematics 15:7

Univ of California, Santa Cruz
- Computer and Information Systems 1:*

Univ of California, Santa Barbara
- Mathematics 1:*

Univ of Southern California
- Mathematics 6:*

## Indiana

Purdue Univ
- Computer Sciences 2:0

## Massachusetts

Massachusetts Inst of Tech
- Mathematics 24:8

## Michigan

Michigan State Univ
- Mathematics 2:*

## Missouri

Washington Univ
- Mathematics 5:5

## New Jersey

Rutgers Univ
- Mathematics 3:*

## New York

Clarkson Univ
- Mathematics and Computer Science 2:0

Cornell Univ
- Applied Mathematics 3:1

SUNY at Albany
- Computer Science 1:*

SUNY at Stony Brook
- Applied Mathematics and Statistics 6:2

## North Carolina

Univ of North Carolina, Chapel Hill
- Biostatistics 2:0

## Ohio

Ohio State Univ
- Mathematics 12:0

## Pennsylvania

Carnegie Mellon Univ
- Mathematics 6:5

Pennsylvania State Univ
- Mathematics 2:2

## South Carolina

Univ of South Carolina
- Mathematics 5:*

## Tennessee

Vanderbilt Univ
- Mathematics 4:3

## Texas

Rice Univ
- Mathematical Sciences 6:*

Univ of Houston
- Mathematics 3:*

## Utah

Brigham Young Univ
- Mathematics 2:*

Univ of Utah
- Mathematics 12:*

## Canada

Concordia Univ
- Mathematics and Statistics 5:2

Queen's Univ
- Computing and Information Science 5:*
- Mathematics and Statistics 4:2

Univ of Alberta
- Mathematics 4:4

Univ of British Columbia
- Mathematics 8:*

Univ of Manitoba
- Mathematics and Astronomy 2:0

Univ of Toronto
- Mathematics 8:4

Univ of Western Ontario
- Applied Mathematics 1:1
- Mathematics 1–2:1

# 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

## Should Research Mathematicians Be Involved in K–6 Mathematics?

*Judith Roitman*
*University of Kansas*

Should research mathematicians be involved in K–6 mathematics? Herb Clemens, a mathematician with a long and honorable history of involvement in mathematics education, questioned in these *Notices* our ability as a community to do so, citing the "questionable belief that, just because mathematicians are good at mathematics, they should also be able to contribute to the effective presentation of elementary mathematics to an often unmotivated and unresponsive public . . . mathematicians [must] find ways to positively influence elementary and secondary mathematics education at the margins." (See the *Notices*, March 1992, page 180.)

While I agree that "the effective presentation of elementary mathematics" is not necessarily what's called for, I do not believe that we belong at the margins. Instead, I believe we belong as close to the center as any other group except classroom teachers.

### Why be involved?

I think everyone would agree that mathematics teaching in U. S. elementary schools has been a mess for a long time. It's a chicken and egg situation: the mathematical community has by and large ignored the problem of educating future elementary school teachers, who arrive at our doors badly taught because *their* elementary school teachers were essentially ignored by us . . . and so on. Twenty years ago, when, as a graduate student, I taught Berkeley's mathematics for elementary school teachers, and asked the students why they wanted to be teachers, all but a few replied "because it is a profession that doesn't require calculus." When I taught the same course a year ago, all but a few of my students entered the course with no love at all for mathematics, and quite a bit of fear and loathing.

So the first reason we should get involved in K–6 mathematics education is because we bear some responsibility for its problems.

Now not everyone in the teaching profession hates mathematics. Those that love it have gotten together and, over the last decade, put together a series of documents[1] which call for school mathematics to change to, in many respects, what mathematicians would recognize as mathematics. Kids are supposed to make hypotheses, test them, and defend or attack them; understand as well as memorize; physically model abstract mathematics; solve interesting nonroutine word problems; and so on. They are encouraged to work together and to write down their mathematical thoughts—just like we do, and starting in kindergarten. None of this is new. Educational visionaries have been talking about, and even doing, things like this for at least a century, but this time change is being implemented, not just in a few places, but mandated by state Boards of Education all around the country.

Which brings us to the second reason to be involved in K–6 education—it's an exciting time.

And the third reason—we're needed. Along with methodological change comes a potentially profound deepening and broadening of the curriculum. Many of the activities being asked of primary (i.e., K–2) teachers only make sense with reference to later mathematics. Statistics, probability, transformation geometry, and algebra, are working their way down the grade levels, not just into fifth and sixth grades, but even into the primary classroom. These content changes cannot be implemented without the help of people who know content, and by and large—not completely, but by and large—this means us.

[1]The National Council of Teachers of Mathematics' *Curriculum and Evaluation Standards; Professional Standards*; and various *Addenda to the Standards*.

**How can we help?**

There are essentially five ways we can help in K–6 education: validation, teacher training, curriculum revision, working directly with children, and assessment. Let's take these areas one by one.

***Validation.*** There are still a lot of teachers who think that a good mathematics education consists of lots and lots of rote problems, period. Even teachers who are enthusiastic about the level of energy and enjoyment the new mathematics curricula produces still may wonder if this is really mathematics. That master teachers tell them so isn't enough; that major scholars in mathematics education tell them so isn't enough. They'll believe it when *we* tell them so.[2] I hasten to say that it is not hubris that makes me say this, but the rather surprising experience of having teachers who had been doing this stuff for years tell me how relieved they were to hear mathematicians validating what they were doing.

***Teacher training.*** This breaks into two parts: teaching people planning to become teachers (pre-service) and teaching people who already are teachers (in-service).

***Pre-service training.*** We already bear quite a bit of responsibility for this, and in general have not been handling this responsibility well—consider the fact that it is still not uncommon to have even first or second year graduate students teaching that mathematics for teachers course that professors would be wasting their time teaching because, after all, it's just going over arithmetic again, isn't it? And with a bunch of dummies (charitably called "weak students"), to boot, right?

If that is our attitude, we have no right to complain about the lousy teacher our kid had in third grade, or the unprepared students in our calculus classes.

If that is not our attitude, then we need to look at the NCTM *Standards* (see footnote 1) and redesign a course that acknowledges them, that acknowledges the fact that we are preparing our students to enter an important profession, and that encourages our students (who may be shut down mathematically, but who are not therefore dummies) to demonstrate the mix of creativity and rigor that they are supposed to help their students achieve—to help them see what mathematics is.

***In-service training.*** I think most of us think of mathematics education for the nonmathematician as the clear and compelling presentation of gorgeous mathematical results (see Clemens' quote). Those of us who have been involved with in-service with K–6 teachers can tell you that this is not what teachers want or need. They want and need mathematics that is relevant to their classroom or to their profession (e.g., interpreting standardized test results) and they want it presented through activities the way they will present mathematics to their students. They want and need methodological considerations to be woven in; they often want methodology to predominate. Furthermore, these are the people we had a chance with when they were in college and we blew it. With good reason they bear us no great love, and we have to win their trust.

These issues of trust and relevance are so important that, while in general I do not want to tell other people what to do, I will make a strong suggestion. The particular way we have won trust and ensured relevance in the in-service programs here at the University of Kansas has been straightforward: we put teachers on the project staff and we take them seriously.[3] This is by no means the only way to do it, but anyone wanting to do in-service needs to give serious thought to the issues of trust and relevance.

***Curriculum revision.*** Mathematicians have been dabbling in the elementary curriculum for a long time, and our reputation is not a good one—the folklore is that that is what was wrong with the new math. But, some of the best curriculum materials that have come out of the movement represented by the *Standards* have been developed by or with mathematicians. There is an entire [National Science Foundation] NSF program that supports curriculum revision, and NSF encourages our involvement. While it is somewhat unusual for mathematicians to be involved directly in developing elementary curricula, some of the most innovative work has come from mathematicians. This is imaginative, painstaking work with tremendous potential impact—a widely-adopted curricular program reaches thousands, even millions, of children a year.

***Working directly with children.*** This is, along with pre-service training, the other traditional area in which mathematicians have been involved, usually taking the form of working with gifted kids or just quietly doing something in our own kids' classrooms. Some programs send mathematicians or mathematics graduate students into elementary classrooms on a regular basis, with established funding. Large and even not-so-large corporations for obvious reasons are particularly willing to give release time to their technical employees for this kind of work. Some events for upper grade kids—science fairs, math competitions, math and science days, inviting kids into technical workplaces—welcome or even require our participation. Minorities and women are especially needed here, not only for their impact on kids, but also for their impact on teacher expectations for kids.

***Assessment.*** While mathematicians have been fairly comfortable with high school assessment (consider Frank Demana's program at Ohio State and all its offshoots), our involvement in K–6 assessment has been fairly minimal. But this may no longer be desirable. Implementation of the *Standards* is forcing schools to change assessment procedures. If people writing mass tests have little knowledge of what mathematics is, the rhetoric of the *Standards* can lead them astray. I will give three examples. The *Standards* put great stress on estimation. Fine. But I have seen multiple choice questions in which the child who figures out the exact answer and rounds off would be marked wrong, because the people writing the question have a certain procedure in mind. The *Standards* put great stress on writing mathematics. Fine. But I've seen kids asked to write down what they'd do on a weekend in New York City and how much money it would

[2] And this is even more true of school boards and parent groups.

[3] We also had teachers help plan our pre-service courses, for similar reasons.

cost—with no constraint, i.e., a creative writing exercise with no mathematical content. Then there was "describe all the geometric shapes you see in a bicycle" as if the only geometric shapes that exist are the ones we have easy words for. We need to be involved in the process of developing such tests, if only to critique the product before its final version.

**The down-side**

Clemens said what he said for good reason. There are pitfalls for a research mathematician working in K–6 education.

It takes time, lots of it—you may not want to do this before tenure. But you don't have to wait until you're mathematically brain-dead to do this work—think of it as the equivalent of a couple of university committees. If we wait until we become brain-dead we won't do much good.

The more serious pitfall is this: elementary education is a different culture, and if we are not comfortable outside academic culture then we will run into trouble. I suspect that culture clash is behind the frequent charge that mathematicians are elitist, and behind Clemens' suggestion that maybe we are not suited to help in K–6 education.

**Transforming college education**

There is a final reason why our community should get involved in K–6 education, and that is because it is good for us. The mathematics community has been generating document after document calling for profound changes in the college mathematics classroom. I can't think of a better way to begin to think about change than working in K–6 education. It is nearly impossible to do this kind of work without asking serious questions about what we do with our own students, and what we should be doing. The best elementary teachers are far ahead of us in pedagogy. Working with them is a terrific way to expand our ideas about teaching and learning—all of it eventually transfers, even little plastic blocks.

# Computers and Mathematics

*Edited by Keith Devlin*

## This month's column

The scene is a familiar one. The brightest student in the mathematics class (who, naturally enough, intends to double-major in philosophy and business administration) has cornered the professor at the end of the third week.

**Student**: I'm not sure exactly what a proof is?

**Professor**: It's exactly what I said in class. A proof is a sound, logical argument that establishes the truth of the statement in question.

**S**: But how do you know an argument is sound and logical? What do those words mean?

**P**: Good heavens, surely you can recognize a logical argument when you see one, can't you? Weren't you convinced by any of the examples I did in class?

**S**: Well, I was convinced that your examples of false proofs were indeed false. In each case, once you pointed out the logical error, I could see why that particular argument was not a proof. But I'm not so sure about the examples you gave that you said were valid proofs. I admit I couldn't see any logical errors, and the arguments did seem pretty convincing. But how can we know for sure that the argument was sound and that there was not some hidden error that we all missed.

**P**: Well, you know, those proofs have all been around for hundreds of years, and lots of very clever mathematicians have examined them, and no one has found any errors. Surely, we can't all be wrong, can we?

**S**: Probably not. But doesn't that mean that the notion of a valid proof is a socially defined one; that what makes a proof valid is that the majority of mathematicians agree it is valid?

**P**: Good Lord, no. To be valid, a proof has to follow the laws of logic. You make a series of statements, each of which follows from the previous ones by the laws of logic.

**S**: What rules of logic? You never told us what they were. It seemed to me that for each of your examples, you presented a series of statements in which each one seemed reasonable, given the previous ones. But where were the rules of logic? How is what you did different from a clever political argument?

**P**: Well, of course, to make it easy for you to follow the proof, I did not write down every step. But it could be done. Logicians sorted all this out early this century. They developed a formal language for expressing proofs, "predicate calculus" they call it, figured out the basic axioms of logic, specified the rules of deduction—I think one of them is called "*modus ponens*" or something like that—and then you get a total rigorous notion of a proof. In fact, it is so rigorous that in some areas of mathematics—not mine, I hasten to add—you can program a computer to do it for you, to generate proofs or to check them.

**S**: So what you are saying is that any one of the ordinary, everyday proofs mathematicians deal with in their work can be rewritten in a formal way that fits into this framework the logicians have axiomatized.

**P**: Right.

**S**: So why didn't you do that in class? Why not tell us what the axioms and rules of logic are and do it that way?

**P**: Good grief, that would be hopeless. If I tried to make even the simplest proof that precise, it would be incredibly long, and quite unreadable. You would never be able to follow it. It would be far less convincing than the version I gave.

**S**: You mean that no one ever does write a proof down in formal logic?

**P**: Yes, now you're getting it. In principle it *could* be done. Any valid proof *could* be written out in full in formal logic, and then it would satisfy the logician's definition of a proof.

**S**: Only, it would be so long that no one could actually read it and check that it was right.

**P**: Absolutely.

**S**: So let me see if I have got this right. What you are saying is that, strictly speaking, a proof is valid if it is written out in predicate calculus and has the right structure according to the rules of logic. But such proofs are far too long and complicated for anyone to read, so no one ever does it. What happens in practice is that a proof is declared to be valid if it *could*, in principle, be written out in this formal way.

**P**: Yes, that's about it.

**S**: But how do you know that your proof, the one you write on the board, could be written out as a formal proof if you never actually do it?

**P**: Well, you just look at it. The irrationality of root-two for example. The argument I gave is quite obviously valid, so you know it could be translated into a valid predicate calculus proof.

**S**: But how do you know, if no one has ever done it?

**P**: (*Impatiently*). Well, you know, those logicians were clever folk, and we know from their work that any valid proof could be written out in that way, at least in principle.

**S**: But how do you know your proof is valid in the first place?

**P**: Look, I really don't have time for this. You're just going round in circles. You clearly haven't really understood what is involved in proving something. Maybe mathematics is not your subject. Have you thought about taking a philosophy course instead?

End of scenario. But not, of course, the end of the debate. And it is a debate that has achieved increasing significance over the past decade or so, with the arrival on the scene of computer proofs, the development and use of automatic theorem provers, and the attempts to provide verification of computer systems. Just what do we mean by a "proof"?

It seems that mathematicians—and to avoid generating too many letters of complaint, let me hasten to rephrase that as "we mathematicians"—are somewhat schizophrenic when it comes to answering this question. When pressured by the persistent student, we fall back on the logician's definition and the "translatable in principle" defense. But in practice, we work happily with what is quite clearly a socially determined notion of proof. Though we might harbor doubts about particularly long and novel proofs, we generally feel confident in our ability to tell a sound argument from an invalid one. Moreover, we tend to feel that it really is not an issue of judgement, and that for all their surface brevity, the proofs we construct and publish are, in an absolute sense, genuine *proofs*. I certainly feel that way. But I also know from experience that the certainty

(we) mathematicians feel about this issue is not easily explained to others outside the field, to whom, I suspect, it really does seem as though we are simply playing a game by rules we determine, decided by some sort of secret poll.

Hitherto, the argument about what constitutes an acceptable proof has largely taken place in the mathematics department coffee room (briefly) and the philosophy lounge (at great length). But the day is drawing near when that argument will move into the law courts. That very nearly occurred in Britain last year, with the so-called VIPER case, as is explained in this month's feature article. The author is Donald MacKenzie, a sociologist at Edinburgh University. Together with Alan Bundy, an expert in automated reasoning in the AI department at Edinburgh, he is currently engaged in an ongoing program of research into the nature of proof as it arises both in university mathematics departments and in the kind of industrial situation he describes in his article. Dr. MacKenzie can be reached by email at: ekja03@castle.edinburgh.ac.uk.

It should also be mentioned that the issue of automated proofs made it onto the pages of the *New York Times* on April 7 of this year, with a report of some startling recent work (by Babai, Fortnow, Lund, Szegedy, and Levin) on the problem of verification of long, formal proofs. One of the researchers involved in this work, László Babai, wrote an expository account of that work that was published in two parts in the MAA newsletter FOCUS (June and September, 1992).

Two reviews complete this month's column. Fernando Gouvêa looks at *MathType* for Windows and Tom Scavo and Larry Riddle report on their experience with *PSMathGraphs*II. The Macintosh version of *MathType* was reviewed in this column by David Hartz in April 1991. The review of *PSMathGraphs*II was prompted by an earlier review of this program by Suzanne Molnar, which appeared in this column in February of this year.

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# Computers, Formal Proofs, and the Law Courts

**Donald MacKenzie***

Three years ago, Jon Barwise drew the attention of readers of this journal to controversy concerning mathematical proof of computer system correctness [1]. The debate he described was to be found in the pages of academic journals, notably *CACM*, the *Communications of the Association for Computing Machinery*. Since then, however, controversy has come close to spilling over into the law courts, and there is every reason to expect that it will actually do so in the not too distant future. At stake are not merely issues specific to computing, but the question of the very nature of mathematical proof.

## Proving Computers Correct

Computer systems are increasingly taking on roles where their failure could have catastrophic results, for example in medical care and in the control systems of aircraft and nuclear power stations. It is obviously crucial that the hardware and software of such systems be designed correctly, yet it is difficult or impossible to establish their correctness by empirical testing. For a system of any complexity, the number of all possible combinations of external inputs and internal states is too large for even the most highly automated testing to be comprehensive. Nor does it necessarily help to install systems in duplicate or triplicate. That is good insurance against physical failure, but not against a hardware or software design flaw common to all three systems.

Concerns about safety (and also about the security of computer systems containing sensitive defense data) have therefore given considerable impetus to, and led to generous funding for, attempts to prove system correctness mathematically. Verification of the correctness of the design of computer hardware, as well as program verification (which has been the subject of most of the published debate), have become important areas of research and practical application.

Despite the heat of controversy, there seems to be reasonable agreement over two points. The first is that mathematical reasoning alone can never establish the "correctness" of a program or hardware design in an absolute sense, but only relative to some formal specification of its desired behavior. Mathematical argument can establish that a program or design is a correct implementation of that specification, but not that implementation of the specification means a computer system that is "safe", "secure", or whatever. As Barwise notes, "many 'bugs' in programs that make it into general use are not program errors at all. Rather they result from a failure to anticipate some situations in which the program is required to operate, and some uses the users put it to " [1].

Also generally agreed (though with many shades of emphasis) is that what can be proven correct is not a physical piece of hardware, or program running on a physical machine, but only a mathematical model of that hardware or program. Mathematical argument alone cannot demonstrate correspondence between the mathematical model and physical actuality. As Barwise puts it, computer system verification is applied mathematics, not pure mathematics. As in all applied mathematics, the results of computer systems verification can be expected to hold only to the extent that "our mathematical model is faithful to the phenomenon being modeled" [1].

These two points, however, by no means exhaust the issues raised by mathematical proof of computer system correctness. A third issue—and my focus in this article—is the question of what kind of mathematical argument counts as a proof.

Mathematicians know very well the scope for dispute over this. For example, arguments that satisfied eighteenth century mathematicians were rejected as not constituting proofs by their nineteenth century successors such as Cauchy [9]. The

*The research on which this article is based is supported by the UK Economic and Social Research Council's Programme on Information and Communication Technologies (PICT), award number WA 35 25 0006. The issues in the last section of the paper are the subject of continuing research by the author and Alan Bundy of the Edinburgh University Department of Artificial Intelligence, and that section is heavily influenced by discussions with him. I'm also grateful for helpful comments on that section from Robin Milner.

twentieth century has seen dispute between formalists and intuitionists over the validity of proofs dependent upon the law of the excluded middle.

The growing practical importance of proofs of computer system correctness is starting to drag disputes over the nature of proof into contexts quite different from those of the academic disciplines of mathematics, philosophy, and logic. To say that one has proven the correctness of a safety-critical or security-critical computer system is to make a claim that has commercial and legal significance. Five years ago, colleagues and I predicted that, as a consequence, it might not be long before a "court of law has to decide what constitutes a mathematical proof procedure" [**15**].

## Litigation over Proof

That prediction has turned out to be correct, although, for contingent reasons, the legal case in question ended before a court ruled on the points at issue. The case concerned VIPER (Verifiable Integrated Processor for Enhanced Reliability), a microprocessor developed in the mid- and late-1980s by a team of researchers from the UK Ministry of Defence's Royal Signals and Radar Establishment. Though VIPER has several other features designed to make it safe (such as simply stopping if it encounters an error state), what was crucial about it was the claimed existence of a mathematical proof of the correctness of its design. VIPER was marketed as "the first commercially available microprocessor with a proven correct design" [**10**].

The claim of proof became controversial. There has been sharp disagreement whether the chain of reasoning connecting VIPER's design to its specifications can legitimately be called a "proof". In January 1991, Charter Technologies Ltd., a small English firm which licensed aspects of VIPER technology from the Ministry of Defence, began legal action against the Ministry in the High Court. Charter alleged, amongst other things, that the claim of proof was a misrepresentation and sought damages under the 1967 Misrepresentation Act. The Ministry vigorously contested Charter's allegations.

Charter went into liquidation before the case could come to court. Nevertheless, the controversy surrounding VIPER, and the aborted litigation, reveals some of the scope for dispute over proof. The development of VIPER and the construction of its controversial proof are discussed elsewhere [**13**]. The core of the criticism of the claim of proof was as follows. The critics (Cambridge University computer scientist Avra Cohn, who worked on the proof, and Bishop Brock and Warren Hunt of the Austin, Texas firm commissioned by NASA to evaluate it) used a definition of formal proof summarized by Brock and Hunt's colleagues Robert Boyer and J. Strother Moore:

> A formal mathematical proof is a finite sequence of formulas, each element of which is either an axiom or the result of applying one of a fixed set of mechanical rules to previous formulas in the sequence [**2**].

By that criterion, there was only a partial proof of the correctness of VIPER's design. This was constructed by Cohn, on contract to the Royal Signals and Radar Establishment, using HOL (Higher Order Logic), an automated system for proof construction developed by her colleague Mike Gordon. Even though large—her main proof consisted of a sequence of over 7 million formulae—this work did not encompass all the steps between the top level specification of VIPER's behaviour and the logic-gate level description used to control the automated equipment employed to construct the "masks" needed to fabricate VIPER chips. (Although work on the VIPER proof is continuing, there is still—to this author's knowledge—no full formal proof, in the above sense, encompassing all these steps.)

Cohn therefore wrote in 1989: "No formal proofs of Viper (to the author's knowledge) have thus far been obtained at or near the gate level" [**5**]. Brock and Hunt, likewise, concluded that "VIPER has been verified in the traditional hardware engineering sense, i.e., extensively simulated and informally checked" but not "formally verified" [**3**].

One can only speculate about precisely how the claim of proof for VIPER would have been defended, if the case had come to court. The one published response (known to this author) by a member of the VIPER team to criticism of the claim of proof does not attempt a rebuttal [**11**], and, in any case, the defendant in the law suit was the Ministry of Defence, not the individual team members, so the line of argument adopted might, therefore, not necessarily have been theirs.

Nevertheless, it seems clear that a defence of the claim of proof would have had to involve challenging the notion of proof underpinning the criticism of it, so that mathematical arguments not conforming to the model summarized by Boyer and Moore could count as proofs. That, certainly, was the position adopted in defense of VIPER by Martyn Thomas, head of the software house Praxis and a leading figure in the UK software industry, in an electronic bulletin board comment on the end of the litigation:

> We must beware of having the term "proof" restricted to one, extremely formal, approach to verification. If proof can only mean axiomatic verification with theorem provers, most of mathematics is unproven and unprovable. The "social" processes of proof are good enough for engineers in other disciplines, good enough for mathematicians, and good enough for me... If we reserve the word "proof" for the activities of the followers of Hilbert, we waste a useful word, and we are in danger of overselling the results of their activities [**16**].

## Formal Proof and Rigorous Argument

These competing arguments, as they bear upon the VIPER proof, were never tested in law, and the shadow of litigation has inhibited open discussion of the VIPER proof in the scientific community. The more general clash of competing notions of proof has, however, been central to the debate over proofs of computer system correctness.

Thus the paper that opened the debate, by Richard DeMillo, Richard Lipton, and Alan Perlis, argued that proofs of theorems in mathematics and formal verifications of computer programs were radically different entities:

> A proof is not a beautiful abstract object with an independent existence. No mathematician grasps a proof, sits back, and sighs happily at the knowledge that he can now be certain of the truth of his theorem. He runs out into the hall and looks for someone to listen to it. He bursts into a colleague's office and commandeers the blackboard... Mathematical proofs increase our confidence in the truth of mathematical statements only after they have been subjected to the social mechanisms of the mathematical community. These same mechanisms doom the so-called proofs of software, the long formal verifications that correspond, not to the working mathematical proof, but to the imaginary logical structure that the mathematician conjures up to describe his feeling of belief. Verifications cannot readily be read; a reader can flay himself through one of the shorter ones by dint of heroic effort, but that's not reading. Being unreadable and—literally—unspeakable, verifications cannot be internalized, transformed, generalized, used, connected to other disciplines, and eventually incorporated into a community consciousness. They cannot acquire credibility gradually, as a mathematical theorem does; one either believes them blindly, as a pure act of faith, or not at all [**6**].

Many mathematicians might agree that, in the words of Jon Barwise, "formal proofs" differ from "real proofs", and that "current formal models of proof are severely impoverished since there are many perfectly good proofs that are not modeled in any direct way by a formal proof in any current deductive system" [**1**]. Nevertheless, the argument of DeMillo, Lipton, and Perlis did not win universal assent. One critic described an earlier version of their paper as a "political pamphlet from the middle ages" [**7**]. Another responded: "I am one of those 'classicists' who believe that a theorem either can or cannot be derived from a set of axioms. I don't believe that the correctness of a theorem is to be decided by a general election" [**12**]. The paper by philosopher James Fetzer that has been the focus of most of the recent controversy over program verification likewise accepted that real proofs are formal proofs [**8**].

Indeed, the formal notion of proof seems set to become dominant in the setting of standards for high-integrity computer systems. Most interesting in this respect, because it addresses the issue directly, is the new UK Interim Defence Standard 00-55, governing the procurement of safety critical software in defense equipment. It differentiates explicitly between "Formal Proof" and what it calls "Rigorous Argument":

> A Formal Proof is a strictly well-formed sequence of logical formulae such that each one is entailed from formulae appearing earlier in the sequence or as instances of axioms of the logical theory...
> A Rigorous Argument is at the level of a mathematical argument in the scientific literature that will be subjected to peer review... [**14**].

Unlike DeMillo, Lipton, and Perlis, who see formal proofs as the mere "imaginary logical structure" corresponding to peer-reviewed rigorous arguments, the Ministry makes it clear that in its view formal proof is to be preferred to rigorous argument:

> Creation of [formal] proofs will... consume a considerable amount of the time of skilled staff. The Standard therefore also envisages a lower level of design assurance; this level is known as a Rigorous Argument. A Rigorous Argument is not a Formal Proof and is no substitute for it... [**14**].

## Formal Proof and the Law Courts

What will be the consequences if other regulatory bodies follow the lead of the UK Ministry of Defence, distinguishing explicitly between formal proof and rigorous argument, and making it clear that formal proof is to be preferred? It would make it unlikely that the VIPER litigation will be repeated, since a claim of proof would be unlikely to be made without there being a full formal proof to be pointed to. But it would by no means rule out future litigation over such formal proofs. Even if it becomes accepted that the only real proofs are formal proofs, it by no means follows that every particular claimed formal proof will be accepted as a real proof.

One issue is the plain fact that formal proofs can contain mistakes. True, formal proofs of computer system correctness are likely to be generated not by human beings but by theorem proving programs (with varying degrees of human guidance), or at the very least checked by automated proof checkers. Indeed, the relative ease of automation of formal proof, compared to that of informal rigorous argument, probably outweighs any philosophical considerations in making regulators prefer the former. However, an automated proof checker cannot be expected to detect an error in the formulation of the definitions and axioms from which the process of deduction begins. In proofs of the correctness of computer systems, these definitions and axioms are likely to be extensive and complex. For example, the high-level and block-level definitions of VIPER, a deliberately simple hardware design, stretch over ten densely-typed pages [**4**].

Most mistakes in formulating axioms and definitions would of course simply make the desired proof impossible to complete, but there remains the possibility that even something as simple as a typing error might introduce an inadvertent inconsistency—and, of course, anything follows from an inconsistent set of axioms and definitions.

More intriguing than mistakes are issues about which people might reasonably disagree. Some of these relate to the "applied mathematical" issues of the appropriateness of models referred to above. For example, formal reasoning about programs typically rests upon a mapping between statements in the relevant programming language and statements in a mathematical theory: i.e., upon what is called a "semantics" of the programming language. But there is a wide variety of competing approaches to programming language semantics, and not all features of how programs actually run on real machines are necessarily captured by a particular semantics.

There is a sense, of course, in which such modeling issues are "extra-mathematical". More "intra-mathematical" are issues to do with the rules of logical inference that are employed in a formal proof. As Barwise notes, "there are as many different deductive systems as there are textbooks in logic" [1]. Formalist, constructive, and modal logics, as well as many particular specialized logics, have all been used in proofs of computer system correctness.

Practitioners typically take a pragmatic, "horses for courses", approach to the choice of logic appropriate to a particular task. Although there are, for example, both formalist and constructive automated theorem provers, the divide has not generated the passions of the Hilbert-Brouwer dispute. But it may be that this relaxed attitude is the product of the experimental, academic phase of the development of proof of computer system correctness. As such proof becomes big business, and particular proofs take on regulatory and commercial significance, pragmatic relaxation may no longer be sustainable.

It takes a leap of imagination to envisage a courtroom in which, with large sums of money at stake, lawyers have to debate the usage of the law of the excluded middle or some other aspect of mathematical logic. Yet, a few years ago it would have seemed unimaginable that a law court might have had to weigh the virtues of formal and informal mathematical proofs, as the English High Court nearly had to do in the VIPER case. It would certainly be foolish to assume that the first legal case centering on the nature of mathematical proof will be the last.

### Bibliography

[1] Barwise, J., Mathematical Proofs of Computer System Correctness, *Notices Amer. Math. Soc.* **36**, 7 (September 1989) 844–851.

[2] Boyer, R.S. and Moore, J.S., Proof Checking the RSA Public Key Encryption Algorithm, *Amer. Math. Monthly* **91** (1984) 181–189.

[3] Brock, B. and Hunt, W.A., Jr., "Report on the Formal Specification and Partial Verification of the VIPER Microprocessor," Computational Logic, Inc., Austin, Texas, 15 January 1990 (Technical report no. 46).

[4] Cohn, A., "Correctness Properties of the Viper Block Model: The Second Level," University of Cambridge Computer Laboratory, Technical Report No. 134, May 1988.

[5] Cohn, A., The Notion of Proof in Hardware Verification. *J. Automat. Reason.* **5** (1989) 127–139.

[6] DeMillo, R.A., Lipton, R.J., and Perlis, A.J., Social Processes and Proofs of Theorems and Programs, *CACM* **22** (1979) 271–280.

[7] Dijkstra, E.W., On a Political Pamphlet from the Middle Ages, *ACM SIGSOFT*, Software Eng. Notes 3 (2) (April 1978) 14–16.

[8] Fetzer, J.H., Program Verification: The Very Idea, *CACM* **31** (1988) 1048–1063.

[9] Grabiner, J.V., Is Mathematical Truth Time-Dependent, *Amer. Math. Monthly* **81** (1974) 354–365.

[10] Hughes, N.H., Foreword to Charter Technologies Ltd., VIPER Microprocessor Development Tools, December 1987.

[11] Kershaw, J., Foreword to [3].

[12] Lamport, L., Letter in ACM Forum, *CACM* **22** (1979) 624.

[13] MacKenzie, D., The Fangs of the VIPER, *Nature* **352** (8 August 1991), 467–468.

[14] Ministry of Defence. The Procurement of Safety Critical Software in Defence Equipment, UK Ministry of Defence Directorate of Standardization, Glasgow, 5 April 1991 (Interim Defence Standard 00-55/Issue 1).

[15] Peláz, E., Fleck, J., and MacKenzie, D., Social Research on Software, paper read to National Workshop of Programme in Information and Communications Technologies, Manchester 1987.

[16] Thomas, M., VIPER Lawsuit withdrawn, electronic mail communication, 5 June 1991.

# Reviews of Mathematical Software

## *MathType* for Windows

### Reviewed by Fernando Q. Gouvêa*

These days, when it comes to writing up papers, it seems that one can divide mathematicians into three types: the TEXies, the WYSIWYGers, and the "let the secretary do it" types. (This article will have little to say to the third camp.) The first two camps are especially sharply divided: very few evangelistic endeavors (in either direction) seem to succeed. This article is an attempt, by a confirmed TEXie, to come to terms with one of the better offerings from the opposing camp.

I guess by now we all know about TEX: it is a very powerful system for typesetting books and articles, built from the beginning with the special requirements of mathematical typesetting in mind. Preparing mathematical documents in TEX requires the usage of a reasonably large number of "control words" which communicate the desired symbols to the TEX program. Only after the basic document is completely prepared can one run it through the program and see what comes out (either by printing or with a screen previewer). The result can be quite beautiful, but it is seldom so at the first attempt: errors in the TEX source file can mess up the output, or even cause there to be no output at all, and finding and correcting these errors can be a daunting process.

Besides the quality of the output, the main advantages of TEX are speed and portability. As for speed, since a TEX source file is a plain text file, typing it in does not require a complex word processing program nor bitmapped fonts: one can use a simple text editor, which speeds up the typing process. Typing in equations does not involve "mousing around", and (once all the control sequences are known, which may be a significant proviso) one can quickly and cleanly integrate mathematics and text. In addition, since the source file is plain text, one can easily transfer it across platforms: a file written on the PC at home can easily be transferred to the Mac at the office, or emailed to a friend who is using a SparcStation. The file (given a few elementary cautions) should survive unscathed, and the TEX program will (or should) produce identical output on any of these platforms.

A final advantage of TEX, which may be significant in budget-conscious times, is that there are many free implementations available (though many people seem to prefer

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the commercial versions, which might offer better support and more integrated TEX environments). The spirit of free distribution introduced to the TEX community by Donald E. Knuth has persisted, and one can often obtain style-files and other additions to TEX directly from the internet or at nominal cost. (Good examples of this are the AMS formats, $\mathcal{A}\mathcal{M}\mathcal{S}$-TEX and $\mathcal{A}\mathcal{M}\mathcal{S}$-LATEX.)

In contrast to TEX stand the WYSIWYG systems. The acronym stands for "what you see is what you get", which is more a programmatic goal than something that is really accomplished; the point is simply that the properties of the final printout should be reasonably faithfully represented on the computer screen, and it should be possible to manipulate those properties as directly as possible. Such systems allow the user to have a very good idea what the printed article will look like, and thus to avoid unpleasant surprises. In most cases, extensive use of the mouse is made, for marking, cutting-and-pasting, and even dragging text from one place to the other. Such visually oriented systems are ideally suited for the inclusion of graphical elements in the text (a notoriously weak point in TEX).

Advocates of WYSIWYG complain that systems like TEX are unintuitive, requiring the user to memorize large numbers of arbitrary codes. For example, to get output like

"I really *mean* it," Don said.

TEX requires the user to type

```
``I really {\it mean} it,'' Don said.
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By contrast, in a visual system one simply types the line in, allowing a "smart quotes" macro handle making the quotation marks come out right, and then italicizes the word "mean" by marking it with the mouse and clicking a button (or using a keyboard equivalent, or a menu choice: word processors usually have a lot of redundancy built in).

An additional problem many users object to is the multistep structure of using TEX: write the source file, run TEX, run a DVI driver to preview, run another DVI driver to print. The argument is that this kind of "batch processing" is unnatural and dates back to the bad old days of mainframes. This problem is somewhat relieved in the integrated environments of some commercial TEX implementations, but even those do not approach the simplicity and naturality of using a word processor.

Advocates of TEX usually reply that using such a word processor can be slow, that the files produced are often system-specific, and that there is the additional matter of the cost of such software. The quality of the output is also sometimes an issue (the battle cry here being "what you see is *all* you get"), though less so than the other points. Or so goes the traditional TEXie argument.

In fact, over recent years, there has been a consistent increase in the power of the computer hardware available to "regular people", and this increase has allowed software companies to produce faster and more powerful word processors. In addition, graphical interfaces seem to be well on the way to becoming dominant, with the widespread use of the Macintosh, Microsoft Windows, and the X-Windows system. If one is using a graphical interface to begin with, the speed gained by using a text editor over a word processor is not all that great, at least while typing text. The ability to transfer files across platforms is also becoming more common. For example, reasonably simple files produced by **Word for Windows** on my PC are read *without special translation* by the Macintosh version of **Microsoft Word** (all that is needed is the **Apple File Exchange** utility); this process is more painful, however, if graphics are involved. Finally, the widespread use of Type 1 PostScript fonts and the **Adobe Type Manager** go a long way toward relieving the problems with quality that many have noted in word processor output.

All of this makes the word processor a more attractive option, certainly for files that are mainly text, or that are text integrated with graphical elements. In fact, I suspect that many of us are now leading dual lives, using TEX for mathematics and a word processor for letters and other writing consisting mostly of text.

Mathematical expressions, however, have remained a challenge for the WYSIWYG camp, the difficulty lying, it seems, in the complexity of much of what mathematicians have to write. The equation editors included in many word processors have often seemed to be written by and for people who rarely use equations in their writing. *MathType* and its main rival *Expressionist* are an attempt to solve this problem by adding a dedicated equation editor to the working environment.

The idea is simple: in these multitasking days, it is plausible to have both *MathType* and one's favorite word processor running together on the desktop. Whenever an equation needs to be inserted, it is produced with *MathType* and transferred to the word processing document by "cutting-and-pasting". (In the Windows 3.0 environment, one can use DDE[1] links, or Microsoft's OLE[2]; on the Macintosh, one might use the "publish and subscribe" feature in System 7.) Of course, modifying the equation requires returning to *MathType*, but this can often be achieved simply by double-clicking the equation in the word processor window, so it is not too painful.

The version of *MathType* under review[3] adds to this basic approach the possibility of creating a file containing its equation. This can be either a Windows graphics metafile, an Encapsulated PostScript file, or even a TEX file. The last possibility is particularly intriguing, since it allows even a TEX user to compose particularly complex equations visually, and then to include them in a TEX source file (we will look at how well this works below).

## A Tour

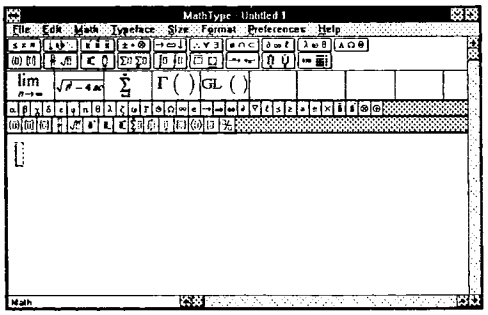
All the groundwork done, let's take a tour of how it works. Let's assume that we are running **Microsoft Windows 3.0**

[1] Dynamic Data Exchange

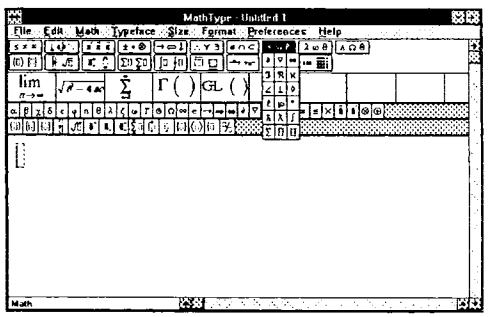
[2] Object Linking and Embedding

[3] *MathType for Windows*, version 1.1a., is available from Design Science, Inc., 4028 Broadway, Long Beach, CA 90803. List price $249.00. A Macintosh version is also available, but was not tested for this review.

and a word processor, say Microsoft's **Word for Windows**. Before starting the word processor, we start up *MathType*, and minimize its window to an icon on the desktop. Once in the word processor, we write normally until the time comes to enter an equation. At that point, we invoke *MathType*, either directly or using a macro (*MathType* comes with ready-to-use macros for **Word for Windows** and **AMI Pro**). Either way, we get an equation editing window (see Figure 1).




(a) Initial state

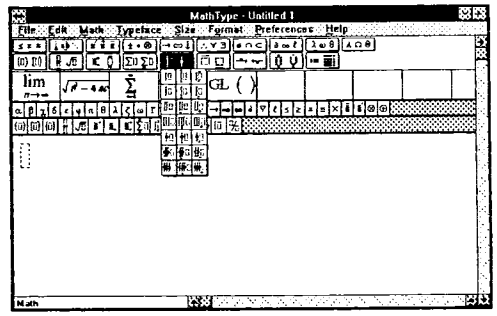



(b) A symbol menu

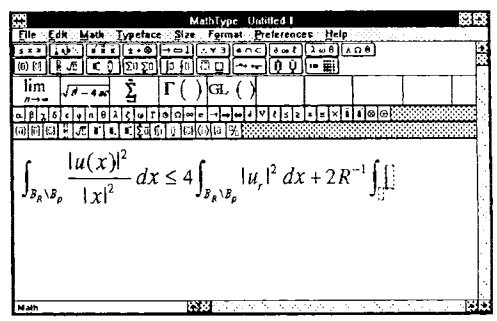
Figure 1: The *MathType* editing window.

The equation editing window contains a number of menus. At the very top, there are the usual "File", "Edit", etc. Next, there is a symbol menu, each of whose boxes will bring down a choice of symbols. The third line contains a template menu, each of whose boxes will bring down a choice of templates (more on templates anon). The final three lines are customizable: the first contains macros, full-blown expressions that are ready to be inserted at any point; the next, a selection of often-used symbols; the last, a selection of often-used templates.

Building an equation in *MathType* turns on the concept of a template. To enter an integral, for example, one clicks on the integral template, and gets on the screen an integration symbol with boxes reserved for the upper and lower limits and for the integrand. One then moves to each of these boxes to fill in as required (see Figure 2). The mouse is used quite heavily, though there are keyboard equivalents for many mouse actions (a keyboard template containing those equivalents would be a welcome addition to the product). While the process is slow, one can build up reasonably complex equations without too much difficulty.




(b) A template menu




(c) Making an equation

Figure 2: The *MathType* editing window.

*MathType* incorporates one of the more important features on TEX, in that it "knows" the proper spacing for the symbols in an equation. Using the spacebar while composing an equation will only get a beep. Symbols are, as a rule, properly placed, and the user can (with some effort) modify them when necessary. (This is definitely a plus: for the most part, one does not have to worry about such issues as which type size should be used for subscripts given the current text size.) As in TEX, *MathType* will set in italics any letters typed into equations, except for certain sequences (such as "sin") which it recognizes as names of functions. One can, of course, override the program if necessary, and it sometimes is. For example, *MathType* preserves a feature of TEX to which many users have objected: the use of italics for upper-case letters in mathematical formulae. That is, it produces

$$\mathrm{GL}_2(N) \qquad \text{as opposed to} \qquad \mathrm{GL}_2(\mathrm{N}).$$

Once the equation is ready, one must transfer it to the word processor, either by cutting-and-pasting or by using the DDE conversation between the two programs (with the **Word for Windows** macro, "save"-ing the equation in the *MathType* window automatically puts it into the word processor's window). For this to work, the "clipboard translator" option must be correctly set to metafile format. One must then close

the *MathType* window[4] to return to writing.

That done, we have a rather nice equation in our word processing document. If things have been set up correctly, double-clicking on this equation will once again open a *MathType* window to allow editing of the equation (provided a copy of *MathType* is still running).

## How Well Does it Work?

There are several things one should evaluate in a program such as *MathType*. First, whether it can handle any equation, however complex. Second, whether entering an equation is a pleasant and reasonably quick process. And third, whether the result offers good printing quality.

To consider last things first, the quality of the printed output from *MathType* is quite high. The program uses Type 1 (PostScript) fonts so that the quality of the printing is comparable to the output of any PostScript printer. The positioning of the symbols is usually quite good, and the whole thing can look quite professional. (Sample pages, printed out on an Apple LaserWriter, are in Figure 3 on next page.)

The question as to whether this is a pleasant (or at least tolerable) way of typing equations is harder to answer. Above all, using *MathType* is slow: mouse operations and selection of symbols from palettes necessarily take more time than typing straight text, or even the control words used in TEX. As an exercise, I timed myself in the process of producing the sample pages in Figure 3: using **Word for Windows** and *MathType*, it took an hour (this includes time out due to an "Unrecoverable Application Error", after which the auto-save feature of **Word for Windows** was instrumental in avoiding a total loss of the work done up to that point; users should save their work often). Using TEX (on the PC, running under Windows), the process took 40 minutes (this includes time for running TEX, previewing the output, and correcting a few errors). As expected, using *MathType* is quite a lot slower for this kind of page. One should also remark that the dynamics of the writing process is quite different in each case. With TEX, one writes quickly (about 15 minutes for the example page) and then spends some time correcting the source file after running TEX and a previewer. With a word processor, all of the time is spent on writing (and very little correction is needed later).

My general impression is that using *MathType* is a good method for writing text that includes small amounts of mathematics, but that it is far less suitable for complex pages or long documents. For such use, I still find TEX better by far, not least because it allows me to "type as fast as I think". For those, however, who cannot live with anything but WYSIWYG, *MathType* is probably the best option available, especially if macros are extensively used, both in *MathType* and in the word processor.

The final question is one of scope: can *MathType* handle any and all equations one might want to write down? One must begin, of course, by noting that even with TEX some kinds of mathematical typesetting are very hard to do: finding a good way to enter commutative diagrams, for example, has been a goal of many add-ons to TEX, from LAMS-TEX to dedicated macro packages. The same can be said for *MathType*: it will very likely handle everything most users will want to do, but there will be some things outside its scope. In our sample page, *MathType* only failed me in that I could not find out how to put a "check" accent on the $G$, so that I had to settle for $\check{G}$. One will also note, in that page, the differences in fonts: in TEX, I used the Computer Modern fonts and the Euler script font; in *MathType*, I used Times, the Park Avenue script font, and the symbol fonts that come with the program.

One difference that is immediately felt is that while in TEX everything is done with the same program, using *MathType* allows for a more modular approach, with different tasks being done by different programs. For example, while *MathType* handles the spacing within the equation, the line spacing around inserted equations has to be adjusted (by hand, in our case) within the word processor. This can be a little unwieldy, but it can also provide some added flexibility: most word processors, for example, have built-in methods for creating tables (notoriously tricky in TEX), and some even have drawing tools that might be called on to handle commutative diagrams of the more complex kind.

## Printing to a File

As mentioned above, I found the fact that *MathType* will save equations in both Encapsulated PostScript and TEX formats intriguing. Files in EPS format can be easily inserted into TEX files (via the `\special` mechanism supported by most DVI-to-PostScript drivers), and can also be manipulated in various ways. The ability to save equations in TEX format, on the other hand, suggests the possibility of composing complex equations visually using *MathType*, and then inserting the resulting code into a TEX file.

To test the quality of the resulting TEX code, I considered the following snatch of LATEX (which was posted as a challenge on the USENET):

```
Plugging the expressions for $K_e$, $k_6$, [H],
and [I] into this,
we get
\[{\ \frac{d[{\mathrm{HI}}]}{dt}
   =2 k_1\left\{{[\mathrm H_2][\mathrm I_2]}
                    -K_e[{\mathrm{HI}}]^2\right\}
   \left\{1 + \frac{k_3 K_d}
          {k_1[{\mathrm I}_2]^{1/2}}
       \cdot \frac{1}
       {\frac{\textstyle k_4[{\mathrm{HI}}]}
        {\textstyle k_5[{\mathrm I_2}]}
        + 1}\right\}  \;\;.}\]
```

[4]This is an important point which the documentation did not seem to get across to me: one must not *exit* the *MathType* window because this exits all instances of the program and will not allow us to produce the next equation. But one must not leave the window open either, because each window consumes some of the precious Microsoft Windows "system resources"; leaving five or six open windows on the desktop gets me down to less than 20% free system resources, which usually either crashes the system or causes erratic behavior.

There is a class of complex-valued distributive functions $f$ for which

$$\sum_{n\leq x} f(n) = \exp\{-\gamma\tau(1)-\alpha\}^{-1} x^{2+i\theta}((2+i\theta)\Gamma(\tau(1))\log x)^{-1}\prod_{f_\theta}(x^2) + \kappa(x(\log\log x)^{-1}\prod_{\|f\|}(x)).$$

Here, $\alpha = \int_1^\infty(\tau(u)/u)du$, $\tau(u)\to -15$ as $u\to\infty$, and $\theta$, $\prod_{f_\theta}(x^2)$, $\prod_{\|f\|}(x)$ are the usual parameter and products. Those who cannot recognize them need not apply. For such functions, our hearts lie in wait.

Now let $N \geq 2$ and $\varepsilon > 0$. For uniformly distributed integers in the interval $[1, N]$, the Eudoxian algorithm requires an average of

$$\frac{312\log 3}{\pi^3}\left(\log N - \frac{1}{4} + \frac{\zeta'(3)}{\zeta(3)}\right) + C - \frac{1}{2} + O(N^{\varepsilon-3/4})$$

steps, where $C$ is Finagle's constant. Putting these facts together, we get that

$$\Xi(x; l, k) = \Omega_\pm((x\log x)^{-1/3}(\log\log x)^{-1/234})$$

An example of output printed in TEX.

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$$\Xi(x; l, k) = \Omega_\pm((x\log x)^{-1/3}(\log\log x)^{-1/234})$$

An example of output printed using *MathType* and word for Windows.

Figure 3

This produces the following output:

Plugging the expressions for $K_e$, $k_6$, [H], and [I] into this, we get

$$\frac{d[\mathrm{HI}]}{dt} = 2k_1\{[\mathrm{H}_2][\mathrm{I}_2] - K_e[\mathrm{HI}]^2\}\left\{1 + \frac{k_3K_d}{k_1[\mathrm{I}_2]^{1/2}} \cdot \frac{1}{\frac{k_4[\mathrm{HI}]}{k_5[\mathrm{I}_2]} + 1}\right\}.$$

I reproduced this equation with *MathType* and asked the program to save it in TEX format (unfortunately, the program will only produce Plain TEX, though the possibility of LATEX and AMS-TEX options being added is mentioned in the manual). The *MathType* window containing the equation is in Figure 4. Here is *MathType*'s TEX output (lightly edited so that the initial phrase is normal text):

```
%MathType!ZZhx47!LPabbeqaceiuceiBceyDce4zce4zceyAceOBce
                                        4zceiiceiDceiAce
%yzceiiceyzceiEceiCceOCceyzce4Cce4CceyAce4BceOBce4Cceii
%ceOzce4BceOCceiism4sd8qaaSqacGOnaebakiGGSiqGGiXGRnWdba
%WcbiaI2aqeaOGabYIabcIabULabIKab2LabcIabgMab6MabsMabcIa
%bULabMKab2LabcIabMMab6MabsNab+MabcIabsNabIMabMMaboNabY
%IabcIabENabwMabcIabEMabwMabshabmGdaaqasmizci4wceisceys
%ciyxaeGedsMedshaaiGH9iaIYiXGRnWdbaWcbiaIXaqeaOWacaaabi
%GGBjqGinWdbaWcbiaIYaqeaOGac2LGWcOGBjiSagysdclGpeaaleiS
%akiSaIOmaejSacGccYiGc2Lag2IedUOapeaaleGaiAdaraGcci4wce
%isceysciyxd8aaaSqebiaIYaaaaOGawUNaw2hadiaaaeGaigJagUYa
%oaaabiXGRnWdbaWcbiaIZaqeaOGedUOapeaaleGedsgaraaakeGedU
%2apeaaleGaigdaraGcci4wceysd8qaaSqacGOmaebakiGGDnWdaaWc
%reGaigJac+IaikdaaaaakiGHxpGdaaqacGymaeWaoaaabiXGRnWdba
%WcbiaIOaqeaOGacULabIKabMKac2fabiXGRnWdbaWcbiaI1aqeaOGa
%cULabMOapeaaleGaikdaraGcciyxaaGagUIaigdaaaGawUNaw2hacc
%iGydaaaiOlaaaa!7FFC!
```

```
Plugging the expressions for $K_6$, $k_6$, [H],
and [I] into this, we get
$$  {{d[HI]} \over {dt}}
=2k_1\left\{ {[H_2][I_2]-K_6[HI]^2}\right\}
  \left\{ {1+{{k_3K_d} \over {k_1[I_2]^{1/2}}}}
          \cdot {1 \over{{{k_4[HI]}
              \over {k_5[I_2]}}+1}}} \right\}.$$
```

The long TEX comment (i.e., the lines beginning with percent signs) at the top consists of the internal *MathType* representation of the equation; its presence allows us to reload this TEX file into *MathType* for editing or correcting. The TEXed output looks like this:

Plugging the expressions for $K_6$, $k_6$, [H], and [I] into this, we get

$$\frac{d[HI]}{dt} = 2k_1\{[H_2][I_2] - K_6[HI]^2\}\left\{1 + \frac{k_3K_d}{k_1[I_2]^{1/2}} \cdot \frac{1}{\frac{k_4[HI]}{k_5[I_2]} + 1}\right\}.$$

The reader will notice that this is essentially identical to the original, except that *MathType* has forgotten to make the variables in upper case roman rather than italic and to adjust the sizes of the variables in the last denominator (in the *MathType* window they are correct: see Figure 4). The TEX conversion is surprisingly good and may indeed prove useful to those who prefer composing complex expressions visually, though editing the resulting TEX code may require a bit of real TEXpertise. One must also note that the method for getting TEX code from the program is not the most natural: one uses "cut-and-paste" after having set the default translator between the program and the clipboard to be the TEX interpreter. The idea, of course, is to paste the result into a TEX source file, but it might have been simpler to offer one more option in the "Save As" dialog box (not least because, to use the program with a word processor, the translator has to be reset; this caused a few very mysterious errors until I figured it out). All in all, the ability to output equations in TEX format may be among the more interesting and useful features of the program, especially if the promised LATEX and AMS-TEX support materializes.

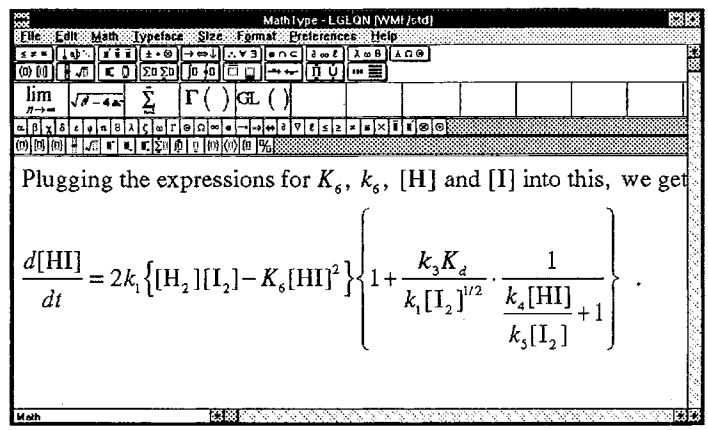


Figure 4: The test equation.

## System Requirements and Other Technical Matters

Using *MathType* is probably not much more demanding on the hardware than running a Windows word processor. My tests were done on a 386/33 IBM-compatible with 8MB memory, whose resources certainly proved more than sufficient. The most serious constraint is probably available memory; if Windows needs to start swapping to disk when one switches from the word processor to *MathType*, a marked slowdown will probably be felt.

Another constraint should be mentioned: *MathType* is ideally suited to printing to a PostScript laser printer, since it uses Type 1 fonts for all of its typesetting. Those using other laser printers will have to use the bitmapped fonts provided; those with dot matrix printers will only be able to use the program with the **Adobe Type Manager**. The use of Type 1 fonts also means that additional fonts, if needed, must be supplied in that format. There is, of course, an abundant supply of such fonts, but most of them are commercial products and

can be costly. (By contrast, the world of TEX fonts is wild-and-woolly, but those who can use METAFONT can access a large and growing number of fonts, most of which are distributed free.)

Finally, it should be noted that *MathType* supports only DDE links between it and the word processor, and not the OLE protocol recently introduced by Microsoft. The latter would make using *MathType* even easier (for example, it would make it possible to start *MathType* from within the word processor, rather than having to have it running on the desktop beforehand), and it is to be hoped that Design Science will soon add that capability to its product.

### Should You Get it?

Well, it's up to you, of course. An important component of the decision may be the fact that the Equation Editor included with Microsoft's Word for Windows (version 2.0) is a scaled-down version of *MathType*. This version, may, in fact, be sufficient for some users. Its main drawback is that it can only be used as an OLE client, and cannot save equations to files. Furthermore, the scaled-down version does not provide the strips of macros and often-used symbols and templates. This makes it cumbersome for extensive use, and I suspect that any mathematician who wants to make serious use of the program will want the full-blown version.

For those who need or like a visual representation of their equation on the screen, the full-blown program represents a good substitute for TEX. It delivers good-quality equations, and, though slow, is not hard to use, especially when paired with a powerful Windows word processor. Veteran TEXies, on the other hand, will probably find it too slow and cumbersome for anything but short documents, but even they may find a use for it in the preparation of very complex TEX code. *MathType* is a welcome addition to the small group of programs designed for mathematics-intensive text.

## *PSMathGraphs*II Version 1.1

### Reviewed by Tom Scavo and Larry Riddle*

This is a follow-up to an earlier review of *PSMathGraphs*II, a Macintosh function grapher, that appeared recently in this column.[1] In that review, the author reported a number of frustrating experiences working with the program. In contrast, we would like to mention some of the many positive experiences we've had and the ease with which *PSMG*II has helped us prepare quality mathematical diagrams. We'd also like to point out recent improvements in the software that address some of the original author's criticisms.

One of us has used *PSMathGraphs*II to draw over a hundred diagrams for a solutions manual, and it worked well for that purpose. Since the solutions manual accompanies a textbook on function iteration, *PSMathGraphs*' ability to draw stair-step or cobweb diagrams proved to be invaluable (see Figure 1). Each such diagram was first created in *PSMathGraphs*II, exported as an encapsulated PostScript file, and then included into a LATEX document later to be processed by OzTEX, a public domain implementation of TEX for the Macintosh.[2]

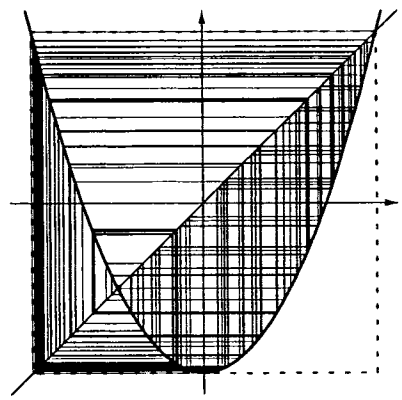

Figure 1: The chaotic orbit of 0.123 under iteration of $Q(x) = x^2 - 2$.

*PSMathGraphs*II exports standard EPSF with an embedded PICT preview. These EPSF files are easily included in LATEX documents, previewed with OzTEX 1.4, and finally printed out as high quality 300 dpi images on a LaserWriter. Alternatively, *PSMathGraphs*II documents can be copied to the Clipboard in EPSF form using the PSCopyAll command and then pasted directly into Microsoft Word 4.0/5.0 without having to resort to the Scrapbook. For those using MultiFinder, this process is extremely simple, but note that the graphic *does* remain on the Clipboard so that one may quit *PSMathGraphs*II before Word is launched. When the Word document is printed, the graph assumes the resolution of the printer whether it be a dot-matrix or PostScript printer. One of us has successfully used this technique numerous times to prepare classroom materials, homework assignments, and examinations using only *PSMathGraphs*II and Word.

Adding text to a diagram is still cumbersome with *PSMathGraphs*II, but the newest version does permit fonts and styles to be mixed to some extent (see Figure 3 on next page, for example). Also, a *PSMG*-generated EPSF file may be opened in Canvas 3.0, SuperPaint 3.0, or any graphics application that reads encapsulated PostScript, so that text may be added on top of it. Typeset equations from programs such as *MathType* or *Expressionist* may also be transferred into Canvas or SuperPaint. In any event, we've been assured by the folks at Mary Ann Software that additional text handling capabilities are high on the priority list of future *PSMathGraphs*II enhancements.

*Tom Scavo is at the University of Oregon. Larry Riddle teaches mathematics at Agnes Scott College, Decatur, GA. Both have served as beta testers for *PSMathGraphs*II. They may be reached at scavo@cie.uoregon.edu and riddle@mathcs.emory.edu.

[1] *Notices* **39** (2), 114–117, February 1992.

[2] *Notices* **36**(6), 680–681, July/August 1989.

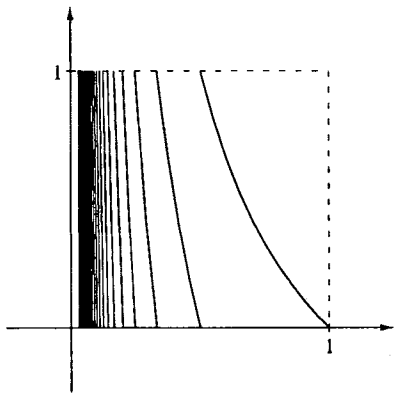


Figure 2: The Gauss map $x \mapsto 1/x \bmod 1$.

One new feature is the handy Preferences command that lets the user specify once and for all certain program characteristics like ruler units and arrowhead styles. You can also set a default magnification factor so that new or existing diagrams open at some predefined size. This is particularly useful in the case of complex images (such as the one in Figure 2) that take a long time to draw on screen.[3] Drawing speed is an issue because curves are defined internally using Bezier cubic splines for maximum speed and resolution on a PostScript printer.

Using standard Mac drawing programs, our previous attempts to generate accurate mathematical diagrams have been very frustrating. *PSMathGraphs*II, on the other hand, lets the user draw precise, high-resolution curves like the one in Figure 3 simply by typing the equation of the desired function (in rectangular, polar, or parameterized form) or, in the case of geometric objects like points, lines, circles, polygons, and histograms, by specifying coordinates. Parameter input may be in numerical form or written as arbitrary mathematical expressions.[4] One may easily include points and tangent lines, shade a region between a curve and the axis (or between two curves), or draw direction fields, vector fields, and solution curves for differential equations.

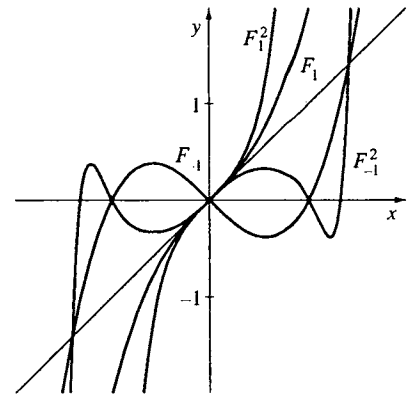


Figure 3: Typical members of the family $F_\lambda(x) = \lambda x + x^3$ and their second iterates.

With the availability of powerful symbolic algebra packages like *Maple*, *Mathematica*, and *Theorist*, there is no shortage of mathematical graphing software for the Macintosh. But few, if any, can match the flexibility of *PSMathGraphs*II in terms of user-definable parameters like line width and type, color, tick marks, numerals, fonts, etc. at a price less than $80. It's true that the user may be forced to learn the rudiments of graphic typesetting to get good results (not unlike typesetting with TEX), but the investment in time and effort is definitely worth the trouble since the results are of the highest quality.

The program's author, John Jacob, can be reached at Mary Ann Software, P.O. Box 6252, San Rafael, CA, 94903-0252. Their phone is 415-662-2486.

[3]The rendering of any particular curve may now be aborted by pressing command-period.

[4]Numerous built-in constants, functions, and operators are supported.

# Inside the AMS

## Report from the Committee on Professional Ethics

*Everett Pitcher, Chair*
*AMS Committee on Professional Ethics*
*Lehigh University*

It has been observed that there are several pairs of papers in the recently published mathematical literature that are similar to the degree of being almost identical. The pairs with the same number, listed below, are among them. Although the formal date received is listed for each paper, there is no record of the prior private circulation of copies.

A (1) Marcu, Danut. The powers of two and three, *Discrete Math.* **89** (1991), no. 2, 211–212. (received Dec. 2, 1987).
(2)_____. Note on the Euclidean embeddings. *Quart. J. Math. Oxford Ser.* (2) **42** (1991), no. 165, 87–98 (received May 9, 1989).
(3)_____. Note on the algebraic matroids, *Riv. Mat. Univ. Parma* (4) **14** (1988), 151–156 (received May 24, 1988).
(4)_____. On the representations of projective geometries in algebraic combinatorial geometries. *Geom. Dedicata* **30** (1989), no. 3, 297–303 (received May 9, 1989).

B (1) Narkiewicz, W. A note on a paper of H. Gupta concerning powers of two and three: "Powers of 2 and sums of distinct powers of 3" [*Univ. Beograd. Publ. Elektrotehn. Fak. Ser. Mat. Fiz.* No. 602–633 (1980), 151–158; *MR* **81g**:10016], *Univ. Beograd. Publ. Elektrotehn. Fak. Ser. Mat. Fiz.* No. 678–715 (1980), 173–174.
(2) Deza, Michel-Marie and Maehara, Hiroshi. Metric transforms and Euclidean embeddings, *Trans. Amer. Math. Soc.* **317** (1990), no. 2, 661–671 (received May 12, 1988).
(3) Lindström, Bernt. Matroids algebraic over $F(t)$ are algebraic over $F$, *Combinatorica* **9** (1989), no. 1, 107–109 (received Oct. 20, 1987).
(4)_____. On $p$-polynomial representations of projective geometries in algebraic combinatorial geometries, *Math. Scand.* **63** (1988), no. 1, 36–42 (received July 4, 1986).

The Committee on Professional Ethics wishes to call the attention of mathematicians in general and of editors in particular to this phenomenon.

Dr. Marcu has responded as follows:

"The single possible explanation concerning the glaring coincidence, between the papers A2–A4 and B2–B4, is the *plagiarism* and, consequently, either the editors' competence is doubtful or the editors had facilitated this plagiarism. Moreover, it is easy to see that, for each one of my papers, a *revised version* was published (according to the referee's comments!!!).

"Related to the paper B1, I am not able to give you an answer, since I have never seen it."

## The AMS Science and Education Strategies

Two AMS committees have over the past year been developing strategies to guide the Society's activities in science policy and education. In doing so, these committees wrestled with some of the thorniest issues facing the AMS today—support for the discipline, the public image of mathematics, connections to other areas of science and to industry, development of mathematical talent, and defining the Society's role in mathematics education.

Last year, the AMS Executive Committee charged the Committee on Science Policy (CSP) to develop a "science strategy" and the Committee on Education (CoE) to develop an "education strategy". The AMS has never before had a science strategy or an education strategy. For the most part, the Society has not been a big player in science policy and was content to let other sciences lead the way. Similarly, the AMS has only just begun to get its feet wet in mathematics education, the traditional domain of such groups as the Mathematical Association of America (MAA) and the National Council of Teachers of Mathematics (NCTM). The development of these strategies marks a clear shift toward a more active role for the Society and increased collaboration with other organizations already working in these areas.

The CoE wrapped up its work on the education strategy during a meeting held in late August in Washington, DC, while the CSP finished up the science strategy at a meeting

in Washington two weeks later. The strategy reports, which follow this article, will be considered by the Executive Committee and Board of Trustees (ECBT) during its meeting in November and by the Council at its meeting in January 1993.

## The Science Strategy

Over the past few years, the CSP has been one of the most active Society committees, having an impact on a wide range of areas, from publications to prizes to education—in fact, the CoE is a "spinoff" committee from CSP. During its September meeting, the CSP reaffirmed that the main focus of the Society must remain on mathematical sciences research. But because there are many issues today that influence the health of the research enterprise and because there is increasing pressure on the research community to take on a wider set of responsibilities, the science strategy proposes many activities not directly related to research.

**Federal Policy.** These recommendations center on improving interactions with federal agencies and with Congress and on developing federal policy agendas that would set goals and guide the AMS in such efforts. Two key groups in this effort are the Joint Policy Board for Mathematics and the newly-established AMS Washington Office. Some of the specific ideas proposed were forming a group of mathematicians who could provide rapid response to develop position statements or testimony when needed, tapping former mathematics staff of federal agencies for help in improving communication with the agencies, and considering resumption of the Congressional Fellows program, through which mathematicians spend time in Washington as Congressional staffers.

**Public Awareness.** The low public awareness of mathematics research stems in part from the fact that the mathematical research community does not produce many expository works in mathematics—neither those intended for the general public nor those intended for mathematicians themselves. Therefore, one of the main recommendations is to develop incentives and rewards for expository writing at various levels. In addition, the CSP suggests that the AMS consider publishing general interest books about the contributions of mathematics to modern society. The CSP also recommends the institution of a prestigious lecture series aimed at the public and held during the AMS winter meeting and/or the annual meetings of the American Association for the Advancement of Science (AAAS) and the NCTM.

**Academic Support of Mathematics.** Today, mathematics departments are confronted by an expanded set of responsibilities, from training teachers to building a research program, from increasing minority achievement in mathematics to initiating collaborations with other sciences and with industry. How does a department take on these challenges while managing the latest budget crisis? The CSP recommends that the Society develop materials to help mathematics departments make a case within their own institutions for increased resources. Such an effort must go hand-in-hand with restructuring the reward system to recognize a department's total mission in teaching, research, and outreach.

**Connections between Research and Teaching.** Part of the "total mission" of a department includes nurturing undergraduate students and providing them with an understanding of the nature of mathematics research. To this end, the CSP recommends that some kind of research experience be made part of the undergraduate mathematics major and that the AMS work with with the MAA and the Society for Industrial and Applied Mathematics (SIAM) to promote this effort. The CSP recognizes the importance of summer programs like the Research Experiences for Undergraduates (REU) sponsored by the National Science Foundation (NSF) and stresses the need for timely information about these programs. In addition, the CSP emphasized, departments have a responsibility to prepare future teachers of mathematics at all levels.

**Connections of Research to the Uses of Mathematics.** The CSP calls upon the AMS to organize meetings activities designed to highlight the uses of mathematics in a way that would attract mathematicians and scientists from other areas. Another recommendation aims to promote awareness, through AMS meetings and publications, of federal agency initiatives that call for participation of mathematics—examples include the various programs of the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET). The CSP also suggests that the *Notices* appoint an editor to solicit a series of articles on effective collaborations between mathematics and other disciplines.

Yet another aspect of the "total mission" of mathematics departments is the responsibility to contribute some of their research expertise to scientific, technological, and societal problems. To this end, the CSP made a number of recommendations directly to departments, such as broadening graduate training to include computing and statistics, as well as teaching and communication skills; these changes would also help new doctorates in the job market. The CSP also recommended that departments appoint and reward faculty members who contribute to the transfer of mathematics to other areas of science.

**Publications and Communication.** Many of the foregoing recommendations relate to publication and communication activities. In addition, the CSP made a number of other recommendations in this area, including: periodic reports in the *Notices* by the chair of the NSF's Advisory Committee for the Mathematical Sciences; a guide, prepared jointly with the MAA, to assist undergraduate mathematics majors in choosing graduate programs; and a collaborative effort with the MAA and SIAM to produce a booklet on jobseeking in academia, industry, and government. The CSP also called upon the AMS to continue to take a leading role in electronic communication and information retreival and to promote distribution of preprints via electronic bulletin boards.

**Meetings.** Meetings are one of the best vehicles the Society has for launching new activities. In addition to those mentioned above, the CSP made a number of other recommendations in this area. First, the AMS should make meetings more interesting to and useful for graduate students, with student presentations, plenary talks, and social activities geared to this group. Second, expository talks for nonexperts

should be built into the special sessions at meetings and should be accessible to graduate students. Third, the AMS short courses should be broadened and connected to scientific and educational initiatives. And finally, the conference and symposia series should encompass professional development, interdisciplinary activities, and education reform.

**Membership and Status of the Profession.** Serving the membership and the profession is one of the Society's main purposes. The CSP recommended that the AMS establish committees to formulate a role for the Society in enhancing the participation of underrepresented groups in mathematics and to assist handicapped mathematicians. To encourage excellence in all aspects of professional activity, the CSP recommended the AMS award prizes for a broad range of achievements and recognize service to the Society and to government agencies by sending letters of appreciation to those who contribute. One great concern in the profession is the job market for mathematicians. On this front, the CSP recommended improving the Employment Register and undertaking a study of various modes of electronic processing of job applications.

## The Education Strategy

One of the CoE's central concerns has been to define an appropriate role for the Society in education. This is no easy matter: organizations such as the MAA, the NCTM, and the Mathematical Sciences Education Board (MSEB) of the National Research Council already have highly successful programs in this area, raising the possibility of duplication of effort or the perception that the AMS is invading others' "turf". Nonetheless, it is clear that the AMS, as the main organization concerned with research in mathematics, could make useful contributions to existing efforts and, in particular, has a natural role in the improvement of education at the graduate level. These are the kinds of issues forming the backdrop for the CoE's discussions about and formulation of the education strategy.

**Undergraduate Education.** The recommendations in this area focus primarily on four areas. First, the CoE stresses the importance of increasing the participation in mathematics of women and minority students at all levels. An important ongoing effort is the MAA's SUMMA program (Strengthening Underrepresented Minority Mathematics Achievement), and the CoE suggests that the AMS should seek collaboration in this program. In particular, a member of CoE could be appointed to the MAA committee overseeing SUMMA in order to assure a liaison between the two committees.

Second, the CoE proposes that the AMS seek ways to improve the preparation of elementary and secondary school mathematics teachers. Such an effort would likely involve collaboration with ongoing programs of the MAA, NCTM, and the American Mathematical Association of Two-Year Colleges (AMATYC). As a starting point, teacher preparation guidelines could be developed based on the NCTM Standards.

The third area centers on enriching the mathematical experiences of undergraduate students in order to develop their mathematical talents and to foster a greater sense of community by increasing their participation in AMS activities. Some specific suggestions are working with the MAA to extend its program of student chapters, organizing undergraduate activities at AMS meetings, and providing information about graduate programs in mathematics and about REU programs (both for student participants and for faculty who wish to organize REUs).

Finally, the CoE recommends keeping the membership informed about research in mathematics education and its applications to classroom practice. The MAA Committee on Research in Undergraduate Mathematics Education and the Mathematicians and Education Reform network are key groups in this effort. Specific ideas include collaborating with these two groups on publications, a *Notices* column on education, and organizing special sessions, conferences, and workshops dealing with educational issues.

**Graduate and Postdoctoral Education.** Both the CoE and the CSP discussed a proposal to establish a national postdoctoral program. The basic idea is to provide opportunities for postdoctoral experiences in research, education, and applications of mathematics and to greatly expand the number of postdoctoral positions available. Both committees saw positive features in the proposal, and in its report the CoE recorded its support for the proposal. However, there was general agreement that further development of the idea is necessary before the Society could undertake such a program.

Currently, there is no AMS committee that focuses on concerns of graduate students. Therefore, the CoE proposes the establishment of a CoE subcommittee on graduate student concerns which would include some graduate students and recent doctorates. This subcommittee would examine such matters as graduate student support, graduate student activities at AMS meetings, and information on job search strategies. The CoE also recommends that the Society publish textbooks for introductory graduate courses and expository works accessible to graduate students.

**Professional Interaction and Information Exchange.** A major concern for the CoE was the fact that, for the most part, the mathematical community has little access to information about developments in mathematics education. The CoE recommends that the Society create formal mechanisms to insure that such information becomes a regular feature at AMS meetings and conferences. In addition, e-MATH could be used to facilitate information exchange among various groups having an interest in mathematics education. Another means would be an "exchange" of speakers at annual AMS and NCTM meetings.

**Interaction with Industry and Government.** In response to the many recent reports calling for broader education of graduate students, the CoE recommends a nationally administered graduate internship program. As a starting point, the Society should study the feasibility of such a program by investigating existing internship programs, surveying mathematics departments to assess their ability to supply properly trained students, and determining the interest and needs of business, industry, and government laboratories.

The CoE also recommends a number of ways in which existing AMS activities could be expanded to increase interactions with business, industry, and government. In the area of meetings, there might be sessions for graduate students to learn about industry and government employment, invited addresses by researchers in industry and government, and sessions which increase communication with researchers from other disciplines. In conjunction with workshops on successful industry-university collaborations, the Society could develop a small grants program to allow mathematics departments to launch industry-university collaboratives. In the area of publications, the CoE suggests a series of articles in the *Notices* reporting on how mathematics is used in industry.

### Comments Welcome

As with all the Society planning activities, input from the membership is encouraged. Comments on the science strategy may be sent to the chair of CSP, Frank W. Warner, III, Department of Mathematics, University of Pennsylvania, Philadelphia, PA 19104-6395, email: fwarner@math.upenn.edu. Comments on the education strategy may be sent to the chair of CoE, Ramesh A. Gangolli, Department of Mathematics, University of Washington, GN-50, Seattle, WA 98195, email: gangolli@math.washington.edu.

**Allyn Jackson**
Staff Writer

What follows is the full text of the CoE Education Strategy Report and the CSP Science Strategy Report. Each report is preceded by the cover letter from the chair of the committee to the ECBT; these letters are included here because they contain useful background and information about the reports.

## CSP Science Strategy Report

### Cover Letter

To: Executive Committee and Board of Trustees

At your meeting in November of 1991, you charged the AMS Committee on Science Policy (CSP) with developing a science policy strategy for the AMS that would be consistent with the Society's mission and goals. You asked the CSP to address the issues facing the mathematical research community including its renewal; levels and quality of academic, corporate, and federal support; communication; and the connections of mathematics research to mathematics education and the uses of mathematics. You requested that the strategic plan be available for presentation to the Executive Committee and Board of Trustees in November of 1992 for a recommendation to the AMS Council in January of 1993.

Four task forces were appointed in February 1993. In addition to the 1992 members of the Committee on Science Policy, the task forces included Avner Friedman, James Glimm, Richard Herman, Jerrold Marsden, Lisa Thompson, and John Thorpe.

**Task Forces**

I. *Federal Support. Public Awareness of Mathematics.*
Eric Friedlander (Chair), Michael Artin, Ronald Graham, Richard Herman, Linda Keen, Lisa Thompson, Frank Warner.

II. *Academic Support of Mathematics. The Connections of Mathematics Research to Education.*
Wm. James Lewis (Chair), Ramesh Gangolli, Rhonda Hughes, Joel Lebowitz, Paul Sally, John Thorpe.

III. *Corporate Support of Mathematics. The Connections of Mathematics Research to the Uses of Mathematics.*
Michael Reed (Chair), Avner Friedman, James Glimm, Jerrold Marsden, Mary Wheeler.

IV. *Science Policy Aspects of Core AMS Activities (Meetings, Publications, Awards).*
Linda Rothschild (Chair), James Donaldson, William Jaco, Joseph Kohn.

The CSP and its task forces received input from many members of the mathematical community. The committee carried out much of its work by email correspondence. The CSP meetings in Chicago on April 4, 1992, and in Washington, D.C., on September 11–13, 1992, were largely devoted to this task. During the Washington meeting we were assisted by Deborah Haimo, president of the Mathematical Association of America, and Cora Sadosky, president-elect of the Association for Women in Mathematics, as well as by AMS staff members John S. Bradley, Timothy Goggins, Allyn Jackson, and Samuel Rankin.

The charge to the CSP was very broad and includes nearly the whole range of activities in which the AMS is involved. The committee has made an equally broad range of recommendations. Some are already underway as part of the activity resulting from the Society's 1992 Operational Plan or as a result of the discussions leading to this report. We include them here as a way of setting priorities and emphasizing CSP support of the activity.

On behalf of its members and the associated task force members, I am happy to submit the report of the Committee on Science Policy.

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# American Mathematical Society Committee on Science Policy Report to the Executive Committee and Board of Trustees September 21, 1992

## Preamble

The Committee on Science Policy presents the following document in response to the November 1991 charge of the Executive Committee of the AMS Council. This charge called for the development of a science policy strategy consistent with the Society's mission and goals which would address the issues facing the mathematical research community.

The AMS has traditionally played a leadership role in the advancement of mathematical research. Whereas the AMS still retains this vital focus through its publications, meetings, and conferences, other objectives consonant with research activity engage an increasing proportion of the Society's effort. For example, advocacy of research policy and effort to heighten public awareness of mathematics are activities which the AMS must continue with renewed vigor. Indeed, activities less directly tied with research activity also demand the Society's care and attention. The AMS should foster the cultural ethic that a mathematician's interest and responsibility should include the exposition of mathematics and mentoring of students at many levels. The health of the profession dictates that the AMS concern itself with the improvement of opportunities for full participation of underrepresented groups in all of its activities, with the training of teachers as well as researchers, and with mathematical education at all levels. Finally, as mathematical applications are developed for an increasingly broad spectrum of mathematical research, the AMS should undertake with renewed vigor efforts to foster the understanding of and participation in such applications by the mathematical community.

In what follows, the CSP has listed general objectives and specific actions which it recommends to the AMS.

## Federal Policy

A primary objective of the American Mathematical Society is to promote support for the mathematical sciences sufficient to guarantee the vitality of U.S. mathematical research and education and to fully capitalize on potential contributions to other sciences, to technology, and to industry. The AMS wishes also to promote interaction between the federal government and the mathematics community in order to maximize the contribution of mathematics to areas of national concern and to communicate the community's perspectives and goals. To help achieve these ends, the CSP makes the following recommendations:

**A1.** The AMS should prepare annual federal policy agendas. This should be carried out by the CSP in conjunction with the Long Range Planning Committee, with review by the Executive Committee, Board of Trustees, and the Council.

**A2.** The AMS should work with the Joint Policy Board for Mathematics (JPBM) to produce a federal policy agenda for the discipline based on a broad consensus of the mathematical community. The CSP recommends that JPBM coordinate follow-up with the appropriate Washington audiences; in particular, that it set up a structure to carry the message to Congress.

**A3.** The AMS should work with JPBM to develop mechanisms for coordination with the science policy committees of member organizations.

**A4.** The AMS Washington Office, together with the Washington Office of JPBM, and with the advice of AMS officers and governing bodies, should compile and regularly update a list of mathematicians (called the Resource Group for Government Affairs) who are willing to be called upon to provide expert and rapid response in developing position statements, testimony needed to seek resources, and support required to sustain and encourage all aspects of the mathematical endeavor. The AMS would utilize this group to carry its agenda to Congress.

**A5.** The AMS should promote the placement of senior mathematicians in policy making positions in Washington.

**A6.** The CSP recommends that the AMS Washington Office develop regular and sustaining activities designed to increase communication between the mathematics community and federal agencies with the objective of determining agency goals, how they operate, and what opportunities exist for mathematics initiatives that meet the goals of the agencies. Findings should be communicated to the mathematics community through the meetings and publications of the AMS.

As a part of this effort, the CSP recommends that the AMS Washington Office, in cooperation with JPBM, institute a program of regular consultations with former Division and Program Directors in the mathematical sciences from the various agencies. The objective would be to have these former directors advise, assist, and participate in the creation of new linkages with the agencies and new communication links with the mathematics community.

**A7.** The AMS should consider re-establishing the Congressional fellowship program.

In addition to these recommendations for AMS action and in order to help achieve the objectives mentioned above,

- the CSP will make the NSF Advisory Committee Chair a regular invitee to CSP meetings, and
- the CSP will work to establish a tradition of interaction with the federal agencies regarding issues they are facing.

## Public Awareness of Mathematics

In order to stimulate public awareness and understanding of mathematics, the CSP makes the following recommendations:

**B1.** The CSP urges the AMS to develop incentives and rewards for expository writing at various levels.

**B2.** The CSP endorses the development of the new *What's Happening in Math* magazine publication into an effective means of communicating mathematics to a broad public audience.

**B3.** The CSP recommends the creation of a highly publicized lecture series for the public in conjunction with

the AMS winter meeting and/or annual AAAS and NCTM meetings. The lectures should be given considerable prestige, should be filmed and made available for distribution, and should have public notices prepared for the general media.

**B4.** The AMS should explore the possibility of publication and distribution of books for the general public presenting contributions of mathematics to modern society.

**B5.** The AMS should explore the possibility of joining with MAA and NCTM in the production of a mathematics publication similar to *Wonder Science–Fun Physical Science Activities for Children and Adults to do Together* which is produced jointly by the American Chemical Society and the American Institute of Physics.

**Connections of Mathematics Research to Education**

U.S. universities and their mathematics departments share an increasing responsibility to the society in which they exist. This responsibility is met primarily by a strong commitment to quality teaching and the advancement of knowledge within the discipline, but increasingly extends to outreach activities that include the preparation of teachers, the encouragement of youth, community service, and a special obligation to encourage women and minorities to be successful in mathematics.

The CSP urges the AMS to take a leadership role in the profession in advocating a rich understanding of the challenges and obligations that face our profession, especially those who teach and engage in research in our universities. While the leading model for faculty is teacher-scholar with a strong commitment to both the creation and transmission of knowledge, the AMS should promote respect for and proper rewards to those who help meet a department's total mission through focused effort in teaching, research, or outreach activities.

The CSP advocates increased attention by departments to educational reform and revitalization of the mathematics curriculum, as well as to activities that encourage and nurture undergraduate students, including increasing their understanding and appreciation of mathematical research and the connections of mathematics to other disciplines and to society's needs. In this regard the CSP makes the following specific recommendations:

**C1.** The AMS in conjunction with MAA and SIAM should promote the inclusion of a research experience as part of the undergraduate major. REU's (Research Experiences for Undergraduates) and summer internships can provide intensive summer programs for undergraduates. The AMS should play a role in insuring that departments obtain timely information as to the availability of these opportunities.

**C2.** The AMS should place special emphasis on the responsibility of mathematics departments for the education of future teachers.

In order to help departments meet the broader range of responsibilities advocated by the AMS, the CSP recommends that the AMS take an active role in the support of mathematics departments, with a special emphasis on supporting the needs of Ph.D. granting departments, by helping departments make the case for adequate resources from their colleges and universities. The CSP makes the following recommendations designed to support mathematics departments and the chairs who lead their departments:

**C3.** The CSP supports the formation of a Task Force on Resource Needs for Excellence in Mathematics Instruction as proposed by the Long Range Planning Committee.

**C4.** The AMS, in possible collaboration with MAA, SIAM, and JPBM, should prepare high impact materials for use by department chairs from the reports issued by the National Research Council and the various mathematical societies.

**C5.** The AMS, in possible collaboration with JPBM, should establish workshops for new chairs of mathematics departments and for graduate program chairs.

**C6.** The AMS development office should provide advice and materials to department chairs so that they may participate effectively with their institutions in soliciting contributions in support of mathematics.

The CSP has received the CoE report and commends it to the ECBT for its consideration. The report contains many excellent recommendations for AMS actions which will lead the membership toward a greater success in meeting its educational responsibilities. In particular, the CSP strongly supports activities for students at meetings and conferences, the creation of mechanisms to monitor communication of education-related developments, a regular column in the *Notices* with a focus on educational research and applications, collaboration with MAA and SUMMA, the development of teacher preparation guidelines, and guidelines for the upper division undergraduate curriculum in mathematics.

**Connections of Mathematics Research to the Uses of Mathematics**

The scope of mathematics has changed rapidly over the past thirty years. Many more fields, both academic and nonacademic, require or could benefit from the sustained application of mathematics. The availability of high speed computation has changed the way applied mathematics is carried out, and is also beginning to have a profound effect on pure mathematics.

The CSP believes that the mathematics community, through its research departments, has a responsibility to contribute some of its expertise to the resolution of the important scientific, technological, and societal problems facing the nation and mankind. This responsibility presents a great opportunity to bring new ideas and problems into mathematics and to find worthwhile, productive work for mathematics Ph.D.s. In order to take advantage of this opportunity, however, both the general mathematics community and departments need to support a broad range of activities which give students and faculty members training and access to the applications of mathematics.

To facilitate these changes the CSP makes the following recommendations to the AMS:

**D1.** The AMS should make a sustained effort at increasing breadth in its regional and national meetings, including special sessions and other events designed to highlight the uses of

mathematics in applications. In addition, the Society should make a sustained effort to attract to these meetings more applied mathematicians as well as scientists from outside our discipline.

**D2.** There should be a *Notices* editor in charge of a regular series of articles on technology transfer, with special emphasis on examples of effective collaboration between mathematicians and scientists in other disciplines. Also useful would be articles on how to make industrial contacts and to set up mutually beneficial industrial/departmental programs.

**D3.** The AMS should make a special effort through its publications to keep the mathematics community informed regarding opportunities for participation in the various initiatives of the Federal Coordinating Council for Science Engineering and Technology (FCCSET).

**D4.** The AMS should organize timely courses at national and regional meetings on FCCSET initiatives and other federal science programs that provide opportunities for mathematical participation.

In addition, the CSP makes the following recommendations to departments of mathematics:

**D5.** The CSP recommends that departments work to broaden the graduate training of mathematicians so as to provide a better match with job opportunities. The CSP recommends that significant attention be devoted to developing communication and teaching skills. The CSP also recommends that professional competency include basic training in computing and statistics as well as algebra, analysis, and geometry/topology.

**D6.** The CSP recommends that departments create and maintain a substantial effort to connect the mathematics community in the department to the applications of mathematics in other disciplines, in industry, and in government. Also, to include the development of educational and information programs for faculty and graduate students; and programs to assist students to get jobs outside academia.

**D7.** The CSP recommends that departments contribute to the transfer of mathematics from theory to applications by appointing and rewarding faculty members who carry out this responsibility.

The CSP recommends that the AMS work with SIAM, MAA, and the federal funding agencies to develop mechanisms to connect the mathematics community to emerging interdisciplinary initiatives and to encourage and enhance the departmental changes recommended in D5, D6, and D7 above.

Finally, the CSP wishes to add its support to the recommendations of the AMS Committee on Education for the establishment of a nationally administered graduate internship program in the mathematical sciences and for a small grant program as seed money for industry-university collaborations.

### Publications and Communication

The CSP has made several recommendations regarding the AMS publications program in the sections above on Public Awareness of Mathematics (B2, B4, B5), Connections of Mathematics Research to Education (C4), and Connections of Mathematics Research to the Uses of Mathematics (D2, D3). In order to enhance the use of the Society's publications and communications to broaden the range of information available to its membership, the CSP makes the following additional recommendations:

**E1.** The AMS should improve the publication and communication effort to increase the dissemination of information on successful programs, exciting new research developments, technology transfer, education, other new initiatives, and public policy.

**E2.** AMS communications and publications should include advanced notice of federal programs of interest to the mathematics community.

**E3.** The CSP recommends that the *Notices* editorial committee periodically ask the Chair of the NSF Advisory Committee to write a report to the mathematics community on issues facing NSF.

**E4.** The AMS should consider the development, jointly with MAA, of a guide to graduate programs in mathematics to assist undergraduates in choosing a graduate mathematics program.

**E5.** The AMS should collaborate with MAA and SIAM in preparing a job information booklet for graduate students. The booklet should include information on academic, industrial, and government jobs for Ph.D. mathematicians.

**E6.** The AMS should continue to take a leading role in the area of electronic scientific communication and information retrieval.

**E7.** The AMS should develop ways to promote the distribution of preprints via electronic bulletin boards.

### Meetings

The CSP has made several recommendations regarding AMS meetings in the sections above on Public Awareness of Mathematics (B3) and Connections of Mathematics Research to the Uses of Mathematics (D1, D4). In order to increase the effectiveness of meetings to serve the changing needs of members, the CSP makes the following additional recommendations:

**F1.** The AMS should take specific steps to make Society meetings, especially summer meetings and regional ones, more appealing to graduate students by including student presentations and plenary addresses, social activities, and other events designed for graduate students. The AMS should encourage the attendance of graduate students at meetings of the Society.

**F2.** The AMS should build expository talks (for nonexperts) into the special sessions at AMS national and regional meetings. These talks should be accessible to a broad audience and, in particular, to mathematics graduate students.

**F3.** The Short Course Program of the Society should be broadened and connected with other scientific and educational initiatives.

**F4.** The AMS conference and symposia series should be broadened over the next few years to include programs in continuing professional development, interdisciplinary activities, and education reform.

## Membership and the Status of the Profession

*Underrepresented Minorities.* With the goal of increasing the participation of underrepresented minorities in all of our professional activities, the CSP recommends that:

**G1.** The AMS should establish a committee to define the role of the AMS in increasing opportunities in mathematics for members of underrepresented groups, including fuller participation in all activities of the Society, encouragement of graduate study, and access to all modes of communication including electronic mail.

*Handicapped Mathematicians.*

**G2.** The CSP recommends that the AMS appoint a committee to study ways in which the Society can help handicapped mathematicians participate fully in professional activities.

*Recognition and Awards.* To encourage excellence and participation in all aspects of professional activities, to stimulate awareness and appreciation for these activities, and to recognize high achievement, the CSP makes the following recommendations:

**G3.** The AMS should broaden considerably the range of activities in which outstanding contributions are recognized by the awarding of prizes.

**G4.** The AMS should recognize the service of members to the Society and to government agencies by sending letters of appreciation to those who contribute.

*Employment Services.* The CSP has recommended in E5 above that the AMS prepare a job information booklet for graduate students. The CSP feels that the AMS should be aggressive in seeking ways to develop materials to assist mathematicians in their job search and to make services such as the employment register as effective as possible. Specifically, the CSP recommends that:

**G5.** The AMS should work through the Joint Committee on Employment Opportunities (JCEO) to determine ways to make the Employment Register truly viable for both academic and nonacademic jobs.

**G6.** The AMS should undertake a study of the various suggestions for electronic processing of job applications to see if any of these suggestions would be useful.

## Priorities

The CSP's top priorities for new action regarding Federal Policy are the preparation of annual federal policy agendas (A1) and the formation of the Resource Group for Government Affairs (A4). Recommendations A2 and A3 regarding science policy coordination with JPBM and the preparation of discipline wide policy agendas are already underway. Recommendations A5 regarding encouraging senior mathematicians into policy positions in Washington and A6 regarding increasing communication with the federal funding agencies are part of an agenda for the new AMS Washington Office.

The highest priorities regarding Public Awareness of Mathematics are the recommendations for encouraging expository writing (B1), for creation of a public lecture series (B3) (the CSP would like to see this implemented by 1994), and the joint exploration with MAA and NCTM of the possibility of creating a mathematics publication similar to *Wonder Science* (B5). *What's Happening in Math* (B2) is an excellent idea and is underway. In B4, the CSP is recommending a long range effort towards making the case for mathematics. It should begin now.

In regard to the Connections of Mathematics Research to Education, the highest priorities are obtaining adequate resources for the mathematical community to meet its broad range of responsibilities (C3 and C6) and providing support materials for use by department chairs (C4). The CSP wishes to emphasize the responsibility of the research community towards the training of undergraduates (C1), including future teachers of mathematics (C2).

The CSP regards all of the recommendations in the section on Connections of Mathematics Research to the Uses of Mathematics as high priorities. Efforts to inform the community through publications and meetings about opportunities to participate in the FCCSET initiatives are particularly important (D3 and D4), as are the recommendations to departments to broaden the training of graduate students (D5) and to contribute to the transfer of mathematics from theory to applications (D6 and D7). The new series recommended for the *Notices* (D2) will help in this regard.

The CSP understands that the Committee to Review Member Publications is beginning action that is related to the CSP's recommendations to increase the effectiveness of the Society's communications effort (E1) and to maintain leadership in the area of electronic communication (E6 and E7).

The CSP wishes to emphasize the importance of this effort. The highest new priorities regarding publications are the recommendations regarding advance notice of federal programs (E2), increasing communication with the NSF Advisory Committee (E3), providing a guide to graduate programs for undergraduates (E4), and preparing a job information booklet for graduate students (E5).

Several high priority recommendations for meetings have already been mentioned, including the public lecture series (B3), an effort at increasing breadth (D1), and courses on FCCSET initiatives (D4). Additional high priorities of the CSP are that the Society make its meetings more useful for graduate students (F1), that it stress exposition (F2), and that it broaden the Short Course Program and conference and symposia series (F3 and F4).

Finally, the CSP has made six recommendations related to the Status of the Profession. Highest priorities are for increasing opportunities in mathematics for members of underrepresented groups (G1) and for handicapped mathematicians (G2). Also of high priority are the recommendations regarding employment services (G5 and G6) and the recommendations regarding recognition and awards (G3 and G4).

It is the hope of the Committee on Science Policy that through implementation of this set of recommendations the AMS will substantially strengthen its roles in support of and as an advocate for the profession. The CSP will monitor progress in the implementation of these proposals and will make additional recommendations as the situation requires.

# CoE Education Strategy Report

## Cover Letter

Date: 21 September 1992
To: ECBT
From: Ramesh Gangolli, Chair, Committee on Education
Re: CoE Report for the Next ECBT Meeting.

At the beginning of 1992, the CoE was charged by the ECBT as follows:

> "to develop a comprehensive plan in which the Society can effectively contribute to the encouragement of talented students to study mathematics, to mathematics education at all levels, and to the continuing professional development of mathematicians. This strategy should pay particular attention to the unique and pervasive role the Society has in graduate education and postdoctoral experience for mathematicians."

Pursuant to this charge, various members of the CoE acting in consultation with colleagues, generated a number of suggestions for appropriate AMS actions, for consideration by the CoE. These preliminary lists of suggestions were discussed by the CoE at its Spring meeting earlier this year. At that meeting, the CoE appointed four task forces who were asked to report back to the CoE with a more definitive list of suggested actions by the AMS, refined from the lists discussed at the Spring meeting. The four areas that were to be addressed were as follows:

A. Undergraduate Education.

B. Graduate and postdoctoral education.

C. Professional interaction and exchange of information.

D. Interaction with industry and government

The task forces consisted of members of the CoE, as well as others co-opted for the task forces' work. At the meeting of the CoE held in August 1992, the four task forces presented revised reports to the CoE. These were discussed at that meeting. The task forces then submitted to the CoE, on the last day of the August meeting, final lists of recommendations for AMS action in each of these areas. These were approved by the full committee.

These recommendations are presented below, edited, and in some cases rephrased by the chair of CoE. The thrust of the editing is, I believe, in the interests of avoiding repetition. I have also prepared a summary of the recommendations organized according to their impact on various areas of AMS operations.

In the summary of recommended actions, I have tried to group the various recommendations according to the continuing activities of the Society. This should make it easier to see exactly how the operations might be modified in order to accommodate the recommendations. It is noteworthy that a number of recommended actions do not neatly fit into the present areas of AMS operations.

That we found it convenient to group these under "new activities" indicates, on the one hand, a need for changes in the structure of operations, (a matter being considered by the changes proposed in committee structure, etc.); on the other hand, this also is indicative of the broader role that the Society is undertaking in areas such as Education, Advocacy, and Science Policy, pursuant to various Long Range Planning activities within the Society in the last few years.

In order to proceed, the ECBT will no doubt want some idea of the priorities that were assigned to the various recommendations by the CoE. As a matter of fact a subset of the committee tried to wrestle with this issue as an exercise prior to a possible full discussion by the Committee. We found it impossible to mediate between so many issues, partly because the weights to be attached to the different activities are by no means clear, being determined by a melange of factors such as history, convenience, principle, and budgetary feasibility. However, I do want to communicate that the task force charged with Undergraduate Education did indicate that recommendations A1-A4 should receive higher priority than recommendations A5-A6. As a practical matter, I would like to summarize the discussions of priorities that I have had with various members of the Committee as follows:

> Many of the recommendations are such that a small but systematic redirection of planning and staff effort will steer the Society, in time, to the goals by which those recommendations are motivated. There is no reason for delay in implementing these (provided, of course, the ECBT accepts them); there are other recommendations that involve a somewhat larger change in operations, and greater allocations of staff time and/or other resources; and finally, there are recommendations that will involve the construction of new mechanisms (e.g., certain collaborative activities, new activities aimed at building connections with industry, etc.), as well as a considerable allocation of both staff time and hard cash. It is very difficult for the CoE to speak on the relative priorities for the recommendations of the last two types. Indeed, in a sense, the meta-level of the ECBT is a more appropriate level at which these two types of recommendations ought to be prioritized, in a manner consistent with their more complete view regarding the implementation of the Society's long range plan. Besides, in a time of budgetary uncertainty with respect to the future of publication activities of the Society, considerations of prudence may overrule any timetable that the CoE might arrive at *a priori*. (Do I see relieved nods from the BT members?)

If, at a later time, the ECBT would like the Committee to offer specific advice regarding their views about prioritizing specific actions, I will be happy to take this matter back to the full Committee. For the moment, I hope that there is enough material here for the ECBT to make a start in these important directions of action for the Society.

## Summary Of Recommended Actions

In this summary, the recommended actions are grouped together according to the impact they have on the main areas of AMS activity. I hope that this will make it easier for the

reader to grasp their impact on the Society's operations. The areas of activity are:

1. Meetings and conferences.
2. Publications.
3. Advocacy; information gathering and dissemination.
4. New activities.

The recommendations of the CoE are referred to in a somewhat cryptic fashion in this summary. I hope they are clear nevertheless. The parentheses refer to the position of each recommendation in the full list of recommendations.

**1. Meetings and Conferences.**

a. *Schedule activities aimed at undergraduate students.*

a1. Student presentations at meetings/conferences.(A3.e)

a2. Hospitality areas at meetings. (A3.e)

a3. Encourage contact between undergraduate student attendees and mathematicians at meetings. (A3.e)

b. *Schedule activities aimed at graduate students.*

b1. Survey lectures, lectures describing broad research agenda, and social events involving graduate students. (B2.b)

b2. Employment information and assistance. (B2.d)

b3. Workshops on industrial research and opportunities. (D2, D4)

c. *Schedule activities with a focus on education.* (A4.a)

d. *Create formal mechanism to monitor communication of education related developments at meetings/conferences.* (C1)

e. *Schedule activities with focus on interaction with industry and government.* (D2, D4, D5)

**2. Publications**

a. *Via the Notices.*

a1. Regular column with focus on educational research and applications (A4.b).

a2. Regular articles with focus on interaction with industry and government labs. (D3).

a3.Publish data, articles on REU programs. (A3.c, A3.d)

b. *Book Series.*

b1. Start an elementary graduate text series. (B3)

b2. Expository books aimed to a general audience. (B4).

c. *Other publications.*

c1. Volumes on research in math education with CRUME. (A4.c)

c2. Continue Issues in Math Ed. with MER. (A4.d)

c3. Facilitate publication of *UME Trends*. (A4.e)

c4. Employment information for grad students. (B2.d)

c5. Data on graduate programs. (A3.b, B2.e)

**3. Advocacy; information gathering and dissemination.**

a. *National postdoctoral fellowship program.* (B1)

b. *Compile data on graduate programs.* (B2.e)

c. *Extend e-MATH to bulletin board/conferencing capability.* (C2)

d. *Affect liaison with MSEB on a regular basis.* (C4)

**4.New activities.**

a. *Collaborate with MAA on SUMMA.* (A1)

b. *Collaborate withh MAA, NCTM, AMATYC in developing teacher preparation guidelines.* (A2)

c. *Collaborate with MAA in extending student chapters to AMS-oriented institutions.* (A3)

d. *Initiate activity to encourage talented high school students, in collaboration with MER.* (A5)

e. *Create task force for guidelines for upper division undergraduate curriculum in mathematics.* (A6)

f. *Collaborate with BMS on developing the concept of a professional master's degree.* (B2.f)

g. *Explore possibility of lectures by mathematicians aimed at high school students and teachers, at NCTM annual meetings.* (C3)

h. *National postdoctoral program.* (D1)

i. *Develop a small grant program to foster university/industry collaboratives.* (D4)

## Recommendations to the ECBT from AMS Committee on Education

**A. Undergraduate Education**

**A1.** The AMS should undertake as an ongoing activity the task of encouraging greater participation at all levels of mathematics by minority and women students and by disadvantaged students. As a beginning, the Society should collaborate with MAA, as well as AMATYC and NCTM as appropriate, to ensure that the benefits of MAA's SUMMA program extend to those institutions in which the AMS presence is strong, while the MAA's presence is weak. The intent is to guard against the possibility that certain institutions may be deprived of participation in the program. The President of the AMS should vigorously seek collaboration with MAA in this matter. As a beginning, the Society should seek to have an AMS representative appointed to the committee of the MAA that oversees SUMMA. This person should be a member of the CoE and should be charged with the task of affecting a liaison between SUMMA and the CoE, so that the objective described above can be met.

**A2.** The AMS should have an ongoing involvement in activities that will help improve the preparation of elementary and secondary school mathematics teachers. Such activities should be collaborative with other organizations such as MAA, AMATYC, and NCTM, and should be coordinated through the CoE. As a beginning, the Society should collaborate with these organizations in developing guidelines (a protocol?) for the preservice preparation of school mathematics teachers, which would help to implement the NCTM standards. Consideration should be given to mathematical content, as well as to the process of reasoning underlying it.

**A3.** The AMS should undertake, on an ongoing basis, some activities which will offer better opportunities for undergraduates to enrich their mathematical life. The objectives would be: to encourage participation by undergraduates in AMS activities, to foster a greater sense of community, and to

nurture talented students in their mathematical pursuits. Here is a list of recommended activities or actions:

a. The AMS should, in collaboration with MAA, extend the student chapter program of MAA to include AMS-oriented institutions in which there is no such program at present.

b. The AMS should compile and disseminate information about graduate programs to interested undergraduates. This could be done primarily through brochures or other publications, or through other means, e.g., opening an information table at meetings, or graduate study information booths at which students could meet faculty members from schools to which they are going to apply, etc.

c.The AMS should develop a database of available REU opportunities and publish it in a timely manner in the *Notices* and/or via an e-math bulletin board.

d. The AMS should publish, in a suitable outlet, articles dealing with: characteristics of successful REU programs, successful models of vertically integrated departments or institutes, experiences of student participants (preferably in their own words), hints for those who wish to start such programs, etc.

e. The AMS should provide opportunities for undergraduate student presentations at appropriate meetings, and also should consider providing a hospitality area for students at certain meetings, similar to that provided by MAA. Opportunities for undergraduate students to meet mathematicians should be provided on a regular basis.

**A4.** The AMS should undertake, on an ongoing basis, the task of keeping its membership informed about issues concerning research in mathematics education, as well as the applications of that research and other innovative methods to classroom practices of teachers of mathematics at all levels. This should be done primarily via the Society's publications and programs at meetings. Moreover, activities that impinge on research in mathematics education should be coordinated with CRUME, while those that impinge on applications and the classroom practices should be coordinated with MER. Some recommended ways are:

a. Organizing symposia, special sessions at meetings, conferences, and workshops dealing with these subjects, etc., on a regular basis, at a suitable frequency.

b. Initiating a regular column in the *Notices*, for which an editor would need to be sought, dealing with subjects such as teaching innovations, teacher preparation, discussion of cognitive research and issues raised by such research, etc.

c. Cooperating with CRUME in publishing annual volumes dealing with issues in research in mathematics education, and in investigating the possibility of publishing a journal devoted to these issues.

d. Continuing the collaboration with MER in the publication of articles dealing with classroom applications, experimental approaches, etc., in the series *Issues in Mathematics Education*.

e. Continuing collaboration with other organizations in the publication of *UME Trends*.

**A5.** The AMS should take steps, in collaboration with MER, to initiate some activity with a view to encouraging mathematically talented high school students. Although this is not, strictly speaking, an activity concerning undergraduate education, the CoE feels that it is an important activity which should not be ignored. The CoE is not ready with specific recommendations for such activity at this time. However, it does recommend that a subcommittee of the CoE be formed to plan and monitor this area. This subcommittee would be chaired by a member of the CoE, and would consist of CoE members as well as others co-opted for the subcommittee. The subcommittee would make recommendations to the CoE, which would pass them on to the ECBT after discussion and modification.

**A6.** The AMS should organize, alone or in collaboration with MAA, a task force to develop guidelines for the upper division undergraduate core courses in mathematics.

### B. Graduate and Postdoctoral Education

**B1.** The CoE recommends that the AMS advocate the establishment of a broad national postdoctoral program in the mathematical sciences that would provide new entrants with opportunities for professional development in research, education, and the applications of mathematics. Such a program should make available postdoctoral positions for new Ph.D.s in approximately double the current number, have a tenure of at least two years, and result in a postdoctoral program giving partial support to a total of 500–700 persons at any given time in the mathematical sciences. This issue falls equally in the scope of the charge to the CSP and will be discussed extensively at the forthcoming meeting of the CSP. The CoE wishes to record its support for the proposal.

**B2.** The CoE recommends the formation of a subcommittee of the CoE to address Graduate Students' concerns. This subcommittee would be chaired by a member of the CoE and would consist of CoE members as well as others co-opted for the subcommittee. The subcommittee would make recommendations to the CoE, which would pass them on to the ECBT after discussion and modification.

This subcommittee should:

a. Consider ways to increase graduate student support,

b. Assist and advise the Committee on Meetings and Conferences so as to make the Society's meetings, especially regional meetings, more friendly to graduate students (here we are thinking of survey lectures, lectures on broad research agenda directed towards graduate students, social events that involve both graduate students and established mathematicians, etc.),

c. Consider ways to incorporate students into the mathematical community,

d. Provide information on how to apply for academic and nonacademic positions,

e. Gather information on a continuing basis relating to a broad cross section of graduate programs across the nation,

which could be useful in the context of program reviews of individual graduate programs by review committees and the like,

f. Work with the BMS as they examine and develop the concept of a professional master's degree.

This subcommittee should include some graduate students and some recent Ph.D.s.

**B3.** The CoE recommends that the Editorial Committee on Graduate Texts develop a series of texts for introductory graduate courses.

**B4.** The CoE recommends that the AMS develop a quality expository book and article acquisition program directed towards a general mathematical audience.

**C. Professional Interaction and Information Exchange**

**C1.** The CoE recommends that a formal mechanism be created to ensure that the communication of developments in mathematics education to mathematicians will become a regular feature of AMS meetings, conferences, symposia, institutes, etc. A variety of means, such as Special Sessions, Short Courses, plenary and other invited talks, etc., could be used for this purpose.

**C2.** The CoE recommends that the AMS should take steps to utilize e-MATH to establish a prototype bulletin board/conferencing ability. External funds should be sought for this purpose. The establishment of such a bulletin board would promote more effective communication and discussion of educational issues between various communities of mathematicians (i.e., postsecondary, K-12, industry and government, etc.).

**C3.** The CoE recommends that the Society explore the possibility of arranging a program, modeled on the "high school lecture series", annually at the national NCTM meeting. The AMS and NCTM should also explore ways to exchange speakers periodically at their national meetings.

**C4.** The CoE recommends that the AMS accept the invitation of the MSEB to send a representative to a meeting of representatives of various professional organizations interested in mathematics education. (These include AMS, MAA, SIAM, NCTM, and AMATYC.) The meeting would focus on coordination of the strategic plans of the various organizations as they pertain to education. The CoE further recommends that the MSEB be strongly encouraged to continue such meetings in the future.

**D. Interaction with Industry and Government**

**D1.** The CoE recommends that the AMS initiate action aimed at establishing a nationally administered graduate internship program in the mathematical sciences. A first step would be to assess accurately the need for and the feasibility of establishing such a program. The CoE suggests that the Society develop a proposal to an appropriate agency to get funding to carry out this first step. The project should survey existing internship programs, as well as contact businesses, industries, and government laboratories to determine their needs and interest in participating in such a national internship program. On the other hand, graduate departments in the mathematical sciences should also be surveyed in order to determine their interest and ability to supply properly trained and motivated graduate students.

**D2.** The CoE recommends that AMS national and sectional meetings should regularly schedule activities that impinge on interaction between mathematics, industry, and government laboratories. These activities should include information sessions for graduate students about industry and government employment, special sessions devoted to industrial research, invited addresses from researchers in industry and government laboratories, and special sessions which would draw researchers from other disciplines for the purpose of increasing communication between mathematicians and users of mathematics.

**D3.** The CoE recommends that the AMS institute a regular series of articles in the *Notices* addressing industrial employment, industrial research, and problem solving. These articles could be about specific research accomplishments, general articles about the role of mathematics in industry and in economic competitiveness, careers of industrial mathematicians, or current successful industry-university research and problem solving collaboratives.

**D4.** The CoE recommends that the AMS sponsor special workshops at national and sectional meetings focusing on successful industry-university research collaborations. Apart from discussing the scientific aspects, such workshops should also address ways in which university departments could establish sustainable industry-university collaborations.

The CoE further recommends that the AMS develop a small grant ($\leq$\$5000) program to which university mathematical sciences departments could apply for developing an industry-university collaborative. The CoE suggests that this grant program follow the implementation of the awareness meetings mentioned above and have a target date of the fall of 1994 or the spring of 1995.

**D5.** The CoE recommends that the AMS include in its conference and short course program topics that are critical to economic competitiveness, technological advance, and related to current governmental science and technical strategies.

# Washington Outlook

This month's column is written by Lisa A. Thompson, who is the Assistant for Governmental Affairs of the Joint Policy Board for Mathematics (JPBM).

## Reexamining Federal Science Policy

Despite the approaching completion of the 102nd Congress and a presidential term, the federal research establishment has been busy this fall with a number of reexaminations of national science policy. Two in particular have far-reaching potential to change the government's approach to supporting basic science.

U.S. science policy was essentially formulated after World War II by Vannevar Bush. In a tract called *Science: The Endless Frontier*, Bush set forth the rationale for federal support of scientific research and established the basic principles that underlie science policy. These have changed little during the subsequent forty-year postwar period.

As is widely acknowledged, the world has seen many changes since then—the collapse of communism and the rise of the global economy to name but two. It is not surprising that science and technology would be asked to help the nation deal with the challenges posed by these changes, especially with the decline of U.S. industrial competitiveness.

But many believe that existing federal science policy, designed in the 1940s, is not suitable if the nation is to prosper in the "post-Vannevar Bush era", as it is labeled by Frank Press, President of the National Academy of Sciences. Press sees the increasing relevance of basic science to economic and social priorities and calls for more rational procedures to determine the federal R&D agenda.

Representative George Brown (D-CA), Chairman of the House Committee on Science, Space, and Technology, also sees a paradox: the challenges the nation faces are accelerating despite its having the most productive and innovative research system in the world. Brown, who has advocated the mobilization of science and technology to address humanity's pressing problems throughout his nearly thirty-year Congressional career, believes science and technology policy must be systematically developed in the context of national goals.

### House Science Committee to Consider Goal-oriented Science Policy

Brown is leading the most revolutionary reassessment of federal support for research since Vannevar Bush's. In September, he released a committee staff report recommending that science policy be more closely linked with national goals. The report questions the validity of long-standing assumptions about federal research and development and suggests a new paradigm for science-policy making in the future. It also cautions that new approaches should be "carefully defined and modular, to avoid throwing out the good with the bad".

Federal support for academic research is based on the premise that basic research, selected by criteria of excellence and performed by individual investigators, indirectly results in societal benefits, and that more high-quality basic research will translate into more societal benefits. The report does not directly dispute this assumption, but points out that it has never been tested, largely because the research system was designed by and for researchers who have no incentive to alter it. Science and technology were given partial credit for the unrivaled economic performance of the U.S. prior to the 1980s, so alternatives to current science policy have never been explored. In today's climate of increasing competition and declining federal budgets, however, carefully designed experiments in policy alternatives are in order.

The report recommends that federal R&D be exploited as a tool for achieving national objectives. Furthermore, research programs, currently evaluated mostly in terms of scientific or technical excellence, need to be measured for progress toward their stated goals by incorporating regular performance assessments into the administration and oversight of federal research programs.

The report calls on the committee to use its legislative authority over the Office of Science and Technology Policy to transform the agency into a "command center" for the implementation and evaluation of major research decisions. Moreover, the report recommends upgrading the responsibilities of the Federal Coordinating Council for Science, Engineering, and Technology from interagency coordination to the development of a coherent national science policy. These measures would, says the report, "help move science-policy making from the current ad hoc, agency-by-agency, OMB-dominated process that exists today, to a more strategic

process oriented toward the conduct, goals, and users (not just the performers) of research."

The committee and its subcommittee on science will begin hearings next year to discuss these proposals and further consider formulation of the goal-oriented science and technology policy envisioned by the staff report.

**The National Science Foundation Rethinks its Mission**

Perhaps of most immediate impact on the federal relationship with the mathematical sciences is a reconsideration of the mission of the National Science Foundation (NSF) by the agency's governing body, the National Science Board. In August, NSF Director Walter Massey issued a white paper describing three options for the agency: reverting to a small agency that supports individual investigators and small groups at universities; continuing both support for academic research and incremental programs that link universities and industries, like the Engineering Research Centers and the Manufacturing Initiative; or, adopting an expanded portfolio of programs closely aligned with the users of research, including industry and other government agencies. (See page 1021 in this issue of the *Notices* for remarks by Massey based on a presentation he made to the National Science Board.)

Massey believes that the current path of the NSF, represented by the second option, is unstable because the demand for these incremental, industrially-oriented programs—often lumped together under the term, technology transfer—will require more resources than NSF can provide without cutting its core research programs. Indeed, Congressional appropriators increasingly emphasize these technology transfer-type programs in their instructions to NSF concerning spending allocations.

Massey's preference, grounded in a keen analysis of the political, economic, and scientific environment, is the third option. "By expanding its function, NSF would have the opportunity to build upon its role as the premier supporter of fundamental research while it assumes further responsibility for forging the links between science and technology."

The National Science Board, in advance of adopting a long-range strategy for the agency, established a Commission on the Future of the National Science Foundation, which is examining, in Massey's words, "how the NSF can maintain and enhance America's strength in science and engineering research in ways that adequately prepare the nation for the 21st century." The commission is responsible for considering the views of the scientific community and other parties concerned with the future direction of the NSF.

The commission's report is due this month. The first opportunity for the research community to gauge its effects could come as early as the FY 1994 budget submission, which will be released in late January or early February. Congress, itself in for some vast changes—perhaps more than 100 new members—will also look closely at the new strategic thrusts of the foundation. The spending committees will consider not only the FY 1994 budget proposal in terms of the NSF's mission, but could also revisit FY 1993 appropriations.

Moreover, the agency must be reauthorized next year. The House Science Committee's efforts to revitalize national science policy should dovetail with its evaluation of the NSF's mission and programs. In fact, Representative Brown is pleased with the strategic planning efforts of NSF, as well as those of the National Institutes of Health. If they are driven by national goals, he says, the plans would be the natural "cornerstones of an evolving research agenda".

The scientific community will still have a voice in the development of principles and policies guiding federal support for research, but we will have to adapt to the new environment in which science policy is made. In short, the onset of the post-Vannevar Bush era could bring unprecedented challenges and opportunities for all concerned with federal support for basic science.

# News and Announcements

### Salem Prize Awarded to Shishikura

The Salem Prize for 1992 was awarded to MITSUHIRO SHISHIKURA of the Tokyo Institute of Technology for his work on complex dynamics and the Mandelbrot set. Established in 1968, the Salem Prize is given each year to a young mathematician who is judged to have done outstanding work in the field of Raphaël Salem, primarily on Fourier series and related topics. The prize jury consisted of J. Bourgain, V. Havin, Y. Katznelson, and E. M. Stein.

### NSF Awards Visiting Professorships for Women

The National Science Foundation (NSF) has made twenty-two awards in its Visiting Professorships for Women (VPW) program. VPW allows women scientists and engineers to do research and to engage in other activities designed to encourage students, especially women students, to pursue careers in science and engineering.

Among the recipients were two in the mathematical sciences. BETTY M. TANG of Arizona State University will spend a year at Harvey Mudd College working on computational mathematics as applied to compartmental models of cell growth. SYLVIA M. WIEGAND of the University of Nebraska at Lincoln will spend a year at Purdue University Research Foundation working on prime ideals and indecomposable Cohen-Macaulay modules.

Information on the VPW program may be found in the Stipends for Study and Travel section of the October issue of the *Notices*.

### EPSCoR Grants Made to States

The Department of Energy has made awards to twelve states under its Experimental Program to Stimulate Cooperative Research (EPSCoR). In each state, between one and six universities will participate in the program and provide matching funds. The grants will help support graduate traineeships for students in energy-related fields and provide advanced training through participation in university research programs. A total of about 100 students is expected to be supported on the grants.

Each grant designates several areas in which students will be supported, and in some cases mathematics is among the areas. Each state has a different plan for awarding the traineeships, so those wishing more information about the programs should contact the principal investigators directly. Listed below are the names of the states, the name and affiliation of the principal investigators, the grant amounts, and the participating universities.

*Alabama:* Kenneth M. Pruitt, University of Alabama at Birmingham, $500,000; Alabama A&M University, Auburn University, University of Alabama, University of Alabama at Birmingham, University of Alabama at Huntsville, and University of South Alabama.

*Arkansas:* Karl David Straub, University of Arkansas at Little Rock, $500,000; Arkansas State University, University of Arkansas at Fayetteville, University of Arkansas at Little Rock, and University of Arkansas for Medical Sciences.

*Idaho:* Edwin W. House, Idaho State University, $500,000; University of Idaho, Idaho State University, and Boise State University.

*Kansas:* James C. Legg, Kansas State University, $250,000; University of Kansas, Kansas State University, and Wichita State University.

*Kentucky:* John W. D. Connolly, University of Kentucky, $250,000; University of Kentucky, University of Louisville, and Western Kentucky University.

*Mississippi:* David L. Wertz, University of Southern Mississippi, $500,000; Jackson State University, Mississippi State University, University of Mississippi, and University of Southern Mississippi.

*Montana:* Jerry Bromenshenk, University of Montana, $500,000; University of Montana, Montana State University, and the College of Mineral Science and Technology.

*Nevada:* William Andrews, University of Nevada at Las Vegas, $500,000; University of Nevada at Las Vegas and University of Nevada at Reno.

*Oklahoma:* Warren L. Jensen, Oklahoma State University, $250,000; Oklahoma State University, University of Oklahoma, and University of Tulsa.

*South Carolina:* James R. Durig, University of South Carolina, $500,000; Clemson University and University of South Carolina.

*West Virginia:* John Holmgren, West Virginia University, $250,000; West Virginia University.

*Wyoming:* Derek J. Hodgson, University of Wyoming, $500,000; University of Wyoming.

### NSF Proposes Changes in Funding Mode for Mathematics

A significant change in the mode of funding in the mathematical sciences

was announced in a letter prepared in September by the Division of Mathematical Sciences (DMS) at the National Science Foundation (NSF). While the letter, signed by M. Kent Wilson, Acting Division Director, was not officially released, it was widely distributed via email. William C. Harris, Assistant Director for Mathematical and Physical Sciences at NSF, has distributed a notice stating that the implementation of the change is being delayed until the Foundation can determine how to address the issues raised by the community.

The "Dear Colleague" letter signed by Wilson describes a "Flat-Rate Budget Demonstration Project" to be implemented in 1993 by DMS and follows resolutions passed by the DMS Advisory Committee in 1991 and 1992 that were intended to increase the number of individual investigators funded by NSF in the mathematical sciences (see pages 292-295 of the April 1991 *Notices* and page 456 of the May/June 1992 *Notices*). The flat-rate budget project is based on a two-tier award scale under which each funded investigator would receive either $20,000 or $30,000 per year. Most awards were expected to be at the $20,000 level. Only projects of exceptional merit would be considered for the higher amount. The duration of awards would be three years. Requests beyond the flat amounts could be made for support of graduate students or postdoctoral associates; funding of such requests would be in increments of $10,000 and $15,000, respectively. These funding units would be considered total or bottom-line amounts; they would include traditional budget categories such as salary, fringe benefits, travel, publication costs, consultants, tuition, and indirect cost.

### *The AMS Gets Involved*

The DMS intended to use the *Notices* as a vehicle to inform the community of the flat-rate funding project, so the Society learned of the project fairly early on. As a result, the AMS Committee on Science Policy (CSP) took the opportunity of its meeting in Washington, DC, September 11–13, 1992, to invite NSF officials to discuss details of the proposed project. Also invited and in attendance were the past and current chairs of the DMS Advisory Committee, Jerry L. Bona of Pennsylvania State University and Peter Sarnak of Princeton University. During the discussion, members of the CSP communicated to the NSF officials a number of concerns that have echoed around the mathematical community: how many more principal investigators could be supported as a result of the project, the fact that those at institutions with high overhead rates would effectively be penalized, whether such a strategy would sabotage future efforts to increase the DMS budget, and so on.

As a result of these concerns, the CSP passed a resolution stating, "The CSP feels strongly that the specifics of the experimental project proposed have not been sufficiently discussed by the community (or even by the NSF's own advisory committee)." The resolution called upon the DMS to postpone the project and to provide specific data and projections that would elucidate its possible effects. The day after the CSP meeting ended, Spud Bradley, head of the AMS Washington Office, delivered the resolution to the NSF. The resolution was accompanied by a cover letter which was drafted during the CSP meeting and signed by Michael Artin, President of AMS, and Frank W. Warner, Chair of the CSP. "The resolution requests that the proposed demonstration project, which involves decoupling grant awards from salary, be postponed," the letter stated. "We ask that the NSF administration give this immediate and careful attention."

The CSP was not the only group discussing the proposed project: the original proposal was sent out on email at the end of the summer and discussed in mathematics departments across the nation. There appears to be widespread support for the spirit of the project, for many believe that the erosion of support for mathematical sciences research has reached a crisis point and that far too many excellent researchers are unsupported. Some argue that perhaps such a drastic plan as the one proposed is necessary in this time of fiscal constraint. Still, there has been great concern over the details of the project and how decisions were made on those details.

In an attempt to convey the community's concerns to the NSF, Artin and AMS President-Elect Ronald L. Graham met with NSF officials in Washington in mid-September, and continued the dialogue in extensive discussions throughout the month. In addition, through its Washington Office, the Society was able to follow closely this rapidly changing situation. The NSF has responded to all of this in a positive way, listening to the concerns of the community and discussing the pros and cons. The DMS has said it will provide information and data about how they arrived at the details of the proposed project and an analysis of what would have happened had such a plan been in place during 1991. In addition to following the situation through its Washington Office, the AMS will send representatives to the DMS Advisory Committee meeting, to be held October 26–27, 1992, at NSF headquarters in Washington, DC.

Larger changes at the NSF may also be afoot. The National Science Board, the policymaking body of the NSF, has appointed a Commission on the Future of the National Science Foundation, which will examine how the NSF will respond to future changes in support of science and engineering in the twenty-first century. The Society is preparing a communication on the issues before the Commission and the crucial role the NSF plays in federal support of the mathematical sciences. (For more information about the Commission, see the article by Walter Massey and the Washington Outlook column of this issue of the *Notices*; in addition, the From the Executive Director column addresses this topic and describes some of the AMS actions in this area.)

### *Next Steps by NSF*

The notice released by Harris announcing that the experiment is put on hold names Judith S. Sunley, Executive Officer for Mathematical and Physical Sciences, as the principal contact within the Foundation for comments or questions involving the proposed demonstration project (email: jsunley@nsf.gov or jsunley@nsf.bitnet, Phone: 202-357-9744, FAX: 202-357-1194). The notice

also states that any proposals prepared in the context of the "Dear Colleague" letter will be accepted by the Division for review and that proposals not yet prepared should use the format described in Grants for Research and Education in Science and Engineering (NSF 92-89) and should include budgets.

It is expected that NSF will release the "Dear Colleague" letter along with the notice signed by Harris and a document providing background material on the planning of the project, including details on how the proposed award levels were determined and projections, under various assumptions, on the number of investigators that would have been supported in 1991 had the demonstration project been in operation then. When such additional information becomes available, it will be reported in a future issue of the *Notices*.

### New Division Director Named for NSF's Division of Mathematical Sciences

Frederic Y. M. Wan has been appointed as Director of the Division of Mathematical Sciences (DMS) at the National Science Foundation (NSF). Wan is a professor in the Department of Applied Mathematics and associate dean at the University of Washington in Seattle. Wan is expected to assume his duties at the Foundation on January 1, 1993, and will serve as a consultant to the DMS prior to that time. He succeeds Judith S. Sunley, who is now Executive Officer of the Directorate for Mathematical and Physical Sciences. M. Kent Wilson, Acting Director of the Division of Astronomical Sciences, served as Acting DMS Director from the time of Sunley's departure in May 1992 until October 1, 1992. Currently, Bernard R. McDonald, DMS Deputy Director, is serving as Acting DMS Director until Wan arrives. Wilson is continuing in his position in the Division of Astronomical Sciences.

### News from the Center for Discrete Mathematics and Theoretical Computer Science (DIMACS)

DIMACS, a national research center funded by the National Science Foundation as a joint project of Rutgers University, Princeton University, AT&T Bell Labs, and BellCore, has recently developed a new Info Service. By telnet to dimacs.rutgers.edu, one may now access a wide assortment of information. In addition to information about DIMACS in general, the current special research year, and upcoming workshops, one may also look up the phone and email address of any DIMACS member or visitor, scan a list of current lectures, seminars, and workshops pertinent to the interests of the discrete mathematics and theoretical computer science community and located within commutable distance of DIMACS, and order technical reports or DIMACS volumes.

To try out the DIMACS Info Service, type "telnet dimacs.rutgers.edu" and then at the login prompt, type "info". You will see a menu of available commands. Typing a unique prefix of any command will suffice. One of the options is "HELP!"

Ms. Virginia Moore at vmoore@dimacs.rutgers.edu is maintaining the calendar of upcoming area events. She is already on many mailing lists. If, however, you are running a seminar within commutable distance of DIMACS institutions and persons outside of your organization would be welcome, please send the pertinent information to Ms. Moore. For seminars held at industry research labs, please include information on how to obtain entrance to the facility and arrive at the location of the seminar.

Comments or suggestions about the new DIMACS Info Service should be directed to Dr. Fred Roberts, Acting Director of DIMACS, at email center@dimacs.rutgers.edu.

### News from the Fields Institute for Research in Mathematical Sciences

In 1993–1994 the Institute will be sponsoring an emphasis year on aspects of number theory having connections with $L$-Functions. The activities will center around a major conference (March 22–29, 1994), together with three additional workshops on "Galois Module Structure" (V. Snaith and A. Weiss, October 18–22, 1993), "Algebraic $K$-theory and Arithmetic" (V. Snaith and M. Kolster, March 1–5, 1994) and "$L$-functions and automorphic forms" (K. and R. Murty, April 2–6, 1994). In addition, particularly during the period September 1–December 31, 1993, a series of graduate and postgraduate courses of various lengths will be given by members of the organizing committee and by visitors. These courses will be designed to introduce graduate students to several of the topics which will be featured in the conferences, workshops, and seminars throughout the program.

The organizing committee for the program consists of M. Kolster and V. Snaith (McMaster University), K. Murty (University of Toronto) and R. Murty (McGill University) supplemented by an advisory panel of S. Bloch (University of Chicago), J. Coates (University of Cambridge), and M. Taylor (University of Manchester Institute of Science and Technology).

The 1994–1995 program will be Operator Algebras and Applications. The organizers are G.A. Elliott (Toronto and Copenhagen), M.D. Choi (Toronto), A. Connes (College de France), K.R. Davidson (Waterloo), P. Fillmore (Dalhousie), D. Handelman (Ottawa), N. Higson (Penn. State), V. Jones (Berkeley), I. Putnam (Victoria), and D. Voiculescu (Berkeley).

There will be a workshop on "Integrators for mechanical systems" in October 1993 organized by J. Marsden (University of California, Berkeley and the Fields Institute) and S. Tremaine (Canadian Institute for Theoretical Astrophysics).

For further information about these programs or the Institute please contact: Trish Greydanus, Acting Executive Assistant, The Fields Institute for Research in Mathematical Sciences, 185 Columbia St. W., Waterloo, Ontario, Canada, N2L 5Z5; Telephone: 519-725-0096, Fax: 519-725-2726, greydanu@fields.uwaterloo.ca.

### News from the Institute for Mathematics and its Applications

*University of Minnesota*

The Institute for Mathematics and its Applications (IMA) 1992–1993 academic year program is **Control Theory and its Applications**. The pro-

gram Coordinators are H.J. Sussmann (Chairman), W.H. Fleming, P.P. Khargonekar, P.R. Kumar, D.L. Russell, and S.E. Shreve. The Advisory Committee is J.S. Baras, A. Bensoussan, R.W. Brockett, C. Foias, R.V. Kohn, H.J. Kushner, A.J. Laub, J.L. Lions, A.Z. Manitius, J.E. Marsden, S.K. Mitter, R.T. Rockafellar, E.D. Sontag, G. Stein, P.P. Varaiya, and J.C. Willems. The year is divided into three parts (corresponding to fall, winter, and spring quarters) although it is expected that there will be considerable fluidity between the various parts.

(1) Fall: September 8–December 30, 1992, Linear and distributed parameter systems

(2) Winter: January 2–March 30, 1993, Nonlinear systems and optimal control

(3) Spring: April 1–June 30, 1993, Stochastic and adaptive systems

Details concerning the fall program can be found in the September *Notices*.

The first winter program workshop will be on **Robotics**, January 25–29, 1993, organized by J. Baillieul, S. Sastry, and H.J. Sussmann. The emphasis will be on those conceptual problems of robotics which are fundamental to understanding a very technologically driven and interdisciplinary field.

This workshop will feature a mathematical introduction to:

(1) kinematics and fine motion planning,

(2) the dynamics and control of kinematically redundant robot arms including snakelike robots, multifingered robotic hands,

(3) methods of non-holonomic motion planning for space robots, multifingered robot hands and mobile robots, and

(4) new techniques in analytical mechanics for writing the dynamics of complicated multibody systems subject to constraints on angular momentum or other non-holonomic constraints.

The Minisymposium **Biological Control of Movement**, organized by W.S. Levine, will be held February 1–3. The study of the means by which animals and humans perform voluntary movements presents interesting and challenging mathematical problems. The primary purpose of this informal workshop is to interest mathematicians in these problems. This will be done by exposing them to recent experimental results that pose fundamental questions about how movement is controlled as well as to recent theoretical results aimed at answering these questions.

February 8–17 there will be a two-part workshop, **Nonsmooth Analysis and Geometric Methods in Deterministic Optimal Control**, organized by V. Jurdjevic, B.S. Mordukhovich, R.T. Rockafellar, and H.J. Sussmann. The purpose is to concentrate on powerful mathematical techniques that have been developed in deterministic optimal control theory after the basic foundations of the theory (existence theorems, Maximum Principle, dynamic programming, sufficiency theorems for sufficiently smooth fields of extremals) were laid out in the 1960s. These advanced techniques make it possible to derive much more detailed information about the structure of solutions than could be obtained in the past, and they support new algorithmic approaches to the calculation of such solutions. In addition to the theoretical side, there will be attention given to applications such as recent work on robotics problems, the control of chemical batch processes, economic models, hierarchical models, and some problems involving uncertainty. Numerical results will also be taken up. The first part of the workshop will be devoted to topics primarily involving geometric methods, and the last part to topics related to nonsmooth analysis methods.

The last workshop of the winter program will be **Systems and Control Theory for Power Systems**, March 15–19, organized by J. Chow (RPI), P.V. Kokotovic, and R.J. Thomas. The emphasis of this workshop will be on the role of mathematical theory in the analysis and control of nonlinear dynamics in large-scale electric power systems. The topics to be discussed will include:

(1) Modeling of large power systems using invariant and integral manifold theory.

(2) Security assessment and enhancement problems including current research methodology for solution of these problems. Areas such as direct methods, voltage stability analysis, and structural stability analysis will be presented.

(3) Control system design considerations including measurement-based control, nonlinear control, parametric robust control, and decentralized and distributed control.

For more information about IMA activities, see the Meetings and Conferences section of this issue or contact the IMA, (ima_staff@ima.umn.edu). Also, weekly IMA seminar schedules with titles and abstracts are available on Usenet: umn.math.dept, and TEX files for the Newsletter and the Update are available via anonymous ftp (at ima.umn.edu).

## News from the Mathematical Sciences Institute

*Cornell University*

During the 1992–1993 academic year, ACSyAM, the Mathematical Sciences Institute (MSI) Center for Symbolic Methods in Algorithmic Mathematics, will host several workshops on **Real Closed Fields**. In addition, the Center will continue its support of **Logic Programming**. Contact Center Director M. Sweedler or MSI Director A. Nerode at moss@msiadmin.cit.cornell.edu or 607-255-8005 for information.

O. Moreno of MSI and the University of Puerto Rico, T. Mora of Genova, and G. Cohen of Paris will organize the **Tenth International Symposium on Applied Algebra and Error Correcting Codes** to meet May 10–14, 1993 in San Juan de Puerto Rico. Abstracts of papers should be submitted immediately to o_moreno@upr1.upr.clu.edu.

Also scheduled for 1993 are a workshop on **Linear Logic** to meet June 14–18 at MSI in Ithaca, New York organized by A. Scedrov (contact andre@saul.cis.upenn.edu); a workshop on **Symbolic Computation in Combinatorics** organized by P. Paule (contact ppaule@risc.unilinz.ac.at); and the **Second International Workshop on Logic Programming and Nonmonotonic Reasoning** to meet June 28–30 in Lisbon, Portugal (contact marek@ms.uky.edu).

In 1994 R. Getoor of UCSD and H. Kesten of Cornell University will orga-

nize a conference in honor of E. Dynkin. Contact H. Kesten: hak@cornella.bitnet.

### News from the Mathematical Sciences Research Institute

*Berkeley, California*

On September 1, William Thurston became Director of the Mathematical Sciences Research Institute (MSRI), replacing Irving Kaplansky, who held the position for eight years. Robert Osserman continues as half-time Deputy Director, and is joined by Lenore Blum, who will also serve half-time as Deputy Director. These changes come at the beginning of the busiest year in MSRI's history, in terms of numbers of visitors and workshops. Information about workshops and other activities can be obtained by writing MSRI at 1000 Centennial Drive, Berkeley, CA 94720, or electronically, as described at the end of this note. A description of this year's activities can also be found on page 719 of the September AMS *Notices*.

During the past year there were changes in governance of MSRI, accompanied by an increase in the number of sponsoring institutions. In the past those sponsors were all in the West, but under the new plan, affiliation with MSRI is open to all institutions. Anybody who is interested in that possibility and would like more information should contact one of the Directors.

During 1993–1994, there will be two programs: a full-year program in Differential Geometry and a half-year program in Dynamical Systems and Probabilistic Methods for PDE's during January–June 1994. The deadline for applying to those programs is **November 30, 1992**. Applications and further information are available by calling or writing MSRI, or electronically, from the list server on info@msri.org. To use this, send email to info@msri.org with

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Subject: help
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and the body of the message consisting of the single word

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help
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You will receive an automated reply leading you through the next steps in using the list server. You may also receive the files by anonymous ftp from msri.org (128.3.188.3.0). We are currently experimenting with a next-generation electronic information and preprint server to replace the admittedly daunting system currently in place. Details will be given in a later note after testing is complete.

### BMS Newsletter Available Online

The Board on Mathematical Sciences (BMS) of the National Research Council publishes three or four times a year a newsletter called *BMS Update*, which reports on upcoming BMS events, recent publications, new study groups or committees, and other items of interest to the community. This newsletter is now available electronically. Those wishing to receive it should send a request to bms@nas.edu (Internet) or to bms@nas (Bitnet).

### Report on Foreign Scientists and Engineers in the U.S.

Advanced degree awards to foreign students, particularly at the doctoral level, are increasing so fast that in some fields, including engineering and mathematics, more than half of the doctorates awarded by American universities are earned by foreign citizens, according to a report of the Commission on Professionals in Science and Technology (CPST).

The new immigration law of 1990 increased substantially the numbers of foreign scientists and engineers who may be employed here for up to six years, as well as the number who may be admitted as resident aliens. Whether foreign influence is good or bad, and how good or bad it is for American science and engineering, is the subject of the CPST report. The report outlines pertinent parts of the immigration law and examines the current status of foreign citizens among students and faculty in U.S. universities and in industrial research.

Graduate enrollments in science and engineering include increasing numbers of foreign students whose principal source of support has been teaching or research assistantships from universities. The report discusses the present impact of foreign students on other graduate students and on undergraduates taught by foreign teaching assistants, as well as the rules that have previously kept foreign students from supporting their studies by off-campus work, as many American graduate students do.

The nation has come to depend on the influx of these highly trained specialists from all over the world to do teaching and research. The report shows that, although there are some disadvantages to having large numbers of foreign citizens preparing for or working in these fields, the advantages strongly outweigh the disadvantages.

The report, *Foreign Citizens Among U.S. Scientists and Engineers* by Betty M. Vetter, is available for $25 from: Commission on Professionals in Science and Technology, 1500 Massachusetts Avenue, NW, Suite 831, Washington, DC 20005. Other titles in this four-paper series include *American Minorities in Science and Engineering* and *Setting the Record Straight: Shortages and Shortfalls*. A subscription to the series is $60.

### Erratum

The article "European Meetings Bring Mathematicians Together," which appeared in the September 1992 issue of the *Notices*, carried a photograph with an incomplete caption. The caption for the photograph appearing on page 689 in the right-hand column should have identified Arlene Baxter, Manager of Business and Finance at the Mathematical Sciences Research Institute in Berkeley.

# 1993 AMS Elections

## *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 1993. 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 50 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 1993.
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 whether he is willing to have his name on the ballot. Petitioners can facilitate the procedure by accompanying the petitions with a signed statement from the candidate giving his consent.

# NOMINATION PETITION FOR 1993 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, 1994.

| 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 1993 AMS elections.
Your suggestions are wanted by

**THE NOMINATING COMMITTEE**
for president-elect, 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

# Joint Mathematics Meetings
# January 13–16, 1993

## *Supplement to Announcement in October Notices*

Please refer to the Preliminary Announcement for this meeting which begins on page 889 in the October 1992 issue of the *Notices*. The Important Deadlines from the preliminary announcement are reproduced below for convenience. The forms for Preregistration/Housing, MAA Minicourses, and the Employment Register are located at the back of this issue.

### *Other AMS Events*

**Mathematical Reviews Reception:** There will be a reception for reviewers (past and present) for *Mathematical Reviews* (MR), on Thursday, January 14, from 5:30 p.m. to 6:30 p.m. All reviewers are encouraged to come to the reception, and others who are interested in MR are also invited. Members of the MR Editorial Committee and the MR staff will make some brief comments and there will be an opportunity for reviewers to ask questions and make comments and suggestions. Refreshments will be provided.

### *Other MAA Sessions*

**Reflections on ICME–7:** This panel discussion from 9:30 a.m. to 10:55 a.m. on Thursday, is being organized by **Betty K. Lichtenberg**, University of South Florida and the United States Commission on Mathematics Instruction. The panelists are **George Berzsenyi**, Rose-Hulman Institute of Technology; **Donald Bushaw**, Washington State University; **Gloria Gilmer**, Math-Tech Inc.; and **Carole Lacampagne**, United States Department of Education. This panel will discuss mathematical competitions, undergraduate mathematics for different groups of students, ethnomathematics and mathematics education, women and mathematics education, and other topics of interest. **Mathematical Research for Undergraduate Research:** A panel discussion from 1:00 p.m. to 2:20 p.m. on Saturday, is being organized and moderated by **John Greever**, Harvey Mudd College. This panel is sponsored jointly by the CUPM Subcommittee on Undergraduate Research in Mathematics and the Council on Undergraduate Research. Panelists will describe and compare several programs which have guided undergraduate students to carry out successful mathematical reserch projects.

**Open Meeting:** There will be an *Open Meeting on MAA Strategic Planning* from 8:00 p.m. to 9:00 p.m. on Thursday. The facilitator will be **Thomas W. Tucker**, Colgate University.

**IMPORTANT DEADLINES**

| | |
|---|---|
| **AMS Abstracts** | |
| **For Consideration for Special Sessions** | **Expired** |
| **Of Contributed Papers** | **Expired** |
| **MAA Abstracts** | |
| **Of Contributed Papers** | **Expired** |
| **EARLY Meetings Preregistration and Housing** | **October 30** |
| **ORDINARY Meetings** | |
| **Preregistration/Housing/Tickets** | **November 13** |
| **Employment Register Preregistration (Applicants & Employers)** | **November 13** |
| **MAA Minicourse Preregistration** | **November 13** |
| **Motions for AMS Business Meeting** | **December 13** |
| **Hotel Changes and Cancellations with Service Bureau** | **December 7** |
| **FINAL Meetings Preregistration (no housing or tickets)** | **December 11** |
| **Cancellations for all Banquets (50% refund)** | **December 30** |
| **Preregistration Cancellations (50% refund)** | **January 10** |

### *Other MAA Events*

**Student Workshops:** The workshops on *Mathematics via hands-on experiments* being held from 1:00 p.m. to 3:00 p.m. on Friday, and also 9:00 a.m. to 10:55 a.m. on Saturday have been organized by **Herbert R. Bailey**, Rose-Hulman Institute.

### *Activities of Other Organizations*

The Association for Women in Mathematics will host a panel discussion on *Is geography destiny*?. The topic will be discussed by women who will examine their decisions on where to live and work.

The **Board on Mathematical Sciences** is sponsoring a session from 2:15 p.m. to 3:45 p.m. on Wednesday. Its Committee on the Mathematical Sciences in Genome and Protein Structure Research has recently completed a book on the contributions of, and the research opportunities for, the mathematical sciences in molecular biology, especially genome and protein structure research. The book describes how geometry, topology, dynamical programming, statistical mechanics, computation, and other areas of the mathematical sciences are important in the analysis of the structure of proteins and, in particular, DNA. **De Witt Sumners**, Florida State University, one of the contributing authors to the book, will summarize the findings of the book. He will elaborate further on one specific topic, namely, the tangle model for

enzyme-based site-specific recombination of DNA. **Eugene Shakhnovich**, Harvard University will discuss analytical and numerical approaches to protein folding. The analytical approach is based on statistical mechanics of random sequences. The numerical approach is based on new lattice models of protein with full enumeration of conformations. The session illustrates how the mathematical sciences have gained enormous importance in helping understand the basic processes of life.

### *Other Information*

**Electronic Preregistration:** Preregistration through electronic mail is available. Anyone wishing to preregister through this method should either send a message to MEET@MATH.AMS.ORG requesting this service where a message will be sent back within 24 hours with instructions on how to complete the format required, or look for the form in e-MATH where further instructions will be given on how to complete the format required.

# 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. 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 the relevant information to the Associate Secretary for the Section who will forward it to the Section Program Committee.

***San Antonio, TX, January 1993***

Please see the first announcement of this meeting beginning on page 889 in the October *Notices*.

***Knoxville, TN, March 1993***

Paul R. Blanchard
Olav Kallenberg
Richard A. Tapia
Michelle L. Wachs

***Washington, DC, April 1993***

Fan R. K. Chung
Leopold Flatto
Joel Spruck
A. Zamolodchikov

***Salt Lake City, UT, April 1993***

Michael Christ
Kenneth M. Golden
Robert M. Guralnick
Michael S. Waterman

***DeKalb, IL, May 1993***

Susan J. Friedlander
Russell D. Lyons
Clark Robinson

***Vancouver, British Columbia, Canada August 1993***

Robert E. Gompf (AMS-CMS)
H. Blaine Lawson (AMS-CMS)
Curt McMullen (AMS-CMS)
Louis Nirenberg (AMS-CMS)
Jill Pipher (AMS-CMS)

***Syracuse, NY, September 1993***

Tadeusz Iwaniec
Charles A. McGibbon
James M. Renegar
Alvany Rocha

***College Station, TX, October 1993***

Steven P. Lalley
Gilles Pisier
Theodore A. Slaman
Stephan A. Stolz

## 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. The section below entitled **Information for Organizers** describes the timetable for announcing the existence of Special Sessions.

***January 1993 Meeting in San Antonio, Texas***

Associate Secretary: W. Wistar Comfort
*Deadline for organizers: Expired*
*Deadline for consideration: Expired*

Please see the first announcement of this meeting beginning on page 889 in the October *Notices*.

***March 1993 Meeting in Knoxville, Tennessee***

Southeastern Section
Associate Secretary:
Joseph A. Cima (until 1/31/93)
Robert J. Daverman (after 1/31/93)
*Deadline for organizers: Expired*
*Deadline for consideration: December* 15, 1992

David F. Anderson and David E. Dobbs, *Commutative ring theory*
Bettye Anne Case, *Interventions to assure success: calculus through junior faculty*
Ben G. Fitzpatrick and Suzanne M. Lenhart, *Optimal control and applications*
Alexandre S. Freire and Conrad P. Plaut, *Variational problems in geometry*
Don B. Hinton and Kenneth Shaw, *Sturm-Liouville operators, applications, and extensions*
Tim Kelley, *Numerical methods in optimization*
John C. Mayer, *Continua theory and dynamical systems*
Balram S. Rajput and Jan Rosinski, *Stochastic processes*
Michelle L. Wachs, *Algebraic combinatorics*

***April 1993 Meeting in Salt Lake City, Utah***
Western Section
Associate Secretary: Lance W. Small
*Deadline for organizers: Expired*
*Deadline for consideration: January 6, 1993*

Andrej Cherkaev and Kenneth M. Golden, *Effective properties of inhomogeneous materials*
Davida Fischman, *Hopf algebras and Hopf algebra actions*
Naomi Fisher and Hugo Rossi, *Mathematics and education reform*
Paul C. Roberts, Roger A. Wiegand, and Sylvia M. Wiegand, *Commutative algebra and modules*
Nat Smale, *Singularities of geometric partial differential equations*
Simon Tavare, *Stochastic processes in population genetics*

***April 1993 Meeting in Washington, DC***
Eastern Section
Associate Secretary:
W. Wistar Comfort (until 1/31/93)
Lesley M. Sibner (after 1/31/93)
*Deadline for organizers: Expired*
*Deadline for consideration: January 6, 1993*

Roy L. Adler and Leopold Flatto, *Geodesic flows, hyperbolic geometry, and symbolic dynamics*
Joseph A. Ball and Cora S. Sadosky, *Dilation and interpolation: operator theoretic methods*
John J. Benedetto and Rodney B. Kerby, *Wavelets in sampling theory and signal processing*
Joseph E. Bonin, *Geometric methods in combinatorics*
Nathaniel Dean, *Graph theory*
Edward Frenkel, *Mathematics of two-dimensional quantum field theory*
Anant P. Godbole and Gary J. Sherman, *Undergraduate research in applied mathematics*
Anant P. Godbole and Gary J. Sherman, *Undergraduate research in pure mathematics*
Valentina S. Harizanov and James C. Owings, *Pure and applied recursion theory*
Kevin G. Hockett and E. Arthur Robinson, *Ergodic theory, dynamical systems, and applications*
Victor J. Katz, *History of mathematics*
Yongwu Rong, *Low dimensional topology*
Joel Spruck, *Nonlinear elliptic problems in geometry and physics*

***May 1993 Meeting in DeKalb, Illinois***
Central Section
Associate Secretary: Andy R. Magid
*Deadline for organizers: Expired*
*Deadline for consideration: February 3, 1993*

Gregory S. Ammar, *Advances in linear algebra: theory, computation, application*
Michael A. Filaseta and Carl Pomerance, *Number theory*
Susan J. Friedlander, *Mathematical topics in fluid dynamics*
Zoltan Furedi, *Combinatorics*
Andrew J. Granville, *Analytic number theory*
Frank Harary, *Beautiful graph theory*
Mohsen Pourahmadi, *Stochastic processes*
Jeanne LaDuke, *History of mathematics*
Linda R. Sons, *Function theory*
Joel H. Spencer, *Probabilistic methods*
Peter Waterman, *Discrete groups*

***August 1993 Meeting in Vancouver, British Columbia, Canada***
Associate Secretary: Lance W. Small
*Deadline for organizers: November 11, 1992*
*Deadline for consideration: April 27, 1993*

David M. Austin, *Four-manifolds* (AMS-CMS)
Nassif Ghoussoub, *Variational methods in partial differential equations* (AMS-CMS)
Linda Keen, *Dynamical systems* (AMS-CMS)
James L. Lewis and Barry Mazur, *Algebraic cycles* (AMS-CMS)
Ram M. Murty and Rajiv Gupta, *Number theory* (AMS-CMS)
Gregory Verchota, *Harmonic analysis techniques in partial differential equations* (AMS-CMS)

***September 1993 Meeting in Syracuse, New York***
Eastern Section
Associate Secretary: Lesley M. Sibner
*Deadline for organizers: December 17, 1992*
*Deadline for consideration: April 27, 1993*

***October 1993 Meeting in Heidelberg, Germany***
(Joint Meeting with the Deutsche Mathematiker-Vereinigung e.V.)
Associate Secretary: Robert M. Fossum
*Deadline for organizers: December 23, 1992*
*Deadline for consideration: April 27, 1993*

***October 1993 Meeting in College Station, Texas***
Central Section
Associate Secretary: Andy R. Magid
*Deadline for organizers: January 22, 1993*
*Deadline for consideration: July 14, 1993*

Randall K. Campbell-Wright, Carl C. Cowen, and Barbara D. MacCluer, *Composition operators on spaces of analytic functions*
David R. Larson, *Non self adjoint operator algebras*
Efton L. Park, *Noncommutative differential geometry*
Sung Yell Song and Paul M. Terwilliger, *Algebraic combinatorics*

***January 1994 Meeting in Cincinnati, Ohio***
Associate Secretary:
Joseph A. Cima (until 1/31/93)
Robert J. Daverman (after 1/31/93)
*Deadline for organizers: April 5, 1993*
*Deadline for consideration: September 23, 1993*

***March 1994 Meeting in Lexington, Kentucky***
Southeastern Section
Associate Secretary:
Joseph A. Cima (until 1/31/93)
Robert J. Daverman (after 1/31/93)
*Deadline for organizers: June 18, 1993*
*Deadline for consideration: To be announced*

***March 1994 Meeting in Manhattan, Kansas***
Central Section
Associate Secretary: Andy R. Magid
*Deadline for organizers: June* 25, 1993
*Deadline for consideration: To be announced*

***June 1994 Meeting in Eugene, Oregon***
Western Section
Associate Secretary: Lance W. Small
*Deadline for organizers: September* 7, 1993
*Deadline for consideration: To be announced*

***October 1994 Meeting in Stillwater, OK***
Central Section
Associate Secretary: Andy R. Magid
*Deadline for organizers: January* 28, 1994
*Deadline for consideration: To be announced*

***January 1995 Meeting in Denver, Colorado***
Associate Secretary: Andy R. Magid
*Deadline for organizers: April* 20, 1994
*Deadline for consideration: To be announced*

***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*

***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*

## Information for Organizers

Special Sessions at Annual and Summer Meetings are held under the supervision of the Program Committee for National Meetings (PCNM). They are administered by the Associate Secretary in charge of that meeting with staff assistance from the Meetings Department in the Society office in Providence.

According to the "Rules for Special Sessions" of the Society, Special Sessions are selected by the PCNM from a list of proposed Special Sessions in essentially the same manner as individuals are selected to give Invited Addresses. The number of Special Sessions at a Summer or Annual Meeting is limited. The algorithm that determines the number of Special Sessions allowed at a given meeting, while simple, is not repeated here, but can be found in "Rules for Special Sessions" on page 614 in the April 1988 issue of the *Notices*.

Each person selected to give an Invited Address is invited to generate a Special Session, either by personally organizing one or by having a Special Session organized by others. Proposals to organize a Special Session are sometimes requested either by the PCNM or by the Associate Secretary. Other proposals to organize a Special Session may be submitted to the Associate Secretary in charge of that meeting (who is an *ex-officio* member of the committee and whose address may be found below). These proposals must be in the hands of the PCNM at least nine months prior to the meeting at which the Special Session is to be held in order that the committee may consider all the proposals for Special Sessions simultaneously. Proposals that are sent to the Providence office of the Society, to the *Notices*, or directed to anyone other than the Associate Secretary will have to be forwarded and may not be received in time to be considered for acceptance.

It should be noted that Special Sessions must be announced in the *Notices* in such a timely fashion that any member of the Society who so wishes may submit an abstract for consideration for presentation in the Special Session before the deadline for such consideration. This deadline is usually three weeks before the deadline for abstracts for the meeting in question.

Special Sessions are very effective at Sectional Meetings and can usually be accommodated. The processing of proposals for Special Sessions for Sectional Meetings is handled in essentially the same manner as for Annual and Summer Meetings by the Section Program Committee. Again, no Special Session at a Sectional Meeting may be approved so late that its announcement appears past the deadline after which members can no longer send abstracts for consideration for presentation in that Special Session.

The Society reserves the right of first refusal for the publication of proceedings of any Special Session. These proceedings appear in the book series *Contemporary Mathematics*.

More precise details concerning proposals for and organizing of Special Sessions may be found in the "Rules for Special Sessions" or may be obtained from any Associate Secretary.

### *Proposals for Special Sessions to the Associate Secretaries*

The programs of Sectional Meetings are arranged by the Associate Secretary for the section in question:

Western Section
Lance W. Small, Associate Secretary
Department of Mathematics
University of California, San Diego
La Jolla, CA 92093
Electronic mail: g_small@math.ams.org
(Telephone 619 – 534 – 3590)

Central Section
Andy R. Magid, Associate Secretary
Department of Mathematics
University of Oklahoma
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Norman, OK 73019
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Eastern Section

W. Wistar Comfort, Associate Secretary (until January 31, 1993)
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Lesley M. Sibner, Associate Secretary (beginning February 1, 1993)
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Southeastern Section

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Robert J. Daverman, Associate Secretary (beginning February 1, 1993)
Department of Mathematics
University of Tennessee
Knoxville, TN 37996 – 1300
Electronic mail: g_daverman@math.ams.org
(Telephone 615 – 974 – 6577)

As a general rule, members who anticipate organizing Special Sessions at AMS meetings are advised to seek approval at least nine months prior to the scheduled date of the meeting. No Special Sessions can be approved too late to provide adequate advance notice to members who wish to participate.

Proposals for Special Sessions at the October 1-3, 1993 meeting in Heidelberg, Germany, only, should be sent to Robert M. Fossum at the Department of Mathematics, University of Illinois, Urbana, Il 61801, Telephone: 217-244-1741, email:rmf@math.ams.org.

## Information for Speakers

A great many of the papers presented in Special Sessions at meetings of the Society are invited papers, but any member of the Society who wishes to do so may submit an abstract for consideration for presentation in a Special Session, provided it is received in Providence prior to the special early deadline announced above and in the announcements of the meeting at which the Special Session has been scheduled. Contributors should know that there is a limitation in size of a single Special Session, so that it is sometimes true that all places are filled by invitation. Papers not accepted for a Special Session are considered as ten-minute contributed papers.

Abstracts of papers submitted for consideration for presentation at a Special Session must be received by the Providence office (Abstracts Coordinator, Meetings Department, American Mathematical Society, P. O. Box 6887, Providence, RI 02940) by the special deadline for Special Sessions, which is usually three weeks earlier than the deadline for contributed papers for the same meeting. The Council has decreed that no paper, whether invited or contributed, may be listed in the program of a meeting of the Society unless an abstract of the paper has been received in Providence prior to the deadline.

Electronic submission of abstracts is available to those who use the TEX typesetting system. Requests to obtain the package of files may be sent electronically via the Internet to **abs-request@math.ams.com.** Requesting the files electronically likely will be the fastest and most convenient way, but users may also obtain the package on IBM or Macintosh diskettes, available free of charge by writing to: Electronic Abstracts, American Mathematical Society, Meetings Department, P.O. Box 6887, Providence, RI 02940, USA. When requesting the abstracts package, users should be sure to specify whether they want the plain TEX, AMS-TEX, or the LATEX package.

### *Number of Papers Presented*
### *Joint Authorship*

Although an individual may present only one ten-minute contributed paper at a meeting, any combination of joint authorship may be accepted, provided no individual speaks more than once. An author can speak by invitation in more than one Special Session at the same meeting.

An individual may contribute only one abstract by title in any one issue of *Abstracts*, but joint authors are treated as a separate category. Thus, in addition to abstracts from two individual authors, one joint abstract by them may also be accepted for an issue.

## Site Selection for Sectional Meetings

Sectional Meeting sites are recommended by the Associate Secretary for the Section and approved by the Committee of Associate Secretaries and Secretary. Recommendations are usually made eighteen to twenty-four months in advance. Host departments supply local information, ten to twelve rooms with overhead projectors for contributed paper sessions and Special Sessions, an auditorium with twin overhead projectors for invited addresses, and registration clerks. The Society partially reimburses for the rental of facilities and equipment, and for staffing the registration desk. Most host departments volunteer; to do so, or for more information, contact the Associate Secretary for the Section.

# Joint Summer Research Conferences in the Mathematical Sciences

*University of Washington, Seattle, July 10 to August 6, 1993*

The 1993 Joint Summer Research Conferences in the Mathematical Sciences will be held at the University Washington, Seattle, from July 10 to August 6. It is anticipated that the series of conferences will be supported by grants from the National Science Foundation and other agencies.

There will be seven conferences in seven 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 conferences emulate the scientific structure of those held throughout the year at Oberwolfach. These 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 or by email: CAK@MATH.AMS.ORG on internet.

**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, email addresses, 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 1, 1993.** Requests to attend will be forwarded to the Organizing Committee for each conference for consideration after the deadline of March 1. 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 1993 conferences: John A. Burns, Fan R. K. Chung, Leonard Evens, Martin Golubitsky, Anthony W. Knapp, Peter W. K. Li, Stewart B. Priddy, Robert J. Serfling, Michael Shub, and Gregg J. Zuckerman.

**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, July 10 to Friday, July 16

*Curvature equations in conformal geometry*

SUNG-YUNG A. CHANG (University of California, Los Angeles), Co-Chair

RICK SCHOEN (Stanford University), Co-Chair

This conference will explore analytic and geometric aspects of the study of some nonlinear partial differential equations which arise naturally from the study of conformal geometry.

One specific nonlinear differential equation which will be the focus of attention of the conference will be the equation of the scalar curvature. It is the nonlinear equation $\Delta u + Ru^{N-1} = R_0 u$, $N = \frac{2n}{n-2}$, expresses the scalar curvature $R$ of a conformal metric $u^{4/(n-2)}g_0$ in terms of the conformal factor $u$ and the curvature $R_0$ of the original metric $g_0$. This equation enjoys several exceptional features which account for its attraction. First of all, it occurs at the critical exponent of the Sobolev inequalities, hence its treatment falls under the general heading of concentration compactness. Secondly, the problem enjoys a natural symmetry: the equation remains invariant under a conformal transformation of the domain. Hence, there is the implicit condition of integrability discovered by Pohozaev, Kazdan-Warner and later found to have generalizations to other geometric equations such as the Futaki condition in the complex Monge-Ampére equation and the balancing condition for the equation of constant mean curvature surfaces. Thirdly, the variational functionals for these equations have a natural spectral interpretation, a prime example being the Polyakov determinant for the associated Laplacian. Finally, it is the simplest geometric equation among many that have the common features delineated above.

In view of the rapid progress in recent years and the high potential of further development, we feel it is an opportune time to bring the active participants and interested students of the problem to a one-week conference, in order to assess the recent progress and to exchange ideas for future prospects in this exciting problem area.

Members of the Organizing Committee: Nickolas Korevaar (University of Utah) and Yanyan Li (Rutgers University).

## Saturday, July 10 to Sunday, July 18

*Multivariable operator theory*

RAÚL E. CURTO (University of Iowa), Co-Chair

RONALD G. DOUGLAS (SUNY at Stony Brook), Co-Chair

JOEL D. PINCUS (SUNY at Stony Brook), Co-Chair

NORBERTO SALINAS (University of Kansas), Co-Chair

The last twenty years have seen increased attention paid by operator theorists to the study of commuting families of Hilbert space operators. J. L. Taylor's discovery in 1970 of the right notion of joint spectrum, with a corresponding analytic functional calculus, and the development of several integral representation formulae for holomorphic functions defined on a neighborhood of a Stein compact set, allowed the Arens-Calderón-Waelbroeck functional calculus of the early 1950s to be broadly generalized and provided operator theorists with a number of techniques from several complex variables for the study of the joint behavior of operators.

A number of important developments have taken place during this period. For instance, we have seen a full description of the multivariable calculus, the Bochner-Martinelli formula has been generalized to commuting $n$-tuples in arbitrary C* -algebras, various forms of the multivariable index theorem have been proved using noncommutative differential geometry and algebraic geometry, and systems of Toeplitz operators on bounded symmetric domains and on domains of finite type have been substantially understood from the spectral and algebraic viewpoints (as have been those associated with Reinhardt measures in two variables).

These developments have been applied successfully to various types of quantizations, functional spaces on Cartan domains, and on pseudoconvex domains with smooth boundary (such as Bloch spaces, Besov spaces, weighted Hardy and Bergman spaces) have been thoroughly studied. An important generalization of the Berger-Shaw formula to several variables has been proved, and connections with the local multiplicative Lefshetz numbers, analytic torsion, and curvature of canonically associated hermitian vector bundles have been established. Moreover, a sophisticated machinery of functional homological algebra suitable for the study of multivariable phenomena has been developed, and a rich theory for invariant pseudodifferential operators on domains with transverse symmetry has been produced.

In addition, boundedness and compactness properties of Hankel operators on strongly pseudoconvex domains and on bounded symmetric domains have been completely characterized, and rigidity phenomena for analytically invariant subspaces of the Hardy and Bergman spaces have been discovered. Sheaf models for subnormal $n$-tuples have been formulated and have led to a substantial understanding of their spectral properties. Deep results from polynomial convexity have been used to solve intriguing problems on joint quasitriangularity, and the polynomially hyponormal conjecture for single operators has been settled using ideas from joint hyponormality. Secondary invariants for elliptic operators have been found, and this has allowed the discovery of concrete Toeplitz operators with irrational index.

As probably expected during the early stages of a new subject, the recent years have seen the rise of many new approaches (all quite different!) to multivariable operator theory, certainly connected, but with relationships not well understood. The subject has developed in several directions and with the aid of many and varied techniques; in addition, a good number of the advances were made through cross pollination among many areas of mathematics. The principal goal of the conference is to provide a forum for the discussion of the actual connections among the various approaches, which one hopes will allow researchers to combine their efforts in finding an understanding of the above mentioned relationships and new directions for future research. Consistent with this goal, participation of young investigators will be encouraged.

## Saturday, July 17 to Friday, July 23

*Spectral geometry*

ROBERT BROOKS (University of Southern California), Co-Chair

CAROLYN GORDON (Dartmouth College), Co-Chair

PETER PERRY (University of Kentucky), Co-Chair

The question of Mark Kac, "Can one hear the shape of a drum?", has inspired a continuing stream of activity over several decades. The interplay between geometry and spectral theory has its origins in spectroscopy and continues to generate research activity in a diverse range of mathematical areas.

Current interest in this question stems from three quite different developments:

(i) **(Counterexamples)** The construction of large numbers of examples of pairs of isospectral but not isometric manifolds, including plane domains, and continuous families of isospectral manifolds.

(ii) **(Compactness and Finiteness Theorems)** The use of spectral invariants such as the determinant and the heat and wave traces to show that spectral conditions determine a manifold up to finitely many topological types, or up to a compact family of metrics.

(iii) **(Spectral Theory of Graphs)** The understanding of various properties of graphs, and the construction of graphs with many extremal properties, through spectral considerations, and conversely the use of graph theory in the study of the spectrum of manifolds.

The purpose of this conference is to bring together workers in each of these areas of activity to promote further progress in spectral geometry.

## Saturday, July 17 to Friday, July 23

*Recent developments in the inverse Galois problem*

WALTER FEIT (Yale University), Chair

MIKE FRIED (University of California, Irvine), Co-Chair

Let $K$ be a field. We say the Inverse Galois Problem over $K$ has a positive solution if every finite group is a Galois group over $K$. The central case is $K = Q$, the rationals. Symmetric groups, alternating groups, solvable groups, most sporadic simple groups, and many Chevalley groups with few (6) outer automorphisms are Galois groups over $Q$. One theme of the conference will be recent progress on including other classes of (almost simple) groups. The main theme, however, is to put the classical Inverse Galois Problem into a broader framework. That is, to show how techniques developed for the realization of groups as Galois groups yield results beyond the original question.

Let $K$ be the separable closure of a field $K$. Automorphisms of $K$ that act trivially on $K$ form a compact topological group. This is the absolute Galois group $G_K$ of $K$. Algebraic number theory and arithmetic geometry have the investigation of $G_K$ at their heart. Many unsolved problems translate to questions about $G_K$. The classical cases for $K$ are the fields $Q$, rational functions over $Q$, or rational functions over a finite field (or its algebraic closure).

Suppose the absolute Galois group of a field $K$ is a free profinite group of infinite rank. Then every finite group is a quotient of $G_K$; the Inverse Galois Problem over $K$ has a positive solution. Furthermore, all subgroups of $G_K$ of finite index are free and many normal subgroups of infinite index (for example, the commutator subgroup).

None of the above-mentioned classical fields $K$ has free $G_K$. However, large normal subgroups of $G_Q$ have been constructed that are free. For the commutator subgroup of $G_Q$, the corresponding question is still open—Shafarevich's conjecture.

### Major subthemes of the conference:

A. KNOWN FINITE QUOTIENTS OF $G_Q$: Work on the Inverse Galois Problem began with Hilbert's study of symmetric and alternating groups. The next milestone was Shafarevich's realization of all solvable groups over $Q$ (in the 1950s). After that, most results on the Inverse Galois Problem used *rigidity* (as Thompson called it) and its generalizations. Matzat and others exploited these criteria to realize many particular groups. Furthermore, Matzat and his students found explicit generating polynomials for Galois extensions of $Q(x)$ realizing many groups of small order.

More recent approaches try to replace the strong rigidity assumptions by using moduli spaces and the braid group action. This goes back to earlier work of Fried (from the 1970s), further developed in recent joint work of Fried and Voelklein. There will be expository lectures on this, with application to the inverse problem.

Examples like the Mathieu groups and spin group covers of alternating groups have a special place in the theory. Serre found the obstruction to solving certain embedding problems involving the spin group covers of subgroups of an alternating group. In this way, even the classical result by Hilbert for realizing alternating groups has a fresh place in recent developments. Furthermore, Voelklein has realized Chevalley groups with arbitrarily many outer automorphisms. This is one application involving the Artin braid group.

The last international conference on the Inverse Galois problem took place at Oxford in the spring of 1990. Then we knew little about realizing Chevalley groups associated to nonprime finite fields. Now there are techniques for this. In addition, every finite group $G$ has infinitely many distinct totally nonsplit covers by finite groups. Even in the case that $G$ is the alternating group of degree 5, investigation of these covering groups has just started.

B. STRUCTURAL RESULTS ABOUT $G_Q$: A long standing conjecture of Shafarevich concerns the cyclotomic closure $Q^{cyc}$ of the rationals. This is $Q$ with all roots of unity adjoined. He conjectured that the absolute Galois group of $Q^{cyc}$ is free (as a profinite group). This would imply that $G_Q$ is an extension of the group of units of the completed integers by a countably free group.

The cyclotomic numbers have the property that they are a Hilbertian field with projective absolute Galois group. Fried and Voelklein conjectured these two properties alone suffice for the conclusion of Shafarevich's conjecture. They have proved special cases of their conjecture [*Annals of Math.*, **135** *1992*]. As a corollary, $G_Q$ is an extension of the product of all symmetric groups $S_n$ by a countably free group. Further, any complex finite extension of the field of totally real algebraic numbers has free absolute Galois group. Analogous results also apply to various fields with valuations.

C. UNRAMIFIED COVERS OF THE AFFINE LINE: In characteristic zero the affine line $A^1$ is simply connected. Yet, in positive characteristic it isn't. Indeed, the affine line in characteristic $p > 0$ has unramified Galois covers with each alternating group of degree $n \geq p$ as Galois group. Abhyankar's conjecture states exactly when a finite group is a Galois group of an unramified cover of $A^1$ in characteristic $p$: its Sylow $p$-subgroups generate it. Recently Serre has shown this for solvable groups. Harbater and Abhyankar have considered far-ranging generalizations. Many principal speakers have worked on Abhyankar's conjecture. Raynaud has even outlined a proof. Our understanding of Riemann's existence theorem in positive characteristic increases rapidly. This topic opens the conference to interests of classical algebraic geometers.

D. INTERACTIONS WITH GROUP THEORY: The Santa-Cruz conference of 1979 included applications of the classification of finite simple groups to problems in Number Theory and Algebraic Geometry. Similarly, there are many topics around the Inverse Galois Problem that have strong connections with group theory. We give a partial list.

(i) Classification of primitive groups of genus 0. (ii) Explicit Hilbert's irreducibility theorem results. (iii) Kronecker conjugacy of number fields. (iv) Relative Brauer groups and admissible groups.

Each topic combines serious group theory with another area of arithmetic or algebra.

Members of the Organizing Committee: Shreeram Abhyankar (Purdue University) and Helmut Völklein (University of Florida).

## Saturday, July 24 to Friday, July 30

*Mathematics of superconductivity*

M. GUNZBURGER (Virginia Tech), Co-Chair

J. OCKENDON (University of Oxford), Co-Chair

The purpose of the conference is:

(i) to review the state of the art concerning the extent to which mathematics can shed light on the phenomenon of superconductivity;

(ii) to review the mathematical challenges posed by current models for superconductivity; and

(iii) to consider likely new models and configurations that will need study in the next few years, especially in view of recent developments in high-temperature superconductors.

Special emphasis will be placed on models that are likely to have relevance to engineering applications, and the format will encourage interaction between pure and applied theorists, numerical analysts, and experimentalists.

There is an ever increasing body of experimental and theoretical information being accumulated with regard to the macroscopic behavior of superconductors. For example, Josephson-type effects in some high-temperature superconductors have been identified, and layered models incorporating such phenomena have been developed. Here scientists, building on existing models for low temperature superconductors, e.g., Ginzburg-Landau models, have devised mathematical models that are amenable to analyses and numerical simulations and that well-describe superconducting phenomena.

The mathematical analysis of macroscopic models for superconductivity has played a major role in validating models and in predicting superconducting phenomena. Stability and bifurcation analyses are important to the determination of what states are physically realizable. Modern tools from the theory of partial differential equations are used to determine properties of solutions of the mathematical models.

The computational difficulties encountered in trying to carry out realistic simulations are numerous and great. For examples, nonstandard boundary conditions are encountered and, for some problems, vortex-like structures are present having fields that experience order one variations over length scales of few hundred Angstroms. Moreover, models for high-temperature superconductors are typically characterized by anisotropies and/or inhomogenieties. Efficient and robust algorithms are therefore necessary to carry out simulations that can be used for the design of superconducting devices and for the study of superconducting pheonomena.

The conference gathers physicists and other scientists, engineers, and mathematicians who will address many of the important questions arising in superconductivity. Among the physical effects to be discussed are Josephson junctions, proximity effects, flux pinning, anisotropies, inhomogenieties, vortex motion, and melting. Speakers will show how numerous areas of mathematics, including numerical, asympototic, and functional analysis, are involved in treating these problems. The intent is to accelerate progress in the modeling, analysis, and numerical simulation of superconducting phenomena.

## Saturday, July 31 to Friday, August 6

*Distributions with fixed marginals, doubly stochastic measures, and Markov operators*

HOWARD SHERWOOD (University of Central Florida), Co-Chair

MICHAEL D. TAYLOR (University of Central Florida), Co-Chair

The past few years have seen a growing pace of development in the topics of this conference. At the same time, people in different areas-statisticians, functional analysts, researchers in functional equations, those with interests in real analysis or

nondeterministic analysis-have come to realize that the topics of this conference constitute an important and unifying area of interest for all of them.

Brown in 1966 showed that there is a homeomorphism between Markov operators and doubly stochastic measures on the unit square. This in turn provided a link between Markov operators and copulas, which are simply the joint distribution functions of doubly stochastic measures on the unit square. Sklar in 1959 showed that for every 2-dimensional joint distribution function $H$ with 1-dimensional margins $F$ and $G$, there exists a copula $C$ satisfying $H(x, y) = C(F(x), G(y))$, from which it follows that copulas can be identified with the type of dependence that exists between random variables. This in turn means that a 1951 result of Fréchet, in which he found upper and lower bounds for $H$, may be looked upon as the first instance of a probabilistic explanation of the type of dependence corresponding to certain copulas. Since then, finding probabilistic explanations of the type of dependence corresponding to a given copula has become an area of active research. For example, Vitale in 1990 showed that any type of statistical dependence (including statistical independence) between two random variables can be approximated arbitrarily closely by the dependence between two other random variables which are related to one another in a strictly deterministic fashion. Probability distributions with fixed marginals also arise in problems that are not originally statistical in nature, for example, in finding the optimal translocation of masses (the Monge-Kantorovich problem) or in the construction of probability metrics which are of increasing importance for the investigation of stability properties of stochastic models. But to mention these results and insights is to barely scratch the surface of what has been done.

Broadly speaking, the conference will have as its theme advances in understanding the theoretical structure of copulas and its applications, doubly stochastic measures, Markov operators, measures of dependence, and the generation of multivariate distributions.

Because of its links to probability, statistics, measure theory, operator theory, generalized functions, and functional analysis, the conference will bring together people with common interests but diverse areas of expertise. Since many of these people have, until recently, had little awareness of each others' existence, there is a real need for person-to-person exchange of ideas. The differences in the perspectives, tools, and problems of the researchers, properly cultivated, can be expected to stimulate growth of understanding and to produce new and important results. This is the principal goal of the conference.

Young Colleagues who received their Ph.D. within the last five years are encouraged to submit a VITA along with their request no later than February 15, 1993, if they want funding. It is not required to present a paper to be eligible for funding.

Members of the Organizing Committee: Peter Fishburn (AT&T Bell Labs), J. H. B. Kemperman (Rutgers University), Ingram Olkin (Stanford University), L. Rüschendorf (Institut für Mathematische Statistik der Universität der Münster), and Berthold Schweizer (University of Massachusetts).

## Saturday, July 31 to Friday, August 6

*Applications of hypergroups and related measure algebras*

WILLIAM C. CONNETT (University of Missouri, St. Louis), Co-Chair

OLIVIER GEBUHRER (Université Louis Pasteur, Strasbourg), Co-Chair

ALAN L. SCHWARTZ (University of Missouri, St. Louis), Co-Chair

A hypergroup is a Banach algebra of measures on a locally compact Hausdorff space with enough structure so that the resulting measure algebra has many of the properties of the measure algebra on a locally compact group. Much of the program of harmonic analysis and probability can be carried out utilizing this structure in the algebra of measures. Natural examples of this arise from the study of Gelfand pairs, Sturm-Liouville systems, and orbit spaces.

The abstract theory of hypergroups was extensively developed in the sixties and seventies and it has been applied successfully by workers in operator theory, special functions, harmonic analysis, probability theory, Lie theory, and quantum groups. This conference will encourage communications among these various user communities by organizing workshops, seminars, and survey talks in the following areas:

- The structure of hypergroups (finite, discrete, and continous)
- Probability and potential theory on hypergroups
- Hypergroups and number theory
- Sturm-Liouville hypergroups
- Hypergroups associated with polynomials in several variables
- Advances in noncommutative hypergroups
- Hypergroups and special functions
- The harmonic analysis of hypergroup characters
- Hypergroups and quantum groups
- Applications of Lie theory to hypergroups

Scientific Committee: Richard A. Askey (University of Wisconsin), Walter Bloom (Murdoch University, Australia), Houcine Chebli (Université de Tunis), Charles F. Dunkl (University of Virginia), Jean Esterle (Université de Bordeaux), Pierre Henri Eymard (Université de Nancy), Gerald B. Folland (University of Washington), Leonard Gallardo (Université de Bretagne Occidentale), Ramesh Gangolli (University of Washington), George Gasper, Jr. (Northwestern University), Herbert Heyer (Universität Tübingen), Roger Howe (Yale University), Andrzej Hulanicki (Universität Wroclawski), Joe Wiley Jenkins (National Science Foundation), Tom Koornwinder (University of Amsterdam), Ray Kunze (University of Georgia), B.M. Levitan (Moscow State University), Jean Ludwig (Université de Metz), Kenneth A. Ross (University of Oregon), Paolo Soardi (Universita di Milano), and Khelifa Trimeche (Université de Tunis).

# 1993 Summer Research Institute

*Stochastic analysis*

Cornell University, Ithaca, New York, July 11 – 30

The forty-first Summer Research Institute sponsored by the American Mathematical Society will be devoted to Stochastic Analysis and will be held at Cornell University from July 11–30, 1993. The Co–Chairs of the Organizing Committee are **Mike Cranston**, University of Rochester; **Rick Durrett**, Cornell University; and **Mark Pinsky**, Northwestern University. The speakers were selected with the advice of a committee that consists of **Rodrigo Banuelos**, Purdue University; **Peter Baxendale**, University of Southern California; **Hans Föllmer**, Universität Bonn; **Nobuyuki Ikeda**, University of Osaka; **Paul Malliavin**, Université Pierre et Marie Curie; **Alain Sznitman**, ETH Zurich, and **Ruth Williams**, University of California, San Diego.

The topic was selected by the 1992 AMS Committee on Summer Institutes whose members at the time were: Craig Evans, Nicholas Katz, Barbara Lee Keyfitz, Brian Parshall (chair), Francois Treves, and Edward Witten.

In recent years there have been exciting interactions between probability theory and analysis, geometry, and mathematical physics, with these three fields furnishing a rich source of problems for probability theory. The conference will highlight recent achievements in the field and promising directions for future research. The meeting will be divided into six two-and-one-half day periods (Sunday morning to Tuesday noon, Wednesday morning to Friday noon, etc.) that will feature the following topics in the order indicated:

1. Stochastic ordinary differential equations (7/11–7/13)
2. Applications to analysis (7/14–7/16)
3. Applications to geometry (7/18–7/20)
4. Stochastic flows (7/21–7/23)
5. Infinite-dimensional problems (7/25–7/27)
6. Stochastic partial differential equations (7/28–7/30)

The institute will have approximately sixty-six one–hour lectures, eleven in each period. To allow time and energy for informal discussions there will be no short talks or parallel sessions. The precise content of the meeting will reflect the interests of the following list of speakers who have indicated that they will attend: L. Arnold, S. Albeverio, R. Banuelos, P. Baxendale, G. Ben-Arous, I. Benjamini, E. Bolthausen, J. Brossard, K. Burdzy, E. Carlen, R. Carmona, K. L. Chung, R. Dalang, B. Davis, D. Dawson, B. Driver, E. B. Dynkin, D. Elworthy, M. Emery, H. Föllmer, L. Gross, T. Hida, E. Hsu, N. Ikeda, G, Kallianpur, W. Kendall, Y. Kifer, S. Kotani, P. Kotelenez, N. Krylov, H. Kunita, S. Kusuoka, T. Kurtz, R. Léandre, F. Ledrappier, J.F. Le Gall, Y. Le Jan, T. Lindstrom, M. Liao, T. Lyons, P. Malliavin, P. March, S. Molchanov, C. Mueller, D. Nualart, D. Ocone, B. Øksendal, G. Papanicolaou, E. Pardoux, E. Perkins, R. Pinsky, M. Röckner, C. Rogers, B. Rozovskii, T. Shiga, I. Shigekawa, A. Sznitman, A. Truman, A.S. Ustunel, M. van den Berg, S. Watanabe, V. Wihstutz, R. Williams, Z. Zhao, and W. Zheng.

It is anticipated that the institute will be partially funded by a grant from the National Science Foundation. Proceedings will be published in the AMS series titled *Proceedings of Symposia in Pure Mathematics*. It is expected that the papers for the proceedings will closely parallel the content of the lectures and will be distributed to the conference participants at the time of the lectures.

All persons who are interested in this topic are welcome to attend. The organizers anticipate being able to provide partial support for travel and subsistence for young researchers, especially women and minorities. Those interested in receiving an invitation to participate in the institute should send the following information to: Summer Institute Conference Coordinator, American Mathematical Society, P.O. Box 6887, Providence R.I. 02940, **prior to April 1, 1993**, or through electronic mail to wsd@math.ams.org.

Please type or print the following:

1. Full name
2. Mailing address
3. Telephone number and area code for office and home, FAX number, and electronic mail address
4. Which week or weeks you wish to attend
5. Your scientific background relevant to the institute topic
6. Financial assistance required (or indicate if no support required).

Information on housing, dining, travel, and the local area will be sent to invited participants in the Spring. Each participant will be required to pay a Conference fee. Questions about the scientific program can be addressed to any of the organizers, preferably by email to cran@uordbv.bitnet, rtd@cornella.bitnet, or m_pinsky@math.nwu.edu. Questions about local arrangements should be sent to Rick Durrett via email or write to him at Department of Mathematics, White Hall, Cornell University, Ithaca, NY 14853-7901.

Requests for invitations will be forwarded to the Organizing Committee for consideration up to the deadline of April 1. All applicants will receive formal invitations. Participants receiving financial support will be notified beginning in mid-May.

# 1993 Symposium

## Mathematics of Computation 1943–1993:

*A half-century of computational mathematics*

University of British Columbia, Vancouver, Canada, August 9–13, 1993

Under the auspices of the American Mathematical Society (AMS) and in celebration of the 50th anniversary of the journal *Mathematics of Computation*, an international symposium devoted to all aspects of computational mathematics will take place at the University of British Columbia, Vancouver, Canada, August 9–13, 1993. The symposium will be held immediately prior to the joint AMS/CMS/MAA summer meeting. As part of the meeting there will be a two-session minisymposium on computational number theory dedicated to the memory of **D. H. Lehmer**. Invited speakers will be presenting survey and state-of-the-art lectures in plenary sessions. There will also be poster sessions and 15-minute contributed paper sessions.

The topic was selected by the 1992 AMS Committee on Summer Institutes and Special Symposia, whose members at the time were: **Lawrence Craig Evens**, **Nicholas Katz**, **Barbara Lee Keyfitz**, **Brian Parshall** (Chair), **Francois Treves**, and **Edward Witten**.

The Organizing Committee for the symposium consists of **James H. Bramble**, Cornell University; **Walter Gautschi**, Purdue University (Chair); **Eugene Isaacson**, New York University; **Vidar Thomée**, Chalmers University of Technology; and **Hugh C. Williams**, University of Manitoba.

The invited speakers are: **James H. Bramble**, Cornell University; **Johannes Buchmann**, Universität des Saarlandes; **Bjørn Engquist**, UCLA; **Donald Goldfarb**, Columbia University; **James N. Lyness**, Argonne National Laboratory; **J. C. Nedelec**, Ecole Polytechnique Palaiseau; **Andrew M. Odlyzko**, AT&T Bell Laboratories; **Frank W. J. Olver**, University of Maryland; **Carl Pomerance**, University of Georgia; **Larry L. Schumaker**, Vanderbilt University; **Hans J. Stetter**, Technical University of Vienna; **G. W. Stewart**, University of Maryland; and **Roger Teman**, Indiana University.

The deadline for submission of contributed papers is **April 1, 1993**. Abstracts should be prepared on AMS abstract forms and should indicate whether they are being submitted for a poster session or for a contributed paper session. Abstract forms are available at most universities or obtainable from the AMS upon request. Abstracts should be sent in duplicate to Walter Gautschi, Department of Computer Sciences, Purdue University, West Lafayette, IN 47907, USA. Decisions on acceptances will be made by May 1, 1993. Proceedings will be published by the AMS.

The deadline for preregistration/housing is **June 6, 1993**. Preregistration and housing forms can be obtained after February 1, 1993 from the Mathematics Meetings Service Bureau, P.O. Box 6887, Providence, RI 02940-6887. There will be a registration fee of $50. Inquiries with regard to registration and housing should be directed to that address or by email to jlm@math.ams.org, or telephone: 401-455-4143. Other inquiries should be sent to **Walter Gautschi**, Chair of the Organizing Committee at the address indicated in the previous paragraph.

It is anticipated that the symposium will be partially supported by a grant from the National Science Foundation. Additional funds for support are being sought from other agencies.

# Mathematics Sessions at the AAAS Annual Meeting Boston, MA, February 11–16, 1993

The annual meeting of the American Association for the Advancement of Science (AAAS), February 11–16, 1993 in Boston, Massachusetts, will feature many outstanding expository talks by prominent mathematicians. These talks include the following symposia (three-hour sessions) and invited addresses cosponsored by Section A (Mathematics) of the AAAS and the Society. In addition to providing travel support to speakers in these session the AMS has a committee to act as liaison with the AAAS. The Society believes that strengthening its ties with the AAAS helps to create new opportunities for mathematicians to interact with scientists from all disciplines.

The names and affiliations of the organizers follow:

- *Contemporary methods of numerical computation and analysis*, organized by Douglas Arnold.
- *Contributions of mathematics to industrial competetiveness*, organized by Peter Castro and James Glimm.
- *Ethnomathematics*, organized by Chandler Davis.
- *Mathematics of everyday language*, organized by Keith Devlin.
- *Emergence of behavior in coupled neural oscillators*, organized by Bard Ermentrout.
- *Interdisciplinary curricula in mathematics, statistics, and science*, organized by Turkan K. Gardenier.
- *How mathematicians think*, organized by Judith V. Grabiner and Karen V. Parshall.
- *Operations research and mathematics*, organized by Carl Harris.
- *Symbolic computation: its impact on mathematics and science*, organized by Zaven Karian.
- *Knots in math/physics*, organized by Louis H. Kauffman.
- *Randomized algorithms in pure mathematics*, organized by Peter Winkler.
- Frontiers of Physical Sciences: *Wavelets*, by Ingrid Daubechies.
- Plenary Address: Vaughn Jones.

In addition, section A of the AAAS will sponsor various symposia that will especially interest mathematicians and mathematics educators. These symposia include:

- *The objectivity crisis: rethinking the role of science in society*, organized by George Brown and Daniel Sarewitz.
- *Statistics and molecular biology*, organized by Herman Chernoff.
- *Public understanding of environmental science*, organized by Jon Miller.
- *Handedness in the scientific domain*, organized by Kurt Mislow.
- *Statistical, methodological, and substantive aspects of meta-analysis*, organized by Robert Rosenthal and Jessica Utts.
- *Adaptive computation and artificial worlds*, organized by Rolf Sinclair.

The above symposia represent only a few of the approximately 150 AAAS program offerings that will broaden the perspectives of students and professionals alike. Indeed, AAAS annual meetings showcase American science and deserve greater mathematical participation. The Section A Committee seeks organizers and speakers who can present substantial new material in understandable ways. This task is not easy, but the outstanding success of the mathematics symposia at last year's AAAS annual meeting in Chicago proved that effort and inspiration can accomplish wonders. The 1992 mathematics program demonstrated that first-rate mathematical researchers can also effectively reach a broad and diverse scientific audience.

Section A of the AAAS knows that increasing the representation and participation of mathematicians at AAAS annual meetings offers an important means for deepening public awareness and appreciation of the manifold ways that mathematics contributes to science and society.

For details about the symposia, see the September 25, 1992 issue of *Science*. Participants are invited to attend the Section A committee meeting, 5:30 p.m. to 7:00 p.m., Saturday, February 13, 1992 in the Liberty E Room, Sheraton Boston hotel. This meeting is open to all who wish to stimulate interest in activities of the mathematical sciences within the AAAS. Symposia proposals for future AAAS meetings should be sent to: Warren Page, Secretary of Section A, AAAS, Department of Mathematics, New York City Technical College, CUNY, 300 Jay St., Brooklyn, NY 11201.

# Mathematical Sciences Meetings and Conferences

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.

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.

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.

## 1992

1992. **IMACS Symposium on Symbolic Computation in Engineering Design**, IDN, Lille, France. (Jul./Aug. 1990, p. 746)

1992. **IMACS International Conference on Computational Physics**, Univ. of Colorado, Boulder, CO. (Oct. 1990, p. 1141)

## November 1992

November 1992. **The International Lie-Lobachevsky Colloquium Dedicated to the Anniversaries of Sophus Lie's 150 birthday and Nikolai Lobachevski's 200 birthday**, Tartu (Estonia). (Feb. 1992, p. 148)

November 1992. **Workshop on Stochastic Control**, Centre de Recherches Mathématiques, Université de Montréal, Montréal Quebec, Canada. (Apr. 1992, p. 349)

7. **Graph Theory Day 24**, Worcester Polytechnic Institute, Worcester, MA. (Oct. 1992, p. 945)

7–11. **Mathematics and Molecular Biology III: Computational Approaches to Nucleic Acid Structure and Function**, Santa Fe, NM. (May/Jun. 1992, p. 494)

8–14. **Numerische Integration**, Oberwolfach, Federal Republic of Germany. (February 1991, p. 148)

8–14. **Third Austrian Symposium on the History of Mathematics**, Neuhofen an der Ybbs (Lower Austria). (Mar. 1992, p. 249)

9–11. **Fundamental Problems in Quantum Field Theory**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 628)

9–13. **IMA Workshop on Control and Optimal Design of Distributed Parameter Systems**, Institute for Mathematics and its Applications, University of Minnesota. (Nov. 1991, p. 1171)

9–13. **Introduction to Industrial Engineering**, Seattle, WA. (Spe. 1992, p. 769)

10–13. **Interdisciplinary Studies on Number Theory**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 628)

13–15. **Second Joint Meeting of the Midwest Conference on Ordinary Differential Equations and the Southeastern-Atlantic Regional Conference on Differential Equations**, University of Kentucky, Lexington, KY. (Apr. 1992, p. 349)

*13–16. **Workshop on Normal Forms and Homoclinic Chaos**, Fields Institute for Research in Mathematical Sciences, Waterloo, Ontario. (Note change of name and date from Apr. 1992, p. 350)

14–16. **The Third Biennial Conference of the Allahabad Mathematical Society**, Allahabad, India. (May/Jun. 1991, p. 477)

15–20. **An Applications Symposium on Optics, Electro-Optics, and Lasers in Industry**, Boston, MA. (Feb. 1992, p. 148)

15–21. **Komplexitatstheorie**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

16–18. **Workshop on Higher Dimensional Geometry**, Mathematical Sciences Research Institute, Berkeley, CA. (Jan. 1992, p. 54)

16–18. **Hardy Spaces and Uniform Algebras**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 629)

16–20. **International Congress on Numerical Methods in Engineering and Applied Sciences**, University of Concepción, Concepción, Chile. (Jul./Aug. 1991, p. 646)

16–20. **IMA Period of Concentration: Flow Control**, Institute for Mathematics and its Applications, University of Minnesota. (Sep. 1991, p. 840)

16–20. **The Fifth Annual High Performance Computing and Communication Conference–Supercomputing 92**, Minneapolis, MN. (Sep. 1992, p. 769)

16–20. **Automorphic Forms and L-functions**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 629)

17–19. **NSF/DoD's National SBIR Conferences**, Phoenix, AZ. (Sep. 1992, p. 769)

18–20. **Mathematical Optimization and its Applications**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 629)

20–22. **Academic Knowledge and Power**, University of Maryland, College Park, MD. (May/Jun. 1992, p. 494)

22–26. **Geometry of Hamiltonian Systems**, Conference Center "Woudschoten", The Netherlands. (Sep. 1992, p. 770)

23–25. **European Symposium on Research in Computer Security**, Toulouse, France. (Feb. 1992, p. 148)

23–27. **Séminaire Sud-Rhodanien de Geometrie**, Marseille, France. (Jan. 1992, p. 54)

*23–27. **Cohomologie Equivariante et Indice des Operateurs Transversalement El-**

**liptiques**, CIRM, Marseille, France.

ORGANIZERS: P. Dazord (U. de Lyon I), L. Niglio (U. d'Avignon).
INFORMATION: Centre International de Rencontres Mathematiques, Case 916, Luminy, 70, Route Leon-Lachamp, 13288 Marseille Cedex 9; tel: (91) 41.82.97.

24–26. **Spectral and Scattering Theory for Differential Equations**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 629)

24–26. **Theory and Applications in Computer Algebra**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 629)

29–December 5. **Theory of Large Deviations**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

* 30–December 1. **Modélisation Mathématique et Simulation Numérique en Physique du Transport de Particules Chargées**, CIRM, Marseille, France.

ORGANIZERS: S. Mas-Gallic (Ecole Polytechnique, Palaiseau).
INFORMATION: Centre International de Rencontres Mathematiques, Case 916, Luminy, 70, Route Leon-Lachamp, 13288 Marseille Cedex 9; tel: (91) 41.82.97.

30–December 2. **Algorithm, Fractal, and Dynamical Systems**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 629)

## December 1992

1. **1992 Science and Technology Symposium "Clinical Trials and Statistics"**, Washington, DC. (Oct. 1992, p. 946)

* 1–4. **Fourth IEEE Symposium on Parallel and Distributed Processing**, Arlington, TX.

PROGRAM: This symposium provides a forum for the presentation and exchange of current work on a wide variety of topics in parallel and distributed processing, including: Computer architecture, neural networks, artificial intelligence, simulation and modeling, programming languages, interconnection networks, parallel algorithms, distributed computing, operating systems, database and knowledge-base systems, VLSI systems design, and scheduling. The technical program features 44 long and 26 short papers, and plenary keynote speeches.
KEYNOTE SPEAKERS: J. Hennessy, Stanford; H.J. Siegel, Purdue; and C. Leiserson, MIT.
INFORMATION: IEEE Symposium on Parallel and Distributed Processing, University of Texas at Arlington, Box 19015, Arlington, TX 76019-0015.

2–4. **Workshop on Curves, Abelian Varieties, and their Moduli**, Mathematical Sciences Research Institute, Berkeley, CA. (Jan. 1992, p. 54)

4–5. **International Workshop on Matrix Methods for Statistics**, University of Auckland, Auckland, New Zealand. (Feb. 1992, p. 148)

4–5. **Workshop on Control and PDE's**, Temple University, Philadelphia, PA. (Oct. 1992, p. 946)

6–12. **Theory and Numerical Methods for Initial-Boundary Value Problems**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

7–11. **IMACS Symposium on Scientific Computing and Mathematical Modelling**, Bangalore, India. (May/Jun. 1991, p. 477)

7–11. **Algebraic Number Theory—Recent Developments and Their Backgrounds**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 629)

8–11. **International Conference on Computer Science and Control**, Paris, France. (April 1992, p. 350)

11–16. **Workshop on Generalized Inverses–Computational Techniques and Applications**, Indian Statistical Institute, Delhi, India. (Mar. 1992, p. 249)

13–19. **Asymptotische Statistik**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

14–18. **Compugraphics '92: Second International Conference on Computational Graphics and Visualization Techniques**, Calouste Gulbenkian Foundation, Lisbon, Portugal. (Oct. 1992, p. 946)

15–17. **Third IMA Conference on Mathematics Signal Processing**, University of Warwick, England. (Feb. 1992, p. 149)

17–19. **Algebraic Combinatorics**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 629)

* 17–19. **Applied Logic Conference**, University of Amsterdam.

PROGRAM COMMITTEE: P. Blackburn, M. Masuch, J.-J. Meyer, L. Pólos, and F. Vetlman.
INVITED SPEAKERS: H. Andréka, J. van Benthem, P. Gärdenfors, D. Gabbay, L. Moss, I. Németi, Y. Shoham, and K. Stenning.
INFORMATION: M. Vrinten, CCSOM, email: michel@ccsom.nl.

* 27–31. **Holiday Symposium on Lie Group Representations and Combinatorics**, New Mexico State University, Las Cruces, NM. (Please note updated information to Sep. 1991, p. 840)

PROGRAM: G. Benkart will deliver ten lectures acquainting researchers and graduate students with Lie theory and combinatorics, and disseminating information presently unfolding about both areas and their applications throughout mathematics. Benkart's lectures will survey the history of this interaction, present recent results, and discuss open problems. **Accomodations**: Rooms at the Holiday Inn de Las Cruces/Plaza Suites complex will be $28.00 per room for up to four people. **Funding**: Funding for limited support for the participation of graduate students and faculty has been requested from the NSF. Nevertheless, participants are urged to seek travel funds from their home institutions.
INFORMATION: D. Finston, dfinston@nmsu.edu; S. Salamanca-Riba, ssalaman@nmsu.edu; or R.J. Wisner, Dept. of Math. Sci., New Mexico State Univ., Las Cruces, 88003.

## 1993

1992–1993. **Mittag-Leffler Institute's Academic Program for 1992–1993: Special Problems in Mathematical Physics**, Djursholm, Sweden. (Nov. 1991, p. 1171)

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)

## January 1993

1–3. **International Symposium on Statistical Physics**, Salt Lake City, Calcutta, India. (Jul./Aug. 1992, p. 629)

3–7. **International Conference on Scientific Computation and Differential Equations**, Auckland, New Zealand. (May/Jun. 1991, p. 477)

3–9. **Grundlagen der Geometrie**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

3–9. **Extensions of Buildings and Geometries**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

4–8. **International Conference on Scientific and Differential Equations "SCADE '93"**, Auckland, New Zealand. (Oct. 1992, p. 946)

4–9. **Advances in Computational Mathematics**, India International Center, New Delhi, India. (Feb. 1992, p. 149)

5. **Short Course on Nonlinear Dynamics and Chaos**, Arizona State University, Tempe, AZ. (Sep. 1992, p. 770)

6–9. **Dynamics Days Arizona, Twelfth Annual International Workshop**, Arizona State University, Tempe, AZ. (Sep. 1992, p. 770)

7–11. **Conference on Evolution Equations**,

Louisiana State University, Baton Rouge, LA. (Sep. 1992, p. 770)

10–15. **First Panamerican Workshop in Applied and Computational Mathematics**, Simon Bolivar University, Caracas, Venezuela. (May/Jun. 1992, p. 494)

10–16. **Computational Methods for Nonlinear Phenomena**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

12–14. **Topology and Field Theory of 3-4 Dimensional Algebras**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 629)

13–16. **Joint Mathematics Meetings**, San Antonio, TX. (including the annual meetings of the AMS, AWM, MAA, and NAM)

INFORMATION: H. Daly, AMS, P.O. Box 6887, Providence, RI 02940.

* 15–16. **1992–1993 ASL Winter Meeting**, San Antonio, TX. (Please note updated information to May/Jun. 1992, p. 495)

INVITED SPEAKERS: S. Friedman, E. Herrmann, J. Krajicek, C. Laskowski, R. Laver, T. Pitassi, and D. Seetapun.
INFORMATION: Program Chair, S. Lempp, Dept. of Math., Univ. of Wisconsin, Madison, WI 53706; lempp@math.wisc.edu.

15–17. **International Conference on Complex Analysis and its Applications**, Hong Kong University of Science and Technology, Hong Kong. (Sep. 1992, p. 771)

17–22. **1993 IEEE International Symposium on Information Theory**, San Antonio, TX. (Feb. 1992, p. 149)

17–23. **Combinatorial Optimization**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

18–21. **Numerical Analysis of Partial Differential Equations in Engineering and Related Topics**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 630)

20–22. **Hyperfunctions and Differential Equations**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 630)

24–30. **Optimale Steuerung Partieller Differentialgleichungen**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

25–27. **Fourth ACM-SIAM Symposium on Discrete Algorithms (SODA)**, Austin, Texas.

25–29. **IMA Workshop on Robotics**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1171)

26–28. **The Development of Algebraic Toplogy**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 630)

* 27–29. **Modern Developments in Complex Analysis and Related Topics on the Occasion of the 70th Birthday of J. Korevaar**, University of Amsterdam, The Netherlands.

ORGANIZING COMMITTEE: F. van der Blij (Utrecht), M.A. Kaashoek (VU Amsterdam), J.J.O.O. Wiegerinck (UV Amsterdam).
INVITED LECTURERS: N.G. de Bruijn (Eindhoven), R.G.M. Brummelhuis (Leiden), C. Chui (Texas A&M), T. Ganelius (Stockholm), T.H. Koornwinder (Amsterdam), W.A.J. Luxemburg (Pasadena), W. Rudin (Madison), L. Zalcman (Bar Ilan), H.J. Alexander (Chicago), B. Berndtsson (Goteburg), P.L. Butzer (Aken), J.J. Duistermaat (Utrecht), I. Gohberg (Tel Aviv), A.A Gonchar (Moscow), W.K. Hayman (York).
CALL FOR PAPERS: For other participants there is limited possibility for presenting 20 minute lectures. Application deadline for participation is December 1, 1992. Abstracts deadline is January 1, 1993.
INFORMATION: J.J.O.O. Wiegerinck, Faculteit Wiskunde en Informatica, Univ. van Amsterdam, Plantage Muidergracht 24, 1018 TV Amsterdam, The Netherlands; email: janwieg@fwi.uva.nl.

31–February 6. **Asymptotics and Adaptivity in Computational Mechanics**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

## February 1993

1–3. **IMA Minisymposium on Biological Control of Movement**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)

5–7. **Representation Theory and Analysis on Homogeneous Spaces in Memory of Lawrence Corwin**, Rutgers University, New Brunswick, NJ. (Sep. 1992, p. 771)

7–11. **The 29th Australian Applied Mathematics Conference (AMC '93)**, Höchstens, Hahndorf, South Australia. (Sep. 1992, p. 771)

7–13. **Partielle Differentialgleichungen**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

8–17. **IMA Workshop on Nonsmooth Analysis and Geometric Methods in Deterministic Optimal Control**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Mar. 1992, p. 250)

14–20. **Applicable Algebra**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

15–19. **1993 Mathematics-in-Industry Study Group**, Melbourne, Australia. (Sep. 1992, p. 771)

15–19. **International Conference on Mathematics, Computer, Control, and Investments**, Moscow, Russia. (Oct. 1992, p. 947)

21–27. **Curves, Images, Massive Computation**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

22–28. **Workshop on Pattern Formation and Symmetry Breaking**, Fields Institute for Research in Mathematical Sciences, Waterloo, Ontario. (Apr. 1992, p. 351)

25–March 1. **A Conference on Numerical Analysis with Automatic Result Verification**, Lafayette, LA. (May/Jun. 1992, p. 495)

28–March 6. **Medical Statistics: Statistical Methods for Risk Assessment**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

## March 1993

7–13. **Mathematische Stochastik**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

* 10–12. **Equations d'Evolution, Theorie du Controle et Biomathematiques**, CIRM, Marseille, France.

ORGANIZERS: W. Arendt and P. Benilan (U. de Besancon).
INFORMATION: Centre International de Rencontres Mathematiques, Case 916, Luminy, 70, Route Leon-Lachamp, 13288 Marseille Cedex 9; tel: (91) 41.82.97.

* 10–13. **The Fourth Annual Ulam Mathematics Conference**, West Palm Beach, FL.

CONFERENCE TOPICS: Papers are being solicited for the following sessions: Mathematical biology, foundations of mathematics, stochastic control, computer science and supercomputers, algebraic geometry/number theory, peaceful applications of fusion, topology, logic, aerospace mathematics, and mathematics education.
INVITED SPEAKERS: R. Smith, U. of Florida; T. and B. Duncan, U. of Kansas; J. Mycielski, U. of Colorado.
CALL FOR PAPERS: Deadline for abstracts: December 15, 1992.
INFORMATION: L. Hill, Manager, Conferences and Special Events, or P. Blass, Chair, Ulam Conference Committee at: Palm Beach Atlantic College, P.O. Box 24708, West Palm Beach, FL 33416-4708; 407-650-7700; FAX: 407-835-4342.

* 11–14. **1992–1993 Annual ASL Meeting**, University of Notre Dame, Notre Dame, IN.

PROGRAM: This will consist of a broadly based program of invited talks reflecting the full range of current activity in logic. Invited talks will include the fourth annual Gödel lecture.
PROGRAM COMMITTEE: S. Buechler (Chair), S. Friedman, A. Gupta, P. Kolaitis, and M. Stob.

CALL FOR PAPERS: Deadline for abstracts of contributed talks: January 10, 1993. Send to address below.
INFORMATION: S. Buechler, Math. Dept., Univ. of Notre Dame, Box 398, Notre Dame, IN 46556; email: buechler@cartan.math.nd.edu.

14–20. **Gewöhnliche Differentialgleichungen**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

15–18. **Arithmetic Geometry with an Emphasis on Iwasawa Theory**, Arizona State University, Tempe, AZ. (Sep. 1992, p. 771)

15–19. **IMA Workshop on Systems and Control Theory for Power Systems**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)

17–20. **Pure and Applied Linear Algebra: The New Generation**, University of West Florida, Pensacola, FL. (May/Jun. 1992, p. 495)

21–27. **Analysis auf Lokalsymmetrischen Räumen**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

22–24. **Sixth SIAM Conference on Parallel Processing for Scientific Computing**, Norfolk, VA. (Oct. 1992, p. 947)

22–28. **Workshop on Pattern Formation in Earth Sciences and Biology**, Fields Institute for Research in Mathematical Sciences, Waterloo, Ontario. (Apr. 1992, p. 351)

*24–28. **Conference on Quantum Topology**, Kansas State University, Manhattan, KS.

PROGRAM AND INVITED SPEAKERS: Talks at the conference will deal with interactions between low-dimensional topology, quantum field theory, statistical mechanics, and the theory of quantum groups. Specific topics include: Knot polynomials, Vassiliev invariants, and classical knot theory; quantum groups and noncommutative topology; gauge theoretic methods in 3- and 4-manifold topology; topological quantum field theory; and exactly solvable models and topology. L. Kauffman and N. Reshetikhin will each present a series of four one-hour lectures. The remainder of the program will consist of additional one-hour invited lectures in plenary sessions, 25- and 50-minute contributed talks in parallel sessions, and a problem session.
INFORMATION: D.N. Yetter, Dept. of Math., Kansas State Univ., Manhattan, KS 66506; 913-532-6750; dyetter@math.ksu.edu.

28–April 3. **Combinatorial Convexity and Algebraic Geometry**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

29–April 2. **Workshop on Diophantine Geometry**, Mathematical Sciences Research Institute, Berkeley, CA. (May/Jun. 1992, p. 495)

*29–April 8. **Workshop on Geometric and Combinatorial Methods in Group Theory**, International Centre for the Mathematical Sciences, Edinburgh, Scotland.

PROGRAM: A 2-week workshop consisting of invited and contributed lectures.
SCIENTIFIC COMMITTEE: S.M. Gersten, E. Ghys, J. Howie, S.J. Pride, A.A. Razborov.
INVITED SPEAKERS: G. Baumslag, M.J. Dunwoody, S.M. Gersten, E. Ghys, P.H. Kropholler, A. Lubotsky, A.J. McIntyre, A. Yu. Ol'shanski, A.A. Razborov, J.R. Stallings, E.I. Zelmanov.
CALL FOR PAPERS: Send abstract by January 1, 1993.
INFORMATION: From the organizers: A.J. Duncan, N.D. Gilbert, and J. Howie, Dept. of Math., Heriot-Watt Univ., Riccarton, Edinburgh EH14 4AS, Scotland; email: groups93@cara.ma.hw.ac.uk; FAX: (+44) 31 451 3249.

*30–April 1. **IEEE Data Compression Conference (DCC '93)**, Snowbird, Utah.

CONFERENCE TOPICS: Coding theory, quantization theory, parallel compression algorithms and hardware, lossless and lossy compression algorithms for specific types of data (including text, images, video, speech, music, maps, instrument data, graphics, animation, and bit-maps), data compression standards, bi-level coding, transform methods, wavelet and fractal techniques, string searching and manipulation, closest-match retrieval, theory of minimal length encoding and applications to learning, system issues relating to data compression (including error control, data security, and indexing), medical imagery, scientific and space data archives.
INFORMATION: DCC '93, Computer Science Dept., Brandeis University, Waltham, MA 02254.

## Spring 1993

*Spring 1993. **Valuations, Topological Fields, and Geometries**, CIRM, Marseille, France.

ORGANIZER: S. Priess-Crampe (U. München).
INFORMATION: Centre International de Rencontres Mathematiques, Case 916, Luminy, 70, Route Leon-Lachamp, 13288 Marseille Cedex 9; tel: (91) 41.82.97.

## April 1993

4–7. **First International Conference on Mathematical Linguistics**, Barcelona, Spain. (Sep. 1992, p. 772)

*4–9. **Copper Mountain Conference on Multigrid Methods**, Copper Mountain, Colorado.

PROGRAM: **Circus and Workshops**: Anyone who wants to give a talk and will not be in the regular session may do so at one of the Circus sessions. There will also be time set aside for Workshops on specific topics of interest. **Student paper competition**: Travel and lodging assistance will be awarded to student authors judged to have the best research papers. Papers containing original research due mainly to the student must be received before December 15, 1992. They must be singly authored and may be no more than 10 pages in length. Sending only an abstract is unacceptable. **Format**: There will be morning and late afternoon lectures of approximately 20 minutes each. Evenings will be reserved for the circus and workshops. Afternoons will be open for more formal workshops and discussions.
CALL FOR PAPERS: Potential contributors should submit an abstract of no more than 200 words to address below.
INFORMATION: Copper Mountain Conference Coordinator, Computational Math Group, University of Colorado at Denver, Campus Box 170, P.O. Box 173364, Denver, CO 80217-3364; email: cm93@copper.denver.colorado.edu.

4–10. **Topics in Pseudo-Differential Operators**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

5–9. **IMA Tutorial: Design and Analysis of Adaptive Systems**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)

*7–10. **The Ninth Conference on the Mathematical Foundations of Programming Semantics**, New Orleans, LA.

PROGRAM: The MFPS conferences are devoted to those areas of mathematics, logic, and computer science which are related to the semantics of programming languages. There will be two special sessions, one on real-time concurrency, organized by G.M. Reed (PRG, Oxford) and A.W. Roscoe (RPG, Oxford), and the second on fully abstract semantics, organized by S. Brookes (CMU).
INVITED SPEAKERS: P. Aczel (Manchester), P.-L. Curien (LIENS-DMI), A. Meyer (MIT), D. Miller (Pennsylvania), A. Pitts (Cambridge), and G. Plotkin (Edinburgh).
INFORMATION: General inquiries about MFPS IX may be addressed to: M. Mislove, Dept. of Math., Tulane Univ., New Orleans, LA 70118; 504-865-5727.

8–10. **Clifford Algebras in Analysis**, University of Arkansas, Fayetteville, AR. (Sep. 1992, p. 772)

9–10. **Western Section**, University of Utah, Salt Lake City, Utah.

INFORMATION: W. Drady, AMS, P.O. Box 6887, Providence, RI 02940.

11–17. **Arbeitsgemeinschaft mit Aktuellem Thema**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

12–16. **IMA Workshop on Adaptive Control, Filtering, and Signal Processing**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)

12–16. **GAMM-Jahrestagung 1993**, Dresden, Germany. (Sep. 1992, p. 772)

14–16. **Seventh SEFI European Seminar on Mathematics in Engineering Education**, Eindhoven University of Technology, The Netherlands. (Feb. 1992, p. 149)

14–16. **The Mathematics of Food Production, Processing, and Presentation**, Belfast, Great Britain. (Sep. 1992, p. 772)

14–23. **International Conference in Abstract Analysis**, Kruger National Park, Republic of South Africa. (Oct. 1992, p. 948)

15–22. **Symposium on Analytic and Geometric Aspects of Hyperbolic Geometry: Research Level Workshop**, University of Warwick, Coventry, UK. (Mar. 1992, p. 250)

18–24. **The Arithmetik of Fields**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

18–24. **Mathematische Grundlagen und Numerische Verfahren bei Transsonischen Strömungen**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

* 19–20. **IMA Minisymposium on Fuzzy Control**, University of Minnesota, Minneapolis, MN.

INFORMATION: Institute for Mathematics and its Applications, University of Minnesota, 514 Vincent Hall, 206 Chruch St., S.E., Minneapolis, MN 55455.

19–21. **SIAM Conference on Mathematical and Computational Issues in the Geosciences**, Houston, TX. (Jul./Aug. 1992, p. 631)

25–May 1. **Low Dimensional Dynamics**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

* 26–29. **NCGA '93 Computer Graphics Solutions: Applications for Implementation**, Philadelphia, PA.

PROGRAM: This conference is dedicated to compuetr graphics applications for engineering and business graphics. NCGA '93 features 150 exhibitors and a comprehensive program focusing on the following: CAD/CAM/CAE; multimedia; mapping and GIS; graphic arts and design; industrial design; visual communications; architecture, engineering, and construction; and printing and publishing.

INFORMATION: Kate Whalen, NCGA, 703-698-9600, ext. 340; or Andrew Barauskas, NCGA, 703-698-6900, ext. 345.

27–29. **NSF/DoD's National SBIR Conferences**, Minneapolis, MN. (Sep. 1992, p. 772)

* 30–May 2. **Third Midwestern Geometry Conference**, University of Missouri, Columbia, MO. (Please note updated information to Oct. 1992, p. 948)

## May 1993

2–4. **Workshop on Operator Algebras**, Institute for Advanced Studies in Mathematics, Technion, Haifa, Israel. (Oct. 1992, p. 948)

3–7. **IMA Tutorial: Verification Issues in Discrete Event Systems, as well as Performance and Control**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)

* 3–7. **Problemes aux Limites, Equations & Integrales de Bord dans des Domaines Non Reguliers**, CIRM, Marseille, France.

ORGANIZER: S. Nicaise (U. de Lille I).
INFORMATION: Centre International de Rencontres Mathematiques, Case 916, Luminy, 70, Route Leon-Lachamp, 13288 Marseille Cedex 9; tel: (91) 41.82.97.

3–9. **Workshop on Ecological Systems**, Fields Institute for Research in Mathematical Sciences, Waterloo, Ontario. (Apr. 1992, p. 352)

* 4–8. **The Third International Colloquium on Cognitive Science (ICCS-93)**, Donostia-San Sebastian, Spain.

CONFERENCE TOPICS: Representation and dynamics in semantics and pragmatics; formalization of cognitive models and complexity; and information processing and communication in natural systems.
INVITED SPEAKERS: J. van Benthem, N. Block, M. Boden, P. Churchland, R. Cummings, V. Demonte, K. Devlin, F. Dretske, J.D. Fodor, J. Higginbotham, D. Israel, R. Jackendoff, P.N. Johnson-Laird, H. Kamp, H. Levesque, F. Lin, A. ter Meulen, R. Millikan, J. Oberlander, F. Pereira, M. Pollack, A. Riviere, L. Shastri, M.D. Singh, D. Sperber, and R. Wilensky.
CALL FOR PAPERS: Abstracts of 2–3 pages written in English should be sent to the address below by February 1, 1993.
INFORMATION: J. Ezquerro, ICCS-93, Dept. of Logic and Philosophy of Science, Univ. del Pais Vasco, Apdo. 1249, 20080 San Sebastian, Spain; email: iccs-93@sf.ehu.es; FAX: 34 43 471699.

9–15. **Reelle Algebraische Geometrie**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

9–17. **Jerusalem Combinatorics '93**, Hebrew University of Jerusalem, Israel. (Jul./Aug. 1992, p. 631)

10–12. **IMACS Symposium on Signal Processing and Neural Networks–SPANN '93**, Université du Québec at Montréal, Canada. (Jan. 1992, p. 56)

10–14. **IMA Workshop on Discrete Event Systems, Manufacturing Systems, and Communication Networks**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)

10–14. **The Tenth International Symposium on Applied Algebra, Algebraic Algorithms, and Error Correcting Codes**, San Juan de Puerto Rico. (Oct. 1992, p. 948)

* 10–14. **Geometrie et Topologie des Sous-Varietes**, CIRM, Marseille, France.

ORGANIZER: Mr. Morvan (U. de Lyon I).
INFORMATION: Centre International de Rencontres Mathematiques, Case 916, Luminy, 70, Route Leon-Lachamp, 13288 Marseille Cedex 9; tel: (91) 41.82.97.

* 13–16. **ASL Spring Meeting in Conjunction with a Meeting of the Society for Exact Philosophy**, York University, Toronto, Canada.

CALL FOR PAPERS: Deadline for abstracts: March 15, 1993.
INFORMATION: S. Thomason, Chair of Program Committee, Dept. of Math., Simon Fraser Univ., Burnaby, B.C., Canada V5A 1S6; email: thomason@sfu.ca.

16–22. **Mathematical Problems in Viscoelastic Flows**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

18–21. **Eighth Annual Conference on Structure in Complexity Theory**, San Diego, CA. (Oct. 1992, p. 948)

* 20–22. **International Symposium on Ordinary Differential Equations and Applications**, Western Michigan University, Kalamazoo, MI.

PURPOSE: To gather experts in the field to exchange recent research results and ideas on theory and applications of ordinary differential equations. In this symposium, W.A. Harris, Jr., M. Iwano, and Y. Sibuya will be honored for their outstanding contributions in the past decades. Also, in addition to the principal speakers, there will be a number of invited speakers.
PRINCIPAL SPEAKERS: S.B. Bank (Illinois), B.L.J. Braaksma (Groningen, Netherlands), H. Gingold (West Virginia), W.A. Harris, Jr. (USC), F.C. Hoppensteadt (MSU), F.A. Howes (Dept of Energy), M. Iwano (Nihon U., Japan), D.A. Lutz (San Diego State), F.W.J. Olver (Maryland), R.E. O'Malley, Jr. (Washington), D. Schmidt and R. Schäfke (Essen, Germany), Y. Sibuya (Minnesota), and D.R. Smith (UC San Diego).
CALL FOR PAPERS: Those interested in presenting a contributed paper (15 min.) should submit an abstract (not over 300

words) to the organizing committee by March 1, 1993.

INFORMATION: The Organizing Committee (Y. Alavi and P.F. Hsieh), Dept. of Math. and Stats., Western Michigan U., Kalamazoo, MI 49008; 616-387-4510; FAX: 616-387-4530; email: hsieh@gw.wmich.edu.

20–23. **International Conference on Approximation Probability and Related Fields**, University of California, Santa Barbara, CA. (May/Jun. 1991, p. 477)

21–22. **Central Section**, Northern Illinois University, DeKalb, IL.

INFORMATION: W.S. Drady, AMS, P.O. Box 6887, Providence, RI 02940.

23–29. **Differentialgeometrie im Grossen**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

24–27. **COMPEURO '93**, Paris-Evry, France. (Jul./Aug. 1992, p. 631)

* 24–27. **Eurocrypt '93: A Workshop on the Theory and Applications of Cryptographic Techniques**, Lofthus, Norway.

CONFERENCE TOPICS: Original papers are solicited on all aspects of the theory and applications of crytpography including symmetric and asymmetric ciphers, authentication, cryptanalysis, protocols, secure transactions, sequences and linear complexity, signatures, hardware and software topics, security of telecommunication systems and computer networks.

CALL FOR PAPERS: Authors are requested to send 12 copies of an extended abstract of at most 10 double-spaced pages to the program chair at the address below by January 10, 1993. The abstract should clearly indicate the results achieved, their significance, and their relation to other work in the area.

INFORMATION: Program Chair, T. Helleseth, Dept. of Informatics, Univ. of Bergen, Hoyteknologisenteret, N-5020 Bergen, Norway; email: torh@ii.uib.no or General Chair, K. Presttun, Alcatel Telecom Norway AS, Eurocrypt '93, Box 255 Okern, N-0510, Norway; eurocrypt93@alcatel.no.

* 24–28. **Matroides et Matroides Orientes**, CIRM, Marseille, France.

ORGANIZER: M. Las Vergnas (U. de Paris VI).

INFORMATION: Centre International de Rencontres Mathematiques, Case 916, Luminy, 70, Route Leon-Lachamp, 13288 Marseille Cedex 9; tel: (91) 41.82.97.

26–29. **First International Conference on Dynamic Systems and Applications**, Morehouse College, Atlanta, GA. (Oct. 1992, p. 948)

30–June 1. **Canadian Society for the History and Philosophy of Mathematics**, Carleton University, Ottawa, Ontario, Canada. (Sep. 1992, p. 772)

30–June 5. **Funktionalanalysis und Nichtlineare Partielle Differentialgleichungen**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

* 30–June 13. **First Caribbean Spring School of Mathematics and Theoretical Physics**, Guadeloupe (French West Indies).

CONFERENCE TOPICS: Infinite dimensional geometry, noncommutative geometry, operator algebras, and fundamental interactions.

INVITED SPEAKERS: L. Alvarez-Gaume, H. Araki, J.P. Bourguignon, A. Connes, L. Faddeev, R. Haag, A. Jadczyk, V. Jones, D. Kastler, G. Mack, P. Ramond, F. Schaposnik, J. Stasheff, R. Stora, A.S. Wightman, S.L. Woronowicz.

INFORMATION: From the organizers: R. Coquereaux, Centre de Physique Theorique, CNRS, Case 907, Luminy, 13288, Marseille, France; coque@frcpn11.in2p3.fr; or M. Dubois-Violette, Laboratoire de Physique Theorique et Hautes Energies, Univ. Paris XI, B.211, 91405, Orsay, France; flad@qcd.circe.fr.

* 31–June 4. **Workshop on Nonnegative Matrices, Applications, and Generalizations**, Technion, Haifa, Israel.

PROGRAM: The workshop will consist of approximately thirteen invited talks (45 minutes each) and of minisymposia. The workshop will be followed by the Eighth Haifa Matrix Theory Conference.

ORGANIZING COMMITTEE: A. Berman, D. Hershkowitz, and R. Loewy (chair).

WORKSHOP TOPICS: Spectral theory for nonnegative matrices; $M$-matrices; numerical and computational aspects and applications; inverse eigenvalue problems; permanents; Markov chains; positive dynamical systems and control; combinatorial aspects; cones of positive operators, and other topics.

INVITED SPEAKERS: *Tentative*: N. Alon (Israel): T. Ando (Japan): M. Boyle (U.S.): R. Brualdi (U.S.); J. Cohen (U.S.); P. Diaconis (U.S.); L. Elsner (Germany); M. Fiedler (Czechoslovakia); K.-H. Foerster (Germany); S. Friedlander (U.S.); R. Grone (U.S.); R. Hartwig (U.S.), C. Johnson (U.S.), M. Neumann (U.S.), U. Rothblum (Israel), H. Schneider (U.S.), B.S. Tam (Taiwan), R. Thompson (U.S.), R. Varga (U.S.).

CALL FOR PAPERS: Participants are invited to present papers in a minisymposia. The number of such talks is limited. Send abstract as soon as possible, but no later than March 15, 1993.

WORKSHOP PROCEEDINGS: A special issue of *Linear Algebra and its Applications* will be devoted to the workshop and the conference. Papers should be submitted to the organizing committee by September 15, 1993.

INFORMATION: The Organizing Committee-Haifa Matrix Workshop, Mathematics Dept. Technion, Haifa 32000, Israel; email: mar23aa@technion.bitnet or mar28aa@technion.bitnet; tel: 972-4-294282; FAX: 972-4-324654.

## June 1993

June 1993. **Fourth IMACS International Symposium on Computational Acoustics**, Cambridge, England. (Jan. 1992, p. 56)

June 1993. **GAMM/IFIP - Workshop on Stochastic Optimization: Numerical Methods and Technical Applications**, Neubiberg/München, Germany. (Sep. 1992, p. 773)

* June 1993. **Summer Workshop: Calculus, Computers, Concepts, and Cooperative Learning**, Purdue University, West Lafayette, IN.

PROGRAM: The two week, intensive, total-immersion program will focus on the use of computers, research into learning theory, and a cooperative learning environment to help students learn calculus concepts. A three day preworkshop tutorial on the basic use of the necessary computer systems will be offered as an option. Participants will be invited to return the following summer for two days to discuss their teaching experiences based on the workshop. The workshop provides hands-on experiences with computer software (both MS DOS and Macintosh), class materials, and seminars on learning theory, including viewing and discussing videos of Purdue classroom laboratory experiences in cooperative learning. The program will feature the use of the mathematical programming language *ISETL* and its graphics package, in addition to *Maple* and *Derive*. Participants are expected to pilot the calculus course presented in the workshop during AY 1993–1994.

INFORMATION: E. Dubinsky or K. Schwingendorf, Dept. of Math., Purdue Univ., West Lafayette, IN 47907; bbf@j.cc.purdue.edu or ks@math.purdue.edu.

* 1–4. **Rigidite et Deformation pour les Systemes Hyperboliques**, CIRM, Marseille, France.

ORGANIZER: P. Foulon (Ecole Polytechnique, Palaiseau).

INFORMATION: Centre International de Rencontres Mathematiques, Case 916, Luminy, 70, Route Leon-Lachamp, 13288 Marseille Cedex 9; tel: (91) 41.82.97.

2–5. **Ninth Biennial Conference of the Association of Christians in the Mathematical Sciences**, Westmont College, Santa Barbara, CA. (Sep. 1992, p. 773)

6–9. **Annual Meeting of the Statistical Society of Canada**, Wolfville, Nova Scotia, Canada. (Feb. 1992, p. 149)

6–12. **Analysis auf Kompakten Varietäten**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

7–10. **SIAM Conference on Mathematical and Numerical Aspects of Wave Propagation Phenomena**, University of Delaware, Newark, DE. (Jul./Aug. 1992, p. 631)

*7–10. **The Eighth Haifa Matrix Theory Conference**, Technion, Haifa, Israel.

PROGRAM: The conference will consist of talks given in plenary sessions (30 minutes or more each talk), and of talks given in parallel sessions (30 minutes or less each talk). The conference will be preceded by the Workshop on Nonnegative matrices, applications, and generalizations.
INVITED SPEAKERS: *Tentative*: H. Bart (Netherlands); R. Bhatia (India); M. Boyle (U.S.); R. Brualdi (U.S.); J. Da Silva (Portugal); D. Djokovic (Canada); M. Fiedler (Czechoslovakia); S. Friedland (U.S.); P. Fuhrmann (Israel); I. Gohberg (Israel); R. Horn (U.S.); C. Johnson (U.S.); T. Laffey (Ireland); P. Lancaster (Canada); R. Mathias (U.S.); V. Mehrmann (Germany); S. Pierce (U.S.); R. Plemmons (U.S.); L. Rodman (U.S.); H. Schneider (U.S.); R. Thompson (U.S.); I. Zaballa (Spain).
CALL FOR PAPERS: Send abstract by March 15, 1993.
CONFERENCE PROCEEDINGS: A special issue of *Linear Algebra and its Applications* will be devoted to the workshop and the conference. Papers should be submitted to S. Friedland, D. Hershkowitz, and R. Loewy by September 15, 1993.
INFORMATION: The Organizing Committee-Haifa Matrix Conference, Mathematics Dept. Technion, Haifa 32000, Israel; email: mar23aa@technion.bitnet or mar28aa@technion.bitnet; tel: 972-4-294282; FAX: 972-4-324654.

7–11. **IMA Tutorial: Mathematical Theory which Has become an Integral Part of Modern Financial Economics**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)

*7–11. **Colloque International en l'Honneur de G. Freiman. La Methode Additive Inverse et ses Applications**, CIRM, Marseille, France.

ORGANIZER: J.-M. Deshouillers (U. de Bordeaux II).
INFORMATION: Centre International de Rencontres Mathematiques, Case 916, Luminy, 70, Route Leon-Lachamp, 13288 Marseille Cedex 9; tel: (91) 41.82.97.

*7–12. **International Conference in Honour of Bernard Malgrange**, Grenoble, France.

CONFERENCE TOPICS: Complex analysis and geometry, singularities, differential equations, and *d*-modules.
INFORMATION: Secretariat du Colloque Malgrange, Institut Fourier, Unversite Grenoble 1, BP.74, 38402 St Martin D Heres, France.

7–13. **Workshop on Pattern Formation and Cellular Automata**, Fields Institute for Research in Mathematical Sciences, Waterloo, Ontario. (Apr. 1992, p. 352)

13–19. **Differential-Algebraic Equations: Theory and Applications in Technical Simulation**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

14–17. **The Fifth Asian Logic Conference**, National University of Singapore, Singapore. (May/Jun. 1992, p. 496)

14–18. **IMA Workshop on Mathematical Finance**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)

14–18. **Linear Logic Workshop**, Mathematical Sciences Institute, Cornell University, Ithaca, NY. (May/Jun. 1992, p. 496)

*14–18. **Homologie des Algebres et Applications**, CIRM, Marseille, France.

ORGANIZER: Mr. Guin (U. de Montpellier III)
INFORMATION: Centre International de Rencontres Mathematiques, Case 916, Luminy, 70, Route Leon-Lachamp, 13288 Marseille Cedex 9; tel: (91) 41.82.97.

*15–17. **IEEE Computer Society Conference on Computer Vision and Pattern Recognition**, Omni Park Central, New York City, NY.

PROGRAM: The program will consist of high quality contributed papers on all aspects of computer vision and pattern recognition.
CONFERENCE TOPICS: Physics of image formation, low-level processing, pattern analysis, texture analysis, motion analysis and stereo, integration of modules and cues, segmentation and perceptual grouping, shape and object representation, object recognition, active vision, real-time vision and architectures, systems and applications.
INFORMATION: General Chair, J.K. Aggarwal, Computer and Vision Research Center, University of Texas at Austin, Austin, TX 78712-1084; jka@emx.utexas.edu.

15–18. **Third IMACS International Workshop on Qualitative Reasoning and Decision Technologies–QR&DT-3**, Polytechnique of Barcelona, Spain. (Jan. 1992, p. 56)

*20–23. **Eighth Annual IEEE Symposium on Logic in Computer Science (LICS)**, Montreal, Canada.

CONFERENCE CHAIRS: M. Okada, Concordia Univ.; and P. Panangaden, McGill Univ.
PROGRAM CHAIR: M.Y. Vardi, IBM Research.
CALL FOR PAPERS: Paper submissions should be sent in the form of 10 hard copies of a detailed abstract and 20 additional copies of the cover page by December 8, 1992.
INFORMATION: LICS Publicity Chair, D. Leivant, Dept. of Comp. Sci., Indiana U., Bloomington, IN 47405; email: lics@cs.indiana.edu.

20–26. **Konvexgeometrie**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

21–25. **Twenty-second Conference on Stochastic Processes and their Applications**, Amsterdam, The Netherlands. (Sep. 1992, p. 773)

21–25. **Graphs on Surfaces**, Johns Hopkins University, Baltimore, MD. (Sep. 1992, p. 773)

21–25. **Fifth International Conference on Formal Power Series and Algebraic Combinatorics**, University of Florence, Florence, Italy. (Oct. 1992, p. 949)

*21–26. **Homogeneisation et Methodes de Convergence en Calcul des Variations**, CIRM, Marseille, France.

ORGANIZER: G. Bouchitte (U. de Toulon & du Var).
INFORMATION: Centre International de Rencontres Mathematiques, Case 916, Luminy, 70, Route Leon-Lachamp, 13288 Marseille Cedex 9; tel: (91) 41.82.97.

*22–24. **The Twenty-third Annual International Symposium on Fault-Tolerant Computing (FTCS 23)**, Toulouse, France.

CONFERENCE TOPICS: Fault-tolerant architectures, fault tolerance in online transaction processing systems, distributed systems and real-time systems, safety-critical systems, software fault tolerance, testing and verification, dependability modeling and prediction, defect tolerance, and concurrent error detection in VLSI circuits.
INFORMATION: General Chair, J.-C. Laprie, LAAS-CNRS, 7 Avenue du Colonel Roche, 31077 Toulouse–France; email: jean-claude.laprie@laas.fr; tel: +(33) 61 33 62 39; FAX: +(33) 61 33 64 11.

*22–25. **Third International Conference on Algebraic Methodology and Software Technology (AMAST '93)**, Enschede, The Netherlands.

PROGRAM: The goal of the conference is to consolidate the trend towards using methodology as a foundation for software technology, and to show that universal alge-

bra provides a practical mathematical alternative to the common, ad-hoc approaches to software engineering and development. Talks will present research in algebra and logic, suitable as a foundation for software technology, as well as in software technologies developed by means of algebraic methods.

CONFERENCE TOPICS: Algebraic methods for language design, compiler construction, and software engineering; algebraic specifications and algorithms to automatically build programs from such specifications; extraction of programs from constructive proofs; categorical, algebraic, and logic programming; applications, including: deductive databases, query language design, concurrent systems, distributed operating systems, reactive systems; practical techniques and examples for verification of program and/or specification properties.

CALL FOR PAPERS: Please send a two-page abstract by December 15, 1992 to: AMAST Conference, Univ. of Twente, Fac. Informatica, Attn: Y. Rokker, P.O. Box 217, NL-7500AE Enschede, The Netherlands; email: rokker@cs.utwente.nl.

INFORMATION: Organizer, G. Scollo, Univ. of Twente, Fac. Informatica, P.O. Box 217, NL-7500AE Enschede, The Netherlands; tel: + 31 53 893779; FAX: + 31 53 356531; email: scollo@cs.utwente.nl.

23–26. **Convergence in Ergodic Theory and Probability**, Ohio State University, Columbus, OH. (May/Jun. 1992, p. 496)

27–July 3. **Algebraische K-Theorie**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

*28–30. **Second International Workshop on Logic Programming and Nonmonotonic Reasoning**, Lisbon, Portugal.

INFORMATION: Contact: marek@ms.uky.edu.

*28–July 2. **Geometrie Algebrique et Theorie des Codes**, CIRM, Marseille, France.

ORGANIZERS: M. Perret (ENS-Lyon), M. Tsfasman (IPPI-Moscou & CNRS-Luminy), M. Stichtenoth (U. GHS Essen).

INFORMATION: Centre International de Rencontres Mathematiques, Case 916, Luminy, 70, Route Leon-Lachamp, 13288 Marseille Cedex 9; tel: (91) 41.82.97.

*28–July 3. **Conference in Honour of Jean-Pierre Kahane**, University Paris-Sud at Orsay.

INVITED SPEAKERS: J. Bourgain, L. Carleson, R. Coifman, Ch. Fefferman, J.-E. Fornaess, C.S. Herz, P. Jones, C. Kenig, Y. Katznelson, T. Körner, P. Malliavin, B. Mandelbrot, W. Rudin, E.M. Stein, S.J. Taylor.

PARALLEL SESSIONS: Complex analysis and iteration (N. Sibony); Harmonic analysis, ergodic theory, and number theory (J.-F. Méla); Real analysis (G. David and G. Weiss); Analysis on symmetric spaces and Riemannian manifolds (A. Ancona, N. Lohoué, and N. Varopoulos); Spaces of holomorphic functions and the $\bar{\partial}$-equation (A.-M. Chollet and J. Détraz); Lacunarity and stochastic methods in functional analysis (M. Déchamps and G. Pisier); Wavelets and signal processing (Y. Meyer); Extremal properties of trigonometric polynomials (H. Queffelec & B. Saffari); Fine properties of Brownian motion (M. Yor).

INFORMATION: Mme. J. Dumas, Univ. de Paris-Sud, Mathematiques-Batiment 425, 91405 Orsay Cedex (France); FAX: 33 1 69 41 60 34; email: collok@matups.matups.fr.

29–July 2. **Number Theoretic and Algebraic Methods in Computer Science**, International Center of Scientific and Technical Information (ICSTI), Moscow. (Sep. 1992, p. 773)

## July 1993

4–9. **Fifth International Fuzzy Systems Association World Congress**, Seoul, Korea. (Mar. 1992, p. 250)

4–10. **Freie Randwertprobleme**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

4–10. **Fifth International Congress on Algebraic Hyperstructures and Applications**, Iasi, Romania. (Sep. 1992, p. 773)

*5–9. **Communications et Reseaux d'Interconnexion**, CIRM, Marseille, France.

ORGANIZER: D. Sotteau (U. de Paris-Sud).

INFORMATION: Centre International de Rencontres Mathematiques, Case 916, Luminy, 70, Route Leon-Lachamp, 13288 Marseille Cedex 9; tel: (91) 41.82.97.

*5–9. **The Thirty-seventh Annual Meeting of the Australian Mathematical Society (AMS '93)**, University of Wollongong, Australia.

INVITED SPEAKERS: R.F. Churchhouse (Cardiff), J.K. Gray (AMP Sydney), J.K. Hale (Georgia Tech), S.N. Chow (Georgia Tech), J. Seberry (Wollongong), J.N. Crossley (Monash), H. Petersen (Odense).

INFORMATION: The latest AMS '93 information is available on anonymous ftp from ftp.cs.uow.edu.au in the directory /pub/AMS93; or send email to Conference Secretary G.H. Williams: ams93@math.uow.edu.au.

*5–31. **NSF Regional Geometry Institute: Discrete Geometry**, Smith College, Northampton, MA.

PROGRAM: Amherst, Hampshire, Holy Cross, Mount Holyoke, Smith, and Williams Colleges, and the University of Massachusetts at Amherst will host an NSF-funded Regional Geometry Institute for approximately 100 discrete geometers, graduate students, undergraduates, and high school teachers on the campus of Smith College. The Institute will develop two broad themes, computational geometry and tilings, in parallel lecture series. Speakers and titles are shown below. There will also be approximately 40 lectures on current research in several other areas of discrete geometry, a weekly Education Forum, and a weekly series of talks by scientists and artists.

DIRECTOR: M. Senechal, Smith College.

INVITED SPEAKERS AND TITLES: **First week**: J. O'Rourke (Smith), Introduction to computational geometry; and R. Connelly (Cornell), Models and theorems. **Second week**: G. Toussaint (McGill), 2D algorithms: triangulations and arrangements; and J. Conway (Princeton), Symmetries, lattices, and tilings; **Third week**: S. Drysdale (Dartmouth), Voroni diagrams; and C. Radin (Texas), Tilings and ergodic theory. **Fourth week**: L. Danzer (Dortmund), Quasicrystal tilings; and H. Edelsbrunner (Illinois), 3D triangulations.

PARTICIPANTS: The Institute seeks approximately 40 mathematicians who have active research programs in or closely related to discrete geometry and who are interested in participating in a "vertically integrated" Institute. The Institute will pay travel, room and board, and a modest stipend. There is also funding for about 16 graduate students. Preference will be given to participants who can stay the entire month.

INFORMATION: Regional Geometry Institute, Clark Science Center, Smith College, Northampton, MA 01063; email: rgi@smith.smith.edu (application can be handled entirely by mail). Deadline for applications: March 30, 1993.

6–9. **European Multigrid Conference '93**, Amsterdam, The Netherlands. (May/Jun. 1992, p. 496)

*6–23. **IMA Summer Program on Modeling, Mesh Generations, and Adaptive Numerical Methods for Partial Differential Equations**, University of Minnesota, Minneapolis, MN.

INFORMATION: Institute for Mathematics and its Applications, University of Minnesota, 514 Vincent Hall, 206 Chruch St., S.E., Minneapolis, MN 55455.

7–10. **The Second International Conference on Fluid Mechanics (ICFM-II)**, Beijing, China. (Sep. 1992, p. 773)

11–17. **Nonlinear Evolution Equations, Solutions and the Inverse Scattering Transform**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

12–16. **SIAM Annual Meeting**, Philadelphia, PA. (Mar. 1992, p. 251)

12–16. **Chaotic Numerics (An International Workshop on the Approximation and Computation of Complicated Dynamical Behavior)**, Deakin University, Geelong, Australia. (Oct. 1992, p. 949)

* 12–17. **Colloque Takeuti: Theorie de la Demonstration et Applications en Informatique**, CIRM, Marseille, France.

ORGANIZERS: J.-P. Ressayre (U. de Paris VII), P. Clote (Boston).
INFORMATION: Centre International de Rencontres Mathematiques, Case 916, Luminy, 70, Route Leon-Lachamp, 13288 Marseille Cedex 9; tel: (91) 41.82.97.

* 12–17. **Third International Conference on Nonassociative Algebra and its Applications**, University of Oviedo, Spain.

PURPOSE: The conference will bring together researchers from different areas on nonassociative algebras and their applications. Emphasis of applications will be focused on theoretical physics, biological sciences, functional analysis, and geometry and differential equations, which frequently use the theory of nonassociative algebras.
INFORMATION: S. González, Dept. de Matemáticas, Facultad de Ciencias, Universidad de Oviedo, 33007 Oviedo, Spain; FAX: (34)-8-5103354; email: santos@pinon.ccu.uniovi.es.

12–23. **Conference on Universal Algebra and Category Theory**, Mathematical Sciences Research Institute, Berkeley, CA. (May/Jun. 1992, p. 496)

18–24. **Dynamische Systeme**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

* 19–23. **Singularites**, CIRM, Marseille, France.

ORGANIZER: C. Sabbah (E. Polytechnique, Palaiseau).
INFORMATION: Centre International de Rencontres Mathematiques, Case 916, Luminy, 70, Route Leon-Lachamp, 13288 Marseille Cedex 9; tel: (91) 41.82.97.

* 20–29. **1993 ASL European Summer Meeting (Logic Colloquium '93)**, University of Keele, United Kingdom.

PROGRAM COMMITTEE: D. Gabbay, W. Hodges (chair), S. Read, C. Steinhorn, A. Troelstra, and J. Truss.

25–31. **Geometric Methods in Theoretical and Computational Mechanics**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

26–30. **NATO Advanced Research Workshop: Classical and Axiomatic Potential Theory**, Les Arcs, Savoy, France. (Oct. 1992, p. 950)

## August 1993

* August 1993. **International Conference on New Trends in Computer Science I (NETCOMS I)**, University of Ibadan, Nigeria.

PURPOSE: This conference aims at bringing together research workers, in the broad sense, from all over the world, in Computer Science—computer scientists, linguistics, philosophers, mathematicians, social and natural scientists, educators, etc.—to present an overview of the computer world today through speeches, discussions, and workshops.
INFORMATION: The Director, L. Shakunle, Think Tank Research Institute, Marktplatz 11, 7900 Ulm, Germany, Tel: (0731) 610510.

1–7. **Abelsche Gruppen**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

* 1–14. **Groups 93 Galway/St. Andrews**, Galway, Ireland. (Please note correction to May/Jun. 1992, p. 496)

INVITED SPEAKERS: A. Lubotzky (Jerusalem) should be added to the list of main speakers.

2–6. **Second Gauss Symposium**, Munich, Germany. (May/Jun. 1992, p. 497)

2–6. **International Symposium on the Mathematical Theory of Networks and Systems**, Regensburg, Germany. (Sep. 1992, p. 774)

2–13. **Georgia International Topology Conference**, University of Georgia, Athens, GA. (May/Jun. 1992, p. 497)

4–6. **SIAM Conference on Simulation and Computational Probability**, San Francisco, CA. (Jul./Aug. 1992, p. 632)

7–21. **Semigroups and their Applications**, York, England. (Sep. 1992, p. 774)

8–14. **Konstruktive Approximationstheorie**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

9–12. **Joint Statistical Meetings**, San Francisco, CA. (Nov. 1991, p. 1172)

9–13. **Sixth International Conference on Structural Safety and Reliability (ICOSSAR '93)**, Innsbruck, Austria. (Sep. 1992, p. 774)

13–17. **Second International Colloquium on Numerical Analysis**, Plovdiv, Bulgaria. (Dec. 1991, p. 1341)

14–17. **First Workshop on Oscillation Theory**, Plovdiv, Bulgaria. (Oct. 1992, p. 950)

15–21. **Noncommutative Algebra and Representation Theory**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

* 15–27. **XI Latin American School of Mathematics (ELAM)**, Mexico.

PROGRAM: There will be several short courses of five lectures on the following topics: topological groups, homotopy theory, topology of 4-manifolds, singularity theory, root systems and Weyl groups, representations of algebras and quantum groups.
INFORMATION: XI ELAM, Instituto de Matematicas, UNAM, Ciudad Universitaria, Mexico 04510, D.F., Mexico.

16–19. **Third SIAM Conference on Linear Algebra in Signals, Systems, and Control**, University of Washington, Seattle, WA. (Jul./Aug. 1992, p. 632)

16–20. **First European Nonlinear Oscillations Conference**, Hamburg, Germany. (Sep. 1992, p. 774)

17–20. **The Mathematical Heritage of Sir William Rowan Hamilton**, Dublin, Ireland. (May/Jun. 1992, p. 497)

17–20. **International Symposium on Statistics with Non-precise Data**, Innsbruck, Austria. (Sep. 1992, p. 774)

17–21. **Second International Conference on Finite Fields: Theory, Applications, and Algorithms**, University of Nevada, Las Vegas. (sep. 1992, p. 774)

18–22. **Fourth International Colloquium on Differential Equations**, Plovdiv, Bulgaria. (Dec. 1991, p. 1341)

22–28. **Special Complex Varieties**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

22–29. **Twenty-ninth International Congress of History of Science**, Zaragoza, Spain. (Apr. 1992, p. 352)

23–28. **International Conference on Algebra Dedicated to the Memory of M.I. Kargapolov**, Krasnoyarsk, Russia. (Jul./Aug. 1992, p. 632)

25–September 3. **Forty-ninth Biennial Session of the International Statistical Institute**, Firenze, Italy. (Nov. 1991, p. 1172)

29–September 4. **Random Graphs and Combinatorial Structures**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

30–September 3. **Inverse Problems: Principles and Applications in Geophysics, Technology, and Medicine**, Potsdam (near Berlin), Germany. (Sep. 1992, p. 774)

* 30–September 3. **Representations des Groupes et Analyse Complexe**, CIRM, Marseille, France.

ORGANIZER: M. Rais (U. de Poitiers).
INFORMATION: Centre International de Rencontres Mathematiques, Case 916, Luminy, 70, Route Leon-Lachamp, 13288 Marseille Cedex 9; tel: (91) 41.82.97.

## September 1993

5–11. **Novikov Conjectures, Index Theorems and Rigidity**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

5–11. **Nonlinear Numerical Methods and Rational Approximation**, University of Antwerp, Belgium. (Oct. 1992, p. 950)

5–12. **First World Conference on Branching Processes**, Varna, Bulgaria. (May/Jun. 1992, p. 497)

12–18. **Topologie**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

13–17. **Fourth European Software Engineering Conference**, Garmisch, Germany. (Jul./Aug. 1992, p. 632)

13–18. **Different Aspects of Differentiability**, Warsaw, Poland. (May/Jun. 1992, p. 497)

19–25. **Mathematical Game Theory**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

*20–24. **Methodes Numeriques dans la Theorie des Surfaces de Riemann**, CIRM, Marseille, France.

ORGANIZER: R. Silhol (U. de Montpellier II).
INFORMATION: Centre International de Rencontres Mathematiques, Case 916, Luminy, 70, Route Leon-Lachamp, 13288 Marseille Cedex 9; tel: (91) 41.82.97.

22–23. **Central Section**, Texas A&M University, College Station, TX.

INFORMATION: W.S. Drady, AMS, P.O. Box 6887, Providence, RI 02940.

26–October 2. **Diophantische Approximationen**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

## October 1993

3–9. **Arbeitsgemeinschaft mit Aktuellem Thema**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

17–23. **Geometrie**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

25–29. **Third SIAM Conference on Geometric Design**, Seattle, WA. (Jul./Aug. 1992, p. 632)

27–30. **Seventh International Conference on Domain Decomposition Methods**, Penn State University, State College, PA. (Oct. 1992, p. 950)

31–November 6. **Algorithmische Methoden der Diskreten Mathematik**, Oberwolfach, Federal Republic of Germany. (Mar. 1992, p. 251)

## November 1993

21–27. **Mathematische Modelle in der Biologie**, Oberwolfach, Federal Republic of Germany. (Mar. 1992, p. 251)

28–December 4. **Nonlinear Equations in Many-Particle Systems**, Oberwolfach, Federal Republic of Germany. (Mar. 1992, p. 251)

**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.**

## July 1994

*25–29. **Representation des Groupes Reductifs *p*-adiques**, CIRM, Marseille, France.

ORGANIZER: G. Henniart (U. de Paris-Sud).
INFORMATION: Centre International de Rencontres Mathematiques, Case 916, Luminy, 70, Route Leon-Lachamo, 13288 Marseille Cedex 9; tel: (91) 41.82.97.

## August 1994

3–11. **The International Congress of Mathematicans 1994**, Zürich, Switzerland. (Oct. 1992, p. 951)

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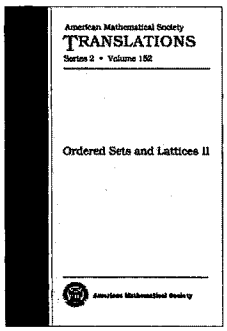


## Ordered Sets and Lattices II

Volume 152

This indispensable reference source contains a wealth of information on lattice theory. The book presents a survey of virtually everything published in the fields of partially ordered sets, semilattices, lattices, and Boolean algebras that was reviewed in *Referativnyí Zhurnal Matematika* from mid-1982 to the end of 1985. A continuation of a previous volume (the English translation of which was published by the AMS in 1989, as volume 141 in Translations—Series 2), this comprehensive work contains more than 2200 references. Many of the papers covered here were originally published in virtually inaccessible places. The compilation of the volume was directed by Milan Kolibiar of Comenius University at Bratislava and Lev A. Skornyakov of Moscow University. Of interest to mathematicians, as well as to philosophers and computer scientists in certain areas, this unique compendium is a must for any mathematical library.

### Contents

**H. Draškovičová, T. Katriňák, and M. Kolibiar**, *Distributive lattices, Boolean algebras, and related lattices*; **N. Ya. Komarnitskiĭ**, *Algebras of logic*; **T. S. Fofanova**, *General theory of lattices*; **V. I. Igoshin**, *Classes of lattices and related algebras*; **V. I. Igoshin, A. V. Mikhalev, V. N. Saliĭ, and L. A. Skornyakov**, *Concrete lattices*; **V. N. Saliĭ**, *Partially ordered sets. Semilattices. Generalizations of lattices.*

1991 *Mathematics Subject Classification*: 06A, 06B, 06D, 06E; 03G, 06C, 08B
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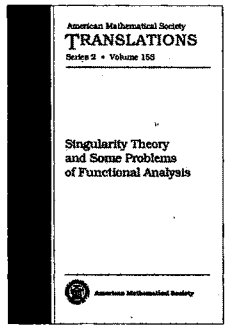


## Singularity Theory and Some Problems of Functional Analysis

S. G. Gindikin, Editor

Volume 153

The emergence of singularity theory marks the return of mathematics to the study of the simplest analytical objects: functions, graphs, curves, surfaces. The modern singularity theory for smooth mappings, which is currently undergoing intensive development, can be thought of as a crossroad where the most abstract topics (such as algebraic and differential geometry and topology, complex analysis, invariant theory, and Lie group theory) meet the most applied topics (such as dynamical systems, mathematical physics, geometrical optics, mathematical economics, and control theory). The papers in this volume include reviews of established areas as well as presentations of recent results in singularity theory. The authors have paid special attention to examples and discussion of results rather than burying the ideas in formalism, notation, and technical details. The aim is to introduce all mathematicians—as well as physicists, engineers, and other consumers of singularity theory—to the world of ideas and methods in this burgeoning area.

### Contents

**A. N. Varchenko**, *Period maps connected with a versal deformation of a critical point of a function, and the discriminant*; **V. A. Vassiliev**, *Characteristic classes of singularities*; **V. A. Vassiliev**, *Lacunas of hyperbolic partial differential operators and singularity theory*; **A. B. Givental′**, *Reflection groups in singularity theory*; **V. M. Gol′dshteĭn and V. A. Sobolev**, *Qualitative analysis of singularly perturbed systems of chemical kinetics*; **V. V. Goryunov**, *Bifurcations with symmetries*; **S. M. Guseĭn-Zade**, *Stratifications of function space and algebraic $K$-theory*; **A. A. Davydov**, *Singularities in optimization problems*; **V. M. Zakalyukin**, *Nice dimensions and their generalizations in singularity theory*; **V. M. Klimkin**, *On an inverse problem of measure theory*; **S. Ya. Novikov**, *Classes of coefficients of convergent random series in spaces $L_{p,q}$*; **Yu. I. Sapronov**, *Corner singularities and multidimensional folds in nonlinear analysis*; **A. G. Khovanskiĭ**, *Newton polyhedra (algebra and geometry).*

1991 *Mathematics Subject Classification*: 40A05, 51F15, 57N75, 57R20, 57R45, 58C27, 58G28, 92C45; 12D99, 19E99, 28A99, 32G20, 35L99, 49N99, 60B99, 92E99
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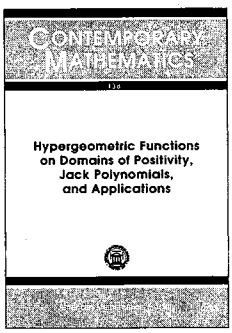
## CONTEMPORARY MATHEMATICS




### Hypergeometric Functions on Domains of Positivity, Jack Polynomials, and Applications

Donald St. P. Richards, Editor

Volume 138

This book is the first set of proceedings to be devoted entirely to the theory of hypergeometric functions defined on domains of positivity. Most of the scientific areas in which these functions are applied include analytic number theory, combinatorics, harmonic analysis, random walks, representation theory, and mathematical physics—are represented here. 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 for it contains many open problems.

#### Contents

**J. Angel, N. Celniker, S. Poulos, A. Terras, C. Trimble, and E. Velasquez,** *Special functions on finite upper half planes*; **R. J. Beerends,** *Some special values for the BC type hypergeometric function*; **N. Bergeron and A. M. Garsia,** *On certain spaces of harmonic polynomials*; **L. C. Biedenharn and J. D. Louck,** *Identities for generalized hypergeometric coefficients*; **P. Diaconis and P. Hanlon,** *Eigen analysis for some examples of the Metropolis algorithm*; **H. Ding,** *Hilbert spaces of vector-valued holomorphic functions and irreducibility of multiplier representations*; **C. F. Dunkl,** *Hankel transforms associated to finite reflection groups*; **J. Faraut,** *Prolongement analytique des series de Taylor spheriques*; **P. J. Hanlon, R. P. Stanley, and J. R. Stembridge,** *Some combinatorial aspects of the spectra of normally distributed random matrices*; **K. D. Johnson,** *Degenerate principle series on tube type domains*; **T. H. Koornwinder,** *Askey-Wilson polynomials for root systems of type BC*; **R. A. Kunze,** *Some special functions in the Fock space*; **M. Lassalle,** *Matrice de Hua et polynômes de Jack*; **Z. Yan,** *Generalized hypergeometric functions and Laguerre polynomials in two variables.*

1991 *Mathematics Subject Classification*: 33C80
ISBN 0-8218-5159-4, LC 92-26610, ISSN 0271-4132
259 pages (softcover), November 1992
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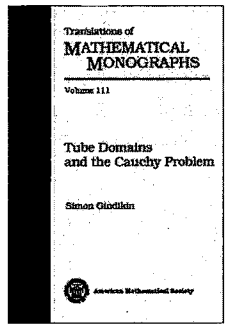
## TRANSLATIONS OF MATHEMATICAL MONOGRAPHS




### Tube Domains and the Cauchy Problem

Simon Gindikin

Volume 111

This book is dedicated to two problems. The first concerns the description of maximal exponential growth of functions or distributions for which the Cauchy problem is well posed. The description is presented in the language of the behavior of the symbol in a complex domain. The second problem concerns the structure of and explicit formulas for differential operators with large automorphism groups. It is suitable as an advanced graduate text in courses in partial differential equations and the theory of distributions.

#### Contents

*Introduction*; *The Cauchy problem in spaces of distributions with exponential estimates*; *Strongly homogeneous differential operators*; *Subject index*; *Notation index*; *References.*

1991 *Mathematics Subject Classification*: 14M17, 35D10, 35G10; 15A48, 32M10
ISBN 0-8218-4566-7, LC 92-19406, ISSN 0065-9282
132 pages (hardcover), November 1992
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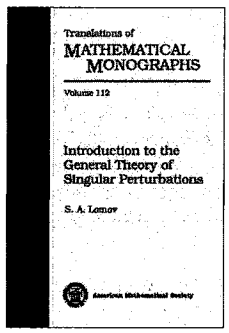


### Introduction to the General Theory of Singular Perturbations

S. A. Lomov

Volume 112

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.

#### Contents

*Introduction. General survey*; **Part I. Asymptotic integration of various problems for ordinary differential equations**: *The method of regularization of singular perturbations*; *Asymptotic integration of a boundary value problem*; *Asymptotic integration of linear integro-differential equaitons*; *Some problems with rapidly oscillating coefficients*; *Problems with an unstable spectrum*; *Singularly perturbed problems for nonlinear equations*; **Part II. Singularly perturbed partial differential equations**: *Asymptotic integration of linear parabolic equations*; *Application of the regularization method to some elliptic problems in a cylindrical domain*; *Asymptotic integration of some singularly perturbed evolution equations.*

(*continued*)

1991 *Mathematics Subject Classification*: 34-02, 34E15
ISBN 0-8218-4569-1, LC 92-26927, ISSN 0065-9282
375 pages (hardcover), November 1992
**Individual member $121**, List price $201, Institutional member $161
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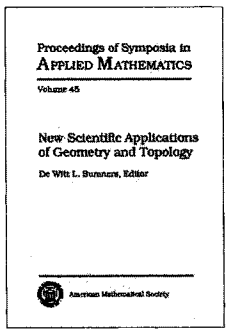
## PROCEEDINGS OF SYMPOSIA IN APPLIED MATHEMATICS




### New Scientific Applications of Geometry and Topology

De Witt L. Sumners, Editor

Volume 45

Geometry and topology are subjects generally considered to be "pure" mathematics. Recently, however, some of the methods and results in these two areas have found new utility in both wet-lab science (biology and chemistry) and theoretical physics. Conversely, science is influencing mathematics, from posing questions that call for the construction of mathematical models to exporting theoretical methods of attack on long-standing problems of mathematical interest. Based on an AMS Short Course held in January 1992, this book contains six introductory articles on these intriguing new connections. There are articles by a chemist and a biologist about mathematics, and four articles by mathematicians writing about science. All are expository and require no specific knowledge of the science and mathematics involved. Because this book communicates the excitement and utility of mathematics research at an elementary level, it is an excellent textbook in an advanced undergraduate mathematics course.

#### Contents

**N. R. Cozzarelli**, *Evolution of DNA topology: Implications for its biological roles*; **J. H. White**, *Geometry and topology of DNA and DNA-protein interactions*; **De Witt L. Sumners**, *Knot theory and DNA*; **S. G. Whittington**, *Topology of polymers*; **J. Simon**, *Knots and chemistry*; **L. H. Kauffman**, *Knots and physics*.

1991 *Mathematics Subject Classification*: 53A05, 57M25; 82B20, 82B41, 82D60, 92C40, 92E10
ISBN 0-8218-5502-6, LC 92-26335, ISSN 0160-7634
250 pages (hardcover), November 1992
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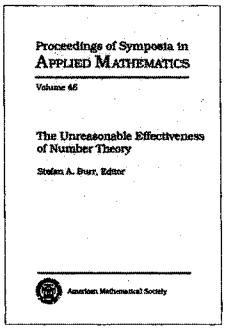


### The Unreasonable Effectiveness of Number Theory

Stefan A. Burr, Editor

Volume 46

"Number theory is one of the oldest and noblest branches of mathematics; indeed, it was already ancient in the time of Euclid. . . .for almost all of its history it has seemed to be among the purest branches of mathematics. It is only within the last few decades that a large number of applications have been encountered, at least by the mathematical community. The applications to cryptology are now famous; but it is not as well known that number theory has found an enormous number and variety of real-world applications in many different fields."
—From the Preface

This book is based on the AMS Short Course, The Unreasonable Effectiveness of Number Theory, held in Orono, Maine, in August 1991. This Short Course provided some views into the great breadth of applications of number theory outside cryptology and highlighted the power and applicability of number-theoretic ideas. Because number theory is one of the most accessible areas of mathematics, this book will appeal to a general mathematical audience as well as to researchers in other areas of science and engineering who wish to learn how number theory is being applied outside of mathematics. All of the chapters are written by leading specialists in number theory and provides excellent introduction to various applications.

#### Contents

**M. R. Schroeder**, *The unreasonable effectiveness of number theory in physics, communication, and music*; **G. E. Andrews**, *The reasonable and unreasonable effectiveness of number theory in statistical mechanics*; **J. C. Lagarias**, *Number theory and dynamical systems*; **G. Marsaglia**, *The mathematics of random number generators*; **V. Pless**, *Cyclotomy and cyclic codes*; **M. Douglas McIlroy**, *Number theory in computer graphics*.

1991 *Mathematics Subject Classification*: 11-06, 11K45, 11T71, 11Z50
ISBN 0-8218-5501-8, LC 92-24328, ISSN 0160-7634
125 pages (hardcover), November 1992
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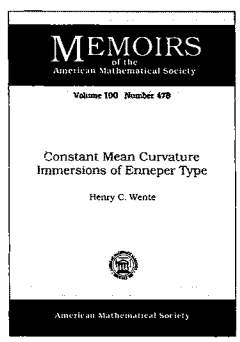
## MEMOIRS OF THE AMS




### Constant Mean Curvature Immersions of Enneper Type

Henry C. Wente

Volume 100, Number 478

This work is devoted to the case of constant mean curvature surfaces immersed in $R^3$ (or, more generally, in spaces of constant curvature). Wente reduces this geometrical problem to finding certain integrable solutions to the Gauss equation. Many new and interesting examples are presented, including immersed cylinders in $R^3$ with embedded Delaunay ends and $n$-lobes in the middle, and one-parameter families of immersed cmc tori in $R^3$. Finally, Wente examines minimal surfaces in hyperbolic three-space, which is in some ways the most complicated case.

#### Contents

*Introduction*; *The differential geometry*; *$H = 1/2$ immersions in $R^3$*; *Minimal surfaces in $R^3$*; *Minimal surfaces in $H^3$*; *Illustrations*; *Bibliography*.

1991 *Mathematics Subject Classification*: 53A10
ISBN 0-8218-2536-4, LC 92-28574, ISSN 0065-9266
77 pages (softcover), November 1992
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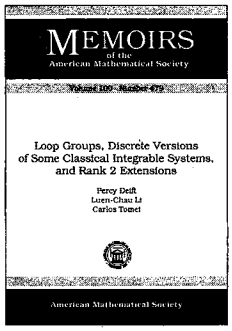


## Loop Groups, Discrete Versions of Some Classical Integrable Systems, and Rank 2 Extensions

Percy Deift, Luen-Chau Li, and Carlos Tomei

Volume 100, Number 479

The theory of classical $R$-matrices provides a unified approach to the understanding of most, if not all, known integrable systems. This work, which is suitable as a graduate textbook in the modern theory of integrable systems, presents an exposition of $R$-matrix theory by means of examples, some old, some new. In particular, the authors construct continuous versions of a variety of discrete systems of the type introduced recently by Moser and Vesclov. In the framework the authors establish, these discrete systems appear as time-one maps of integrable Hamiltonian flows on co-adjoint orbits of appropriate loop groups, which are in turn constructed from more primitive loop groups by means of classical $R$-matrix theory. Examples include the discrete Euler-Arnold top and the billiard ball problem in an elliptical region in $n$ dimensions. Earlier results of Moser on rank 2 extensions of a fixed matrix can be incorporated into this framework, which implies in particular that many well-known integrable systems—such as the Neumann system, periodic Toda, geodesic flow on an ellipsoid, etc.—can also be analyzed by this method.

### Contents

*Introduction*; *The discrete Euler-Arnold equation* (I); *The discrete Euler-Arnold equation* (II); *Billiards in an elliptical region*; *Loop groups and rank* 2 *extensions*; *Appendix*: *Classical R-matrix theory*.

1991 *Mathematics Subject Classification*: 34, 70, 15
ISBN 0-8218-2540-2, LC 92-28571, ISSN 0065-9266
101 pages (softcover), November 1992
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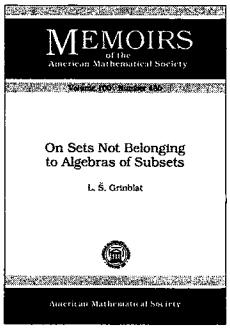


## On Sets Not Belonging to Algebras of Subsets

L. Š. Grinblat

Volume 100, Number 480

The main results of this work can be formulated in such an elementary way that it is likely to attract mathematicians from a broad spectrum of specialties, though its main audience will likely be combintorialists, set-theorists, and topologists. The central question is this: Suppose one is given an at most countable family of algebras of subsets of some fixed set such that, for each algebra, there exists at least one set that is not a member of that algebra. Can one then assert that there is a set that is not a member of *any* of the algebras? Although such a set clearly exists in the case of one or two algebras, it is very easy to construct an example of three algebras for which no such set can be found. Grinblat's principal concern is to determine conditions that, if imposed on the algebras, will insure the existence of a set not belonging to any of them. If the given family of algebras is finite, one arrives at a purely combinatorial problem for a finite set of ultrafilters. If the family is countably infinite, however, one needs not only combinatorics of ultrafilters but also set theory and general topology.

### Contents

*Introduction*; *Main results*; *Fundamental idea*; *Finite sequences of algebras* (1); *Countable sequences of algebras* (1); *Proof of Theorem* II; *Improvement of Theorem* II (*Proof of Theorem* II*); *Proof of Theorems* III *and* IV; *The inverse problem*; *Finite sequences of algebras* (2); *Countable sequences of algebras* (2); *Improvement of some main results*; *Sets not belonging to semi-lattices of subsets and not belonging to lattices of subsets*; *Unsolved problems*; *References*.

1991 *Mathematics Subject Classification*: 03E05, 04A20, 28A05, 54D35
ISBN 0-8218-2541-0, LC 92-28572, ISSN 0065-9266
111 pages (softcover), November 1992
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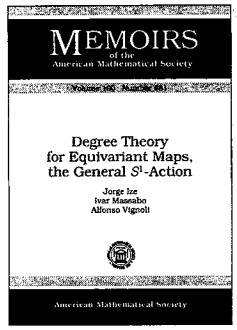


## Degree Theory for Equivariant Maps, the General $S^1$-Action

Jorge Ize, Ivar Massabo, and Alfonso Vignoli

Volume 100, Number 481

This work is devoted to a detailed study of the equivariant degree and its applications for the case of an $S^1$-action. This degree is an element of the equivariant homotopy group of spheres, which are computed in a step-by-step extension process. Applications include the index of an isolated orbit, branching and Hopf bifurcation, and period doubling and symmetry breaking for systems of autonomous differential equations. The authors have paid special attention to making the text as self-contained as possible, so that the only background required is some familiarity with the basic ideas of homotopy theory and of Floquet theory in differential equations. Illustrating in a natural way the interplay between topology and analysis, this book will be of interest to researchers and graduate students.

### Contents

*Introduction*; *Preliminaries*; *Extensions of $S^1$-maps*; *Homotopy groups of $S^1$-maps*; *Degree of $S^1$-maps*; *$S^1$-index of an isolated non-stationary orbit and applications*; *Index of an isolated orbit of stationary solutions and applications*; *Virtual periods and orbit index*; *Appendix*: *Additivity up to one suspension*; *References*.

1991 *Mathematics Subject Classification*: 58B05; 34C25, 47H15, 54F45, 55Q91, 58E09
ISBN 0-8218-2542-9, LC 92-28573, ISSN 0065-9266
179 pages (softcover), November 1992
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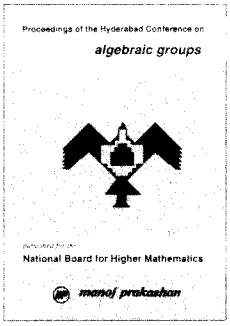
## MISCELLANEOUS




### Proceedings of the Hyderabad Conference on Algebraic Groups

S. Ramanan, Editor

In December 1989, a Conference on Algebraic Groups and Applications was held at the University of Hyderabad in India. Bringing together some of the world's leading experts in this area, the conference covered a variety of topics in algebraic groups. Some current research results are presented here, but the primary focus of the volume is on survey lectures, making it useful for students and experts alike. This volume was published for the National Board for Higher Mathematics by Manoj Prakashan and is distributed by the AMS worldwide except in India. Orders from India should be sent to Manoj Prakashan, (Thiru Complex), 44/2 Pantheon Road, Madras-600 008 India.

**Contents**

**A. Borel**, *The work of Chevalley in Lie groups and algebraic groups*; **J. B. Carrell**, *Vector fields, flag varieties and Schubert calculus*; **R. W. Carter**, *Deligne-Lusztig theory and block theory*; **V. Chari and A. Pressley**, *Introduction to quantum groups*; **S. Doty**, *Symmetric algebra and representations of general linear groups*; **A. G. Helminck**, *On groups with a Cartan involution*; **J. E. Humphreys**, *Cohomology of line bundles on flag varieties in positive characteristic*; **T. Józefiak**, *Schur Q-functions and applications*; **F. Knop**, *The Luna-Vust theory of spherical embeddings*; **H. Kraft**, *Algebraic automorphisms of affine spaces*; **S. Kumar**, *Proof of Wahl's conjecture and surjectivity of Gaussian map for flag varieties*; **V. Lakshmibai and C. S. Seshadri**, *Standard monomial theory*; **A. Lascoux**, *Cyclic permutations on words, tableaux and harmonic polynomials*; **A. O. Morris**, *Projective representations of Weyl groups*; **C. Musili**, *Applications of standard monomial theory*; **T. Oda**, *Geometry of toric varieties*; **B. J. Parshall**, *Quasi-hereditary algebras in representation theory*; **M. S. Raghunathan**, *The congruence subgroup problem*; **K. N. Rajeswari**, *Standard monomial-theoretic proof of PRV conjecture*; **G. Schwarz**, *Differential operators and orbit spaces*; **T. A. Springer**, *On representations of Weyl groups*; **B. Srinivasan**, *Representations of finite groups of Lie type*.

1991 *Mathematics Subject Classification*: 20, 22
ISBN 81-231-0090-6
546 pages (hardcover), May 1991
**Individual member $36**, List price $60, Institutional member $48
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## ERRATUM

The number of pages for the *Combined Membership List* was incorrectly reported in the October *Notices*. The correct number of pages is 592.

# AMS Reports and Communications

## Recent Appointments

Committee members' terms of office on standing committees expire on January 31 following the year given in parentheses following their names, unless otherwise specified.

Nancy Anderson (1993), Keith J. Devlin (1992), John M. Franks (1994), Maria M. Klawe (1994), Frank S. Quinn (1993), David Rodgers, consultant, and William B. Woolf (ex officio) have been appointed to the *Electronic Publications Committee* by President Michael Artin. Professor Franks has been appointed chair.

Michael Artin (ex officio), Sheldon Axler, John S. Bradley, consultant, H. Hope Daly, consultant, John H. Ewing, Robert M. Fossum (ex officio), John M. Franks, Judy Green, William H. Jaco (ex officio), Haynes R. Miller, Richard S. Palais, John C. Polking, Samuel M. Rankin III, Hugo Rossi, Carol S. Wood, and William B. Woolf, consultant, have been appointed to an ad hoc *Committee to Review Member Publications* by President Michael Artin. Professor Rossi will serve as chair.

President Michael Artin has appointed Sheldon Axler, M. Susan Montgomery, Samuel M. Rankin III, and Jeremy Soldevilla to an ad hoc *Committee on Copyright Policy*.

R. Keith Dennis (1994) has been appointed to the *Library Committee* by President Michael Artin. Continuing members of the committee are Nancy Anderson (1994), co-chair, Richard A. Askey (1993), Robert S. Doran (1993), Dorothy McGarry (1994), James Rovnyak (1994), co-chair, Mary Ann Southern (1994), and Jack Weigel (1993).

Harvey B. Keynes, Paul J. Sally, Jr., and Jean E. Taylor have been appointed to an ad hoc *Arnold Ross Lecture Series Committee* by President Michael Artin. Professor Sally will serve as chair.

President Michael Artin has appointed Lenore Blum, H. Hope Daly, consultant, Robert M. Fossum (ex officio), Andy Roy Magid, Nancy K. Stanton, and Ruth J. Williams to an ad hoc *Meetings Committee*. Professor Magid will serve as chair.

Michael Artin (ex officio), William H. Jaco (ex officio), Robert D. MacPherson, Cathleen S. Morawetz, John C. Polking, Linda Preiss Rothschild, and Daniel Strook have been appointed by President Michael Artin to an ad hoc *Advisory Committee on Former Soviet Union Mathematics*. Professor Artin will serve as chair.

President Michael Artin appointed Murray Gerstenhaber, Frank L. Gilfeather, Judy Green, Linda Keen, and Elliott H. Lieb to an ad hoc *Advisory Committee on Professional Ethics*. Professor Keen will serve as chair.

H. Jerome Keisler (1994), Peter Sarnak (1994), Birgit Speh (1994), and Lai-Sang Young (1994) have been appointed by President Michael Artin to the *Centennial Fellowship Committee*. Henry Pinkham (1993) has been appointed chair. Continuing members of the committee are Richard M. Hain (1993) and Douglas A. Lind (1993). Terms expire on June 30.

President Michael Artin has appointed Eugenio Calabi (1995), Robert P. Langlands (1995), and Paul Rabinowitz (1995) to the *Committee to Select the Winner of the Steele Prize*. Sylvain E. Cappell (1993) has been appointed chair. Continuing members of the committee are Vaughn F. R. Jones (1994), Harry Kesten (1993), Joseph J. Kohn (1993), Jane Cronin Scanlon (1994), and Jean E. Taylor (1994). Terms expire on June 30.

Brian Parshall (1993) has been reappointed to the *Committee on Summer Institutes and Special Symposia* and as chair by President Michael Artin. Continuing members of the committee are Donald L. Burkholder (1995), Lawrence Craig Evans (1994), Melvin Hochster (1995), Nicholas Katz (1993), François Trèves (1993), and Edward Witten (1994). Terms expire on February 28.

Alan F. Karr (AMS, 1996) and Sue Whitesides (AMS, 1996) have been appointed by President Michael Artin to the AMS-IMS-SIAM *Committee on Joint Summer Research Conferences*. Fan R. K. Chung (AMS, 1993) has been appointed chair. Continuing members of the Committee are John A. Burns (SIAM, 1992), Leonard Evens (AMS, 1993), Martin Golubitsky (SIAM, 1992), Peter W. K. Li (AMS, 1993), Stewart B. Priddy (AMS, 1994), Robert J. Serfling (IMS, 1993), and Michael Shub (AMS, 1994). Terms expire on June 30.

Constantine M. Dafermos (1996) has been reappointed as representative to the *U.S. National Committee on Theoretical and Applied Mechanics* by President Michael Artin. The term expires on October 31.

# Miscellaneous

## Personals

**Rosanne M. de Vera**, of Electronic Data Systems, received the Math Service Award from St. Louis University in May 1992.

**Józef Ignaczak**, of the Rochester Institute of Technology, has received a National Science Foundation grant for 1992–1995 to conduct research on thermoelasticity under a U.S.-Poland Cooperative Science Program.

**David A. Sanchez**, formerly Assistant Director for Mathematical and Physical Sciences at the National Science Foundation, has taken a position as Deputy Associate Director for Research and Education at Los Alamos National Laboratories.

**Doris S. Stockton**, of the University of Massachusetts, has been promoted to Professor at that institution.

## Deaths

**Charles R. Deprima**, Professor Emeritus of the California Institute of Technology, died on November 10, 1991, at the age of 73. He was a member of the Society for 51 years.

**F. Edward Ehlers**, of Seattle, Washington, died on July 13, 1992, at the age of 75. He was a member of the Society for 44 years.

**Lyman C. Knight**, Professor Emeritus of Muskingum College, died on December 20, 1991, at the age of 76. He was a member of the Society for 46 years.

**Charles J. Lewis**, of Georgian Court College, died on December 21, 1991, at the age of 74. He was a member of the AMS for 39 years.

**Wen Gui Luan**, of Academia Sinica, died on January 22, 1992, at the age of 55. He was a member of the Society for 7 years.

**Alan H. Mekler**, of Simon Fraser University, died on June 10, 1992, at the age of 44. He was a member of the Society for 12 years.

**Fouad Mohamed**, of Texas Tech University, died on August 2, 1992, at the age of 41. He was a member of the Society for 4 years.

**Hans J. Reiter**, Professor Emeritus of Vienna University, died on August 13, 1992, at the age of 70. He was a member of the Society for 45 years.

**Benjamin T. Sims**, of Eastern Washington University, died on September 12, 1992, at the age of 57. He was a member of the Society for 31 years.

## Visiting Mathematicians

*Supplementary List*

Mathematicians visiting other institutions during the 1991–1992 academic year have been listed in recent issues of the *Notices*: May/June 1992, p. 519–521; July/August 1992, p. 640–641; and October 1992, p. 960.

**Flavio Coelho**, (Brazil), Université de Sherbrooke, Algebra, 8/92–2/93.

**Miroslav Husek**, (Czechoslovakia), University of Toledo, Topology, 9/92–6/93.

**Marie Huskova**, (Czechoslovakia), University of Toledo, Statistics, 9/92–6/93.

**Xie Xu Kai**, (People's Republic of China), Appalachian State University, Control Theory, 9/92–8/93.

**Donald A. Lutz**, (U.S.A.), Ordinary Differential Equations in the Complex Domain, University of Essen (Germany), 9/92–2/93; Universität Ulm (Germany), 3/93–7/93.

**Van Hien Nguyen**, (Belgium), Université de Sherbrooke, Optimization, 1/93–5/93.

**Wim Vervaat**, (Netherlands), York University, Probability, 9/92–12/92.

# New Members of the AMS

## ORDINARY MEMBERS

Bahram Alidaee, West Texas State Univ, Canyon
Susan Elise Allen, Enumclaw, WA
Steven D Antinucci, New York, NY
Justin Ronald Appel, Shepherd, MT
David Assaf IV, Rhodes College, Memphis, TN
Charles A Atkins, Charleston, SC
Christina L Baker, Jefferson, MD
Junhwa Ban, Seoul National Univ, Korea
Britt W Barrett, Sierra Vista, AZ
Kathryn L Barta, St Louis, MO
David S Beach, Chanute, KS
Thomas J Becvar, Elgin, IL
Michael J Belanger, Portland, MI
Joe Bellizzi, Moreno Valley, CA
Felix Luis Belzunce Torregrosa, Murcia, Spain
William R Bennett, Tucson, AZ
Lawrence Alan Berk, Gaithersburg, MD
Daniel J Bernstein, COU, Emeryville, CA
Manjul Bhargava, Bethpage, NY
Anne Bourlioux, Univ of California Berkeley
Robert E Bowers, Gates Energy Products, Warrensburg, MO
Don R Brown, Sacramento, CA
Thomas Albert Bryan, Goleta, CA
Andris A Buikis, Latvian Academy of Sciences, Riga
Kenneth Robert Burkett, Philadelphia, PA
Robert L Butler, San Diego, CA
Jonathan Russell Caforio, Elmhurst, IL
Amos Joel Carpenter, Butler Univ, Indianapolis, IN
Roseann Y Casciato, Pittsburgh, PA
Karyn Jean Chambers, Grosse Pointe, MI
Bhavna Chaudhary, Fremont, CA
John O Cheeseborough, Syracuse, NY
Jui-Jung Chen, Univ of Utah, Salt Lake City
Alessandra O P Chiareli, Northwestern Univ, Evanston, IL
Sungwoo Choi, Seoul National Univ, Korea
Lee R Clendenning Jr, Gainesville Junior College, GA
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**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 1992 RATE IS** $60 per inch on a single column (one-inch minimum), calculated from the top of the type; $30 for each additional ½ 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 ½ inch rate. Ads will appear in the language in which they are submitted.

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**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 for further information.

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## POSITIONS AVAILABLE

## ARIZONA

**UNIVERSITY OF ARIZONA**
**Department of Mathematics**
**Tucson, AZ 85721**

The Mathematics Department at the University of Arizona will have tenure-track and postdoctoral positions available beginning Fall 1993.

**Tenure-track positions**. Excellent research record or potential, strong commitment to teaching required. Fields should complement but not duplicate existing department research strengths in arithmetic geometry, computational science, dynamical systems, differential geometry, nonlinear science, and number theory.

**Postdoctoral Fellowships** (Research Associates). Applicants with strengths in all areas compatible with department interests are encouraged to respond. In addition, special Center of Excellence Awards in nonlinear optics and fluid mechanics are available.

The Mathematics Department may also have several *visiting positions* for next year.

We encourage early application. **Deadline** date will be **December 15, 1992**, or whenever positions are filled. *Women and minority applicants are especially welcome.* Send application, which should include a letter of interest, curriculum vitae with a list of publications, and a minimum of three (3) letters of recommendation (enclose or arrange to be sent) to:

Personnel Committee
Department of Mathematics
University of Arizona
Tucson, Arizona 85721, U.S.A.

The University of Arizona is an Affirmative Action/Equal Opportunity Employer.

## CALIFORNIA

**BROOKS/COLE PUBLISHING**

Applications are invited for Associate Technical Editor. The Associate Technical Editor is directly involved in the acquisition, production, marketing, and support of technology based products. Applicants must have experience in developing and using software in college instruction. Address application to Director of Electronic Publishing, 511 Forest Lodge Road, Pacific Grove, CA 93950. Applications may also be sent to d2248@applelink.apple.com. To be considered applications must be received before December 15, 1992. AA/EOE

**HARVEY MUDD COLLEGE**
**Department of Mathematics**
**Claremont, CA 91711**

The Mathematics Department of Harvey Mudd College solicits applicants for a tenure-track Assistant Professorship in an area bridging mathematics and computer science. A strong commitment to and promise of excellence in teaching are essential. Applicants should be active in a research area such as Parallel or Combinatorial Algorithms, Numerical Analysis and Algorithms, Automated Reasoning, or Computational Geometry. Applicants must be able to teach broadly within mathematics and the mathematical aspects of computer science and to work well with others in developing departmental programs.

Harvey Mudd College is a highly selective undergraduate institution. Our students major in mathematics, computer science, biology, chemistry, engineering, or physics. A one-year course in calculus is a prerequisite for admission to the college. Ph.D. degrees have been earned by 40.7% of the college's pre-1980 graduates, the highest percentage in the nation. The college has an enrollment of 630 and is associated with four other undergraduate colleges and a graduate school in Claremont, forming an academic community of about 5,000 students. The College has 12 mathematics faculty and the Claremont Colleges combined have a total of 48 Mathematics and Computer Science faculty. An excellent network of modern computer workstations is available.

Harvey Mudd College is an affirmative action, equal opportunity employer. Minority and women candidates are especially encouraged to apply. Preference will be given to applications received by January 10, 1993. Applicants should send a curriculum vitae, a description of their research, and arrange to have three letters of reference sent directly to:

Search Committee
Department of Mathematics
Harvey Mudd College
Claremont, CA 91711

**STANFORD UNIVERSITY**
**Department of Mathematics**

The department expects to make at least one tenure-track or tenured appointment beginning September 1993, among the following fields: (1) analysis, (2) geometry or topology, (3) algebra, number theory, or logic, (4) applied mathematics or probability; in the last case there are also possibilities for joint appointments with other departments. At the tenured level, preference would go to individuals in the earlier years of their ranks, though a more senior appointment may be possible for an extremely well-qualified individual.

Candidates should send a letter of application and a curriculum vitae with a list of publications, and arrange to have three letters of recommendation and some evidence of commitment to excellence in teaching sent to Prof. Ralph L. Cohen, Department of Mathematics, Stanford University, Stanford, CA 94305-2125 by January 1, 1993.

Stanford is an Equal Opportunity, Affirmative Action Employer, and welcomes applications from women and minorities.

**STANFORD UNIVERSITY**
**Department of Mathematics**
**Assistant Professorships**
**in honor of Gabor Szego**

The department expects to make one or more appointments in 1993-94 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, Chairman, Department of Mathematics, Stanford University, Stanford, CA 94305-2125, by January 1, 1993. Stanford is an Affirmative Action, Equal Opportunity Employer, and welcomes applications from women and minorities.

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**UNIVERSITY OF CALIFORNIA**
**AT BERKELEY**
**Department of Mathematics**
**Berkeley, CA 94720**
**Charles B. Morrey Jr.**
**Assistant Professorships**

We invite applications for these special two-year (nontenure-track) positions effective July 1, 1993. Applications 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, 1993. Applications submitted after the deadline will not be considered. The University of California is an Equal Opportunity, Affirmative Action Employer.

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**UNIVERSITY OF CALIFORNIA**
**AT BERKELEY**
**Department of Mathematics**
**Berkeley, CA 94720**
**Temporary Postdoctoral Positions**

Several temporary positions beginning in Fall 1993 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, 1993. Applications submitted after the deadline will not be considered. The University of California is an Equal Opportunity, Affirmative Action Employer.

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**UNIVERSITY OF CALIFORNIA**
**AT BERKELEY**
**Department of Mathematics**
**Berkeley, CA 94720**
**Tenured Position**

We invite applications for one or more positions effective July 1, 1993, at tenure level (Associate or Full Professor) subject to budgetary approval, in the areas of algebra, analysis, applied mathematics, foundations, or geometry and topology. Demonstrated leadership in research is expected of applicants. Applicants should send a 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, 1993. Applications received after the deadline will not be considered. The University of California is an Equal Opportunity, Affirmative Action Employer.

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**UNIVERSITY OF CALIFORNIA**
**AT BERKELEY**
**Department of Mathematics**
**Berkeley, CA 94720**
**Assistant Professorships**

We invite applications for one or more positions effective July 1, 1993, at the tenure-track Assistant Professor level, subject to budgetary approval, in the areas of algebra, analysis, applied mathematics, foundations, or geometry and topology. Applicants are expected to have demonstrated outstanding research potential, normally including major contributions beyond the doctoral dissertation. 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. We should receive this material no later than January 15, 1993. Applications received after the deadline will not be considered. The University of California is an Equal Opportunity, Affirmative Action Employer.

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**UNIVERSITY OF CALIFORNIA, DAVIS**
**Research Assistant Professor**
**Positions in Mathematics**

Applications are invited for several research assistant professorships in mathematics at the University of California, Davis, effective July 1, 1993. Appointments will be made at a salary commensurate with qualifications. These appointments are for one year and renewable up to two times. Qualifications include a Ph.D. and an outstanding record or great promise in teaching and research. Duties include undergraduate and graduate teaching and mathematical research. The teaching load is five quarter courses per year, and may include one advanced course in the candidate's field.

*The postmarked deadline for applications is February 19, 1993.* An application consists of a curriculum vitae, list of publications, and at least three letters of reference sent to

Chair of Search Committee
Department of Mathematics
University of California
Davis, California 95616-8633

The University of California is an equal opportunity/affirmative action employer with a strong institutional commitment to the achievement of diversity among its faculty and staff. In that spirit, we are particularly interested in receiving applications from persons of underrepresented groups including women, ethnic minorities, disabled veterans, and handicapped persons.

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**UNIVERSITY OF CALIFORNIA,**
**LOS ANGELES**
**Department of Mathematics**

TEMPORARY POSITIONS

Subject to availability of resources and administrative approval:

(1) Two E. R. Hedrick Assistant Professorships. 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, 1993.

(2) Several 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 applications completed by January 1, 1993.

(3) One or two Adjunct Assistant Professorships in the Program in Computing (PIC). Applicants 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. Preference will be given to applications completed by February 1, 1993.

(4) A Lectureship in the Program in Computing (PIC). Applicants 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 times, 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, 1993.

(5) A few Adjunct Assistant Professorships. One year appointments, probably renewable once. Strong research and teaching background required. Salary $35,900–$40,500. Teaching load: five quarter courses per year.

(6) Several 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.

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**UNIVERSITY OF CALIFORNIA, LOS ANGELES**
**Department of Mathematics**

REGULAR POSITIONS IN PURE AND APPLIED MATHEMATICS

Subject to availability of resources and administrative approval, one regular position in pure and applied mathematics. The six specific search areas are as follows: 1) statistics; 2) applied and computational mathematics; 3) logic and mathematical computer science; 4) geometry and topology (including dynamical systems and geometric partial differential equations; 5) analysis and differential equations (including mathematical physics); 6) algebra, number theory and combinatorics (including algebraic geometry and representations). Very strong promise in research and teaching required. Positions initially budgeted at the assistant professor level. Sufficiently outstanding candidates at higher levels will also be considered. Teaching load: averaging 1.5 courses per quarter, or 4.5 quarter courses per year. 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.

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**UNIVERSITY OF SOUTHERN CALIFORNIA**
**Los Angeles, California**

The Department of Mathematics has available several tenure-track or 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. The Department of Mathematics also seeks to fill at least one tenured position at the senior level. Successful applicants will have an outstanding record of mathematical research and scholarship, and proven administrative skills for academic leadership. 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 email 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.

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**UNIVERSITY OF SOUTHERN CALIFORNIA**
**Los Angeles, California**

The Mathematics Department at the University of Southern California seeks nominations and applications for the Herbert and Ruth Busemann Assistant Professorship starting in the academic year 1993. The Assistant Professorship has been established for young mathematicians specializing in geometry and will be awarded to recent Ph.D.s with outstanding scholarship. Special consideration will be given to those who have demonstrated in their work geometric insight and ingenuity, over and above the technical expertise and broad knowledge of the field that is usually expected.

Appointments will be made for a term of three years and will be renewable only in exceptional circumstances. Nominations and applications should be addressed to: Chairman, Department of Mathematics MC 1113, University of Southern California, Los Angeles, CA 90089-1113. The University of Southern California is an Equal Opportunity/Affirmative Action employer.

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## FLORIDA

**NEW COLLEGE OF USF**

**New College of USF**, the honors college of the State University System of Florida, has a tenure track position in Mathematics starting Fall 1993, pending budgetary approval. A Ph.D. in Mathematics is required. Duties consist of two classes per semester, plus individual or group tutorials and supervising senior theses (these are required for all students). New College is a small, highly selective liberal arts college with a student/faculty ratio of 11:1. New College students have among the highest public-college SAT scores in the nation. New College is also listed as second in *Money Guide: Best College Buys*, 1992/93 edition. New College has a system of contracts and written evaluations rather than grades. Submit application by December 31, 1992 with vita, three letters of recommendation, and a statement on your teaching philosophy to Prof. David Mullins, Division of Natural Sciences, New College, 5700 N. Tamiami Trail, Sarasota, FL 34243-2197. New College of the University of South Florida is an EOE/AA/ADA employer.

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**UNIVERSITY OF CENTRAL FLORIDA**
**Department of Mathematics**

Applications are invited for at least one tenured track position at Full, Associate, or Assistant Professor level beginning August 1993. A Ph.D. degree, a strong research record, dedication to teaching, and a proven ability to generate external grants are required for appointment at Full or Associate Professor level. Candidates with substantial completion of Ph.D. requirements with a strong teaching and research potential will be considered for the Assistant Professor level. These appointments will be made preferably in the areas of abstract algebra, graph theory and combinatorics, numerical analysis, computational mathematics, differential and integral equations, measure theory and probability, mathematical statistics, real or functional analysis, or applied mathematics. However, other areas of specialization may be considered provided there are no strong candidates with the preferred research areas. Candidates should send a detailed resume and arrange for at least three letters of recommendation and a transcript to be sent to: Dr. Lokenath Debnath, Chair, c/o Search Committee, Department of Mathematics, University of Central Florida, P.O. Box 161364, Orlando, Florida 32816-1364, postmarked by December 2, 1992.

The University is an equal opportunity affirmative action employer. As an agency of the State of Florida, UCF makes all application materials and selection procedures available for public review.

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**UNIVERSITY OF FLORIDA**
**Department of Mathematics**

We invite applications for three tenured or tenure-track appointments in mathematics, effective August 1993. In the case of junior candidates, preference will be given to applicants with postdoctoral experience who have made substantial research contributions beyond the doctoral dissertation. Senior candidates are expected to have demonstrated leadership in research. Applicants should forward a curriculum vitae, a list of publications, and a small number of reprints and/or preprints to

Chair of Search Committee
Department of Mathematics
University of Florida
Gainesville, FL 32611-2082

Candidates should supply evidence of commitment to teaching and arrange for at least three letters of recommendation to be forwarded.

UF is an Affirmative Action Employer, and the Department especially welcomes applications from women and minority candidates. Full consideration will be given to candidates whose materials arrive by December 31, 1992.

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## GEORGIA

**EMORY UNIVERSITY**
**Department of Mathematics and Computer Science**

The Department of Mathematics and Computer Science, Emory University, invites applications for two anticipated tenure track Assistant Professorships for 1993-94.

Applicants must have a Ph.D. in Mathematics, with a promising research program centered in Algebra or Topology. As the department offers several undergraduate programs within Emory College, and the Ph.D. in Mathematics, applicants are expected to have strong records, or promise, as undergraduate and graduate teachers.

Applicants should send their CV's (including at least three recommenders' names) and 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 1993. Emory University is an Affirmative Action/Equal Opportunity Employer.

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**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 1993. 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.

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**GEORGIA INSTITUTE OF TECHNOLOGY**

The Center for Dynamical Systems and Nonlinear Studies expects to have some long- and short-term visiting positions beginning Fall 1993. These positions are in nonlinear differential equations, dynamical systems, computational methods and related areas. In addition to a resume and at least three letters of reference, candidates should send a summary of future research plans to Professor Jack K. Hale, Director, CDSNS, Georgia Institute of Technology, Atlanta, GA 30332-0190. Deadline for applications: postmarked no later than 2/15/93. Georgia Tech, a member of the University System of Georgia, is an Equal Opportunity/Affirmative Action Employer.

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## HAWAII

**UNIVERSITY OF HAWAII**
**Department of Mathematics**

One or more tenure-track/visiting professorships possible for fall 1993, pending clearance and availability of funds. The ranks for these positions are open. Minimum qualifications include a Ph.D. in mathematics, a commitment to research and teaching, and achievement appropriate to rank. Preference will be given to those applicants whose specialties blend well with those already represented in the department. Applicants should send a detailed resume, and have 3 confidential letters of recommendation sent to R. R. Colby, Chairman, Dept. of Mathematics, University of Hawaii, Honolulu, HI 96822. Applications and letters of reference must be postmarked by 12/24/92 to be guaranteed full consideration. EOE/AA Employer.

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## ILLINOIS

**BRADLEY UNIVERSITY**

Applications are invited for one or more tenure-track positions at the rank of Assistant Professor beginning August 1993. Candidates should have a strong commitment to undergraduate teaching. The Ph.D. in mathematics is required, and continuing professional growth (publication) is required for tenure and advancement. Preference will be given to applicants in the fields of dynamical systems, numerical analysis, or ring theory. Salary is competitive. The closing date is January 18, 1993, or until the position is filled. Send letter of application, vita, copy of graduate transcript, description of research, and three or more letters of recommendation (at least one of which addresses teaching ability and one scholarly activity) to: Dr. T. V. Sastry, Search Committee, Department of Mathematics, Bradley University, Peoria, IL 61625. Bradley University gives preference in hiring to U.S. Citizens, permanent residents, and aliens authorized to work in the U.S. Bradley University is an affirmative-action/equal-opportunity, employer.

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**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 1993. 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 fostering 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. C. Robinson, Chair, Personnel Committee, Department of Mathematics, Northwestern University, Evanston, Illinois 60208-2730. Alternatively, applications and supporting documentation can be sent via email to "hiring@math.nwu.edu". In order to receive full consideration, applications should be received by January 1, 1993. Hiring is contingent upon eligibility to work in the United States.

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**NORTHWESTERN UNIVERSITY**
**Mathematics Department**
**2033 Sheridan Road**
**Evanston, Illinois 60208-2730**

The Mathematics Department will sponsor an Emphasis Year in probability and stochastic analysis. This program will include two-year assistant professorship positions starting September 1993 and possible visiting positions for more senior mathematicians for part or all of the academic year. Applications should be sent to Professor Mark A. Pinsky at the department address and include a curriculum vitae and three letters of recommendation. In order to ensure full consideration, an application must be received by January 1, 1993. Northwestern University is an affirmative action, equal opportunity employer committed to fostering a diverse faculty; women and minority candidates are especially encouraged to apply. Hiring is contingent upon eligibility to work in the United States.

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**SOUTHERN ILLINOIS UNIVERSITY**
**AT CARBONDALE**
**Carbondale, IL 62901**
**Department of Mathematics**
**Numerical Analysis Position**

Applications are invited from qualified candidates for a tenure-track position at the assistant professor level beginning on August 16, 1992. 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, 1992 or until the position is filled. SIUC IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER. Women and minorities are particularly encouraged to apply.

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**SOUTHERN ILLINOIS UNIVERSITY**
**AT CARBONDALE**
**Carbondale, IL 62901**
**Department of Mathematics**
**Statistics Position**

Applications are invited from qualified candidates for a tenure-track position at the assistant professor level beginning on August 16, 1993. Ph.D. in statistics or in mathematics with a concentration in statistics is required. Preference is for mathematical statistics and statistical inference with interest in applications. 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:

Statistics
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, 1992 or until the position is filled. SIUC

IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER. Women and minorities are particularly encouraged to apply.

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**UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN**
**Department of Mathematics**

Applications are invited for the following positions commencing August 1993: 1) one or more assistant professor tenure-track faculty positions, 2) one rank open faculty position. We are particularly interested in hiring in the areas of applied mathematics, combinatorics, optimization, partial differential equations, and probability. Outstanding candidates in all fields of mathematics are encouraged to apply and will be seriously considered. Some visiting appointments for the 1993-94 academic year are also anticipated. Salary and teaching load are competitive. Candidates 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

Gerald J. Janusz, Chair
Department of Mathematics
University of Illinois at
Urbana-Champaign
1409 W. Green St.
Urbana, Illinois 61801
tel. (217)333-3352
email: search@symcom.math.uiuc.edu.

In order to ensure full consideration, all application materials including letters of reference should be received by December 7, 1992. Interviews may be conducted prior to December 7, 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.

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## INDIANA

**BUTLER UNIVERSITY**
**Department of Mathematics and Computer Science**

A tenure-track Assistant Professor position teaching courses in our undergraduate mathematics and computer science majors is available beginning Fall 1993. Must have a Ph.D. in one of Mathematics or Computer Science, and a Master's in the other. Responsibilities include a nine-hour teaching assignment per semester and research. Academic computing facilities include a cluster of VAX 6610's, and well-equipped micro-computer labs. Butler University is a comprehensive, medium-sized, liberal arts-based institution, with a beautiful campus located in a residential area of Indianapolis. Send vitae and three letters of recommendation, (at least one addressing teaching effectiveness) by January 31, 1993., to: Professor Prem Sharma, Department of Mathematics and Computer Science, Butler University, 4600 Sunset Ave., Indianapolis, IN 46208 (email maclaren@BUTLER.EDU). AA/EOE. Women and minorities are encouraged to apply.

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## IOWA

**IOWA STATE UNIVERSITY**
**Department of Mathematics**

Subject to budgetary approval, there will be two tenure-track positions starting in August 1993. The positions will be full time during the 9-month academic year; they require a Ph.D. or equivalent.

One position will be numerical analysis, and will be at the assistant professor or associate professor level. The successful candidate level. He or she should maintain an active research program in some branch of numerical funded grants. Senior candidates should have a strong record of publications and grants. Start-up funds for a workstation will be available. The salary will be commensurate with qualifications.

The second position will be in mathematics education, at the assistant professor level. Candidates should have strong interest and qualifications in teaching both mathematics and mathematics education, the latter at both the graduate and undergraduate level. They should maintain an active research program in mathematics education. The duties will include teaching, advising, supervision of student teachers, and participation in regional and national math ed activities.

Iowa State University is an Affirmative Action/Equal Opportunity Employer. Women and minorities are encouraged to apply.

The department will begin screening applications January 15, 1993; applications will be accepted, however, until the positions are filled. Applications (vita, description of research plans, and three letters of recommendation) should be sent to Stephen J. Willson, Chair, Department of Mathematics, Iowa State University, Ames, Iowa 50011.

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**LUTHER COLLEGE**

LUTHER COLLEGE invites applications for a tenure-eligible position as assistant professor of mathematics beginning late August 1993. Ph.D. preferred; ABD minimum requirement in mathematics, with core in algebra. Under the college's 4-1-4 academic calendar, the teaching load comprises three courses per semester and one course in each of two out of three January Terms. Luther College is seeking a person committed to excellence in teaching and to professional and scholarly activity in mathematics. Luther College is a liberal arts college of the Evangelical Lutheran Church in America and maintains close ties with that church; faculty members at Luther College are expected to be willing to work with colleagues in sustaining its strong liberal arts tradition in the context of Christian higher education. Review of applications begins December 10, 1992, and continues until the position is filled. All correspondence including letter of application, three letters of reference, transcripts of academic work and placement files should be sent to Dr. George Trytten, Head, Department of Mathematics, Luther College, Decorah, Iowa 52101, Telephone: 319/387-1174; FAX: 319/387-1080. An AA/EEO employer; minorities and women are encouraged to apply.

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**UNIVERSITY OF IOWA**

The Mathematics Department of the University of Iowa invites applications for the following positions:

1. Two tenure-track appointments at the Assistant or beginning Associate Professor level, starting in August 1993. One position is for a specialist in some aspect of harmonic analysis/representation theory, probability theory/stochastic analysis, or topology of manifolds/dynamical systems. The other position is for a specialist in some aspect of differential equations (including dynamical systems), numerical analysis, harmonic analysis (including representation theory, mathematical physics, and quantum groups), differential geometry, algebraic geometry or topology of manifolds.

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 1993-94 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.

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 on January 4, 1993. 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 Opportunity and Affirmative Action Employer.

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## KANSAS

**KANSAS STATE UNIVERSITY**
**Department of Mathematics**

Subject to budgetary approval, applications are invited for several tenure track and visiting positions commencing August 18, 1993; rank and salary commensurate with qualifications. All fields will be considered, but for some of the tenure-track positions, preference will be given to candidates in Differential Equations, Geometry/Topology, Algebra, and Functional Analysis. 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:

Louis Pigno
Department of Mathematics
Cardwell Hall 137
Kansas State University
Manhattan, KS 66506

It is expected that offers will begin on December 15, 1992, but applications for all positions will be accepted until February 1, 1993, or until positions are closed. AA/EOE

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**THE WICHITA STATE UNIVERSITY**

The Department of Mathematics and Statistics invites applications for tenure-eligible positions starting August, 1993. Special consideration will be given to persons having expertise in the following areas of research: probability and statistics, geometric analysis, numerical analysis, or complex analysis. We seek persons whose research interests are consonant with those of our faculty. Senior candidates should have distinguished research records, and junior candidates are expected to have excellent research potential and progress toward establishing a strong research record. All candidates should have a strong commitment to excellence in teaching and the ability to participate in and contribute to our doctoral program in Applied Mathematics. Salary and rank negotiable. Ph.D. in Mathematics or Statistics is required. Women and minority candidates are especially urged to apply. Send application letter, detailed resume, and arrange to have three reference letters sent to:

The Wichita State University
Professor Stephen W. Brady, Search Committee Chair
Department of Mathematics and Statistics
Wichita, Kansas 67260-0033
email: brady@twsuvm
fax: 316-689-3748

Deadline is January 15, 1993 (or monthly until positions are filled).

AA/EOE

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**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 on funding) beginning August 17, 1993 or as negotiated. For the tenure-track position, preference will be given to candidates first in statistics, then computational mathematics (e.g., in numerical analysis, PDE, or dynamical systems), 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 requirement completed by August 15, 1993. 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, 1992 and will continue until the positions are filled.

EO/AA Employer.

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## KENTUCKY

**MURRAY STATE UNIVERSITY**
**Department of Mathematics & Statistics**

Applications are invited for a tenure-track position in mathematics education beginning August 1993.

Candidates must have a doctorate in mathematics or a doctorate in mathematics education with at least a masters 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 are required.

Responsibilities include a maximum three course teaching load, continuing research/scholarly activities, and university/departmental service. The person who fills this position will teach a range of mathematics courses, including content and methods courses for prospective K-12 teachers, supervise field experience, seek external funding to conduct workshops and seminars for public school teachers, and work in collaboration with public schools to help implement the Kentucky Education Reform Act which was recently enacted by the state legislature.

The application package must include a vita, copies of graduate transcripts, and a statement of teaching philosophy. The immigration status of non-U.S. citizens should be indicated on the vita. All applicants must meet federal guidelines for working in the U.S. For full consideration, applications must be complete by December 15, 1992.

Send the application package and direct three letters of recommendation to:

Dr. Robert Pervine, Search Committee Chair
Department of Mathematics & Statistics
Murray State University
Murray, KY 42071

MSU does not discriminate on the basis of race, color, national origin, six or handicap in its programs or activities. For information contact the MSU Affirmative Action Office, 502/762-3155.

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## LOUISIANA

**LOUISIANA STATE UNIVERSITY**
**Department of Mathematics**
**Baton Rouge, LA 70803;**
**(504)388-1534**

Applications are invited at the Assistant/Associate Professor level for three anticipated tenure-track or visiting positions. Duties include teaching at the graduate and undergraduate level and maintenance of a strong research program. Selection is based on demonstration and promise of excellence in research and teaching. An applicant must complete all requirements for a Ph.D. or equivalent degree by August 1993. The department is primarily seeking to build on its strengths in probability, analysis and pde's, algebra, combinatorics, and topology. To apply, send a current vita and arrange for at least three letters of evaluation to be sent to Prof. James R. Retherford, Chair (address above).

LSU IS AN EQUAL OPPORTUNITY UNIVERSITY.

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## MARYLAND

**THE JOHNS HOPKINS UNIVERSITY**
**Department of Mathematical Sciences**

Applications are invited for 3 anticipated faculty positions within the areas of

1) numerical linear algebra (Senior applicants preferred), 2) statistics, 3) operations research, 4) applied discrete mathematics.

Selection is based on demonstration and promise of excellence in research, teaching and innovative applications.

Minority and women candidates are encouraged to apply. The Johns Hopkins University is an Affirmative Action/Equal Opportunity Employer.

Applicants are asked to furnish a curriculum vitae, transcripts (junior applicants only), reprints (if available), a letter describing professional interests and aspirations, and to arrange for three letters of recommendation to:

Prof. John C. Wierman, Chair
Department of Mathematical Sciences
220 Maryland Hall
The Johns Hopkins University
Baltimore, Maryland 21218-2689

Applications are requested by January 15, 1993.

Applicants whose primary research is in algebra, analysis, geometry, logic, number theory, or topology will not be considered.

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**THE JOHNS HOPKINS UNIVERSITY**
**Department of Mathematics**

Applications are invited for anticipated faculty positions (beginning fall 1993) within the general areas of algebra, analysis, geometry, number theory and topology. Of particular interest is the area of algebraic number theory, and one position may be filled at the senior 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 Univ., 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

**WHEATON COLLEGE**
**Norton, MA**

The Mathematics Department at Wheaton College invites applications for a two-year renewable tenure-track assistant professorship in computer science beginning September 1993. Requirements are a Ph.D. in computer science or related field, a commitment to quality teaching, and active scholarly activity. Teaching experience preferred. We offer an interdisciplinary Math/Computer Science major and a Computer Studies minor. Wheaton College is a private liberal arts college of 1200 students situated in a small New England town between Providence, Rhode Island and Boston. Send a letter of application, vitae, and three letters of recommendation to: Rochelle Leibowitz, Chair, Mathematics Department, Wheaton College, Norton, MA 02766. Deadline: December 15, 1992. AA/EOE.

**WILLIAMS COLLEGE**
**Department of Mathematics**
**Williamstown, Massachusetts 01267**

One or possibly two anticipated positions, one of them preferably in statistics, probably at the rank of assistant professor, for Fall 1993. Strong commitment to both teaching and scholarship is essential.

Please have a vita and three letters of recommendation on teaching and research sent to Hiring Committee. Formal evaluation of applications will begin November 15, 1992, and continue until the positions are filled. AA/EOE.

## MICHIGAN

**MICHIGAN TECHNOLOGICAL UNIVERSITY**
**Department of Mathematical Sciences**
**Houghton, MI 49931**

Applications are invited for four tenure track positions as well as visiting and temporary positions starting August 1993.

Subject to funding, the department anticipates tenure track openings in the areas of algebra (1 position), applied mathematics (2 positions) and mathematics education (1 position). Candidates for the positions in algebra and applied mathematics must have a Ph.D. in mathematics while candidates in mathematics education are expected to have a Ph.D. or Ed.D. degree and be able to teach undergraduate mathematics courses.

The successful candidates are expected to have strong teaching credentials and outstanding research potential. Appointment at the senior level will require a strong research record. Duties include teaching, service and research with a normal teaching load of courses (6 to 8 hours) per quarter. Preference will be given to candidates who can complement existing research interests in the department.

Send curriculum vitae, transcript and three letters of recommendation to

Alphonse Baartmans, Head
Department of Mathematical Sciences
Michigan Technological University
1400 Townsend Drive
Houghton, MI 49931-1295

Review of applications will begin on December 1, 1992. Applications will be accepted until the positions are filled.

MTU is an equal opportunity educational institution/equal opportunity employer.

## MISSISSIPPI

**MISSISSIPPI STATE UNIVERSITY**
**Department of Mathematics and Statistics**

Applications are invited for two or more anticipated tenure-track Assistant Professor positions for 1993-94. Candidates should possess a doctoral degree, demonstrate a strong potential for research, and have a commitment to effective teaching. All areas are welcomed but preference will be given to the following: for the mathematics position(s), applied mathematics, computational mathematics, and differential equations; for the statistics position(s), multivariate analysis, nonparametric and robust inference, and linear and nonlinear models.

The Department offers graduate programs leading to the Master of Science degree (M.S.) in both mathematics and statistics and the Doctor of Philosophy degree (Ph.D.) in mathematical sciences. Opportunities exist for applicants with interest in interdisciplinary research and consulting.

Applicants should send a curriculum vitae and arrange for three letters of recommendation to be sent to: C. Wayne Mastin, Chairman, Search Committee, Department of Mathematics and Statistics, P.O. Drawer, MA Mississippi State, MS 39762; email: office@math.msstate.edu.; fax: (601)325-0005. The committee will begin to review applications on January 15, 1993, and continue until positions are filled. Mississippi State University is an equal opportunity/affirmative action employer.

**MISSISSIPPI STATE UNIVERSITY**
**Department of Mathematics and Statistics**

Applications are invited for a tenure-track position at the rank of Assistant or Associate Professor in the area of numerical analysis/computational mathematics beginning in August 1993. Candidates at the Assistant Professor level should possess a doctoral degree, demonstrate a strong potential for research, and have a commitment to effective teaching. The rank of Associate Professor requires, in addition, teaching experience, and a substantial research record.

The Department offers graduate programs leading to the Master of Science degree (M.S.) in both mathematics and statistics and the Doctor of Philosophy degree (Ph.D.) in mathematical sciences. Opportunities exist for applicants with interest in computational methods in the engineering sciences.

Applicants should send a curriculum vitae and arrange for three letters of recommendation to be sent to: C. Wayne Mastin, Chairman, Search Committee, Department of Mathematics and Statistics, P.O. Drawer, MA Mississippi State, MS 39762; email: office@math.msstate.edu.; fax: (601)325-0005. The committee will begin to review applications on January 15, 1993, and continue until position is filled. Mississippi State University is an equal opportunity/affirmative action employer.

## MISSOURI

**UNIVERSITY OF MISSOURI-ROLLA**
**Department of Mathematics and Statistics**
**Rolla, MO 65401**

Possible tenure track positions available for Fall 1993. Rank and salary are open and depend on qualifications, but applicants must have completed the Ph.D. by August 15, 1993. We are specifically seeking applicants whose training is in statistics, partial differential equations, numerical analysis or algebra/combinatorics. Research potential and teaching ability will be considered in the selection. Submit curriculum vitae, summary of research, transcripts and three letters of reference to W. T. Ingram, Chairman. In your cover letter and on the outside of the envelope, please clearly identify your area of training. Applicant review will begin in January 1993. In order to receive full consideration, please have all materials in by January 1. AA/EOE

## NEVADA

**THE UNIVERSITY OF NEVADA**
**LAS VEGAS**

The Department of Mathematical Sciences has one senior-level, tenure-track position for Associate/Full Professor, starting Fall 1993. Applicants from all areas of mathematics are encouraged to apply. A Ph.D. in Mathematics, Applied Mathematics, Statistics, or Math Education, and a record of successful research and teaching are required. Rank and salary will be commensurate with experience and qualifications.

UNLV, a growing urban university with an enrollment of approximately 19,500 students, houses a National Supercomputing Center funded by the DOE.

Submit a letter of application, a current resume, and at least 3 letters of reference to the Department of Mathematical Sciences,

University of Nevada, Las Vegas, Las Vegas, NV 89154-4020. The processing of applications will begin on November 1, 1992. Applications will continue to be accepted until the position is filled. Proof of Eligibility for U.S. Employment (under the Immigration Reform and Control Act of 1986) will be required prior to employment. Women and minorities are especially encouraged to apply. The University of Nevada, Las Vegas 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 post-doctoral 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, algebraic geometry, 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 specialty 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 interests 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.

**DARTMOUTH COLLEGE**

The Department of Mathematics and Computer Science has an opening for a tenure-track Assistant Professor in Differential Geometry, with initial appointment in the 1993-1994 academic year. A candidate for the position must be committed to outstanding teaching at all levels of the undergraduate and graduate curriculum and must give evidence of a well-regarded research program that shows real promise for the future. Candidates with several years of experience should in addition be ready to direct Ph.D. theses.

To create an atmosphere supportive of research, Dartmouth offers new faculty members grants for research-related expenses, a quarter of sabbatical leave for each three academic years in residence and flexible scheduling of teaching responsibilities. The teaching responsibility in mathematics is four courses spread over two or three quarters. The department encourages good teaching with a combination of committed colleagues and bright, responsive students.

Though first priority is to appoint a differential geometer, our second priority is in algebra. Exceptional circumstances could lead to making the appointment in some third field. To apply, send a letter of application, curriculum vitae, and a brief statement of research results and interests. Also arrange for four letters of reference to be sent, at least one of which addresses teaching, and, if the applicant's native language is not English, the applicant's ability to use English in a classroom. All application materials should be addressed to Phyllis Bellmore, Recruiting Secretary, Mathematics and Computer Science, 6188 Bradley Hall, Dartmouth College, Hanover, NH 03755-3551. Applications completed by February 1 will receive first consideration. Dartmouth is committed to Affirmative Action and encourages applications from African Americans, Asian Americans, Hispanics, Native Americans, and women. Inquiries about the progress of the selection process can be directed to Richard E. Williamson, Recruiting Chair.

## NEW JERSEY

**RUTGERS, THE STATE UNIVERSITY OF NEW JERSEY**
**Department of Mathematics**
**New Brunswick, NJ 08903**

The Rutgers University Mathematics Department invites applications for the following positions which may (subject to the availability of funds) be open beginning September 1993.

(1) TENURE-TRACK AND TENURE POSITIONS. Depending on qualifications of the applicant appointments may be made to tenure track assistant professorships or to tenured positions at the rank of associate professor or higher. Candidates must have Ph.D., outstanding research ability in pure or applied mathematics and concern for teaching. Semester course load now averages 5 hours. Strong candidates in all fields are encouraged to apply and will be given careful consideration.

(2) HILL ASSISTANT PROFESSORSHIPS. The Hill Assistant Professorships are three-year nonrenewable positions. Candidates should have recently received the Ph.D., show outstanding promise of research ability in pure or applied mathematics, and have concern for teaching. Semester course load is approximately 6 hours. Similar positions (LECTURESHIPS) for shorter terms may also be available.

(3) INSTRUCTORSHIPS. These are one or two year nontenure-track positions. Semester course load is 12 hours, mainly at the level of precalculus and below. Candidates must have masters degree or equivalent related experience and provide evidence of teaching ability.

(4) VISITING POSITIONS. Full-time or part-time positions may be available for individuals with regular appointments elsewhere who wish to visit Rutgers for the purpose of engaging in joint research with members of the faculty. Candidates must have Ph.D., outstanding research ability in pure or applied mathematics and concern for teaching.

Applicants should send resume and at least three letters of recommendation to the SEARCH COMMITTEE, Department of Mathematics, Rutgers University, New Brunswick, NJ 08903 as soon as possible. Please indicate the position desired and give the AMS Subject Classification number of your area(s) of specialization. Applicants who applied in 1991-92 should request to have their previous application reactivated and submit *only* such new materials as they choose. Rutgers University is an Affirmative Action/Equal Opportunity employer and encourages applications from women and minority-group members.

## NEW MEXICO

**NEW MEXICO STATE UNIVERSITY**
**Department of Mathematical Sciences**

The department invites applications for possible visiting and tenure track positions in pure and applied mathematics and statistics for academic year 1993-94. New tenure track positions will be primarily at the assistant professor level, but appointments at a higher rank may be possible. Strong commitment to both research and teaching required. The department welcomes applications from women and members of minority groups.

The department has 32 tenure faculty positions, and offers B.S., M.S., and Ph.D. degrees. Applications are kept on file through hiring period and positions filled as openings occur. Arrange for vita, short research description, and at least three reference letters to be sent to: Hiring Committee, Department of Mathematical Sciences, New Mexico State University, Las Cruces, NM 88003.

An Equal Opportunity/Affirmative Action Employer.

## NEW YORK

**CLARKSON UNIVERSITY**
**Math and Computer Science**

The Department of Mathematics and Computer Science at Clarkson University invites applications for a tenure-track position in mathematics. Candidates must have: Ph.D. in mathematics or a closely related discipline; demonstrated excellence in research and in teaching; expertise in nonlinear waves or dynamical systems. Rank and salary are negotiable.

Applications including vita and names of at least three references must be received by November 30, 1992. Starting date is January 1, 1993. Applications should be submitted to Professor A. Fokas, Department of Mathematics and Computer Science, Clarkson University, Potsdam, NY 13699-5815. Clarkson University is an AA/EOE. Women and minorities are urged to apply. POS #387.

**POTSDAM COLLEGE**
**Assistant Professor**

Potsdam College of the State University of New York invites applications for an anticipated tenure-track position in Mathematics, at the rank of Assistant Professor, commencing September 1, 1993. The normal teaching load is 12 hours of undergraduate and beginning graduate level mathematics courses per semester. Applicants must have a Ph.D. in Mathematics (or be near completion). The successful candidate must, in addition, show evidence of being (or having the potential to become) an excellent teacher. The salary will be competitive. Send letter of application, resume, graduate transcripts (copies are acceptable) and three letters of reference to: Dr. J. Parks, Search Committee Chair, Department of Mathematics, Potsdam College, Potsdam, NY 13676. Review of applications will commence February 1, 1993 and continue until the position is filled. Potsdam College is an equal opportunity affirmative action employer committed to excellence through diversity. We actively seek candidates with significant multicultural experience.

## NORTH CAROLINA

**DUKE UNIVERSITY**
**Department of Mathematics**

Applications are invited for two tenure/tenure track positions in Mathematics: all fields, rank, and salary open, starting September 1, 1993. Applicants should send a curriculum vitae, a research plan, and a completed information form (available from the Department by email at *apply@math.duke.edu*); and they should arrange for three letters of recommendation to be sent. A teaching recommendation is also strongly suggested. Complete applications received by January 15, 1993 will be guaranteed full consideration. Address correspondence to: Faculty Search Committee, Department of Mathematics, Duke University, Box 90321, Durham, NC 27708-0321. Duke University is an affirmative action/equal opportunity employer.

**UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL**
**Department of Mathematics**

Applications are invited for a senior faculty appointment effective Fall 1993. Rank and salary depend on qualifications and budget considerations. Ph.D. in mathematics, exceptionally strong research program and commitment to excellent teaching required. Applicants are asked to send a curriculum vitae, an abstract of current research program, and to arrange to have four letters of recommendation sent to Search Committee Chairman, Math. Dept., CB #3250 Phillips Hall, UNC at Chapel Hill, Chapel Hill, NC 27599–3250. EO/AA Employer. Women and minorities are encouraged to identify themselves voluntarily. Completed applications received by December 31, 1992 are assured full consideration.

**WINTHROP UNIVERSITY**

Applications are invited for two faculty positions in the Mathematics Department. One will be a tenure-track position with the rank of assistant professor. A doctorate is required. Specialization in secondary mathematics education is preferred; linear programming/numerical analysis may be considered. The other available position is nontenure-track at the rank of instructor and may be renewed yearly up to six years. A master's degree is required for this position.

Commendations or awards documenting teaching excellence will merit special consideration.

Winthrop University is a state-assisted, comprehensive, residential institution of approximately 5,000 students emphasizing excellence in undergraduate instruction. The campus is located in Rock Hill, SC, 20 miles south of Charlotte, NC.

A separate application is required for each position. Submit a letter of interest, a vitae and at least three letters of reference to Dr. Ron Goolsby, Chair of Mathematics, Winthrop University, Rock Hill, SC, 29733. Closing dates are 2-1-93 for the assistant professor and 3-15-93 for the instructor. The filling of these replacement positions is contingent upon the continued availability of funding. Winthrop University is an equal opportunity/affirmative action employer.

## OHIO

**OBERLIN COLLEGE**

A temporary position starting February 1993 for a term of 1-5 semesters (depending on authorization). Responsibilities include teaching undergraduate courses (5/year), academic advising, work with honors students, service on committees and sustained scholarly production. All fields considered but preference given to **statistics**. Qualifications required include the Ph.D. degree (in hand or expected by January 1993). Candidates must demonstrate potential excellence in teaching. Oberlin is a selective college playing a historic role in the education of minorities and women with a strong record producing students earning a Ph.D. degree in science and mathematics. Please send letter of application, curriculum vitae, academic transcripts, and 3 letters of reference to: Michael Henle, Department of Mathematics, Oberlin College, Oberlin, OH 44074 by **November 6, 1992**. Late applications may be considered until the position is filled. AA/EOE

## OKLAHOMA

**SOUTHEASTERN OKLAHOMA STATE UNIVERSITY**
**Position Announcement**

**DEPARTMENT CHAIR OF MATHEMATICS–** A Ph.D. is required for this position. Administrative skills necessary. Rank negotiable. Teaching load is 3–6 hrs. per semester. Demonstrated scholarship and at least 5 years teaching and/or administrative experience at the university level required. Duties include teaching undergraduate mathematics at all levels, scholarly activity, and administrative responsibilities. To apply submit a letter of application, resume, statement of academic philosophy, and three letters of reference to: Personnel Office, Station A, Durant, OK 74701. Application deadline is March 1, 1993.

**ASSISTANT PROFESSOR/INSTRUCTOR OF MATHEMATICS–** A Ph.D. in Mathematics is required for the Assistant Professor position (tenure-track). ABD required for the Instructor position. Duties include teaching undergraduate mathematics at all levels, student advising, scholarly activities, and committee service. Minorities and women are especially encouraged to apply. To apply submit a letter of application, resume, all university transcripts, a statement of your teaching philosophy, and three letters of reference to: Personnel Office, Station A, Southeastern Oklahoma State University, Durant, OK, 74701. Application deadline is March 1, 1993.

EOE/AA

## PENNSYLVANIA

**BRYN MAWR COLLEGE**
**Department of Mathematics**

Applications are invited for positions in Mathematics and Computer Science, starting September 1993. They should be sent to the appropriate committee, Department of Mathematics, Bryn Mawr College, Bryn Mawr, PA 19010.

MATHEMATICS POSITIONS: One tenure track assistant professorship and one three-year renewable lectureship. Candidates must have completed a doctorate in a mathematical science by the starting date, and must show promise in research and a serious commitment to undergraduate and graduate teaching. All fields are acceptable, with a preference for applied mathematics or geometry. Please send a vita, research plan and three letters of recommendation to the Mathematics Search Committee.

COMPUTER SCIENCE POSITION: Three-year renewable lectureship. Candidates should have completed a doctorate in computer science or a related field by the starting date, and must display a commitment to both teaching and scholarship, and an interest in curriculum development in a joint program with Haverford College. Please send a vita and three letters of recommendation to the Computer Science Search Committee.

Bryn Mawr College is an equal opportunity affirmative action employer. The col-

lege wishes particularly to encourage applications from individuals interested in joining a multicultural/international academic community. Minority candidates and women are especially encouraged to apply. CLOSING DATE: 1 January 1993 (late applications may be considered). Telephone: (215)526-5348. Email: msearch@cc.brynmawr.

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**CARNEGIE MELLON UNIVERSITY**
**CENTER FOR NONLINEAR ANALYSIS**
**Department of Mathematics**

The Center for Nonlinear Analysis expects to make four to five Postdoctoral appointments for 1992-1993 in the area of applied analysis. This is a one-year (twelve-month) joint appointment by the Center and Department of Mathematics. Recipients will teach at most one course per semester. Applicants should send a vita, list of publications, a statement describing current and planned research, and arrange to have at least three letters of recommendation sent to the committee. The deadline for application is January 20, 1993; late applications may be considered on a space-available basis. All communications should be addressed to: Postdoctoral Appointments Committee, Department of Mathematics, Carnegie Mellon University, Pittsburgh, PA 15213. Carnegie Mellon University is an Affirmative Action/Equal Opportunity Employer.

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**CARNEGIE MELLON UNIVERSITY**
**Department of Mathematics**

The Department expects to make two or more tenure-track appointments, to begin in the Fall of 1993, at the Assistant Professor level. We seek candidates in areas of research which strongly intersect those of the current faculty of the Department. Applicants should send a vita, list of publications, and a statement describing current and planned research, and arrange to have at least three letters of recommendation sent to the committee. All communications should be addressed to: Tenure-track Appointments Committee, Department of Mathematics, Carnegie Mellon University, Pittsburgh, PA 15213. Carnegie Mellon University is an Affirmative Action/Equal Opportunity Employer.

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**CARNEGIE MELLON UNIVERSITY**
**Richard J. Duffin**
**Assistant Professorship in Mathematics**

The Richard J. Duffin Assistant Professorship was established in 1990 to honor Professor Emeritus Duffin. The position available is for an initial period of one or two academic years, beginning in September 1993, and extendable for one additional year when mutually agreeable. It carries a reduced academic year teaching load of six hours per week during one semester and three hours per week during the other. Applicants are expected to show exceptional research promise, as well as clear evidence of achievement and should have research interests which intersect those of current faculty of the Department. Applicants should send a vita, list of publications, and a statement describing current and planned research, and arrange to have three letters of recommendation sent to the committee. All communications should be addressed to: Appointments Committee, Department of Mathematics, Carnegie Mellon University, Pittsburgh, PA 15213. Carnegie Mellon University is an Affirmative Action/Equal Opportunity Employer.

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**CARNEGIE MELLON UNIVERSITY**
**Department of Mathematics**

The Department invites applications for a senior level appointment in Computational Mathematics/Numerical Analysis. We are particularly interested in candidates who will enhance existing computational and analytical programs which involve continuum models in fluid dynamics, mechanics of solids including microstructure, phase transitions, as well as other aspects of materials science. Applicants should send a vita, list of publications, and a statement describing current and planned research, and arrange to have at least three letters of recommendation sent to: Computational Mathematics Search Committee, Department of Mathematics, Carnegie Mellon University, Pittsburgh, PA 15213. Carnegie Mellon University is an Affirmative Action/Equal Opportunity Employer.

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**CARNEGIE MELLON UNIVERSITY**
**Zeev Nehari**
**Assistant Professorship in Mathematics**

The Zeev Nehari Assistant Professorships have been instituted in the Department of Mathematics of Carnegie Mellon University to honor the memory of Professor Zeev Nehari, a member of the Department from 1954 to his death in 1978. The position available is for an initial period of one or two academic years, beginning in September 1993, and extendable for one additional year when mutually agreeable. It carries a reduced academic year teaching load of six hours per week during one semester and three hours per week during the other. Applicants are expected to show exceptional research promise, as well as clear evidence of achievement and should have research interests which intersect those of current faculty of the Department. Applicants should send a vita, list of publications, and a statement describing current and planned research, and arrange to have three letters of recommendation sent to the committee. All communications should be addressed to: Appointments Committee, Department of Mathematics, Carnegie Mellon University, Pittsburgh, PA 15213. Carnegie Mellon University is an Affirmative Action/Equal Opportunity Employer.

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**GETTYSBURG COLLEGE**

Gettysburg College invites applications for a tenure-track assistant professor position in mathematics beginning September 1993. A Ph.D. in mathematics, promise of excellence in teaching, and a commitment to continued scholarship are essential.

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 half drive of the Washington-Baltimore area.

Send letter of application stating teaching and scholarship interests and goals, curriculum vitae, and the names of three references (at least one who can address teaching effectiveness) to: James P. Fink, Chair, Department of Mathematics and Computer Science, Gettysburg College, Gettysburg, PA 17325. Formal evaluation of applications will begin on January 20, 1993 and continue until the position is filled. Gettysburg College is an Equal Opportunity/Affirmative Action employer. Women and minority candidates are encouraged to apply.

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**UNIVERSITY OF PITTSBURGH**
**Department of Mathematics and Statistics**

The department invites applications for the following position, which will be available for September 1993 if funding permits.

Assistant Professor in mathematical biology. We have a preference for an individual with a strong computational aspect to their research. This is a tenure track position.

Requirements include outstanding research accomplishment and potential commensurate with experience, and ability and interest in excellent teaching.

Applicants should send a resume and arrange to have at least three letters of recommendation sent to: S. Hastings, Chairman, Department of Mathematics and Statistics, University of Pittsburgh, Pittsburgh, PA 15260. Applications which are complete by January 10, 1993 are assured of complete consideration.

The University of Pittsburgh is an equal opportunity/affirmative action employer. Women and minorities are especially encouraged to apply.

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## PUERTO RICO

**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 applied mathematics (with emphasis in general relativity theory), with a salary of $26,220 per year. Fluency in spoken and written Spanish and English, a Ph.D. degree in mathematics, and at least 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 resumé and three

letters of recommendation to: Prof. Yuri Rojas-Ramirez, Acting Chairperson, Department of Mathematics, UPR, P.O. Box 5000, Mayaguez, PR 00681-5000. EEO/AA.

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**UNIVERSITY OF PUERTO RICO AT MAYAGUEZ**
**Department of Mathematics**

The Department of Mathematics has a tenure-track opening at the assistant professor level in the area of functional analysis (with special interest in operator theory). The salary is $26,220 per year. A Ph.D. degree and at least one year of academic or industrial/research experience are required, as is fluency in both English and Spanish. The appointee will be required to teach graduate and undergraduate courses and to do research. Send resumé and three letters of recommendation to: Prof. Yuri Rojas-Ramírez, Acting Chairperson, Department of Mathematics, UPR, P.O. Box 5000, Mayaguez, PR 00681-5000. EEO/AA.

"An Equal Opportunity Employer - M/F/V/H" "Announcement Required by the Council of Higher Education"

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## RHODE ISLAND

**BROWN UNIVERSITY**
**Division of Applied Mathematics**

The Division of Applied Mathematics expects to have a position at the Assistant Professor level in the general area of nonlinear analysis. The ideal candidate should be able to combine research on the theory of partial differential equations and/or dynamical systems with applications to the physical or life sciences.

Applicants should have a curriculum vita, at least three letters of recommendation, and relevant publications sent to: Professor Wendell H. Fleming, Chair, *Nonlinear Analysis position,* Division of Applied Mathematics, Brown University, 182 George Street, Providence, RI 02912. The closing date for applications is January 15, 1993.

Brown University is an affirmative action/equal opportunity employer.

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## SOUTH CAROLINA

**CLEMSON UNIVERSITY**
**Clemson, SC**

Applicants are invited for a tenure-track position at the assistant professor level, and possibly other levels. The department encompasses the areas of algebra/combinatorics, analysis, computational math, operations research and statistics. One position will be in statistics with possible positions in our other mathematical areas. Desirable attributes for candidates include an interdisciplinary research orientation in the mathematical sciences and an interest in innovative applications. Candidates should have strong potential or demonstrated capability for effective research and teaching. Applications received by February 15, 1993, will be given highest priority, but others will be considered until position is filled. Applicants should indicate in the cover letter their research specialities. Vita and names of three references should be sent to address below. Reference letters should *only* be sent when requested. CU is an AA/EO employer.

Professor R. D. Ringeisen, Head
File A, Box 341907
Department of Mathematical Sciences
Clemson University
Clemson, SC 29634-1907

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## TENNESSEE

**TENNESSEE TECHNOLOGICAL UNIVERSITY**
**Department of Mathematics**
**Cookeville, TN 38505**

Two tenure-track Asst. Prof. positions to begin August 1993. Ph.D. in Mathematical Sciences, evidence of excellent teaching ability/potential & strong promise of research required. Analyst preferred for one position. Duties including teaching grad. & undergrad. courses, directing master's students, engaging in research activities & participating in course development. Initial review of applications to begin 1-15-93; applications accepted until positions filled. Transcripts, curriculum vitae & 3 letters of recommendation should be sent to: Dr. J. T. B. Beard, Jr., Chairperson, Search Committee. TTU will hire only U.S. citizens and aliens lawfully authorized to work in the U.S. Qualified women, minorities & disabled individuals strongly urged to apply. AN AA/EEO/ADA EMPLOYER.

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**THE UNIVERSITY OF THE SOUTH**
**Department of Mathematics and Computer Science**

Tenure-track position in mathematics, to begin Fall 1993, at a highly selective church-related (Episcopal) liberal arts college of 1100 students located on a 10,000-acre forested domain in the Tennessee uplands. Applicants should have an appreciation for the liberal arts and some interest in computing. Applications from women and minorities are especially encouraged. The position is at the level of assistant professor, with excellence in teaching and continued interest in research expected. A complete application will include a letter stating one's professional aims, a resumé, graduate and undergraduate transcripts, and three recommendations. All should be sent to Sherwood F. Ebey, The University of the South, 735 University Avenue, Sewanee, TN 37375-1000. Applications received by November 27 will have first consideration. AA/EOE.

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**UNIVERSITY OF TENNESSEE AT CHATTANOOGA**
**Department Head**

The University of Tennessee at Chattanooga invites applications for Head of the Department of Mathematics. A Ph.D. in a mathematical science and at least five years of college mathematics teaching experience 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 22 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 8100. Send applications with current vita to: Dr. Irene Loomis; Chair of the Search Committee, Dept. of Mathematics, UTC, Chattanooga, TN 37403-2598. Consideration of applications will begin November 1, 1992, 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 Institution.

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**VANDERBILT UNIVERSITY**
**Department of Mathematics**
**1326 Stevenson Center**
**Nashville, TN 37240**

ASSISTANT PROFESSOR. (Pending Administrative Approval.)

Ph.D. is required with two year appointment beginning Fall 1993. This is not a tenure track appointment but is intended for a person with demonstrated research potential who would like to spend time in a department with a vigorous research atmosphere. We are especially interested in someone who works in one of the areas of departmental strengths which include universal algebra, differential equations, approximation theory, operator theory, mathematical biology, applied mathematics, graph theory, and topology. Have vita and four letters of recommendation (including one about teaching) sent to Professor G. F. Webb, Chair.

VANDERBILT UNIVERSITY IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER.

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**VANDERBILT UNIVERSITY**
**Department of Mathematics**
**1326 Stevenson Center**
**Nashville, TN 37240**

ASSISTANT PROFESSOR. (Pending Administrative Approval.) Specialization in an area of analysis or applied mathematics. We are especially interested in someone who works in differential equations, operator theory, mathematical biology, or approximation theory. Initial 3 year appointment beginning Fall 1993 (renewable; tenure track.) Outstanding research potential and evidence of effective teaching required.

Have vita and 4 letters of recommendation sent to Professor G. F. Webb, Chair.

VANDERBILT UNIVERSITY IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER.

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**VANDERBILT UNIVERSITY**
**Department of Mathematics**
**1326 Stevenson Center**
**Nashville, TN 37240**

ASSISTANT PROFESSOR. (Pending Administrative Approval.) Specialization in computer related mathematics, approximation theory, or computer aided design. This position is intended for a person whose primary research involves computing. It is an initial 3 year appointment beginning Fall 1993 (renewable; tenure track). Outstanding research potential and evidence of effective teaching required. Have vita and 4 letters of recommendation sent to Professor G. F. Webb, Chair.

VANDERBILT UNIVERSITY IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER.

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## TEXAS

**RICE UNIVERSITY**
**Department of Mathematics**

Applications are invited for a tenure-track assistant professorship. There is a possibility of an upgrade to associate or full professorship for an exceptional senior candidate. Candidates must have an extremely strong research background and good teaching skills. Preference will be given to applicants in algebraic geometry, geometric analysis, and geometric topology. Duties will include research and classroom teaching.

Please send a curriculum vitae and at least 3 letters of recommendation to: Appointments Committee, Department of Mathematics, Rice University, PO Box 1892, Houston, TX 77251.

Applications received by December 31, 1992 will be assured full consideration.

Rice University is an Equal Opportunity/Affirmative Action Employer and strongly encourages applications from women and minority group members.

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**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, 1992 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 addressed to Chair, Evans Committee, Department of Mathematics, Rice University, PO Box 1892, Houston, TX 77251-1892.

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**SOUTHERN METHODIST UNIVERSITY**
**Department of Mathematics**

The Department of Mathematics at Southern Methodist University invites applications for a senior mathematician and for two tenure-track assistant professorships, with employment beginning in Fall 1993. 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. Senior applicants must have the ability to supervise doctoral dissertations; a strong grant record is desirable. The standard teaching load is two courses (six hours) per semester.

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 (nonlinear waves), M. Melander (computational fluid dynamics), G. W. Reddien (numerical bifurcation theory), D. A. Reinelt (fluid dynamics), and L. F. Shampine (numerical ordinary differential equations). Southern Methodist University has good Internet connections and a 20 processor Sequent Symmetry for research use.

The application deadline is January 8, 1993. Send a letter of application and a vita to: Professor I. Gladwell, Department of Mathematics, Southern Methodist University, Dallas, Texas 75275 (Tel: (214) 768-2506; Fax: (214) 768-4138. Junior applicants should arrange for three letters of recommendation to be sent directly to Professor Galdwell.

I. Glawell's email addresses:
h5nr1001@cis.vm.smu.edu
gladwell@seas.smu.edu

SMU is an equal opportunity/affirmative action/Title IX employer.

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**TEXAS A&M UNIVERSITY**
**Research Instructorships in Mathematics**

The department expects to have several Research instructorships available for the 1993-1994 academic year. These are two year positions, and candidates should have recently received their Ph.D., show promise of research excellence in an area of pure or applied mathematics, and have a commitment to teaching. Preference will be given to applicants whose expertise augments our existing research strengths.

Application material consisting of a vita which should include a statement of research goals, and 3 letters of recommendation should be sent to

William Rundell, Interim Head
Department of Mathematics
Texas A&M University
College Station, Texas 77843-3368

Texas A&M University is an Equal Opportunity/Affirmative Action employer. Women and minority applicants are especially encouraged.

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**TEXAS A&M UNIVERSITY**
**Department of Mathematics**

Applications are invited for one or more tenure-track or tenured faculty positions beginning in the 1993-1994 academic year. Outstanding candidates in all fields of mathematics are encouraged to apply. Significant research accomplishments or, in the case of a junior appointment, exceptional promise plus an earned Ph.D., together with evidence of good teaching ability, will be expected of successful applicants. Salary will be commensurate with qualifications. Candidates should send a letter of application, full vita, and arrange to have at least 3 letters of recommendation sent to

William Rundell, Interim Head
Department of Mathematics
Texas A&M University
College Station, Texas 77843-3368

Texas A&M University is an Equal Opportunity/Affirmative Action employer. Women and minority applicants are especially encouraged.

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**THE UNIVERSITY OF TEXAS AT AUSTIN**
**Department of Mathematics**
**Austin, Texas 78712**

For Fall 1993 openings are expected only at the Instructor level. Instructorships at The University of Texas at Austin are postdoctoral appointments, renewable for up to three years. They are restricted to recent Ph.D. recipients: applicants are expected to have completed all Ph.D. requirements by no later than August 31, 1993 but not to have received their degrees prior to January 1, 1991. Candidates should have outstanding research ability and a solid commitment to teaching. Strong preference will be shown toward applicants whose research interests are closely allied with those of the permanent faculty. Duties include teaching undergraduate or graduate courses and conducting independent research. The anticipated salary is $31,000 for the nine-month academic year.

Individuals wishing to apply should send a vita and a brief research summary to the above address, % Recruiting Committee. Transmission of these materials via e-mail to **recruit@math.utexas.edu** is encouraged. **Please do not have any letters of recommendation sent with your application.** Following an initial screening, the Recruiting Committee will request additional information, part of which will be letters of recommendation from selected applicants. Unsolicited letters of recommendation will be disregarded. The screening of applicants will begin on December 1, 1992.

The University of Texas at Austin is an equal opportunity employer. Qualified women and minority group members are urged to apply.

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**THE UNIVERSITY OF TEXAS AT DALLAS**
**Programs in Mathematical Sciences**

Applications are invited for an anticipated tenure track assistant professor faculty position in Applied Mathematics beginning Fall 1993. Ph.D. in relevant field is required. Applicants should have outstanding research ability. The successful candidate is expected to participate in the activities of the Center for Engineering Mathematics. Candidates with both a strong theoretical background and a strong interest in applications are particularly encouraged to apply. Areas of special interests are mathematical modeling, system theory, signal processing, and numerical analysis. Responsibilities include research, teaching, and supervision of Ph.D. Dissertations. Excellent computing facilities.

Applicants should send a curriculum vita and at least three letters of reference (indications of sex and ethnicity for affirmative action statistical purposes is requested but not required) to: Academic Search #*2006*, M/S AD 23, The University of Texas at Dallas, P.O. Box 830688, Richardson, Texas 75083-0688. Applications accepted until 12/15/92, or later if position not filled. The University of Texas at Dallas is an Affirmative Action/Equal Opportunity Employer.

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## UTAH

**UNIVERSITY OF UTAH**
**Department of Mathematics**

The University of Utah, Department of Mathematics, invites applications for the following positions:

1. At least two **full time tenure track appointments** on the professional levels. The Department is primarily interested in applicants who work in the research areas represented in the Department and who received their Ph.D. degrees prior to 1992. Selection will be based on research and teaching ability.

2. Two or more nonrenewable **three-year Instructorships**. Persons of any age receiving Ph.D. degrees in 1992 or 1993 are eligible. Applicants will be selected on the basis of ability and potential in teaching and research. Starting salary will be $33,000; 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.

3. 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 $37,000. Duties consist of teaching four courses during the three quarter academic year.

4. 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, 1993, but applications for all positions will be accepted until January 31, 1993, 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, University of Utah, Salt Lake City, Utah 84112. The University of Utah is an Equal Opportunity, Affirmative Action Employer and encourages nominations and applications from women and minorities.

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## VIRGINIA

**CHRISTOPHER NEWPORT UNIVERSITY**
**Dean, College of Science and Technology**

THE POSITION: Christopher Newport University invites applications for the position of Dean of the College of Science and Technology. The successful candidate is required to: fulfill the requirements for a tenured appointment at a senior rank in one of the departments of the College (biology, chemistry and environmental science; mathematics; or physics and computer science); have an earned doctorate in a field of science or technology; present a record of significant scholarly activity; have at least five years in a full-time teaching position at the college or university level; show evidence of significant and successful administrative experience in higher education or a related organization; and demonstrate the capacity for vision, wisdom, communication and interpersonal skills necessary to lead the development of the College of Science and Technology. Preferred qualifications include: demonstration of the ability to generate external support for scientific or technological projects at the University; relevant international experience; and significant experience in an academic institution. The successful candidate will be expected to integrate the College into the expanding scientific and technological community of eastern Virginia, to broaden its growing international emphasis, and to work with the academic community, within the University in shaping the future of the College. As a representative of the University to the scientific community, the successful candidate will need to be effective in the areas of human relations and public service.

THE UNIVERSITY: Christopher Newport University is an urban, master's-degree-granting, state-supported institution of higher education located on an attractive campus in the city of Newport News, Virginia. Newport News is a part of the greater Hampton Roads metropolitan area which has a population of about 1,500,000 people. The University is located within ten minutes of three internationally recognized scientific laboratories: the Continuous Electron Beam Accelerator Facility, the NASA-Langley Research Center, and the Virginia Institute of Marine Science. Atlantic beaches and Colonial Williamsburg are within a 30-minute drive. The University enrolls more than 5,000 students, offers more than 30 undergraduate degree programs, and has a growing graduate student population. The College of Science and Technology has 47 full-time instructional faculty and an adjunct and part-time faculty of 34. The College offers five baccalaureate degree programs (with numerous concentrations), master's programs, and is developing a number of new programs at the master's level. Within the context of liberal learning, the College is committed to meeting the needs of its constituencies through excellence in instruction and through public service and research.

TO APPLY: Interested parties are invited to send: a letter of application; a current resume; and names, addresses, and phone numbers of four references to:

Dr. Harold Cones, Chairman,
S&T Dean's Search Committee
c/o Office of the Provost
Christopher Newport University
Newport News, VA 23606-2998
FAX No. 804-594-7713

The search will remain open until the position is filled, but a first review of applications will begin in December 1992. The anticipated starting date for the position is July 1, 1993. Christopher Newport University employs only United States citizens and aliens lawfully eligible for employment in the United States. The University encourages and invites applications from women and minorities.

EEO/AA

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**CHRISTOPHER NEWPORT UNIVERSITY**
**Department of Mathematics**
**Newport News, VA 23606-2998**

Three Tenure track positions in Mathematics/Mathematics Education at the assistant professor level are available Fall 1993. Salary is competitive.

Christopher Newport University is Virginia's newest comprehensive, state-supported university on an attractive campus in the heart of Tidewater. Christopher Newport University enrolls over 5,000 students and offers bachelor's degrees in 30 fields (including mathematics, computer science, and applied physics) and master's degrees in the teaching of mathematics and science and in Applied Physics. The mathematics department currently consists of eleven full time members and has part-time instructors teaching approximately thirteen sections per semester. The department offers a BA/BS in mathematics or in mathematics with concentrations in computer science, physics, or secondary teaching, and is considering offering a master's in mathematics and one in secondary teaching. The University is ten minutes from two national labs, the Continuous Electron Beam Accelerator Facility (CEBAF) and NASA-Langley, and from high-tech companies such as Canon-USA and Siemens, at which some faculty at CNU do consulting. Beaches and Colonial Williamsburg are within 30 minutes,

and the Blue Ridge Mountains are within three hours.

The department is interested in candidates having ability and potential in teaching and research, interest in curriculum development, particularly for the master's in mathematics, and a willingness to be actively involved in departmental and college duties. The usual teaching load is either three or four three-credit courses in each of the two semesters.

Research backgrounds in areas appropriate to support master's degrees in computational and applied mathematics and in mathematics education are preferred. Effective language communication skills are essential. A doctorate in mathematics, mathematics education, or a closely-related field, earned by the beginning of the contract period is required.

Candidates must send a resume indicating teaching experience and areas of specialization, and three letters of reference to support the applicant's professional qualifications. Applications will be accepted until February 1, 1993. Send information to Professor John J. Avioli, Mathematics Department, Christopher Newport University, Newport News, VA 23606-2998.

CNU is an AA/EEO employer. Women and minorities are strongly urged to apply.

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**UNIVERSITY OF VIRGINIA**
**Department of Mathematics**
**Charlottesville, Virginia 22903**

The Department of Mathematics is seeking outstanding candidates to fill its Whyburn Instructorship. Applicants should show exceptional promise in teaching and research. Preference is to be given to applicants who have received the Ph.D. within the past two years, and who are working in analysis. The Instructorship is a two-year appointment with reduced teaching load and partial summer support.

Please send application materials by January 15, 1993 to the Committee on Hiring. The University of Virginia is an Equal Opportunity/Affirmative Action Employer.

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**VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY**
**Department of Mathematics**

We are seeking applicants for an anticipated tenure-track appointment at the Assistant Professor level in the area of Computational Mathematics/Numerical Analysis beginning with the 1993-94 academic year. We seek applicants with a strong research potential as well as the ability to be an effective teacher. A vita, brief description of research interests, three letters of recommendation including at least one which addresses teaching, and any supporting materials should be sent to Janet S. Peterson, Chair, Computational Mathematics Search Committee, ICAM, Wright House, Virginia Tech, Blacksburg, VA 24061-0531. Applications will be accepted for as long as there is a possibility of making an appointment or until 3/15/93; however, applications completed by 1/1/93 will be included in the first round of evaluations. Equal Opportunity/Affirmative Action Employer. The University takes its affirmative action mission seriously and is especially interested in receiving applications from women and people of color.

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**VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY**
**Department of Mathematics**

The Department of Mathematics is actively seeking applications for an anticipated tenure-track position at the Assistant Professor level in the area of discrete mathematics, combinatorics, and graph theory beginning with the 1993-94 year. A Ph.D. in mathematics, strong research potential, and good teaching credentials are required. Preference will be given to candidates with postdoctoral experience. Applications will be accepted for as long as there is a possibility of making an appointment or until March 15, 1993. Those completed by January 1, 1993 will be included in the first round of evaluations. Applicants should send a curriculum vitae and arrange to have three letters of reference sent to Professor Charles Parry, Chair, Discrete Math Search Committee, Department of Mathematics, VPI&SU, Blacksburg, VA 24061-0123. At least one letter should address the applicants teaching credentials. VPI&SU is an Equal Opportunity/Affirmative Action Employer. The University takes its affirmative action mission seriously and is especially interested in receiving applications from women and people of color.

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**VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY**
**Department of Mathematics**

Applications are invited for an anticipated tenure-track appointment at the Assistant Professor level in the general area of Dynamical Systems beginning with the 1993-94 academic year. A Ph.D. and strong research potential are required. The likelihood of productive interaction with current faculty members, such as the group in partial differential equations and continuum mechanics, will be a consideration. Position involves teaching duties of approximately six hours per week. Evidence that candidate is or will become an effective teacher should be included in application materials; in particular, at least one reference letter should address this issue. Send a vita and arrange to have three letters of reference submitted to Kenneth Hannagen, Chair, Dynamical Systems Search, Mathematics Department, Virginia Tech, Blacksburg, VA 24061-0123. Applications will be accepted for as long as there is a possibility of making an appointment or until 3/15/93. Those completed by 1/1/93 will be included in the first round of evaluations. Equal Opportunity/Affirmative Action Employer. The University takes its affirmative action mission seriously and is especially interested in receiving applications from women and people of color.

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**VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY**
**Department of Mathematics**

Applications are invited for an anticipated tenure-track appointment in Geometry (differential or algebraic, or related areas) beginning Fall 1993. Because we seek applicants who will be able to develop a strong case for eventual promotion and tenure, preference will be given to those with postdoctoral or instructorship experience and established research programs. Please send vita and brief description of research and have three letters of reference sent to Prof. William Floyd, Chair, Geometry Search Committee, Department of Mathematics, Virginia Tech, Blacksburg, VA 24061-0123. At least one letter should address the applicant's qualifications as a teacher. Applications will be accepted until March 15, 1993, or until position is filled. Applications completed by January 1, 1993 will be included in the first round of evaluations. Virginia Tech is an Equal Opportunity/Affirmative Action Employer. The University takes its affirmative action mission seriously and is especially interested in receiving applications from women and people of color.

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**WASHINGTON AND LEE UNIVERSITY**
**Department of Mathematics**
**Lexington, VA 24450**

**RADFORD PROFESSOR / DEPARTMENT HEAD**. The Radford Chair of Mathematics will be filled in September 1993. An applicant should have a background that warrants tenure and the rank of full professor, a record of effective teaching and scholarship, and a commitment to mathematics education in a liberal-arts setting. The Radford Professor will assume the position of department head for a five-year term.

The mathematics faculty numbers seven, all with Ph.D.s. The University is primarily a liberal-arts college with 1600 undergraduates. It is 240 years old and is located in the lower Shenandoah Valley. Address inquiries to Prof. T. O. Vinson, Search Committee, Mathematics Department. The selection process will begin in November 1992. AA/EOE.

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## WASHINGTON

**UNIVERSITY OF WASHINGTON**
**Department of Applied Mathematics**

The department is seeking a candidate for a tenure track Assistant Professor position effective September 1993.

The department offers the M.S. and Ph.D. degrees in applied mathematics and its teaching responsibilities within the university include advanced undergraduate and graduate level specialty and service courses. The research interests of the current twelve faculty members are strongly focused on applications in the physical and biological sciences, ranging over various aspects of modeling, analysis, and computation.

All applicants should have an applied mathematics background that is compatible with the departmental teaching requirements and research ambitions. Applicants with an interest in applied scientific computation are especially encouraged to apply; however, all specialty areas within applied mathematics will be considered.

A resume and the names of three people familiar with the applicant's qualifications should be forwarded to:

Professor Robert E. O'Malley, Jr., Chair
Department of Applied Mathematics, FS-20
University of Washington
Seattle, WA 98195

The search committee will contact references when appropriate. Priority will be given to applications received before December 31, 1992.

The University of Washington is building a multicultural faculty and strongly encourages applications from female and minority candidates.

## WEST VIRGINIA

**WEST VIRGINIA UNIVERSITY**
**Chairperson**
**Department of Mathematics**

Applications and nominations are invited for the position of Chairperson. The position requires a Ph.D. in mathematics or its equivalent, administrative experience, and research credentials sufficient to justify a tenured appointment at the Associate Professor or Professor level. It is expected that the successful applicant will continue his/her research program while serving as chairperson. The Department is searching for a person with a desire for administrative responsibility who will continue to strengthen the Department's research program while maintaining a substantial commitment to quality teaching.

The Department consists of 32 faculty, 5 support staff, and 25 graduate teaching assistants, and offers the B.A., M.S., and a newly established Ph.D. degree. The Department is located in newly refurbished facilities that include its own departmental research library, a mathematics learning center with CAI capacity, and fully integrated computer offices, classrooms, and computer laboratories. Faculty have direct access to the University's mainframe computer facilities and to Internet. The Department has faculty active in various areas of pure and applied mathematics and in mathematics education. West Virginia University has an enrollment of 22,500. Morgantown is a culturally diverse college community with a population of about 40,000, and is located on the Monongahela River, 70 miles south of Pittsburgh and 200 miles west of Washington, D.C.

Applicants should provide a vita and the names of five references. Applications and inquiries should be sent to Dr. Bernard Cooper, Benedum Professor of Physics, Chair of the Search Committee, 201 Woodburn Hall, West Virginia University, PO Box 6286, MORGANTOWN, WV 26506-6286. Screening of applicants will begin on January 15, 1993 and will continue until a successful candidate is chosen.

WYU is an equal opportunity/affirmative action/Title IX employer.

## WYOMING

**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 starting August 1993. Applicants must demonstrate strong ability in research, breadth of mathematical knowledge, interest in collaboration with mathematicians in other areas, strong commitment to high quality undergraduate and graduate teaching, and willingness to supervise masters and doctoral students. Preference will be given to researchers with strength in the areas of functional, complex and harmonic analysis. 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 1993 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 Applied Mathematics**

Applications are invited for a tenure-track position in Applied Mathematics at the rank of assistant professor. Candidates should demonstrate promise for excellence in both teaching and research. Strong consideration will be given to, but is not limited to, numerical analysis and mathematical modeling. Salary is competitive and commensurate with experience and qualifications. The Mathematics Department has 25 full-time faculty members and about 35 M.S. and Ph.D. students. Applicants should send vita, three letters of recommendation, and brief description of research plans to: Dr. Myron Allen, Chair, Department of Mathematics, University of Wyoming, Laramie, Wyoming 82071. Applications completed by January 1, 1993 will receive first consideration. The University of Wyoming is an equal-opportunity employer and encourages applicants from women and minorities.

## CANADA

**CONCORDIA UNIVERSITY**
**Department of Computer Science**

We are looking for a new faculty member with either strong research records or excellent research potential to fill a tenure track position at the Assistant or Associate Professor rank. Applicants must have an interest and ability to teach effectively at both the undergraduate and graduate levels. The successful candidate will be expected to carry out independent research and other academic duties associated with our bachelor's, master's and Ph.D. programs. Priorities will be given to the following areas of specialization: **software systems, programming languages, and parallel computing. However, truly exceptional candidates** in all computer science areas are encouraged to apply.

The university is located in Montreal, which is well known for its cultural diversity and beauty. The department houses approximately 600 undergraduates, 90 Masters, and 35 Ph.D. students. While the undergraduate program emphasizes both fundamental and practical skills, our graduate research concentrates in **artificial intelligence, combinatorics, computer algebra, databases, distributed computing, large-scale scientific computing, pattern recognition, programming languages, software engineering, and VLSI architectures.** There are twenty-eight full-time faculty positions supporting these activities.

The department has established CENPARMI (Centre for Pattern Recognition and Machine Intelligence) with specialization in pattern recognition and related expert systems research. The research groups in mathematical computing and VLSI architectures are also members of two inter-university research centres: CICMA (Centre Interuniversitaire en Calcul Mathématique Algébrique) and GRIAO (Groupe de Recherche Interuniversitaire en Architecture de Haute Performance et VLSI). In particular, CICMA promotes research in algebraic computing, combinatorics and computational group theory. Recently, the department has set up a small parallel computing facility as a start-up platform to develop and focus interest in this area. We expect to upgrade this facility in the coming years. To promote the development of new faculty members, the university has a program to provide seed grants for their research in the first three years.

Concordia University is committed to Employment Equity and encourages applications from women, aboriginal peoples, visible minorities, and disabled persons. All things being equal, priority will be given to women candidates. Interested applicants should send a resume and the names of at least three references to:

**Chair**
**Department of Computer Science**
**Concordia University**
**1455 de Maisonneuve West**
**Montreal, Quebec H3G 1M8**
**Canada**
**Fax: (514) 848-2830**
**email: hiring@cs.concordia.ca**

In accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada.

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**McGILL UNIVERSITY**
**Mathematics and Statistics**

The Department of Mathematics and Statistics of McGill University is seeking to fill a tenure-track position in the field of automorphic forms and representation theory. The candidate should also have a proven record of strong interaction with number theory and arithmetic algebraic geometry. The position is subject to final budgetary approval and would commence in September 1993. Your application should be sent to:

Professor K. Peter Russell, Chair
Department of Mathematics and Statistics
McGill University
805 Sherbrooke Street West
Montreal, Quebec, Canada H3A 2K6

Please include a statement of research and teaching accomplishments and plans along with your letter of application, and arrange for 3 letters of recommendation to be sent to the above address. McGill University is committed to equity in employment. In accordance with the Canadian immigration requirements priority will be given to Canadian citizens and permanent residents. The deadline for receipt of completed applications is December 7, 1992.

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**UNIVERSITY OF WATERLOO**
**Department of Pure Mathematics**

The Department of Pure Mathematics at the University of Waterloo invites applications for one or more tenure track positions at the Assistant Professor level starting July 1, 1993. For its first appointment the Department is particularly interested in candidates whose research interests are related to Algebraic Geometry, Algebraic Topology or Differential Geometry. A second appointment (tenure track or definite term) may also be made in the above areas or in some area of Analysis. 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 candidate's qualifications. The deadline for applications is January 15, 1993. 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 regulations this advertisement is directed at Canadian citizens and permanent residents of Canada. The University of Waterloo encourages applications from qualified women and men, members of visible minorities, native peoples and persons with disabilities. All appointments are subject to the availability of funds. Please send applications to: Dr. J.W. Lawrence, Chair, Department of Pure Mathematics, University of Waterloo, Waterloo, Ontario, Canada, N2L 3G1.

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## FOR SALE

**PASCAL-XSC**

The programming language for mathematicians. Compilers and documentation. FBSoftware, P. O. Box 44666, Madison, WI 53744-4666. (608) 273-3702.

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## POSITIONS WANTED

Mathematics Professor, Teaching and Research. Ph.D. 1974. Specialty: general and set-theoretic topology. Strong commitment to teaching. Over twenty published articles. Seven external research grants. Eighteen years of university teaching and research. Supervised master's theses. U.S. citizen. Any U.S. location. References and resume available upon request. Available immediately. Respond to applicant code 96, AMS *Notices*, 1-800-321-4267 Ext. 4084.

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Young mathematician seeks position as Assistant Professor. No school too big or small. Excellent teacher with strong research capability. Write or call RICHARD W. RUEDEMANN, 546 S. Country Club Dr., Mesa, AZ 85210; (602)834-8672.

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## PUBLICATIONS FOR SALE

**MATH SCI PRESS**, 53 Jordan Rd., Brookline, MA 02146, 617-738-0307. **Constrained Mechanics and Lie Theory**, $95. **Geometric Structures in Nonlinear Physics**, $95, both by R. Hermann.

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## 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. email: dennis@mssun7.msi.cornell.edu

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# *MATHEMATICAL REVIEWS*

## ASSOCIATE EDITOR - HALF-TIME

Applications and recommendations are invited for a one- or two-year half-time appointment as an Associate Editor of *Mathematical Reviews* (*MR*), to commence in January 1993. Applications will be welcome from persons taking leave from other positions and in particular from tenured faculty members who can take leave to come to *MR* for one or two years.

The *MR* office of the American Mathematical Society is located in Ann Arbor, Michigan, not far from the campus of the University of Michigan. The editors, although employees of the AMS, enjoy many privileges at the University. At present, *MR* employs fourteen mathematical editors, about six consultants, and over sixty nonmathematicians. It produces *Mathematical Reviews*, *Current Mathematical Publications*, various indexes, the on-line service MathSci and MathSci Disc. The responsibilities of an Associate Editor fall primarily in the day-to-day operations of selecting articles and books suitable for review, classifying these items, assigning them to reviewers, editing the reviews when they are returned, and correcting the galley proof. An individual with considerable breadth in pure or applied mathematics is sought and preference will be given those applicants with expertise in numerical analysis. The ability to write good English is essential and the ability to read mathematics in major foreign languages is important. (The ability to read mathematical articles in Russian or Chinese is especially desirable.)

Persons interested in combining a sabbatical or other leave with this half-time appointment as an Associate Editor are encouraged to write (by letter or email) for further information. The twelve-month salary is negotiable and will be commensurate with the experience the applicant brings to the position.

Applications (including curriculum vitae, bibliography, and names and addresses of at least three references) should be sent to

Dr. D. G. Babbitt, Executive Editor
*Mathematical Reviews*
P. O. Box 8604
Ann Arbor, MI 48107-8604
Telephone: 313-996-5255
FAX: 313-996-2916
INTERNET: DGB@MATH.AMS.COM

Interested applicants are urged to inquire without delay.

The American Mathematical Society is an equal opportunity employer.

# INSTITUTE FOR MATHEMATICS AND ITS APPLICATIONS

announces a program on

# EMERGING APPLICATIONS OF PROBABILITY

ORGANIZING COMMITTEE: J. MICHAEL STEELE, DAVID ALDOUS, PERSI DIACONIS, RICK DURRETT, LARRY SHEPP

A one-year program with three parts: (1) Fall: September 10 – December 20, 1993, Probability & Computer Science; (2) Winter: January 2 – March 31 1994, Mathematical Genetics; Queuing Networks; (3) Spring: April 1 – June 30, 1994, Probability in Geo-Systems.

## POSTDOCTORAL MEMBERSHIPS*

All requirements for a doctorate should be completed by September 1, 1993. 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 15, 1993):

(1) Personal statement of scientific interests, research plans, and reasons for wishing to participate in the Emerging Applications of Probability 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.
* The actual hiring title will be "Research Associate"

## SENIOR MEMBERSHIPS

Preference will be given to supplementary support for persons with sabbatical leaves, fellowships, or other stipends.

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## POSTDOCTORATES IN INDUSTRIAL MATHEMATICS

IMA announces at least 4 one-to-two year positions in Industrial Mathematics, effective September 1, 1993. 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, 1993. 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 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 actual hiring title will be "Research Associate".

The University of Minnesota is an equal opportunity educator and employer.

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The application forms are available via anonymous 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, Hitachi, Honeywell, IBM, Kao, Motorola, Siemens, 3M, UNISYS

# The Geometry Center

***The National Science & Technology Research Center for Computation and Visualization of Geometric Structures***

The Geometry Center is based at the University of Minnesota in Minneapolis in 15,000 square feet of space overlooking the Mississippi.

The Geometry Center is looking for highly talented and motivated individuals with a strong background in mathematics or computer science. The Center has created a unified computing environment centered on math and supporting:

- math and computer science research,
- software and tool development,
- application development,
- mathematical visualization,
- video animation production, and
- high school and college math education.

**Apprentices**

In the past, successful apprentices have included those who wish to take time off from college to get work experience, and those who have graduated from college and want to get more experience before deciding on a future career or further graduate education. The unique Center environment reflects elements of both the corporate and academic worlds.

Based on his or her interests and the needs of the Center, an apprentice will work with senior staff or faculty on a primary project related to the areas listed above. In addition, each apprentice will assist in visitor orientation and related tasks.

The salary will be at the level of a full time graduate student, between $20,000 and $25,000/year according to background.

**Postdoctoral Fellowships**

Up to three fellowships will be awarded for start up to Fall, 1993. They are for one year with the possibility of a one year extension. Remuneration will normally be $40,000/12 months if there is no other support.

Applicants will be accepted from all branches of the mathematical sciences; preference may be given to those whose work relates to current interests of the Center. A very high level of accomplishment and breadth of education is expected from the applicants and also a substantial computing background. Applicants should also be willing to supervise student assistants and otherwise participate in the education program of the Center.

**Research Professorships**

Application is encouraged and welcomed from those with full or partial independent funding who would like to consider resi-dence in the intensive computer environment of the Center. A few grants may be available up to half-salary or $30,000.

**Applications**

To apply, please send a letter of interest including a description of your research program along with a resumé and letters of recommendation as appropriate to:

Angie Vail, Sr. Admin. Dir.
The Geometry Center
1300 South Second Street
Minneapolis, MN 55454

Please address letters of inquiry regarding research professorships to Professor Albert Marden, Director, The Geometry Center.

*The University of Minnesota is an equal opportunity educator and employer.*

# CRM/ISM POSTDOCTORAL FELLOWSHIPS

ISM
Institut des sciences mathématiques

The Centre de recherches mathématiques (CRM) and Institut des sciences mathématiques (ISM) of Montréal invite applications for their joint postdoctoral program. At least four two-year positions are expected to be filled, the starting dates being approximately September 1993. The annual stipend is $32,000 CDN, and a modest research grant is provided.

CRM is a national research center for mathematics and its applications. Its ongoing areas of research include analysis and differential equations, mathematical physics, numerical analysis, optimization, and interdisciplinary modeling. CRM also organizes special years that involve a wide range of events and international participation. The main theme for 1993-94 is *Dynamical Systems*, and for 1994-95 it is *Geometry and Topology*.

ISM is an inter-university institute which combines the resources of Montréal's five departments of the mathematical sciences, in particular for purposes of graduate education. Approximately 125 faculty members participate in its ten programs:

1. Algebra and Number Theory
2. Analysis and Applications
3. Combinatorics, Algebraic Computation and Algorithms
4. Nonlinear Dynamics
5. Geometry and Topology
6. Applied and Computational Mathematics
7. Mathematical Physics
8. Probability: Theory and Applications
9. Decision Theory and Mathematical Statistics
10. Category Theory and Applications

Applications, which should be complete by February 1, 1993, comprise a curriculum vitae, a statement of research interests, and three letters of recommendation sent directly to:

**Francis Clarke, Director**
CRM
Université de Montréal
P.O.Box 6128-A
Montréal, Québec
Canada H3C 3J7

Concordia UNIVERSITY · McGill · Université de Montréal · ÉCOLE POLYTECHNIQUE · Université du Québec à Montréal

# The Fields Institute for Research in Mathematical Sciences

The Fields Institute for Research in Mathematical Sciences invites applications for Institute Junior Fellowships for the 1993-94 program year. These fellowships will be tenable for two years, the second of which being held at McMaster University, the University of Toronto or McGill University. Candidates should possess a PhD degree in mathematical sciences and have a strong research record. Partial support may also be available for a limited number of additional participants and graduate students working in the program area.

For the 1993-94 academic year the topic of concentration is L-Functions. The organising committee for the programme consists of Manfred Kolster and Victor Snaith (McMaster University), Kumar Murty (University of Toronto) and Ram Murty (McGill University) supplemented by an advisory panel of Spencer Bloch (University of Chicago), John Coates (University of Cambridge), and Martin Taylor (University of Manchester Institute of Science and Technology).

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**Applications, including curriculum vitae and three letters of reference sent directly to the Institute on your behalf, should be sent by January 15, 1993 to:**

**Dr. J.E. Marsden, Director**
**The Fields Institute for Research in Mathematical Sciences**
**185 Columbia St. W.**
**Waterloo, Ontario, Canada**
**N2L 5Z5**

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The Institute is a collaboration involving McMaster University, the University of Toronto, the University of Waterloo and affiliate universities across Canada. It is supported by the Ministry of Colleges and Universities of Ontario and the National Sciences and Engineering Research Council of Canada.

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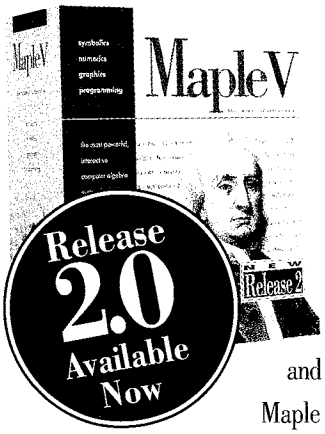


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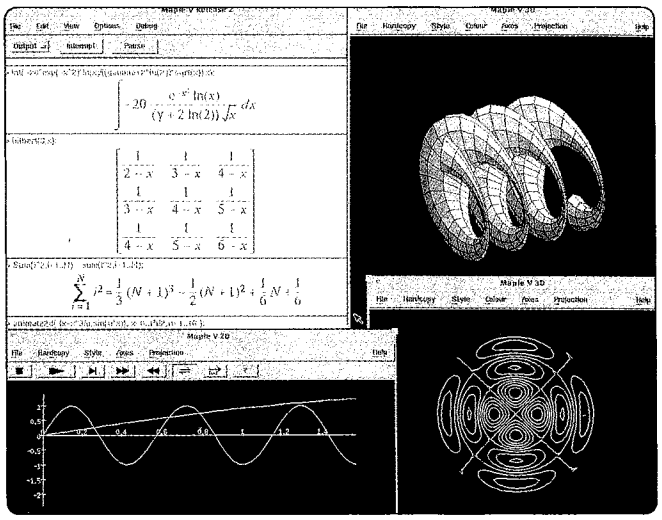

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August 1992
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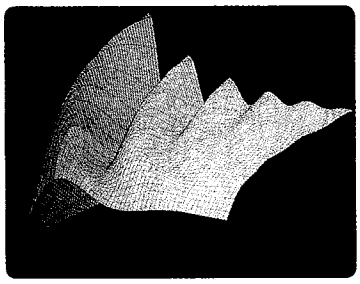

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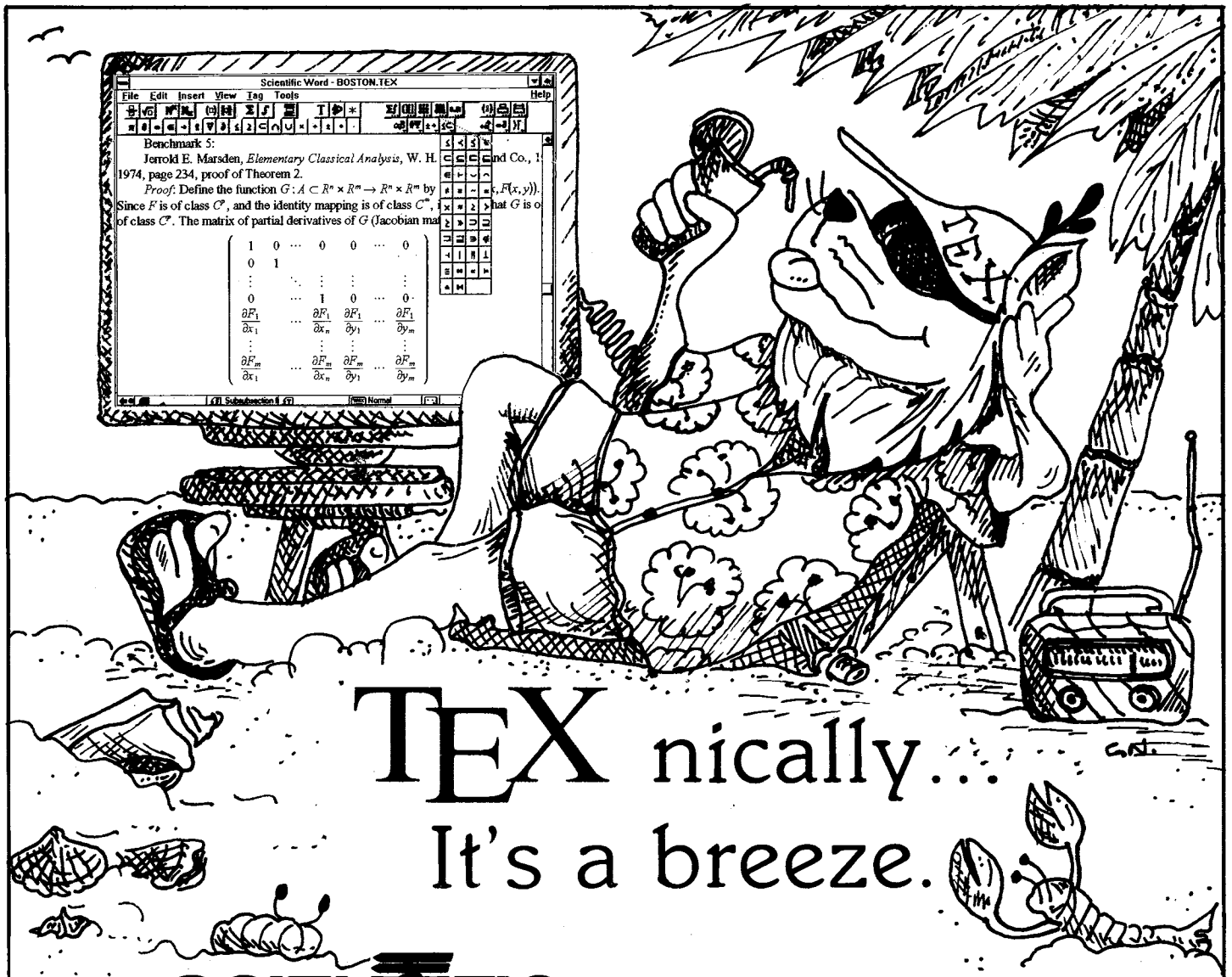


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*Subscriptions to the* Notices *and the* Bulletin *(New Series) are included as part of your membership.*

.....

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.....

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Date of Birth .....

***Day*** ***Month*** ***Year***

If formerly a member of AMS, please indicate dates .....

Check here if you are now a member of either MAA ☐ or SIAM ☐

Degrees, with institutions and dates .....

.....

.....

Present position .....

Firm or institution .....

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(January–December)

Date ..... 19 .....

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00 General
01 History and biography
03 Mathematical logic and foundations
04 Set theory
05 Combinatorics
06 Order, lattices, ordered algebraic structures
08 General algebraic systems
11 Number theory
12 Field theory and polynomials
13 Commutative rings and algebras
14 Algebraic geometry
15 Linear and multilinear algebra; matrix theory
16 Associative rings and algebras
17 Nonassociative rings and algebras
18 Category theory, homological algebra
19 *K*-theory
20 Group theory and generalizations
22 Topological groups, Lie groups
26 Real functions
28 Measure and integration
30 Functions of a complex variable
31 Potential theory
32 Several complex variables and analytic spaces
33 Special functions
34 Ordinary differential equations
35 Partial differential equations
39 Finite differences and functional equations
40 Sequences, series, summability
41 Approximations and expansions
42 Fourier analysis
43 Abstract harmonic analysis
44 Integral transforms, operational calculus
45 Integral equations
46 Functional analysis
47 Operator theory
49 Calculus of variations and optimal control; optimization
51 Geometry
52 Convex and discrete geometry
53 Differential geometry
54 General topology
55 Algebraic topology
57 Manifolds and cell complexes
58 Global analysis, analysis on manifolds
60 Probability theory and stochastic processes
62 Statistics
65 Numerical analysis
68 Computer science
70 Mechanics of particles and systems
73 Mechanics of solids
76 Fluid mechanics
78 Optics, electromagnetic theory
80 Classical thermodynamics, heat transfer
81 Quantum theory
82 Statistical mechanics, structure of matter
83 Relativity and gravitational theory
85 Astronomy and astrophysics
86 Geophysics
90 Economics, operations research, programming, games
92 Biology and other natural sciences, behavioral sciences
93 Systems theory; control
94 Information and communication, circuits

M3NO

## *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 $81, for those whose annual professional income is $45,000 or more, the dues are $108.*

*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 $69 and for those whose annual professional income is above $45,000, the dues are $92.*

*For a **joint family membership,** one pays ordinary dues, based on his or her income, and 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 $162.*

*For either **students** or **unemployed individuals,** dues are $27, and annual verification is required.*

*The annual dues for **reciprocity members** who reside outside the U.S. and Canada are $54. 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 ($81 or $108).*

*The annual dues for **Category-S members,** those who reside in developing countries are $27.*

*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 either unemployed or student members.*

## *1993 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 ..... ☐ $81 ☐ $108

CMS Cooperative rate ..... ☐ $69 ☐ $92

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Student member (please verify)[1] ..... ☐ $27

Unemployed member (please verify)[2] ..... ☐ $27

Reciprocity member (please verify)[3] ..... ☐ $54 ☐ $81 ☐ $108

Category-S member ..... ☐ $27

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.*

## *Reciprocating Societies*

- ☐ Allahabad Mathematical Society
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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*.

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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.

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# MAA Minicourse Preregistration Form, San Antonio, Texas

January 13–16, 1993

**NOTE: This is NOT an AMS Short Course Form. Please use the Joint Meetings Preregistration/Housing Form to preregister 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 preregistration: November 13, 1992 (After this date, potential participants are encouraged to call the MAA headquarters at 800-331-1622.)
- Deadline for cancellation in order to receive a 50% refund: December 30, 1992
- Each participant must fill out a separate Minicourse Preregistration form.
- Enrollment is limited to two Minicourses, subject to availability.
- Please complete the following and send both form and payment to 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

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| Minicourse Number and Name | Organized by | Fee |
|---|---|---|
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| 2. How to make effective use of inexpensive pocket computers to develop the concepts and techniques of calculus | Franklin Demana & Bert K. Waits | $45 |
| 3. All right! I've got a graphing calculator. What happens next? | Iris Brann Fetta | $36 |
| 4. Unifying themes in discrete mathematics | Ralph Grimaldi | $36 |
| 5. Using supercalculators to enhance instruction and learning in linear algebra | Donald R. LaTorre | $36 |
| 6. Teaching the introductory statistics course | Donald L. Bently, Robin Lock, Mary Parker, Thomas L. Moore & Jeffrey A. Witmer | $36 |
| 7. Project CALC: Calculus as a laboratory course | Lawrence C. Moore & David A. Smith | $36 |
| 8. Environmental models | Roland H. Lamberson | $36 |
| 9. Earth algebra: College algebra with applications to environmental issues | Christopher Schaufele & Nancy Zumoff | $36 |
| 10. Why, when and how to use CAS calculators in calculus and differential equations instruction | John Kenelly & Gil Proctor | $45 |
| 11. Using group projects in calculus | Stephen Hilbert, John Maceli, Eric Robinson, Diane Schwartz & Stanley Seltzer | $36 |
| 12. Bringing calculus to life | Bob Decker | $45 |
| 13. Teaching mathematical modeling | J. S. Hartzler | $36 |
| 14. Linear algebra, applications and computing | Gareth Williams | $45 |
| 15. The Harvard calculus reform project: Hands-on experience with the project materials | Deborah Hughes Hallett, Sheldon P. Gordon, William McCallum & Thomas Tucker | $45 |
| 16. Instituting a mathematics placement program: Creating order out of chaos in freshman mathematics | Geoffrey Akst | $36 |
| 17. Mathematics in a real and complex world | Frank Wattenberg | $36 |

☐ I plan on preregistering for the San Antonio, Texas 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, full refund of the San Antonio meetings preregistration fee will be made.

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MATHEMATICAL SCIENCES EMPLOYMENT REGISTER
JANUARY 13-15, 1993
SAN ANTONIO, TEXAS

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2. **This form CANNOT be submitted by electronic mail.**
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4. **Please check if Preregistration/Housing Form previously sent.** ❑
5. **Return form with payment with your Preregistration/Housing Form by November 13 to AMS, PO Box 6887, Providence, RI 02940, in order to be included in the Winter List of Employers.**

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Department _____

City, State, Zip _____

Name of Interviewer(s) 1. _____

2. _____

3. _____

4. _____

(A) Specialties Sought _____

(B) Title(s) of Position(s) _____

(C) Number of Positions _____

(D) Starting Date _____ / _____
Month Year

(E) Term of Appointment _____
Years

(F) Renewal ❑ Possible ❑ Impossible

Tenure Track Position ❑ Yes ❑ No

Teaching Hours per Week _____

(G) Degree Preferred _____ Degree Accepted _____

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Number of Interviewers **Session 1:** _____ **Interviewers** **Session 2:** _____ **Interviewers** **Session 3:** _____ **Interviewers** **Session 4:** _____ **Interviewers**

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**APPLICANT:** Name _____
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Ⓐ Specialities _____
Ⓑ Career objectives and accomplishments
ACADEMIC: ☐ Research ☐ University Teaching College Teaching: ☐ 4-year ☐ 2-year
Would you be interested in non-academic employment? ☐ yes ☐ no
Near-term career goals _____

Significant achievements _____

Paper to be presented at this meeting: _____

Ⓒ Degree Year (expected) Institution
_____ _____ _____ Ⓓ No. of abstracts, internal reports _____
_____ _____ _____ Ⓔ No. of papers accepted _____
_____ _____ _____ Ⓕ No. of books and patents _____

**PROFESSIONAL EMPLOYMENT HISTORY:**

| Ⓖ Employer | Position | Ⓗ Experience | Years |
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| 4. | | | to |

**DESIRED POSITION:**
Ⓘ Duties _____
Available mo. _____ /yr. _____ Ⓙ Desired geographical location _____
References (Name and Institution)

Citizenship: (check one) ☐ U. S. Citizen ☐ Non-U.S. Citizen, Permanent Resident
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**AVAILABLE FOR INTERVIEWS:**

| Session 1 ☐ | Session 2 ☐ | Session 3 ☐ | Session 4 ☐ |
|---|---|---|---|
| Thurs. AM 9:00-12:15 | Thurs. PM 1:30-4:45 | Fri. AM 9:00-12:15 | Fri. PM 1:30-4:45 |

**I do not plan to attend the San Antonio meetings.** ☐

**EMPLOYER FORM**

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JANUARY 13-15, 1993
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Years

(F) Renewal ❑ Possible ❑ Impossible

Tenure Track Position ❑ Yes ❑ No

Teaching Hours per Week _____

(G) Degree Preferred _____ Degree Accepted _____

(H) Duties _____

(I) Experience Preferred _____

Citizenship Restriction (Check One) ❑ U.S. Citizen ❑ Non-U.S. Citizen, Permanent Resident ❑ Non-U.S. Citizen, Temporary Resident

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Number of Interviewers **Session 1:** _____ **Interviewers** **Session 2:** _____ **Interviewers**
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❑ Not Interviewing

# Preregistration/Housing Form, San Antonio, Texas

January 13–16, 1993

Please complete this form and return it with your payment to
Mathematics Meetings Service Bureau
P.O. Box 6887, Providence, Rhode Island 02940 – Telephone: (401) 455-4143-Telex: 797192

| **DEADLINES:** | |
|---|---|
| Room Lottery Qualification | October 30, 1992 |
| Joint Meetings & AMS Short Course Preregistration/ Employment Register/Hotel Reservations/Tickets | November 13, 1992 |
| Final Preregistration ONLY (No housing, Employment Register, and/or tickets) | December 11, 1992 |
| Housing Changes/Cancellations | December 7, 1992 |
| 50% Refund on Tickets | December 30, 1992 (no refunds after this date) |
| 50% Refund Joint Meetings Preregistration/Employment Register/AMS Short Course | January 10, 1993 (no refunds after this date) |

| | REGISTRATION FEES Preregistration by December 11, 1992 $ |
|---|---|
| JOINT MATHEMATICS MEETINGS | |
| Member of AMS, ASL, CMS, MAA | 115 |
| * Emeritus Member of AMS or MAA | 30 |
| Nonmember | 178 |
| * Students: | |
| High School | 2 |
| Graduate or Undergraduate | 30 |
| * High School Teachers or Librarians | 30 |
| * Unemployed | 30 |
| AMS SHORT COURSE | |
| Member/Nonmember | 70 |
| * Student, Unemployed, or Emeritus | 30 |

| | Preregistration by November 13, 1992 |
|---|---|
| EMPLOYMENT REGISTER – Employer fee (1st Interviewer) | 125 |
| – Employer fee (2nd / 3rd Interviewer) | 60 |
| – Applicant fee | 30 |
| – Posting fee for job descriptions for noninterviewing employers | 30 |

(N.B.: A separate form appears in this issue for preregistration for MAA Minicourses)

* See section on "How to Preregister" in *Notices* or *Focus* for definitions of various registration categories.

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**PREREGISTRATION SECTION:** Please check the function(s) for which you are preregistering:

Joint Meetings ☐ AMS Short Course (January 11–12, 1993) ☐ Employer ☐ Co-Interviewer ☐ Applicant ☐ Posting ☐

1) _____ Telephone: _____
(Please print) Surname First Middle

2) _____ _____
(Mailing address) (e-mail address)

**I do not wish my badge, program, and/or Employment Register material to be mailed; however, the mailing address for my acknowledgement is given above.** ☐

3) Badge information: Affiliation _____

4) Students: Grad ☐ Undergrad ☐ High School ☐ 5) Emeritus member ☐ Unemployed ☐ Librarian ☐ High School Teacher ☐

6) Member of: AMS ☐ ASL ☐ 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 @ $27 each = $ ____ Veg. meal ☐ ____ MAA Monthly Banquet @ $27 each = $ ____ Veg. meal ☐
____ MER Banquet @ $28 each = $ ____ Veg. meal ☐ ____ AWM Workshop Dinner @ $28 each= $ ____ Veg. meal ☐
____ Country Western Social @ $10 each = $ _____ I will be attending the graduate student reception on 1/12/93. ☐

15) **Total amount enclosed for 7 through 14 $**_____ **Method of Payment:** ☐ Credit Card (Visa or MasterCard only)
☐ Purchase Order (original institutional PO attached) ☐ Check (payable to AMS; Canadian checks must be marked in "U.S. Funds")

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)

**See reverse for hotel reservations.** ☐ I will not require housing. ☐ I am making my own arrangements. ☐ I am staying in the local area.

For office use only:

| Codes: | Options: | Hotel: | Room type: |
|---|---|---|---|
| Dates: | Hotel Deposit | Total Amt. Paid: | |
| Special Remarks: | | | |

**HOUSING SECTION:** PREREGISTRATION/HOUSING FORM, San Antonio, Texas January 13–16, 1993

Please rank hotels in order of preference by writing 1, 2, 3, etc. in the spaces at the left on form, and by circling the requested room type and rate. If the rate requested is no longer available, you will be assigned a room at another hotel at the next available rate. **If not all hotels are ranked, and all rooms have been filled at the ranked hotels, the assignment will be made at an unranked hotel with the next available rate.** Rates listed below are subject to 13% sales/occupancy tax. **GUARANTEE REQUIREMENTS:** $50 by check **OR** a credit card guarantee with VISA, MasterCard, or American Express (for housing only). PLEASE SUPPLY THIS INFORMATION ON THE REVERSE, together with mailing address for confirmation of room reservation.

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Hyatt Regency** | .30 miles | $ 90 | $ 100 | $ 100 | $ 100 | $ 110 | $ 100 | $ 110 | $465+ |
| | **Hilton Palacio Del Rio** | .06 miles | | | | | | | | |
| | Regular | | 83 | 93 | 93 | 103 | 103** | 113 | 113** | 325+ |
| | Student*** | | 73 | 73 | 73 | 73 | 93 | 73 | 93 | N/A |
| | **Marriott Riverwalk (HEADQUARTERS)** | .06 miles | | | | | | | | |
| | Regular | | 83 | 93 | 93 | 103 | 113 | 113 | 123 | 478+ |
| | Student*** | | 73 | 73 | 73 | 73 | 83 | 73 | 83 | N/A |
| | **Marriott Rivercenter** | .10 miles | | | | | | | | |
| | Regular | | 82 | 92 | 92 | 112 | 132 | 132 | 152 | 225+ |
| | Student*** | | 72 | 72 | 72 | 72 | 92 | 72 | 92 | N/A |
| | **Plaza** | .10 miles | | | | | | | | |
| | Regular | | 81 | 91 | 91 | 101 | 111 | 111 | 121 | 250+ |
| | Student*** | | 71 | 71 | 71 | 71 | 81 | 71 | 81 | N/A |
| | **The Crockett** | .20 miles | | | | | | | | |
| | Regular | | 77 | 77 | 77 | 77 | 87 | 77 | 87 | 250+ |
| | Student*** | | 67 | 67 | 67 | 67 | 77 | 67 | 77 | N/A |
| | **Menger** | .20 miles | | | | | | | | |
| | Regular | | 74 | 84 | 84 | 94 | 104 | 104 | 114 | 152+ |
| | Student*** | | 70 | 70 | 70 | 70 | 80 | 70 | 80 | N/A |
| | **Emily Morgan** | .80 miles | | | | | | | | |
| | Regular | | 73 | 73 | 73 | 83 | 93 | 93 | 103 | N/A |
| | Student*** | | 63 | 63 | 63 | 63 | 73 | 63 | 73 | N/A |
| | **Holiday Inn Riverwalk** | .50 miles | 65 | 65 | 65 | 75 | 85 | 85 | 95 | 165+ |
| | **Travelodge on the River** | .50 miles | 65 | 65 | 65 | 75 | 83 | 75 | 83 | N/A |

*** Reservations for suites must be made directly with the Service Bureau. The hotel can supply general information only.**
**** Rollaway fee for non-family members is an additional $20 per day.**
***** Participant must be a certified student or unemployed (as described in the "How to Preregister" section of *Notices* or *Focus*) to qualify for these rates.**

Special housing requests: _____

☐ Please check here if you are physically challenged and have special needs. 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 to insure that your stay in San Antonio 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, and departure. Please also indicate ages of children. Please check here if one of the occupants is your spouse** ☐

_____

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