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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.

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

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<td>Heidelberg, Germany</td>
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<td></td>
<td>(Joint Meeting with the Deutsche Mathematiker-Vereinigung e.V.)</td>
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Please refer to page 1101 for listing of Special Sessions.

### Conferences

- **January 11–12, 1993**: AMS Short Course on Wavelets and Applications, San Antonio, Texas.
- **July 10–August 6, 1993**: Joint Summer Research Conferences in the Mathematical Sciences, University of Washington, Seattle,
  Washington.

### Other Events Cosponsored by the Society


### Deadlines

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* 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.
ARTICLES

1021 The Future of the National Science Foundation Walter E. Massey
Walter E. Massey, Director of the National Science Foundation (NSF), discusses the future of the NSF in remarks based on a presentation made to the National Science Board.

1024 Is It Time for a New GRE Mathematics Test? Would you Like to See Essay Questions on It?
The Committee of Examiners for the GRE (Graduate Record Examination) outlines some of the issues and constraints involved in making the decision to change the GRE, and solicits the mathematical community's comments.

1026 1992 Annual AMS-MAA Survey First Report
The first report on the 1992 survey includes the 1992 survey of new doctorates, starting salaries of new doctorates, faculty salaries, and a list of names and thesis titles for members of the 1991-1992 Ph.D. class. Also, a list of postdoctoral positions available in 1991-1992 in research or research/teaching is included.

FEATURE COLUMNS

1065 Computers and Mathematics Keith Devlin
"What constitutes an acceptable mathematical proof?", is the subject matter of Keith Devlin's editorial and this month's feature article by Donald Mackenzie. Also, two reviews complete the column. Fernando Gouvêa looks at MathType for Windows, and Tom Scavo and Larry Riddle report on their experience with PSMathGraphsII.

1077 Inside the AMS
Over the past several months, the AMS Committee on Science Policy and the AMS Committee on Education have been formulating a science strategy and an education strategy for the Society. This article contains the full strategy reports of the two committees, preceded by a summary article by Allyn Jackson. Also included is a report from the Committee on Professional Ethics.

1089 Washington Outlook
This month Lisa Thompson discusses a reexamination of federal science policy, in particular, federal support for research and a reconsideration of the mission of the National Science Foundation.
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 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 Vannevar 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-page 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...
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 Nezavisimaya 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 furthest 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.

1993 Advertising Rates
Notices of the American Mathematical Society

Beginning in January 1993 classified advertising rates in the Notices will be $65 per inch on a single column (one inch minimum), calculated from top of type; $35 for each additional 1/2 inch or fraction thereof.

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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 with 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
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 AMS. 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 G. 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.

¹These 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 382–383. 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.

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**

<table>
<thead>
<tr>
<th>Group</th>
<th>Response Rate</th>
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<tbody>
<tr>
<td>Group I</td>
<td>39 of 39 including 1 with 0 degrees</td>
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<tr>
<td>Group II</td>
<td>40 of 43 including 2 with 0 degrees</td>
</tr>
<tr>
<td>Group III</td>
<td>77 of 88 including 26 with 0 degrees</td>
</tr>
<tr>
<td>Group IV</td>
<td>52 of 75 including 6 with 0 degrees</td>
</tr>
<tr>
<td>Group Va</td>
<td>14 of 17</td>
</tr>
<tr>
<td>Group Vb</td>
<td>13 of 33 including 3 with 0 degrees</td>
</tr>
</tbody>
</table>

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**

<table>
<thead>
<tr>
<th>Fall/Spring</th>
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<th>Fall/Spring</th>
<th>Fall/Spring</th>
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<td>88–89</td>
<td>89–90</td>
<td>90–91</td>
<td>91–92</td>
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<tr>
<td>804 828</td>
<td>905 919</td>
<td>933 950</td>
<td>1074 1125</td>
<td>1050*</td>
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</table>

* 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**

<table>
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<th>Fall/Spring</th>
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<th>Fall/Spring</th>
<th>Fall/Spring</th>
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<tr>
<td>87–88</td>
<td>88–89</td>
<td>89–90</td>
<td>90–91</td>
<td>91–92</td>
</tr>
<tr>
<td>760 854</td>
<td>881 1034</td>
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</table>

* 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.


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

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*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

<table>
<thead>
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<th>TYPE OF DOCTORATE-GRANTING DEPARTMENT</th>
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<td></td>
<td>1050</td>
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*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 165 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 nondonorate 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 non-doctorate 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*

<table>
<thead>
<tr>
<th>TYPE OF EMPLOYER</th>
<th>TYPE OF CITIZENSHIP</th>
<th>TOTAL DOCTORATES WHOSE CITIZENSHIP IS KNOWN*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>U.S. Citizens</td>
<td>Non-U.S. Citizens</td>
</tr>
<tr>
<td></td>
<td>Number</td>
<td>Percent</td>
</tr>
<tr>
<td>U.S. Academic, Ph.D. Department</td>
<td>88</td>
<td>21</td>
</tr>
<tr>
<td>U.S. Academic, non-Ph.D. Department</td>
<td>153</td>
<td>36</td>
</tr>
<tr>
<td>U.S. Research Institute</td>
<td>33</td>
<td>8</td>
</tr>
<tr>
<td>U.S. Nonacademic</td>
<td>58</td>
<td>14</td>
</tr>
<tr>
<td>Foreign Academic</td>
<td>22</td>
<td>5</td>
</tr>
<tr>
<td>Foreign Nonacademic</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Not seeking employment</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Still seeking employment</td>
<td>46</td>
<td>11</td>
</tr>
<tr>
<td>Unknown status (U.S. address)</td>
<td>24</td>
<td>6</td>
</tr>
<tr>
<td>Unknown status (foreign address)</td>
<td>26</td>
<td>4</td>
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<tr>
<td>TOTALS</td>
<td>428</td>
<td>100%**</td>
</tr>
</tbody>
</table>

* 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 indispensable 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 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 are bounded by the former Soviet Union and China to the north, and by Indochina in the east.

### Table 4A: Sex, Racial/Ethnic Group, and Citizenship of U.S. New Doctorates

<table>
<thead>
<tr>
<th>RACIAL/ETHNIC GROUP</th>
<th>MEN</th>
<th>WOMEN</th>
<th>TOTAL</th>
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<tr>
<td></td>
<td>U.S.</td>
<td>Canada</td>
<td>Other</td>
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<tr>
<td>Asian, Pacific Islander</td>
<td>16</td>
<td>2</td>
<td>297</td>
</tr>
<tr>
<td>Black</td>
<td>6</td>
<td>11</td>
<td>17</td>
</tr>
<tr>
<td>American Indian, Eskimo, Aleut</td>
<td>4</td>
<td>25</td>
<td>29</td>
</tr>
<tr>
<td>Mexican American, Puerto Rican, or other Hispanic</td>
<td>295</td>
<td>8</td>
<td>128</td>
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<tr>
<td>None of the above</td>
<td>6</td>
<td>1</td>
<td>23</td>
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<tr>
<td>Total</td>
<td>327</td>
<td>11</td>
<td>462</td>
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</tbody>
</table>

### Table 4B: Region of Citizenship of 1991-1992 U.S. New Doctorates

<table>
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<tr>
<th>GEOGRAPHICAL REGION</th>
<th>Number</th>
<th>% Change from 1983-86 Annual Average</th>
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<tr>
<td>U.S.A.</td>
<td>428</td>
<td>+3</td>
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<tr>
<td>Canada</td>
<td>15</td>
<td>+36</td>
</tr>
<tr>
<td>Central and South America</td>
<td>31</td>
<td>-14</td>
</tr>
<tr>
<td>Western Europe</td>
<td>79</td>
<td>+95</td>
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<td>Eastern Europe*</td>
<td>27</td>
<td>+151</td>
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<tr>
<td>Middle East</td>
<td>32</td>
<td>-21</td>
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<td>Southern Asia**</td>
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<td>+21</td>
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<td>Far East***</td>
<td>314</td>
<td>+172</td>
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<td>Africa</td>
<td>24</td>
<td>+13</td>
</tr>
<tr>
<td>Australia and Oceania****</td>
<td>15</td>
<td>+25</td>
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</tr>
<tr>
<td>Total</td>
<td>1050</td>
<td>+41</td>
</tr>
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</table>

* 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 in the east.

*** Including Indochina.

**** Including Central and South Pacific islands, Australia, New Zealand, and the Malay Archipelago.
TABLE 5: U.S. Citizen Doctorates

<table>
<thead>
<tr>
<th>Year</th>
<th>Adjusted Total* of Doctorates given by U.S. universities</th>
<th>Total of Doctorates who are U.S. citizens</th>
<th>%</th>
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</thead>
<tbody>
<tr>
<td>1973-1974</td>
<td>938</td>
<td>677</td>
<td>72</td>
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<td>1974-1975</td>
<td>999</td>
<td>741</td>
<td>74</td>
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<td>1975-1976</td>
<td>965</td>
<td>722</td>
<td>75</td>
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<tr>
<td>1976-1977</td>
<td>901</td>
<td>689</td>
<td>76</td>
</tr>
<tr>
<td>1977-1978</td>
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<td>634</td>
<td>75</td>
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<td>1978-1979</td>
<td>806</td>
<td>596</td>
<td>74</td>
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<td>1979-1980</td>
<td>791</td>
<td>578</td>
<td>73</td>
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<tr>
<td>1980-1981</td>
<td>839</td>
<td>567</td>
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<td>1981-1982</td>
<td>798</td>
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<td>65</td>
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<td>1982-1983</td>
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<td>61</td>
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<td>1983-1984</td>
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<td>433</td>
<td>59</td>
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<td>1984-1985</td>
<td>726</td>
<td>396</td>
<td>55</td>
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<td>1985-1986</td>
<td>755</td>
<td>386</td>
<td>51</td>
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<tr>
<td>1986-1987</td>
<td>739</td>
<td>362</td>
<td>49</td>
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<tr>
<td>1987-1988</td>
<td>798</td>
<td>363</td>
<td>45</td>
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<td>1988-1989</td>
<td>884</td>
<td>411</td>
<td>46</td>
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<tr>
<td>1989-1990</td>
<td>929</td>
<td>401</td>
<td>43</td>
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<tr>
<td>1990-1991</td>
<td>1061</td>
<td>461</td>
<td>43</td>
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<tr>
<td>1991-1992</td>
<td>1016</td>
<td>430</td>
<td>42</td>
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</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Doctorates who are U.S. citizens</th>
<th>Male</th>
<th>Female</th>
<th>% Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973-1974</td>
<td>677</td>
<td>618</td>
<td>59</td>
<td>9</td>
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<tr>
<td>1974-1975</td>
<td>741</td>
<td>658</td>
<td>83</td>
<td>11</td>
</tr>
<tr>
<td>1975-1976</td>
<td>722</td>
<td>636</td>
<td>86</td>
<td>12</td>
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<tr>
<td>1976-1977</td>
<td>689</td>
<td>602</td>
<td>87</td>
<td>13</td>
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<tr>
<td>1977-1978</td>
<td>634</td>
<td>545</td>
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<td>14</td>
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<td>1978-1979</td>
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<tr>
<td>1979-1980</td>
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<td>1980-1981</td>
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<td>102</td>
<td>18</td>
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<tr>
<td>1981-1982</td>
<td>519</td>
<td>431</td>
<td>88</td>
<td>17</td>
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<td>1982-1983</td>
<td>455</td>
<td>366</td>
<td>89</td>
<td>19</td>
</tr>
<tr>
<td>1983-1984</td>
<td>433</td>
<td>346</td>
<td>87</td>
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<td>1984-1985</td>
<td>386</td>
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<td>81</td>
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<tr>
<td>1985-1986</td>
<td>386</td>
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<td>82</td>
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<tr>
<td>1986-1987</td>
<td>362</td>
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<tr>
<td>1987-1988</td>
<td>363</td>
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<tr>
<td>1988-1989</td>
<td>411</td>
<td>313</td>
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<td>24</td>
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<tr>
<td>1989-1990</td>
<td>401</td>
<td>312</td>
<td>89</td>
<td>22</td>
</tr>
<tr>
<td>1990-1991</td>
<td>461</td>
<td>349</td>
<td>112</td>
<td>24</td>
</tr>
<tr>
<td>1991-1992</td>
<td>430</td>
<td>327</td>
<td>103</td>
<td>24</td>
</tr>
</tbody>
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**Applied Discrete Mathematics and Theoretical Computer Science**

**Convergence Theory of Feasible Direction Methods**

Du Dingzhu

This monograph is the first in a new series published by Science Press New York and Science Press Beijing and distributed by the American Mathematical Society. Many of the basic results included in this volume have not appeared in other books on this subject. Providing state-of-the-art review of convergence theory, this book will prove useful as an introduction to the field as well as a reference for specialists.

1991 *Mathematics Subject Classification*: 90, 49

ISBN 1-880132-00-1; 7-03-002633-0/O.495 Science Press, Beijing.

118 pages (hardcover), 1991. List price $31

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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

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One year or less experience (112 men + 31 women)

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### Nine-Month Teaching or Teaching and Research

![Graph showing salary distribution with box plots and outliers]
### Nine-Month Salaries

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#### Nine-Month Research

Graph omitted because sample size too small.

### Twelve-Month Salaries

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#### Twelve-Month Teaching or Teaching and Research

![Box plot graph]
### Twelve-Month Salaries

**Ph.D. Year** | **Min** | **Q₁** | **Median** | **Q₃** | **Max** | **Reported Median in 1991 $**
---|---|---|---|---|---|---
**RESEARCH**  
(19 men + 6 women)
1960 | 97 | 105 | 140 | 474 |
1965 | 81 | 93 | 107 | 366 |
1970 | 90 | 120 | 205 | 402 |
1975 | 90 | 119 | 180 | 265 |
1980 | 120 | 180 | 321 | 296 |
1985 | 190 | 295 | 400 | 520 | 427 |
1989 | 180 | 250 | 385 | 623 | 344 |
1990 | 180 | 280 | 366 | 546 | 312 |
1991 | 190 | 277 | 320 | 480 | 320 |
1992 | 186 | 300 | 360 | 480 | 300 |
1989M | 180 | 250 | 300 | 393 | 623 |
1989F | 200 | 295 | 350 | 373 | 400 |
1990M | 180 | 280 | 366 | 546 |
1990F | 330 | 330 | 365 | 400 | 400 |
1991M | 190 | 290 | 310 | 360 | 480 |
1991F | 240 | 272 | 340 | 405 | 450 |
1992M | 210 | 300 | 393 | 480 |
1992F | 186 | 250 | 370 | 380 | 400 |

One year or less experience (19 men + 6 women)
1992M | 210 | 300 | 358 | 480 |
1992F | 166 | 250 | 380 | 400 |

### Twelve-Month Research

**Year**  | **Hundreds Of Dollars**
---|---
1989 | 300 |
1990 | 350 |
1991 | 400 |
1992 | 450 |

### Twelve-Month Government

**Ph.D. Year** | **Min** | **Q₁** | **Median** | **Q₃** | **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 | 381 | 440 | 406 |
1989 | 330 | 363 | 438 | 540 | 410 |
1990 | 320 | 345 | 378 | 387 | 333 |
1991 | 230 | 365 | 423 | 630 | 423 |
1992 | 315 | 438 | 530 | 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 | | 402 | 435 | 440 | 675 |
1992F | | | | |
### Twelve-Month Salaries

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**BUSINESS AND INDUSTRY**

(31 men + 8 women)

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**One year or less experience** (12 men + 5 women)

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**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>.
1992 Annual AMS-MAA Survey

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

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<td>Associate Professor</td>
<td>226</td>
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1992–1993 Academic year salary

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

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<td>833</td>
<td>&lt;50,55&gt;</td>
<td>&lt;60,65&gt;</td>
<td>&lt;70,75&gt;</td>
<td>61,616</td>
<td>62,443</td>
</tr>
</tbody>
</table>

1992–1993 Academic year salary
1992 Annual AMS-MAA Survey

FACULTY SALARIES 1992–1993

GROUP V — Doctorate-granting depts. of applied mathematics and operations research (21)
11 usable responses (52%)

<table>
<thead>
<tr>
<th>Rank</th>
<th>No. Reported</th>
<th>Q1</th>
<th>Median</th>
<th>Q3</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assistant Prof.</td>
<td>24</td>
<td>&lt;40,45&gt;</td>
<td>&lt;45,50&gt;</td>
<td>&lt;50,55&gt;</td>
<td>49,746</td>
</tr>
<tr>
<td>Associate Prof.</td>
<td>40</td>
<td>&lt;45,50&gt;</td>
<td>&lt;50,55&gt;</td>
<td>&lt;65,70&gt;</td>
<td>63,284</td>
</tr>
<tr>
<td>Full Prof.</td>
<td>95</td>
<td>&lt;60,65&gt;</td>
<td>&lt;70,75&gt;</td>
<td>&lt;80,85&gt;</td>
<td>74,578</td>
</tr>
</tbody>
</table>

* 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%)

<table>
<thead>
<tr>
<th>Rank</th>
<th>No. Reported</th>
<th>Q1</th>
<th>Median</th>
<th>Q3</th>
<th>Mean</th>
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</thead>
<tbody>
<tr>
<td>Assistant Prof.</td>
<td>861</td>
<td>&lt;30,35&gt;</td>
<td>&lt;35,40&gt;</td>
<td>&lt;35,40&gt;</td>
<td>35,994</td>
</tr>
<tr>
<td>Associate Prof.</td>
<td>1006</td>
<td>&lt;35,40&gt;</td>
<td>&lt;45,50&gt;</td>
<td>&lt;45,50&gt;</td>
<td>43,850</td>
</tr>
<tr>
<td>Full Prof.</td>
<td>1178</td>
<td>&lt;45,50&gt;</td>
<td>&lt;50,55&gt;</td>
<td>&lt;60,65&gt;</td>
<td>55,257</td>
</tr>
</tbody>
</table>

1992–1993 Academic year salary

1992–1993 Academic year salary

NOTICES OF THE AMERICAN MATHEMATICAL SOCIETY
1992 Annual AMS-MAA Survey

### FACULTY SALARIES 1992–1993

<table>
<thead>
<tr>
<th>Rank</th>
<th>No. Reported</th>
<th>Q1 Median</th>
<th>Q3 Median</th>
<th>Mean</th>
<th>1991–1992 Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assistant Professor</td>
<td>1101</td>
<td>&lt;30,35&gt;</td>
<td>&lt;35,40&gt;</td>
<td>33,882</td>
<td>32,889</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>1020</td>
<td>&lt;35,40&gt;</td>
<td>&lt;40,45&gt;</td>
<td>41,420</td>
<td>39,967</td>
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<tr>
<td>Full Professor</td>
<td>1080</td>
<td>&lt;40,45&gt;</td>
<td>&lt;45,50&gt;</td>
<td>51,538</td>
<td>49,057</td>
</tr>
</tbody>
</table>

**1992–1993 Academic year salary**

**ADVANCES IN SOVIET MATHEMATICS**

**Topics in Nonparametric Estimation**

*R. Z. Khasminskii, Editor*

**Volume 12**

This book contains papers presented at the Seminar on Mathematical Statistics held at the Institute for Problems of Information Transmission of the Academy of Sciences in the former Soviet Union. The topics covered include density, regression, image estimation, adaptive estimation, stochastic approximation, median estimation, sequential experimental design, and large deviations for empirical measures. This collection is distinguished by the high scientific level of the papers and their modern approach. This book will be of interest to scientists and engineers who use probability and statistics, to mathematicians and applied statisticians who work in approximation theory, and to computer scientists who work in image analysis.

1991 *Mathematics Subject Classification:* 60, 62, 68  

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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**


**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**


**Mathematics**

Cho, Gyeong-Mi, Stability analysis in stochastic multiple objective programming problems. Rigsby, Myron, Sylow p-subgroups of pseudo-complete nilpotent groups.

**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.

**Doctoral Degrees Conferred 1991–1992**


**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**


**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**

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 $H^*(B(1), \mathbb{R})$.

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


Radunskaya, Ami, Statistical properties of deterministic Bernoulli flows.

OPERATIONS RESEARCH

Chan, Nathanial 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


MATHEMATICS


Bishop, Edward Everitt, 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 $\omega_n$ minimal structures.

Rida, Ahmed-Said, On subfactors with the generating properties with graphs.

Rowan, William Haynie, Enveloping ringoids of universal algebras.

Schaefer, Edward Frank, Class groups and Selmer groups.

Schirolekner, Ober, On pro-finite groups and on discrete logarithms.

Starr, Edith N., Curves in handlebodies.

Tao, Yu, Numerical study of Stokes flows with suspended particles.

Vineberg, Susan Nicolet, Conditionalization and rational belief change.

Zeitz, Paul, Rank-one actions.

Zidariz, 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 non-linear 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


Iscri, 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-Khooon, Geometric quantities and topological structures of Riemannian manifolds.

Kuang, Wei-Jia, 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 Szegö 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 airfoils.

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 flows dynamo.

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, Mori contexts, and exact embeddability.


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.

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, Congruence patterns in subgroup counting functions.

Korol, Oleg, 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 boundary 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.


University of California, Santa Cruz (4)

Mathematics

Imamoglu, Ozlem, Theta functions and the Kubota homomorphisms for Sp(2n, Q(i)).

Liu, 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)

Mathematics 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 CP² – 1 and related association schemes.

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

Rijavec, Nenad, A Lagrangian relaxation algorithm for some multidimensional assignment problems.
1992 Annual AMS-MAA Survey

Statistics
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, Matrices for non-Gaussian linear processes.
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)
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Chattamvelli, Rajan, A comparison of selected algorithms for four noncentral statistical distributions.
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University of Connecticut (8)
MATHEMATICS
Feng, Yanling, The study of nonlinear flexions 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, Shihao, 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.
University of Delaware (6)
MATHEMATICAL SCIENCES
Borkowski, John J., Jr., The evaluation of mixed resolution designs.
Ju, Huey Lin, Spilt plotting and randomization in industrial experiments.
Mehrotra, Devan, Circularity diagnostics for repeated measures designs.
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
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MATHEMATICS AND STATISTICS
Ellis, Nancy F., The effect of in-class study groups on achievement and course completion rates in developmental algebra classes.
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Florida Institute of Technology (2)
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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)
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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.
**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.

**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**

Feigi, 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**

Arny, 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**

University of Illinois, Chicago (18)

MATHEMATICS, STATISTICS AND COMPUTER SCIENCE


Afenya, Kwasi Evans, Modelling abnormal granulocytopoiesis and its 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.

Huihuang, Wei, On Hilbert transforms, cardinal interpolation and Bernstein's inequality.

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 systems.

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

Naimpouropoulos, Kostas, Numerical convergence for the Bellman equation of stochastic optimal control with quadratic costs and constraints.

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

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

Tsai, Han-Ping, Construction of stable and omega-stable pseudoplanes.

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

Zabric, Eva, Hall polynomials for symplectic 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-generality and recursively enumerable weak truth table degrees.

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

Haputanagirige, Sunil Gunaratne, Generalized Kummer congruences and Iwasawa invariants.

Kugendran, Thambithurai, Quasiconvex optimization via generalized gradients and symmetric duality.

Kwon, K-Ho, Growth comparisons for certain Nevanlinna theory functionals.

Lee, Jinsuk, 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.

Pudlak, Pavel, 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 special data.

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

Indiana University (11)

MATHEMATICS

Chen, Shin, 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.

Purdue University (32)

INDUSTRIAL ENGINEERING

Bingelston, Liwana, Group mental model transfer.

Encenyo, 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, Lontief 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.

Veeraman, 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, Mathab Chafic, Electrostatics and the index of vector fields.

Kim, Hyungsun, 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 non-parametric 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.
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Ho, Yue-Chan, Some results on rings generated by semigroups.
Hu, Zhibao, Some properties related to the Radon-Nikodym property in Banach spaces.
Huang, Zhen, Mathematical models and algorithms for distribution system design and operation.

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Tang, Junjie, Prescribing curvature on manifolds with singularities.

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

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

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

Noble, William, First order allocations.

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

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

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

Yang, Shanshuang, Quasiextremal distance domains and quasiconformal reflections.

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

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

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

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

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Lei, Xingye (Cherry), A test of homogeneity with a simply ordered alternative based on dependent observations.
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Candel, Alberto, Uniformization of foliations by surfaces.
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University of Nebraska-Lincoln (3)
MATHEMATICS AND STATISTICS
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Dartmouth College (4)
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Princeton University (10)
MATHEMATICS
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New Mexico State University (2)
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Li, Jian-Hua, Stress analysis of Griffith cracks in nonhomogeneous elastic solids.

Shinde, Madhvi, Stochastic models in inventories and games.

Zhang, Zhao, 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-geostrophic flow.

Paternain, Gabriel, Geometric and topological properties of manifolds with completely integrable geodesic flow.

Slone, 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 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)**

Dynamical systems 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.

Nairn, 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.

Ferring, Ruennhwa, Lanczos-based condition estimation in signal processing and optimization.

Hwang, Dongming, Convergence of a Broyden’s method in Banach spaces.

Jang, Ho-Jong, The equilibrium equation: Subtracting the force method.

Mathews, David McCoy, Valuations defined by Ostrowski nets.

Mukundan, Lakshmi, Convergence analysis of the harmonic balance method.

Nagy, James Gerard, Toepitz 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**

Bonazzoli, Alberto, Modeling intransitive preferences among objects with transitively.

Harirhan, Rema, Routing and scheduling and queuing networks.

**OHIO**

Bowling Green State University (5)

**Mathematics and Statistics**

Boukasbar, 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.

Oulyed, 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

Soegiasto, Restuti, A covariate model in finite mixture survival distributions.
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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 reallc=ompact 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 semiproperr functions.
Donahu, 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 arithmetic functions.
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-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 permeability coefficients in elliptic and parabolic equations by mollification techniques.
Kim, Seong A., Convexity criteria and the hyperbolic density.

Oklahoma (3)
Oklahoma State University
Mathematics
Farmer, David Wayne, Mean value of Dirichlet series associated with cusp forms.

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 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, Isab 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.

Mathematics
Lei, Junjiang, Approximation by multi-integer translates of functions having global support.
O’Connor, Christopher, Seminormalizations of coordinate rings of unions of hyperplanes.

Pennsylvania (14)
Bryn Mawr College (1)
Mathematics

Carnegie Mellon University (13)
Mathematics
Antonić, Nenad, Memory effects in homeo-gerization and propagation of singularities.
Bridge, David S., Finite fuel singular stochastic control of an n-dimensional infinite horizon discounted problem.
Choi, Sea-Mean, Theory of connections.
Issar, Sunil, Operational issues in automated theorem proving using matchings.
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.
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.

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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, Ayaneendranath, 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 $H_{3,0}(z)$.
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.
Kunoro, 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.

ROHDE 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.
Rovelli, Todd Anthony, Simultaneous estimation of isotope intensity and attenuation coefficients in single photon emission tomography.
Rutot, Anthony 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
Cranell, Annalisa, The existence of many periodic non-travelling solutions to the Boussinesq equation.
Li, Ping, Li, Sheng, 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.
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 binding sites in biological transduction phenomena.

University of South Carolina (8)

Mathematics
Chen, Hsinjun, Compact convex sets and the barycenter in $L^1_0$.
Hong, Weihu, Interpolation of function spaces.
Kammoun, Jamel, Products with a K-metrizable factor.
Li, Kuo-Ming, $L^q$-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 $m^2 + n^2$. 
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.
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, Baladurage (Mahinda), Estimating the odds ratio under double sampling.
Sepanski, Jungsywan Hwang, Semiparametric quasi-likelihood 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.

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, Lingyu, 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.
Liao, Pen Hwang, Fractional factorial designs.
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.
Zhao, 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.
Zhang, 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 fibrations.
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 Kirchhoff plate equations with boundary feedback acting via bending moments only.
Sennin, Jonathan Reed, Parallel methods for elliptic finite element problems on a shared memory vector multiprocessor.
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-Maclaurin 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 $E$-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, Realing, 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 $n$th derivatives not much larger than necessary.

Lamb, David A., Pseudocompact and densely compact spaces in products.

Lazarov, Bora, 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.

Mekis, Hocine, Flow due to a singularity beneath a free surface.

Muchlis, Ahmad, Some combinatorial properties of polytopes of symmetric, nonsymmetric 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 Sag, 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 polynomials 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-fold socle.
Wyoming

University of Wyoming (2)

Mathematics
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 multiregion nonlinear regression.
Grinell, Raymond, Lorentz-improving measures on compact abelian groups.
Huay, Jay J., Tail probability of noncentral indefinite Gaussian quadratic form with applications to trellis coded MDPSK studies.
Jaworski, Wojciech, Solutions presque périodiques d'équation différentielle du type pendule forcée.

University of Alberta (8)

Mathematics
Fabbri, Marc, Generalized Heisenberg algebras and their vertex operator representations.
Kim, Hansoo, 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 boundaries of random walks.
Yang, Aihua, Optimization of Poisson means—a hierarchical Bayes approach.

Simon Fraser University (5)

Mathematics and Statistics
Chen, Ge, Empirical processes based on regression residuals theory and applications.
Das, Satil, Parameter estimation in oceano- graphic 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, Málcev products and related topics on the lattice of completely regular semigroups varieties.

Université de Montréal (5)

Mathématiques et Statistique
Adjoungue, Luc Désiré, Estimation pour des processus spatiaux définis sur un treillis triangulaire.
Benhabane, Moussa, Représentations poid 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 irrégulières.
Yeza, Abdelwahab, Optimisation des systèmes gouvernés par des équations intégrales.

Université de Sherbrooke (3)

DÉPARTEMENT DE MATHEMATIQUES 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 forcée.

University of British Columbia (3)

Mathematics
Chang, Huaxiong, Incompressible viscous flow in tubes with partial occlusions.
Chiarello, 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 Yuk Lun, Integral formulæ in differential geometry via mixed exterior algebra.
Livshits, Leonid, Generalized Schur product 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
Gittel, 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.
Ehong, Efrain O., Prepayment and pricing of mortgage-backed securities.
El-Haddad, John N., Outliers and time series modelling.
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

CANADA
University of Alberta (1)
MATHEMATICS
Kuang, Yang, Limit cycles in Gauss-type predator-prey systems.

Doctoral Degrees Conferred 1989–1990
Supplementary List

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 Schiemmel totients and some related questions.

Doctoral Degrees Conferred 1990–1991
Supplementary List

KENTUCKY
University of Kentucky (3)
MATHEMATICS
Akatsa, Victor, Flat envelopes and negative torsion functors.
Lilly, Glenn M., The $C_5$ 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 Information 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 2:0
Science
Cornell Univ
Applied Mathematics 3:1
SUNY at Albany
Computer Science 1:*
SUNY at Stony Brook
Applied Mathematics and 6:2
Statistics

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
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 documents1 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.

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1The 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. 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 correct answer and rounds it 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 have seen kids asked to write down what they’d do on a weekend in New York City and how much money it would

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²And this is even more true of school boards and parent groups.

³We 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.
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.
Student: But how do you know an argument is sound and logical? What do those words mean?
Professor: 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?
Student: 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?
Professor: 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?
Student: 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?
Professor: 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.
Student: What rules of logic? You never told us what they were.
Professor: Well, you just look at it. The irrationality of root-two for example. It it is obviously valid, so you know it could be translated into a valid predicate calculus proof.
Student: But how do you know your proof is valid in the first place?
Professor: (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.
Student: But how do you know your proof is valid in the first place?
Professor: 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

Edited by Keith Devlin

Computers and Mathematics
computers 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: ekj003@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 PSMathGraphsII. The Macintosh version of MathType was reviewed in this column by David Hartz in April 1991. The review of PSMathGraphsII 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
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 un provable. 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 DeMilllo, 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 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**


**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 \TeX\Xies, the w\ysiw\y\wizards, 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 \TeX\Xie, to come to terms with one of the better offerings from the opposing camp.

I guess by now we all know about \TeX\X: 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\X requires the usage of a reasonably large number of "control words" which communicate the desired symbols to the \TeX\X 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\X 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\X are speed and portability. As for speed, since a \TeX\X 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\X program will (or should) produce identical output on any of these platforms.

A final advantage of \TeX\X, 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, \AMSc-\TeX and \AMSc-T\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 \textit{mean} it,'' Don said.

\TeX requires the user to type

``I really \{it mean\} it,'' Don said.

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 \textit{all} you get”), though less so than the other points. Or so goes the traditional \TeXic 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 \textit{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\textsuperscript{1} links, or Microsoft’s OLE\textsuperscript{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\textsuperscript{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 source 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).

\section*{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

\begin{footnotesize}
\item[\textsuperscript{1}]Dynamic Data Exchange
\item[\textsuperscript{2}]Object Linking and Embedding
\item[\textsuperscript{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.
\end{footnotesize}
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).

MathType incorporates one of the more important features on **\LaTeX**, 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 **\LaTeX**, **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 **\LaTeX** to which many users have objected: the use of italics for upper-case letters in mathematical formulae. That is, it produces

\[
\text{GL}_2(N) \quad \text{as opposed to} \quad \text{GL}_2(N).
\]

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 wisswysg, 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 \(\LaTeX\)-\(\TeX\) 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 \texttt{\special} mechanism supported by most DVI-to-PostScript drivers), and can also be manipulated in various ways. The ability to save equations in a perfect, 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 snippet of \(\LaTeX\) (which was posted as a challenge on the USENET):

Plugging the expressions for $K_e$, $k_6$, $[\mathrm{H}]$, and $[\mathrm{I}]$ into this, we get

\[
\left\{\frac{\partial}{\partial t}\left\{\frac{\partial}{\partial t}\right\}\frac{\partial}{\partial x}\right\} = 2k_1\left\{\left[\frac{\partial}{\partial x}\right]^2\right\} - K_e\left\{\left[\frac{\partial}{\partial x}\right]^2\right\} \cdot \frac{1}{2}
\]

\[
\frac{\partial}{\partial x}\left\{\frac{\partial}{\partial x}\right\} + 1 \right\}
\]

\[\ldots\ldots\]

\(^4\)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
\[
\sum_{n \leq x} f(n) = \exp \left\{ -\gamma \tau(1) - \alpha \right\}^{-1} x^{2+i\theta} ((2 + i\theta)\Gamma(\tau(1)) \log x)^{-1} \prod_{\mathcal{P}(x^2)} \left( x(\log \log x)^{-\frac{1}{2}} (\log \log x)^{-\frac{1}{234}} \right).
\]

Here, $\alpha = \int_{1}^{\infty} \tau(u)/u \, du$, $\tau(u) \to -15$ as $u \to \infty$, and $\theta$, $\prod_{\mathcal{P}(x^2)}$, $\prod_{\mathcal{P}(x^2)}(x)$ 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
\[
\Xi(x; l, k) = \Omega_{\pm} \left( (x \log x)^{-1/3} (\log \log x)^{-1/234} \right)
\]

An example of output printed in \TeX.

There is a class of complex-valued distributive functions $f$ for which
\[
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\[
\Xi(x; l, k) = \Omega_{\pm} \left( (x \log x)^{-1/3} (\log \log x)^{-1/234} \right)
\]

An example of output printed using MathType and word for Windows.
This produces the following output:

Plugging the expressions for $K_e$, $k_6$, [H], and [I] into this, we get

$$\frac{d[H]}{dt} = 2k_1\left\{[H_2][I_2] - K_e[H]^2\right\}\left\{1 + \frac{k_3 K_d}{k_1 [I_2]^{1/2}} \cdot \frac{1}{K_s[H]^2 + 1}\right\}.$$  

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 $\LaTeX$-$\TeX$ options being added is mentioned in the manual). The $\TeX$ window containing the equation is in Figure 4. Here is MathType’s $\TeX$ output (lightly edited so that the initial phrase is normal text):

\[
\frac{d[H]}{dt} = 2k_1\left\{[H_2][I_2] - K_e[H]^2\right\}\left\{1 + \frac{k_3 K_d}{k_1 [I_2]^{1/2}} \cdot \frac{1}{K_s[H]^2 + 1}\right\}.
\]

Plugging the expressions for $K_e$, $k_6$, [H], and [I] into this, we get

\[
\text{d[H]} \text{d}t = 2k_1\left\{[H_2][I_2] - K_e[H]^2\right\}\left\{1 + \frac{k_3 K_d}{k_1 [I_2]^{1/2}} \cdot \frac{1}{K_s[H]^2 + 1}\right\}.
\]

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 $\TeX$ed output looks like this:

\[
\frac{d[H]}{dt} = 2k_1\left\{[H_2][I_2] - K_e[H]^2\right\}\left\{1 + \frac{k_3 K_d}{k_1 [I_2]^{1/2}} \cdot \frac{1}{K_s[H]^2 + 1}\right\}.
\]

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 $\TeX$pertise. 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 will probably be felt. All in all, the ability to output equations in $\TeX$ format will be among the most interesting and useful features of the program, especially if the promised LATEX and $\LaTeX$-$\TeX$ support materials.

\[
\frac{d[H]}{dt} = 2k_1\left\{[H_2][I_2] - K_e[H]^2\right\}\left\{1 + \frac{k_3 K_d}{k_1 [I_2]^{1/2}} \cdot \frac{1}{K_s[H]^2 + 1}\right\}.
\]

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

Figure 4: The test equation.
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.

**PSMathGraphsII Version 1.1**

**Reviewed by Tom Scavo and Larry Riddle**

This is a follow-up to an earlier review of PSMathGraphsII, 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 PSMathGraphsII 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 PSMathGraphsII 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, PSMathGraphsII’s ability to draw stair-step or cobweb diagrams proved to be invaluable (see Figure 1). Each such diagram was first created in PSMathGraphsII, exported as an encapsulated PostScript file, and then included into a \LaTeX document later to be processed by Oz\LaTeX, a public domain implementation of \LaTeX for the Macintosh.2

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**Figure 1:** The chaotic orbit of 0.123 under iteration of \( Q(x) = x^2 - 2 \).

PSMathGraphsII exports standard EPSF with an embedded PICT preview. These EPSF files are easily included in \LaTeX documents, previewed with Oz\LaTeX 1.4, and finally printed out as high quality 300 dpi images on a LaserWriter. Alternatively, PSMathGraphsII 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 PSMathGraphsII 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 PSMathGraphsII and Word.

Adding text to a diagram is still cumbersome with PSMathGraphsII, 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 PSMathGraphsII enhancements.

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1Tom Scavo is at the University of Oregon. Larry Riddle teaches mathematics at Agnes Scott College, Decatur, GA. Both have served as beta testers for PSMathGraphsII. They may be reached at scavo@cse.uoregon.edu and riddle@mathcs.emory.edu.

Computers and Mathematics

Figure 2: The Gauss map $x \mapsto 1/x \mod 1$.

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. \textit{PSMathGraphsII}, 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.](image)

With the availability of powerful symbolic algebra packages like \textit{Maple}, \textit{Mathematica}, and \textit{Theorist}, there is no shortage of mathematical graphing software for the Macintosh. But few, if any, can match the flexibility of \textit{PSMathGraphsII} 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 \LaTeX), 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.
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.


(3) Lindström, Bernt. Matroids algebraic over \( F(t) \) are algebraic over \( F \), Combinatorica 9 (1989), no. 1, 107–109 (received Oct. 20, 1987).


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 mathematicians 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 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 retrieval 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 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, postdoctoral 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
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.

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.

Frank W. Warner, III, Chair  
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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 MSEG on a regular basis. (C4)

4. New activities.
   a. Collaborate with MAA on SUMMA. (A1)
   b. Collaborate with 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 collaborative. (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 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 (≤$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.
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.

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Matching of Asymptotic Expansions of Solutions of Boundary Value Problems
Transl. of Mathematical Monographs, Vol. 102  •  A. M. Il'in

This book deals with the solution of singularly perturbed boundary value problems for differential equations. It presents, for the first time, a detailed and systematic treatment of the version of the matching method developed by Il'in and his colleagues. The book covers formal constructions of asymptotic expansions and provides rigorous justifications of these asymptotics. One highlight is a complete asymptotic analysis of Burger’s equation with small diffusion in the neighborhood of the gradient catastrophe point. The book is suitable as a text for graduate study in asymptotic methods in calculus and singularly perturbed equations.

1991 Mathematics Subject Classification: 34; 41
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All prices subject to change. Free shipment by surface: for air delivery, please add $6.50 per title. Prepayment required. Order from: American Mathematical Society, P.O. Box 1571, Annex Station, Providence, RI 02901-1571, or call toll free 800-321-4AMS (321-4267) in the U.S. and Canada to charge with VISA or MasterCard. Residents of Canada, please include 7% GST.
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.

**Tennessee**: John Holmgren, Western Kentucky University, $250,000; Western Kentucky University.

**West Virginia**: 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 letter will be accepted by the Division in the context of the parad should use the format described for review and that proposals not yet prepared should include budgets.

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.

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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, greydanus@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-
The year is divided into Marsden, ter, 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 mechanisms 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, efficiency 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 Subject: help

and the body of the message consisting of the single word

help

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.

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 ap-
ppears, 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


Name and Address (printed or typed)

________________________
Signature

________________________
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
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 research 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.

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
Meetings

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)
(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
Theodore A. Slaman
Gilles Pisier
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
Invited Addresses and Special Sessions

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

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 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 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 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

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

January 1994 Meeting in Cincinnati, Ohio
Associate Secretary:
Joseph A. Cima (until 1/31/93)
Robert J. Daverman (after 1/31/93)
Deadline for consideration: February 3, 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 consideration: June 18, 1993
Deadline for consideration: To be announced
Invited Addresses and Special Sessions

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
601 Elm PHSC 423
Norman, OK 73019
Electronic mail: g_magid@math.ams.org
(Telephone 405 – 325 – 6711)
Invited Addresses and Special Sessions

Eastern Section
W. Wistar Comfort, Associate Secretary (until January 31, 1993)
Department of Mathematics
Wesleyan University
Middletown, CT 06457
Electronic mail: wcomfort@math.wesleyan.edu
(Telephone 203-327-4461)
Lesley M. Sibner, Associate Secretary (beginning February 1, 1993)
Department of Mathematics
Polytech University of New York
Brooklyn, NY 11201-2990
Electronic mail: g.sibner@math.ams.org
(Telephone 718-260-3505)

Southeastern Section
Jesse A. Cima, Associate Secretary (until January 31, 1993)
Department of Mathematics
University of Tennessee
Knoxville, TN 37996-1300
Electronic mail: g_cima@math.ams.com
(Telephone 919-962-1050)
Robert J. Daverman, Associate Secretary (beginning February 1, 1993)
Department of Mathematics
University of North Carolina, Chapel Hill
Chapel Hill, NC 27599-3902
Electronic mail: g_daverman@math.ams.org
(Telephone 919-962-1050)

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 presenta-
tion at a Special Session must be received by the Providence
office (Abstracts Coordinator, Meetings Department, Amer-
ican 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 pack-
age of files may be sent electronically via the Internet to
abs-request@math.ams.com. Requesting the files electronic-
ly 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 Depart-
ment, 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, A\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.
The 1993 Joint Summer Research Conferences in the Mathematical Sciences will be held at the University of 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.
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 \( \Delta u + R(u)^{N-1} = R_g u, N = \frac{2n}{n-2} \), expresses the scalar curvature \( R \) of a conformal metric \( u^{\frac{2}{n-2}}g_0 \) in terms of the conformal factor \( u \) and the curvature \( R_g \) 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-Ampère 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).

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 formulas 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 Lefschetz 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 quasitangentiality, 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.
Joint Summer Research Conferences

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 $K = \mathbb{Q}$, 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 $\mathbb{Q}$. 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 $\mathbb{Q}$, rational functions over $\mathbb{Q}$, 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 finite 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 $\mathbb{Q}$ (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 $\mathbb{Q}(x)$ 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 $\mathbb{Q}^c$ of the rationals. This is $\mathbb{Q}$ with all roots of unity adjoined. He conjectured that the absolute Galois group of $\mathbb{Q}^c$ 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 inhomogeneities. 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 phenomena.

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, inhomogeneities, vortex motion, and melting. Speakers will show how numerous areas of mathematics, including numerical, asymptotic, 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 Frechet, in which he 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 continuous)
- 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 Wrocławsk), Joe Wiley Jenkins (National Science Foundation), Tom Koonwinder (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 (Università 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)


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@cornell.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 Evans, Nicholas Katz, Barbara Lee Keyfitz, Brian Parshall (Chair), François 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; Björn 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 sessions 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 competitiveness, 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.
- 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: Vaughan 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.
November 1992


November 1992. Workshop on Stochastic Control, Centre de Recherches Mathématiques, Université de Montréal, Montréal Quebec, Canada. (Apr. 1992, p. 349)


9–11. Fundamental Problems in Quantum Field Theory, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 628)


10–13. Interdisciplinary Studies on Number Theory, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 628)


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)


16–18. Hardy Spaces and Uniform Algebras, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 629)


23–27. Séminaire Sud-Rhodanien de Géométrie, Marseille, France. (Jan. 1992, p. 54)

23–27. Cohomologie Equivariante et Indice des Operateurs Transversalement El-
Meetings and Conferences

December 1992


* 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.


4-5. Workshop on Control and PDE’s, Temple University, Philadelphia, PA. (Oct. 1992, p. 946)


7-11. IMACS Symposium on Scientific Computing and Mathematical Modelling, Bangalore, India. (May/June 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)


17-19. Algebraic Combinatorics, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 629)

* 17-19. Applied Logic Conference, University of Amsterdam.


Information: M. Vrinten, CCSOM, email: michel@ccsom.nl.


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. Accommodations: 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.

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Spring 1993. IMACS Symposium on Mathematical Modelling, Wiener Neustadt, Germany. (Jan. 1992, p. 54)


January 1993


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)


7-11. Conference on Evolution Equations,
Meetings and Conferences

Louisiana State University, Baton Rouge, LA. (Sep. 1992, p. 770)


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.


INVITED SPEAKERS: S. Friedman, E. Hermann, J. Krajcic, 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)


ORGANIZING COMMITTEE: F. van der Blij (Utrecht), M.A. Kaashoek (VU Amsterdam), J.J.O.O. Wiegerinck (UV Amsterdam).


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.


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), Hothamstens, Hahndorf, South Australia. (Sep. 1992, p. 771)


March 1993


INFORMATION: Centre International de Rencontres Mathematiques, Case 916, Luminy, 70, Route Leon-Lachamp, 13288 Marseille Cedex 9; tel: (91) 41.82.97.


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.


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.


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 Godel lecture.

PROGRAM COMMITTEE: S. Buechler (Chair), S. Friedman, A. Gupta, P. Kolaitis, and M. Stob.

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Meetings and Conferences

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.


*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.


29–April 2. Workshop on Diophantine Geometry, Mathematical Sciences Research Institute, Berkeley, CA. (May/June. 1992, p. 495)


PROGRAM: A 2-week workshop consisting of invited and contributed lectures.


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@carma.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, hi-level coding, 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


*4–9. 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 173564, Denver, CO 80217-3364; email: cm93@copper.denver.colorado.edu.


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. Dwyer, AMS, P.O. Box 6887, Providence, RI 02940.
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14–16. The Mathematics of Food Production, Processing, and Presentation, Belfast, Great Britain.
*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, S.E., Minneapolis, MN 55455.


PROGRAM: This conference is dedicated to computer graphics applications for engineering and business graphics. NCQA '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, NCQA, 703-698-9600, ext. 340; or Andrew Barauskas, NCQA, 703-698-6900, ext. 345.


May 1993

*3–7. Problemes aux Limites, Equations & Integrales de Bord dans des Domaines Non Regulliers, CIRM, Marseille, France.

ORGANIZER: S. Niculae (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.

*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 printing and publishing.

INFORMATION: Kate Whalen, NCQA, 703-698-9600, ext. 340; or Andrew Barauskas, NCQA, 703-698-6900, ext. 345.

10–12. IMACS Symposium on Signal Processing and Neural Networks–SPANN '93, Universite du Quebec at Montreal, Canada. (Jan. 1992, p. 56)

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.

INFORMATION: S. Thomason, Chair of Program Committee, Dept. of Math., Simon Fraser Univ., Burnaby, B.C., Canada V5A 1S6; email: thomason@sfu.ca.

*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.


21--22. Central Section, Northern Illinois University, DeKalb, IL.

INFORMATION: W.S. Drady, AMS, P.O. Box 6887, Providence, RI 02940.


CONFERENCE TOPICS: Original papers are solicited on all aspects of the theory and applications of cryptography 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: tor@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.


*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.


INFORMATION: From the organizers: R. Coquerea, Centre de Physique Theorique, CNRS, Case 907, Luminy, 13288, Marseille, France; coque@rcp2.in2p3.fr; or M. Debotts-Violette, Laboratoire de Physique Theorique et Hautes Energies, Univ. Paris XI, B.211, 91405, Orsay, France; flad@qcdcirce.fr.


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. Förster (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-Technion, Haifa Matrix Workshop, Mathematics Dept. Technion, Haifa 32000, Israel; email: mar23aa@technion.bitnet or mar23aa@technion.bitnet; tel: 972-4-294282; FAX: 972-4-324654.

June 1993


*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 SETL 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. Schwindgendorf, 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.
Meetings and Conferences


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. 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, Universite Grenoble 1, BP.74, 38402 St Martin D’Heres, France.


14-18. IMA Workshop on Mathematical Finance, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)


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.


*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.


21-25. Graphs on Surfaces, Johns Hopkins University, Baltimore, MD. (Sep. 1992, p. 773)


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.


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. Kokker, P.O. Box 217, NL-7500 AE Enschede, The Netherlands; email: kokker@cs.utwente.nl.

INFORMATION: Organizer, G. Scolo, Univ. of Twente, Fac. Informatica, P.O. Box 217, NL-7500 AE Enschede, The Netherlands; tel: +31 53 893779; FAX: +31 53 356531; email: scolo@cs.utwente.nl.


INFORMATION: Contact: marcek@ms.uky.edu.

28–July 2. Geometrie Algebrique et Theorie des Codes, CIRM, Marseille, France.


INFORMATION: Centre International de Rencontres Mathematiques, Case 916, Luminy, 70, Route Leon-Lachamp, 13288 Marseille Cedex 9; tel: (91) 41.82.97.


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 \( \partial \)-equation (A.-M. Chollet and J. Détraz); Lacunary 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: colloq@matups.matups.fr.


July 1993


5–9. Communications et Rezeaux 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. Sebery (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.


PROGRAM: Amherst, Hampshire, Holy Cross, Mount Holyoke, Smith, and Williams Colleges, and the University of Masachusetts at Amherst will host an NSF-funded Regional Geometry Institute for approximately 100 discrete geometer, 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), Voronoi diagrams; and C. Radin (Texas), Tilings and ergodic theory. Fourth week: L. Danzer (Dortmund), Quasicrystal tilings; and R. 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.


6–23. 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 Chrch St., S.E., Minneapolis, MN 55455.

7–10. The Second International Conference on Fluid Mechanics (ICFM-II), Beijing, China. (Sep. 1992, p. 773)

August 1993


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. Shakkun, Think Tank Research Institute, Marktplatz 11, 7900 Ulm, Germany; Tel: (0731) 610510.


INVITED SPEAKERS: A. Lubotzky (Jerusalem) should be added to the list of main speakers.


9-13. Sixth International Conference on Structural Safety and Reliability (ICOSAR '93), Innsbruck, Austria. (Sep. 1992, p. 774)


*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.


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.


*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.
27–30. Seventh International Conference on Domain Decomposition Methods, Penn State University, State College, PA. (Oct. 1992, p. 950)
November 1993

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

Proceedings of the Steklov Institute of Mathematics, Volume 191
N. N. Bogolyubov, Jr., Editor

This volume contains articles covering a wide range of current directions in modern statistical mechanics and dynamical systems theory. Scientists, researchers, and students working in mathematical physics and statistical mechanics will find this book of great interest. Among the topics covered are: phase transition problems, including superconductivity and superfluidity; methods of nonequilibrium statistical mechanics and fluctuation theory; quantum collective phenomena; superradiance; spin glasses; polaron problems; chains of Bogolyubov equations and kinetic equations; algebraic aspects of quantum-dynamical semigroups; the collective variables method; and qualitative properties of classical dynamical systems.

1991 Mathematics Subject Classification: 11, 45, 46, 47, 57, 58, 81, 82, 42, 70
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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 Referativnyi 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


1991 Mathematics Subject Classification: 06A, 06B, 06D, 06E; 03G, 06C, 08B
ISBN 0-8218-7501-9, LC 88-38112, ISSN 0065-9290
247 pages (hardcover), November 1992
Individual member $77, List price $128, Institutional member $102
To order, please specify TRANS2/152N

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, Lacunae of hyperbolic partial differential operators and singularity theory; A. B. Givental', Reflection groups in singularity theory; V. M. Gol'dshtein and V. A. Sobolev, Qualitative analysis of singularly perturbed systems of chemical kinetics; V. V. Goryunov, Bifurcations with symmetries; S. M. Gusein-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 Lp; Yu. I. Sapronov, Corner singularities and multidimensional folds in nonlinear analysis; A. G. Khovanskiǐ, Newton polyhedra (algebra and geometry).

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Use the order form in the back of this issue or call 800-321-4AMS (800-321-4267) in the U.S. and Canada to use VISA or MasterCard.
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

1991 Mathematics Subject Classification: 33C80
ISBN 0-8218-5159-4, LC 92-26610, ISSN 0271-4132
259 pages (softcover), November 1992
Individual member $26, List price $44, Institutional member $35
To order, please specify CONM/138N

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, 35C10; 15A48, 32M10
ISBN 0-8218-4566-7, LC 92-19406, ISSN 0065-9282
132 pages (hardcover), November 1992
Individual member $47, List price $78, Institutional member $62
To order, please specify MMONO/111N

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 non-uniform 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

(continued)
New Publications Offered by the AMS

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
To order, please specify MMONO/112N

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

1991 Mathematics Subject Classification: 53A05, 57M25; 82B20, 82B41, 82D60, 92C40, 92E10
ISBN 0-8218-5501-8, LC 92-24328, ISSN 0160-7634
250 pages (hardcover), November 1992
Individual member $29, List price $49, Institutional member $39
To order, please specify PSAPM/46N

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 Eudox. . . 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 cryptography 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 cryptography 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 Mcllroy, 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 immersedcmc 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
250 pages (softcover), November 1992
Individual member $14, List price $24, Institutional member $19
To order, please specify MEMO/100/478N
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 step-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
112 pages (softcover), November 1992
Individual member $16, List price $26, Institutional member $21
To order, please specify MEMO/100/479N

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 combinatorialists, 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
ISBN 0-8218-2541-0, LC 92-28572, ISSN 0065-9266
111 pages (softcover), November 1992
Individual member $16, List price $26, Institutional member $21
To order, please specify MEMO/100/480N

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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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 Wali'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. Raghu Nath, The congruence subgroup problem; K. N. Rajeswaran, 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.

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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.

TRANSLATIONS OF MATHEMATICAL MONOGRAPHS
Conformal Mappings and Boundary Value Problems
Guo-Chen Wen
Volume 106

This book presents a systematic exposition of the theory of conformal mappings, boundary value problems for analytic and harmonic functions, and the relationship between the two subjects. It is suitable for use as an undergraduate or graduate-level textbook, and exercises are included.

Contents
Some properties of analytic and harmonic functions; Conformal mappings of simply connected domains; Conformal mappings of multiply connected domains; Applications of integrals of Cauchy type to boundary value problems; The Hilbert boundary value problem for analytic functions on multiply connected domains; Basic boundary value problems for harmonic functions; Appendix 1. A brief introduction to quasiconformal mappings; Appendix 2. Some connections between integral equations and boundary value problems.

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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.


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 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.


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 Evans (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

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, 9/92–5/93.

Van Hien Nguyen, (Belgium), Université de Sherbrooke, Optimization, 1/93–5/93.

Wim Vervaat, (Netherlands), York University, Probability, 9/92–12/92.
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A full description of the positions and the application procedure is on the AMS Mathjobs Web pages at http://www.mathjobs.org. The AMS serves as the outside clearinghouse for all applications. Applications will also be accepted via the AMS Mathjobs Electronic Posting System, http://www.mathjobs.org.

The AMS has no role in the selection process or in interpreting the AMS Mathjobs Web pages.

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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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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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(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 computer science. Teaching load: four quarter programming courses and an advanced quarter course, probably renewable, once. 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 $35,000-$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.
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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 is 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.

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FLORIDA
NEW COLLEGE OF UF

New College of UF, 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, 1982/83 edition. New College has a system of contracts and written evaluations rather than grades. Submit application before 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 34243-2157. New College of the University of South Florida is an EOE/AA/ADA employer.

UNIVERSITY OF CENTRAL FLORIDA
Department of Mathematics

Applications are invited for at least one tenure 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 Deb-nath, Chair, c/o Search Committee, Department of Mathematics, University of Central Florida, P.O. Box 161354, Orlando, Florida 32816-1354, 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.

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 a letter that recommends appointments are sent to Professor Dwight Duffus, Screening Committee.
 screened of applications will begin on 1 January 1993. Emory University is an Affirmative Action/Equal Opportunity Employer.

GEORGIA INSTITUTE OF TECHNOLOGY
The School of Mathematics expects to have some visiting and tenure-track positions in several areas, including probability and statistics, at various levels beginning in Fall 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.

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, CDNSS, 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.

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.

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 16, 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. Satsy, 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.

NORTHERN VIRGINIA 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.

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, IL 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.

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, IL 62901
The closing date for applications is December 10, 1992 or until the position is filled. SIUC

1135
UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN
Department of Mathematics

Classified Advertisements

IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER. Women and minorities are particularly encouraged to apply.

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)333-2352 email: search@symcoo.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.

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 is 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)333-2352 email: search@symcoo.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.

Applications for the post are invited 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. Pending availability of funds, one or more visiting appointments 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 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 the Graduate Committee, Department of Mathematics, University of Iowa, Iowa City, Iowa 52242. The University of Iowa is an Equal Opportunity/Affirmative Action Employer.

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.

KANSAS STATE UNIVERSITY
Department of Mathematics

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 appointments 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 15, 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/Affirmative Action Employer.
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

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: 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. degree 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@wsuv.m State University

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, sex or handicap in its programs or activities. For information contact the MSU Affirmative Action Office, 502/762-3155.

LOUISIANA
LOUISIANA STATE UNIVERSITY
Department of Mathematics
Baton Rouge, LA 70803; (504)386-1534

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 other recognized 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

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.

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.

Applicants are invited to send a 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, 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 38762; 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.

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 three 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 $7,555 (two-ninths). Send letter of application, resume, 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, Dartmouth College, 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, N.J. 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 tenure 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 Professors 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 (LECTURE-SHIPS) for shorter terms may also be available.

Applications will be accepted until position is filled. Dartmouth College is an AA/EOE. Women and minorities are urged to apply.

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. 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 Chair, 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 non-tenure-track at the rank of instructor and may be renewed yearly up to six years. A master’s degree is required for this position. Recommenda- tions 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 vita 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.

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. Applicants should 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

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 sponsored 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

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 Ph.D. 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-
Carnegie Mellon University Center for Nonlinear Analysis Department of Mathematics

The Center for Nonlinear Analysis expects to make two or more tenure-track 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. 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.

Carnegie Mellon University Department of Mathematics

The Department 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.

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: J. 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.

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.

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 résumé and three letters of recommendation to: Professor R. J. Duffin, Assistant Professor in Mathematics, University of Puerto Rico at Mayaguez, Mayaguez, Puerto Rico 00681.

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.

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: J. 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.

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.

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Puerto Rico University of Puerto Rico at Mayaguez Department of Mathematics

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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 résumé 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/N/H"

**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 résumé 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/N/H"

**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.

**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 capability 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 specialties. Vita and names of three references should be sent to address below. Reference letters should only be sent when requested. CU is an AA/EEO employer.

Professor R. D. Ringeisen, Head
File A, Box 341907
Department of Mathematical Sciences
Clemson University
Clemson, SC 29634-1907

**TENNESSEE**

**TENNESSEE TECHNOCALOGICAL 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 vita & 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.

**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 capability 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 specialties. Vita and names of three references should be sent to address below. Reference letters should only be sent when requested. CU is an AA/EEO employer.

Professor R. D. Ringeisen, Head
File A, Box 341907
Department of Mathematical Sciences
Clemson University
Clemson, SC 29634-1907

**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/Affirmative Action title IX Section 504 Institution.

**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, 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.**

**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.

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.

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 Gladwell.

I. Gladwell's email addresses:
hs5r1001@cis.vsm.edu
gladwell@seas.smu.edu
SMU is an equal opportunity/affirmative action/Title IX employer.

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.

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I. Gladwell's email addresses:
hs5r1001@cis.vsm.edu
gladwell@seas.smu.edu
SMU is an equal opportunity/affirmative action/Title IX employer.

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 degree 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 aligned 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.

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.

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 at least some research background in geometric analysis and good teaching skills. Preference will be given to applicants in geometric analysis or geometric topology. Duties will include teaching and classroom teaching.

Please send a curriculum vitae and at least three letters of recommendation to: Applications 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.

RICE UNIVERSITY

Griffith Conrad Evans Instructorships. Postdoctoral appointments for two to three years in 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 include instruction and classroom teaching. Applications will be considered after December 31, 1992. The 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.

RICE UNIVERSITY

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.

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I. Gladwell's email addresses:
hs5r1001@cis.vsm.edu
gladwell@seas.smu.edu
SMU is an equal opportunity/affirmative action/Title IX employer.
The University of Texas at Austin is an equal opportunity employer. Qualified women and minority group members are urged to apply.

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 interest 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 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.

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 all 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 a statement 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.

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&TD 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/AAP

CHRISTOPHER NEWPORT UNIVERSITY
Department of Mathematics

Newport News, VA 23606-2998
Three Tenure track positions in Mathematics/Engineering at the assistant professor level are available Fall 1993. Salary is competitive.

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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.

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 position at the Assistant Professor level in the area of Computational Mathematics/Numeral Analysis beginning with the 1993-94 academic year. We seek candidates 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

Applications are invited for an anticipated tenure-track position 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**

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 include advanced undergraduate and graduate level courses 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,
F5-20
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.

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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 Bachelor's, Master'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.

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WYOMING UNIVERSITY OF WYOMING

Chair of the 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. 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.

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UNIVERSITY OF WYOMING

Chair of the 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, WY 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.

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CONCORDIA UNIVERSITY

Chair of the 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. Priority 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 Mathematique Algebrique) 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.

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.

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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PUBLICATIONS FOR S


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.

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INSTITUTE FOR MATHEMATICS AND ITS APPLICATIONS
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EMERGING APPLICATIONS OF PROBABILITY

ORGANIZING COMMITTEE: J. MICHAEL STEELE, DAVID ALDOUS, PERSI DIACONIS, RICK DURRETT, LARRY SHEPP


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.

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”.

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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 Center is looking for highly talented and motivated individuals with a strong background in mathematics or computer science. The Center has created a unified computer 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 residence 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 resume 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

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

ISM Institut des sciences mathématiques

Concordia 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).

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

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.
MATH INTO \TeX
by George Grätzer, University of Manitoba
This book is for the mathematician, engineer, or scientist, who wants to write and typeset articles with mathematical formulas but who does not want to spend a great deal of time learning how to do it. It assumes little familiarity with \TeX{} or \LaTeX{}.

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Day .........................................................
Month ....................................................... 
Year .........................................................

If formerly a member of AMS, please indicate dates .....................

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Degrees, with institutions and dates .....................................

Present position ...........................................

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08 General algebraic systems
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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
59 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
88 Operations research, mathematical programming
92 Biology and other natural sciences, behavioral sciences
93 Systems theory; control
94 Information and communication, circuits

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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

(Please print) Surname First Middle Telephone:

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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13. Teaching mathematical modeling | J. S. Hartsler | $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 |

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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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### EMPLOYER FORM

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**JANUARY 13-15, 1993**  
**SAN ANTONIO, TEXAS**

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### EMPLOYER CODE

| Institution | ____________________________ |
| 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**

F. **Renewal**  
   □ Possible  □ Impossible  □ Yes  □ No

   **Tenure Track Position**  
   Teaching  
   Hours per Week ________

G. **Degree Preferred**

   **Degree Accepted**

H. **Duties**

I. **Experience Preferred**

Citizenship Restriction (Check One)  
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   □ Session 3 (Fri. AM, 9:00-12:15)  
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Number of Interviewers  
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   Session 2: _____ Interviewers  
   Session 3: _____ Interviewers  
   Session 4: _____ Interviewers

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APPLICANT FORM
MATHEMATICAL SCIENCES EMPLOYMENT REGISTER
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APPLICANT: Name

CODE: Mailing Address (include zip code).

A Specialties

B 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:

C Degree Year (expected) Institution

D No. of abstracts, internal reports

E No. of papers accepted

F No. of books and patents

PROFESSIONAL EMPLOYMENT HISTORY:

G Employer Position H Experience Years

1. ____________________________ ____________________________ to __________

2. ____________________________ ____________________________ to __________

3. ____________________________ ____________________________ to __________

4. ____________________________ ____________________________ to __________

DESIRED POSITION:

J Duties

Available mo. _____/yr. _____

Desired geographical location

References (Name and Institution)

Citizenship: (check one) □ U.S. Citizen □ Non-U.S. Citizen, Permanent Resident

□ Non-U.S. Citizen, Temporary Resident

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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. □
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### EMPLOYER CODE

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<th>Institution</th>
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### Specialties Sought

### Title(s) of Position(s)

### Number of Positions

### Starting Date

### Term of Appointment

### Renewal

### Tenure Track Position

### Teaching Hours per Week

### Degree Preferred

### Degree Accepted

### Duties

### Experience Preferred

### Citizenship Restriction (Check One)

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<td>Session 4: ___ Interviewers</td>
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| Not Interviewing |
**Preregistration/Housing Form, San Antonio, Texas**

January 13-16, 1993

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<td>Final Preregistration/Hotel Reservations/Tickets</td>
<td>December 11, 1992</td>
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<td>Housing Changes/Cancellations</td>
<td>December 7, 1992</td>
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<td>50% Refund on Tickets</td>
<td>December 30, 1992 (no refunds after this date)</td>
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<td>50% Refund Joint Meetings Preregistration/ Employment Register/AMS Short Course</td>
<td>January 10, 1993 (no refunds after this date)</td>
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</tbody>
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**REGISTRATION FEES**

Preregistration by

<table>
<thead>
<tr>
<th>Date</th>
<th>Fee</th>
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</thead>
<tbody>
<tr>
<td>December 11, 1992</td>
<td>$115</td>
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<tr>
<td>November 13, 1992</td>
<td>$125</td>
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**JOINT MATHEMATICS MEETINGS**

<table>
<thead>
<tr>
<th>Category</th>
<th>Fee</th>
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</thead>
<tbody>
<tr>
<td>Member of AMS, ASL, CMS, MAA</td>
<td>$15</td>
</tr>
<tr>
<td>* Emeritus Member of AMS or MAA</td>
<td>$30</td>
</tr>
<tr>
<td>Nonmember</td>
<td>$178</td>
</tr>
<tr>
<td>* Students:</td>
<td></td>
</tr>
<tr>
<td>High School</td>
<td>$2</td>
</tr>
<tr>
<td>Graduate or Undergraduate</td>
<td>$30</td>
</tr>
<tr>
<td>* High School Teachers or Librarians</td>
<td>$30</td>
</tr>
<tr>
<td>* Unemployed</td>
<td>$30</td>
</tr>
</tbody>
</table>

**AMS SHORT COURSE**

<table>
<thead>
<tr>
<th>Category</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Member/Nonmember</td>
<td>$70</td>
</tr>
<tr>
<td>* Student, Unemployed, or Emeritus</td>
<td>$30</td>
</tr>
</tbody>
</table>

**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

**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) (Please print) Surname First Middle Telephone: 

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:

<table>
<thead>
<tr>
<th>Event</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMS 25-Year Banquet</td>
<td>$27 each = $    Veg. meal</td>
</tr>
<tr>
<td>MAA Monthly Banquet</td>
<td>$27 each = $    Veg. meal</td>
</tr>
<tr>
<td>MER Banquet</td>
<td>$28 each = $    Veg. meal</td>
</tr>
<tr>
<td>AWM Workshop Dinner</td>
<td>$28 each = $    Veg. meal</td>
</tr>
<tr>
<td>Country Western Social</td>
<td>$10 each = $</td>
</tr>
</tbody>
</table>

15) Total amount enclosed for 7 through 14 $ Method of Payment: [ ] Credit Card (Visa or MasterCard only)

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:

<table>
<thead>
<tr>
<th>Codes:</th>
<th>Options:</th>
<th>Hotel:</th>
<th>Room type:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Dates:</th>
<th>Hotel Deposit</th>
<th>Total Amt. Paid:</th>
</tr>
</thead>
</table>

Special Remarks:
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.

<table>
<thead>
<tr>
<th>Order of choice</th>
<th>Distance from Conv. Ctr.</th>
<th>Single 1 bed</th>
<th>Double 2 beds</th>
<th>Triple 2 beds</th>
<th>Triple 2 beds w/cot</th>
<th>Quad 2 beds</th>
<th>Quad 2 beds w/cot</th>
<th>Suites*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyatt Regency</td>
<td>.30 miles</td>
<td>$90</td>
<td>$100</td>
<td>$100</td>
<td>$110</td>
<td>$100</td>
<td>$110</td>
<td>$465+</td>
</tr>
<tr>
<td>Hilton Palacio Del Río</td>
<td>.06 miles</td>
<td>83</td>
<td>93</td>
<td>93</td>
<td>103**</td>
<td>113</td>
<td>113**</td>
<td>325+</td>
</tr>
<tr>
<td>Marriott Riverwalk (HEADQUARTERS)</td>
<td>.06 miles</td>
<td>73</td>
<td>73</td>
<td>73</td>
<td>73</td>
<td>93</td>
<td>93</td>
<td>N/A</td>
</tr>
<tr>
<td>Marriott Rivercenter</td>
<td>.10 miles</td>
<td>82</td>
<td>92</td>
<td>92</td>
<td>112</td>
<td>132</td>
<td>132</td>
<td>225+</td>
</tr>
<tr>
<td>Plaza</td>
<td>.10 miles</td>
<td>81</td>
<td>91</td>
<td>91</td>
<td>101</td>
<td>111</td>
<td>111</td>
<td>250+</td>
</tr>
<tr>
<td>The Crockett</td>
<td>.20 miles</td>
<td>77</td>
<td>77</td>
<td>77</td>
<td>77</td>
<td>87</td>
<td>87</td>
<td>250+</td>
</tr>
<tr>
<td>Menger</td>
<td>.30 miles</td>
<td>74</td>
<td>84</td>
<td>84</td>
<td>94</td>
<td>104</td>
<td>104</td>
<td>152+</td>
</tr>
<tr>
<td>Emily Morgan</td>
<td>.80 miles</td>
<td>73</td>
<td>73</td>
<td>73</td>
<td>83</td>
<td>93</td>
<td>93</td>
<td>N/A</td>
</tr>
<tr>
<td>Holiday Inn Riverwalk</td>
<td>.50 miles</td>
<td>65</td>
<td>65</td>
<td>65</td>
<td>75</td>
<td>85</td>
<td>85</td>
<td>165+</td>
</tr>
<tr>
<td>Travelodge on the River</td>
<td>.50 miles</td>
<td>65</td>
<td>65</td>
<td>65</td>
<td>75</td>
<td>83</td>
<td>83</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Reservations for suites must be made directly with the Service Bureau. The hotel can supply general information only.**

**Participant must be a certified student or unemployed (as described in the “How to Preregister” section of Notices or Focus) to qualify for these rates.**

<table>
<thead>
<tr>
<th>Order of choice</th>
<th>Distance from Conv. Ctr.</th>
<th>Single 1 bed</th>
<th>Double 2 beds</th>
<th>Triple 2 beds</th>
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<td>N/A</td>
</tr>
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<td>75</td>
<td>83</td>
<td>83</td>
<td>N/A</td>
</tr>
</tbody>
</table>

* Rollaway fee for non-family members is an additional $20 per day.

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.

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<th>Discount price</th>
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</thead>
<tbody>
<tr>
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<td></td>
</tr>
</tbody>
</table>

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