Calendar of AMS Meetings and Conferences

This calendar lists all meetings 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, insular as is possible. Abstracts should be submitted on special forms which are available in many departments of mathematics and from the headquarters office of the Society. Abstracts of papers to be presented at the meeting must be received at the headquarters of the Society in Providence, Rhode Island, on or before the deadline given below for the meeting. The abstract deadlines listed below should be carefully reviewed since an abstract deadline may expire before publication of a first announcement. Note that the deadline for abstracts for consideration for presentation at special sessions is usually three weeks earlier than that specified below. For additional information, consult the meeting announcements and the list of special sessions.

Meetings

<table>
<thead>
<tr>
<th>Meeting #</th>
<th>Date</th>
<th>Place</th>
<th>Abstract Deadline</th>
<th>Program Issue</th>
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<tr>
<td>871</td>
<td>* January 8–11, 1992 (98th Annual Meeting)</td>
<td>Baltimore, Maryland</td>
<td>October 2</td>
<td>December</td>
</tr>
<tr>
<td>872</td>
<td>* March 13–14, 1992</td>
<td>Tuscaloosa, Alabama</td>
<td>January 2</td>
<td>March</td>
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<tr>
<td>873</td>
<td>* March 20–21, 1992</td>
<td>Springfield, Missouri</td>
<td>January 2</td>
<td>March</td>
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<tr>
<td>874</td>
<td>* April 11–12, 1992</td>
<td>Bethlehem, Pennsylvania</td>
<td>January 30</td>
<td>April</td>
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<tr>
<td>875</td>
<td>* June 29–July 1, 1992 (Joint Meeting with the London Mathematical Society)</td>
<td>Cambridge, England</td>
<td>February 28</td>
<td>May-June</td>
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<tr>
<td>876</td>
<td>* October 30–November 1, 1992 (99th Annual Meeting)</td>
<td>San Antonio, Texas</td>
<td>August 3</td>
<td>October</td>
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<td></td>
<td>January 13–16, 1993</td>
<td>Knoxville, Tennessee</td>
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<td>March 26–27, 1993</td>
<td>Salt Lake City, Utah</td>
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<td>April 9–10, 1993</td>
<td>DeKalb, Illinois</td>
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<td>May 21–22, 1993</td>
<td>Vancouver, British Columbia</td>
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<td>August 16–19, 1993 (96th Summer Meeting)</td>
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<td>(Joint Meeting with the Canadian Mathematical Society)</td>
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<td>October 22–23, 1993</td>
<td>College Station, Texas</td>
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<td>January 12–15, 1994</td>
<td>Cincinnati, Ohio</td>
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<td></td>
<td>(100th Annual Meeting)</td>
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<td>March 18–19, 1994</td>
<td>Lexington, Kentucky</td>
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<td>March 25–26, 1994</td>
<td>Manhattan, Kansas</td>
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<td>January 25–28, 1995</td>
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<td></td>
<td>(101st Annual Meeting)</td>
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<tr>
<td></td>
<td>January 10–13, 1996 (102nd Annual Meeting)</td>
<td>Orlando, Florida</td>
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</table>

* Please refer to page 1158 for listing of Special Sessions.

Conferences

January 6–7, 1992: AMS Short Course on New scientific applications of geometry and topology, Baltimore, Maryland.
June 13–July 24, 1992: Joint Summer Research Conferences in the Mathematical Sciences, Mount Holyoke College, South Hadley, Massachusetts.
July 6–24, 1992: AMS Summer Research Institute on Quadratic forms and division algebras: connections with algebraic K-theory and algebraic geometry, location to be announced.
July 26–August 1, 1992: AMS-SIA Summer Seminar in Applied Mathematics, Exploiting symmetry in applied analysis, Colorado State University, Fort Co

Deadlines

<table>
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<tr>
<th>January Issue</th>
<th>February Issue</th>
<th>March Issue</th>
<th>April Issue</th>
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</table>

* 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

1086 1991 Annual AMS-MAA Survey  First Report

1123 Mathematics under Hardship Conditions in the Third World
Neal Koblitz
What is the situation for mathematics in the Third World? In this lively and controversial article, Koblitz examines such questions as why mathematics research flourishes in Vietnam, while other countries contend with "brain drain" to the U.S. and Europe. He also looks at mathematics education in some Central American countries, where the "New Math" craze took hold, sometimes with disastrous results. Koblitz concludes with a number of suggestions for ways to improve the conditions for mathematical colleagues in the Third World.

FEATURE COLUMNS

1133 Computers and Mathematics  Keith Devlin
Computer-assisted proofs are the theme of this month's feature article, by William Farmer and Javier Thayer of the MITRE Corporation. This is followed by two software reviews. Larry Riddle of Agnes Scott College reviews Plot and Tevian Dray of Oregon State University describes his experiences with the two programs Cube and Tess.

1142 Inside the AMS
Jeremy Soldevilla, the director of marketing, discusses the role of the newly formed AMS Marketing Division.
From the Executive Director . . .

VALUES

What do we, as mathematicians, value in our profession? Do we adequately encourage our values? How do we recognize merit within our value system? What is the basis for reward? These questions, addressed here to mathematicians, echo a central theme facing the professoriate and higher education. The value and reward system of faculties and the relationship between mission and practice of institutions of higher education are under examination. Although these issues, in the broad sense, are independent of discipline, it is necessary that we as mathematicians consider discipline-dependent values and how we recognize and reward merit.

Responsibilities of the mathematics professoriate have not really changed; research, teaching, and service are the generally accepted broad categories. What has changed is the clear need to respond in a more pro-active and balanced way to our full range of responsibilities. Of course, not every faculty member will have the same expectations, but collectively, ours is a challenging range of responsibilities.

U.S. mathematics research has been preeminent in the world, but there are serious concerns for the maintenance and renewal of the mathematics research enterprise. We have a responsibility to the quality and vitality of mathematics research. Socioeconomic and demographic trends indicate that fewer students will study mathematics and choose mathematically related careers, while other indicators point toward the increasing need for a mathematically literate workforce. The nation depends on the success of mathematics education, and the college/university mathematics faculty share the responsibility for mathematics education. Mathematics is identified as a critical and enabling component of science and technology that is vital to economic competitiveness. It is a responsibility of mathematics faculty to connect discovery in mathematics to discovery, education, and applications in other disciplines. The need for mathematics faculty to respond to these responsibilities is more critical than ever before; in this context, it is essential that the value and reward system reflect all the responsibilities borne by the college/university faculty.

The Joint Policy Board for Mathematics (JPBM), which represents the AMS, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics, has appointed a task force to undertake a study of the values and rewards structure within the mathematics professoriate. The task force is to identify those characteristics and activities of professional mathematicians that are most valued, formulate ways to measure and evaluate merit within this value structure, and review rewards. The task force is to report its findings, make recommendations based on these findings, and lay plans to mobilize the community for action.

The task force activities are intended to set directions for mathematicians to look closely at what they value and how these values fit within their broad responsibilities. If we do hold discovery and creativity in highest esteem, then we need to examine their connections to the traditional roles of teaching and research. Are there nontraditional ways that discovery and creativity can be brought to bear on the responsibilities for connecting research mathematics to education and applications? Creativity and scholarship exist not only in new discoveries but also in the organization of knowledge, the communication of knowledge, and the applications of knowledge. There is little question that we do value good exposition, the lucid lecture, the novel approach to an old question that brings new understanding, and the stimulating connections of mathematical research to discovery and applications in other disciplines. However, do we encourage and promote this valued scholarship in our reward system?

The task force will receive staff support from the Society. It begins its work this fall and expects to have a report to JPBM and the community within a year. There may be concurrent studies by other groups that are cross-disciplinary or directed at some particular responsibility of the professoriate. The mathematics community is taking a progressive step in addressing, directly and actively, these important issues as they affect our discipline.

William Jaco
Letters to the Editor

Funding Small College Researchers

In his letter to Notices (Notices 38, No. 6, p. 541), Sheldon Kamienny expresses the fear that the NSF peer review system acts against research proposals that do not fit the preconceptions of the reviewers. He may well have a point. But worrying funding priorities at NSF are not restricted to the role played by the independent reviewers. In my own recent case, all three reviewers were extremely positive about my proposal, which also was of the novel, "non-standard" nature Kemienny is concerned about, but despite the reviewers positive remarks and their rankings of E, VG, VG, and despite the program director stating in his report that the research definitely deserved support, the proposal was turned down.

Now, the pages of Notices are not the appropriate place to discuss one particular research proposal. But they are, I think, exactly the right forum to examine a general issue raised by this proposal, namely the increased emphasis that should be given to research at small undergraduate colleges such as my own, something I see as crucial to the future growth of our subject.

Let me start by saying that I know the value of a small college experience, where the students are in close daily contact with active research faculty. I was an undergraduate at King’s College in London, a highly selective institution that admitted at most 25 mathematics majors each year. As one of the most prestigious colleges in the University of London system, King’s had a faculty of world class calibre, and my fellow students and I got to know them very well, both as teachers and on a social basis. The experience quite literally changed my life. I went to college knowing I wanted some sort of career involving mathematics; but, at the time, I had little conception of mathematics as a highly active research field. By the time I graduated, I knew what I wanted to do with my life, and have been actively involved in research and teaching in mathematics ever since. Three years close contact with a small group of highly active mathematicians did that for me, and for well over half my class who went on to pursue Ph.D.s and research careers in mathematics. (At least three of us are now on college faculty in the U.S.A. and one is a former program director at NSF!)

When, a few years ago, government policies made conditions for teaching and research so intolerable at my university in Britain that I was forced to consider moving to the United States, I could see the value of accepting the offer of the chairmanship of a good, small college that sought to provide its students with the same kind of research exposure that I had received. The problem is, how does any mathematician sustain research at such an institution? For the small British colleges there is no problem; they are all grouped into larger units, in London, Cambridge, and Oxford. In the U.S.A., most of the good small colleges are geographically spread out, so the active researcher at such a place has to work hard to keep in touch with new developments. Email is a great help in this regard. But the biggest factor is the extended summer research trip to a large research center. Indeed, two of the three external reviewers of my recent research proposal stressed in their reports, as I did in the proposal, the crucial importance to my work of being able to spend large parts of each summer at a large research center.

Now the NSF has a special program for people such as myself: The RUI program (Research at Undergraduate Institutions). RUI proposals are evaluated along with all other research proposals, and subject to the same peer review process, the only difference at the initial evaluation stage being that reviewers are sent a cover sheet explaining that as a professor at a small college, the proposer will have a considerably larger teaching load than colleagues at a research university, will be working largely on his or her own, and will in general have access to poorer library and computational facilities, all of which may result in a far lower publications rate than might be expected of someone at a large research school.

The existence of the RUI program played a large factor in my own decision to go to such a school (Colby College) as chairman two years ago. As I set about hiring four new faculty over the past two years, I mentioned the program to every candidate I interviewed, in order to encourage them to come to Colby. That hiring process led to our acquiring four young mathematicians who are not only excellent teachers with a strong commitment to undergraduate, liberal arts education, but are also highly successful researchers, with fairly recent doctorates from Harvard, Berkeley, Madison, and New Hampshire. In short, Colby now has the kind of department that, like my own Alma Mater, should be successful not only
Letters to the Editor

Keith Devlin
Colby College
(Received August 12, 1991)

Speaking to High School Students

The collegiate and industrial profession has a great deal to offer high school students in a 45-minute talk. The following suggestions (based on years of observing high school speakers) can help maximize the impact of any talk to young people.

1. Make the talk interactive by asking questions, or getting students to guess or draw a conclusion before it is stated, or by asking students to consider something curious. It is my impression that a high school instructor should not speak for more than three minutes without asking a question.

2. Motivate interest in the topic. Some concession must be made to the student who asks: Why would anybody want to know this? Do not give a normal classroom lecture.

3. Prepare the talk. Transparencies of diagrams and proofs should be made ahead of time. Helpful handouts should be duplicated prior to the meeting. Physical devices to illustrate mathematical applications should not be made so crudely that they are disappointing.

4. Learn the level of the students' ability and speak at that level. Most high school students need long pauses between equations to verify and understand them, and their minds will wander when apparently true statements are rigorously proved.

5. If your talk is not especially insightful, informative, or entertaining, then don’t give it.

The following quotation is an example of what is highly desired in expository talks. It would be appropriate for a high school calculus class.

[Isaac Newton’s] Principia was written almost entirely in the language of geometry; nearly all subsequent progress in gravitational astronomy has been made by mathematical methods known as analysis [calculus, limits, infinite sequences, etc.]. In the geometrical treatment of an astronomical problem each step of the reasoning is expressed in such a way as to be capable of being interpreted in terms of the original problem, whereas in the analytical treatment the problem is first expressed by means of algebraic symbols; these symbols are manipulated according to certain purely formal rules, no regard being paid to the interpretation of the intermediate steps, and the final algebraic result, if it can be

at producing research mathematicians (among other things), but also ensuring that those students who go on to pursue other careers, leave Colby with a heightened awareness of the nature of contemporary mathematics.

But it will only be possible to sustain the momentum we have built up if all of us have a reasonable chance to secure summer research funding. Without that, it will wither and die. Their small size and intimate atmosphere makes the selective small colleges the best chance the nation has to produce new generations of scientists of all disciplines. Students learn best from example. The professor at the chalkboard is their role model. Over their four years at the college, the students can get to know the professor extremely well. So, by giving increased priority to the funding of small college researchers, the NSF would be placing its limited resources into the sector most likely to produce the long term results it surely aims for.

(And remember, I am not suggesting that the NSF gives priority to “second class research”. RUI proposals are subjected to the same initial peer scrutiny as any other proposal.)

Having taught at both large research schools (in Britain, Germany, and North America) and now at a small college, I can confirm that it is at least an order of magnitude more difficult to sustain an active research program at a remote small college. Relatively few small college professors seem able to sustain it for long, given the huge effort it takes both to find enough time and to keep in touch with one’s colleagues. Considering the tiny amounts of money involved (usually just summer salary and travel to another location) the financial savings to the nation achieved by scrimping on RUI support must be paltry. The potential loss to the nation is surely enormous, and constitutes a tragic waste both of financial resources and of natural talent.

Incidentally, I disagree violently with the views expressed by Dave Trautman in the same issue of Notices (pp. 540-541) to the effect that there is far too much mathematical research being done and that we should concentrate instead on “teaching”. There is undoubtedly a place in society, and an important one, for the activity that constitutes the normally understood semantics of the word “teaching”. But this is not at all appropriate for the kind of institution of primary concern to the AMS. People learn far more from example than from being shown “what to do”, cookbook style. Mathematics is a living, breathing, growing subject, and to those who choose to learn it for its own sake (i.e. not just as a utility), it should be “taught” as such, and that I maintain can only be done by someone active in research. (Of course, Mr. Trautman has a point if that research comes in the way of student-professor interaction, but that is another matter altogether.)

Let me stress that, to the best of my knowledge, the people working at NSF are doing the very best they can. But they can only operate within the budget they are allocated, and have to set the priorities they think are best.

Maybe letters such as this can help them as they argue the budget with the government. As to setting priorities, I suspect that the voice of small college research is not very well represented at NSF, if at all. So, here is an offer to the NSF. Let me offer my own services to try to explain to you just what is involved in maintaining an active research program at a small teaching college. As a professor at such a school, I don’t really have the time of course, but given the stakes involved, I am prepared to take it on. I doubt that I am alone.

Keith Devlin
Colby College
(Received August 12, 1991)
obtained, yields on interpretation the solution of the original problem. The geometric solution of the problem, if it can be obtained, is frequently shorter, clearer, and more elegant; but on the other hand, each special problem has to be considered separately, whereas the analytic solution can be conducted to a great extent according to fixed rules applicable in a larger number of cases. —Arthur Berry, A Short History of Astronomy (John Murray, 1898; Dover reprint, 1961) pages 247-248.

Michael Stueben
Thomas Jefferson High School for Science and Technology
(Received September 3, 1991)

Style in Recent Reports
I write to express my exasperation at the deplorable style of English in which two recent reports about teaching undergraduate mathematics are written. The July/August 1991 issue of Notices, with the essay “Moving Beyond Myths” (pages 545-559), arrived on the same day that I received the booklet “What Works: Building Natural Science Communities—A Plan for Strengthening Undergraduate Science and Mathematics,” the report of the Project Kaleidoscope Committee. The examples of officialese, sociologese, incongruous vocabulary, vogue words, and overdone metaphors are so numerous that one is tempted to throw the reports down and say “Enough!”

Those who read “Moving Beyond Myths” must put up with phrases like: Statewide mathematics articulation, to replicate effective intervention programs, to enable students to interactively understand, the goal for each experience [experience is a new word for course], to mainstream students, to remediate students, to sensitize teaching assistants, to educate intending teachers, pipeline population, a lens...polished by their own education, harmful myths about mathematics metastasize to the body politic, interest payments on the deficit of scholarly maturity balloon college enrollments, etc. etc.

The Project Kaleidoscope report is much worse. We find there: Hands-on curriculum, hands-on learning, hands-on approach, hands-on research, hands-on learning experience, hands-on experiments, hands-on connections, hands-on workshops, hands-on pedagogy, hands-on program, lean and lab-rich, faculty enhancement activities, mathematics...is enhanced, enhance the learning community, set of K-12 experiences, laboratory experiences, hands-on and lab-rich experiences, research experiences, kinesthetic experiences in which students use proprioceptive senses, student-led educational experiences, science experiences, enmeshing the teacher in a laboratory setting, empowering learners, may not be informed by a clear understanding, filtering action, a critical pump in the career pipeline, science and mathematics pipeline, portrait of leakage from the science pipeline, disaggregative enterprise, disaggregated by gender, gender make-up, degrees by gender, facilitators, capstones, clusters, gatekeeper courses, varied menu of courses, upper-class students will socialize lower-level students, spaces [i.e., rooms], shape the spaces, etc. etc.

Since the authors of these reports have something important to say, why don’t they say it in plain English? They find much to complain about, and it is well that there be no faults in them who point out the faults of others.

Anthony Lo Bello
Allegheny College
(Received August 9, 1991)
1991 Annual AMS-MAA Survey
(First Report)

Report on the 1991 Survey of New Doctorates, Donald E. McClure
Faculty Salary Survey

This first report on the 1991 Survey includes a report on the 1991 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 1990-1991 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 Canada, and later to the recipients of doctoral degrees granted by these departments between July 1990 and June 1991, 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 1991 Survey, in a spring 1992 issue of Notices.

The 1991 Annual AMS-MAA Survey represents the thirty-fifth in an annual series begun in 1957 by the Society. The 1991 Survey is under the direction of the AMS-MAA Data Committee whose members are Edward A. Connors, Lincoln K. Durst (consultant), John D. Fulton, James F. Hurley, Charlotte Lin, Don O. Loftsgaarden, David J. Lutzer, James W. Maxwell (ex officio), Donald E. McClure (chair), and Donald C. Rung. Comments or suggestions regarding this Survey may be directed to the committee.

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

- **Groups I and II** include the leading departments of mathematics in the U.S. according to the 1982 assessment of Research-Doctorate Programs conducted by the Conference Board of Associated Research Councils in which departments were rated according to the quality of their graduate faculty.1
  - **Group I** is composed of 39 departments with scores in the 3.0-5.0 range.
  - **Group II** is composed of 43 departments with scores in the 2.0-2.9 range.
  - **Group III** contains the remaining U.S. departments reporting a doctoral program.
  - **Group IV** contains U.S. departments (or programs) 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 VI** contains doctorate-granting departments (or programs) in the mathematical sciences in Canadian universities.
  - **Group M** contains U.S. departments granting a master's degree as the highest graduate degree.
  - **Group B** contains U.S. departments granting a baccalaureate degree only.

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

Highlights

- U.S. institutions awarded 1074 doctorates in the mathematical sciences from July 1, 1990 to June 30, 1991, an increase of 15 percent over last year's fall count and 26 percent more than the average of the fall counts for the last four years.
- The number of U.S. citizens reported to have received doctorates in the mathematical sciences is 461, which is 15 percent higher than the number earning doctorates last year and 27 percent higher than the record lows recorded in 1986-87 and 1987-88.
- The number of non-U.S. citizens receiving doctorates in the mathematical sciences reached a new high of 600, well above the average of the fall counts for the last four years.
- Of the 461 U.S. citizen doctorates 10 are black. In 1989-90 only 4 of the U.S. citizen doctorates were black.
- Total employment of new doctorates in the U.S. increased from last year, but employment in some sectors decreased and the percentage of unemployed increased substantially. As of late September 1991, approximately 12 percent of the new doctorates were reported to be still seeking employment. The percentage unemployed is over twice the corresponding percentage reported last fall.
- The median starting salary of new doctorates reporting teaching (or teaching and research) was $33,000 for men and $33,200 for women.
- In almost all cases, the mean salary by faculty rank reported for 1991-92 increased less than five percent over that reported for 1990-91. Major exceptions were the 1991-92 mean salaries reported for associate and full professors in doctorate-granting departments of applied mathematics and operations research (Group V), which increased 9% and 7% respectively.

Donald E. McClure

This report presents a statistical profile of new doctorates in the mathematical sciences awarded by universities in the United States and Canada during the period July 1, 1990 through June 30, 1991. It includes the employment status of recipients of 1990–91 doctorates in the mathematical sciences (as of September 20), an analysis of the data by sex, racial/ethnic group, and citizenship, and reports trends in the number of doctoral degrees for each of Groups I through V (see box on preceding page for description of groups). Table 1 provides the response rates for the 1991 Survey of New Doctorates.

### Table 1: Response Rates

<table>
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<td>I</td>
<td>39/39</td>
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<tr>
<td>II</td>
<td>42/43 (including 3 with 0 degrees)</td>
</tr>
<tr>
<td>III</td>
<td>80/86 (including 27 with 0 degrees)</td>
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<td>IV</td>
<td>53/75 (including 5 with 0 degrees)</td>
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<tr>
<td>Va</td>
<td>12/16</td>
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<tr>
<td>Vb</td>
<td>18/33</td>
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<tr>
<td>VI</td>
<td>27/31 (including 8 with 0 degrees)</td>
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</tbody>
</table>

**Doctorates Granted**

The number of new doctorates reported in 1990–91 by U.S. and Canadian mathematical sciences departments is 1142. Table 2A gives the fall counts for the past five Annual Surveys. This year’s fall count will be updated in the Second Report of the 1991 Survey, to appear in a spring 1992 issue of Notices. Table 2B reports for comparison the fall and spring counts in the years 1986–87 through 1989–90.

The total number of new doctorates increased substantially this year. The total count has been increasing steadily since 1984–85. This year’s increase is the largest in absolute numbers (151) and in percentage (+15 percent) during this six-year period. Cumulatively, the total number of new doctorates has increased 49 percent since 1984–85.

### Table 2A: New Doctorates, Fall Counts

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<td>Canada</td>
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<tr>
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<td>856</td>
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### Table 2B: New Doctorates, Fall and Spring Counts

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<td>Canada</td>
<td>66 66 52 55 53 62 58 59 68</td>
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<tr>
<td>Total</td>
<td>845 874 856 883 958 981 991 1009 1142</td>
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</table>


In 1990, the Annual Survey started adding new questions to monitor the changing employment market. At the time, the AMS-MAA Data Committee was interested in collecting baseline data against which the future shortages of Ph.D.s projected in the science press could be compared. In the past two years, however, changing economic conditions and other perturbations of the employment market have refocused the interest of the mathematics community on a difficult job market. In this report, we shall present a broader analysis than customary to illuminate patterns of employment for new doctorates.

Table 3A shows the employment status, by type of employer and field of degree, of the 1142 recipients of doctoral degrees conferred by the mathematical sciences departments in the U.S. and Canada between July 1, 1990, and June 30, 1991. The names of these individuals are listed with their thesis titles in a later section of this First Report of the 1991 Annual Survey. Again this year we present the employment status of the 227 women new doctorates in Table 3B. The employment information was obtained initially from the departments granting the degrees and subsequently from data provided by the degree recipients themselves.

The first five rows of Table 3A give the numbers of new doctorates who have accepted appointments in U.S. departments granting mathematical sciences departments (Groups I–V). The next two rows give the numbers who have accepted appointments in mathematical sciences departments granting masters and bachelors as the highest degrees.

Table 2C records the number of new doctorates in the mathematical sciences in the U.S. from the years 1986–87, exclusive of Group Vb. The response rate for Group Vb, which includes departments in engineering and management science, is the lowest of all groups.

Groups I and II account for the largest part of the increase shown in Table 2C. The count for Group I increased by 72 (20 percent) and the count for Group II increased by 46 (33 percent) over the corresponding fall counts in the 1990 Annual Survey. There was virtually no change in the fall counts for Group III. The fall count for Group IV (statistics) showed a modest decrease, though that finding must be interpreted cautiously in view of the lower response rate for Group IV.
### Table 3A: Employment Status of 1990–1991 New Doctorates in the Mathematical Sciences

<table>
<thead>
<tr>
<th>Type of Employer</th>
<th>Algebra or Number Theory</th>
<th>Real or Complex Analysis</th>
<th>Geometry or Topology</th>
<th>Logic</th>
<th>Probability or Statistics</th>
<th>Applied Mathematics</th>
<th>Discrete Math or Combinatorics</th>
<th>Numerical Analysis</th>
<th>Linear or Nonlinear Optimization</th>
<th>Other</th>
<th>TOTAL</th>
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<td>2</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".

### Table 3B: Employment Status of 1990–1991 New Doctorates in the Mathematical Sciences Females Only

<table>
<thead>
<tr>
<th>Type of Employer</th>
<th>Algebra or Number Theory</th>
<th>Real or Complex Analysis</th>
<th>Geometry or Topology</th>
<th>Logic</th>
<th>Probability or Statistics</th>
<th>Applied Mathematics</th>
<th>Discrete Math or Combinatorics</th>
<th>Numerical Analysis</th>
<th>Linear or Nonlinear Optimization</th>
<th>Other</th>
<th>TOTAL</th>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>3</td>
<td>6</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>28</td>
<td>21</td>
<td>28</td>
<td>4</td>
<td>70</td>
<td>29</td>
<td>9</td>
<td>7</td>
<td>6</td>
<td>25</td>
<td>227</td>
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</table>

*Non-U.S. citizens who returned to their country of citizenship and whose status is reported as "unknown" or "still seeking employment".
Most new doctorates accept academic positions. Of the 704 new doctorates employed in the U.S., a total of 564 (80 percent) hold jobs in academia. For comparison, last year's First Report showed 678 new doctorates employed in the U.S., including 571 in academic positions. The 564 academic positions this year include a total of 247 in U.S. doctorate-granting departments (Groups I–V). This number is only slightly smaller than last year's First Report (Groups I–V). This number is only slightly smaller than last year (259 positions in Groups I–V) and remains above the corresponding numbers in the previous two years (240 in 1988–89 and 207 in 1987–88). Among these Groups, the number hired by Group I has been essentially constant for three years. The numbers hired by Group II and Group III both declined by nine (-20 percent and -14 percent, respectively). The number of new doctorates employed by bachelor's degree-granting colleges and universities increased by 20 (19 percent) from 1989–90.

Excluding those whose employment status is unknown, 22 percent of the women and 25 percent of the men accepted appointments in Groups I–V departments.

The number of new doctorates taking jobs in U.S. nonacademic positions increased significantly this year. The 140 positions in government, business and industry in the U.S. account for 20 percent of total U.S. employment. Last year at this time, the total of 107 U.S. nonacademic positions represented 16 percent of the U.S. total.

A striking change has occurred in the numbers shown as "not yet employed" in Tables 3A and 3B. Of those whose employment status is known, over 12 percent are unemployed.

At the same time last year, 5.7 percent of the 1989–90 new doctorates were reported as "not yet employed". The data in Table 3A were obtained in many instances early in the summer of 1991 and do not reflect subsequent hiring. Nonetheless, the year-to-year comparison shows compelling evidence of the difficult job market faced by this year's new doctors. An update of Table 3A is planned for the Second Report in a spring 1992 issue of Notices. In a similar update last year, the percentage of 1989–90 new doctorates who had reported not finding employment was two percent (see Notices, November 1990, page 1219, and May/June 1991, page 413).

The 1991 Survey sent to individual new doctorates asked for information about the type of academic position held. Based on an early response from 377 individuals who provided information about their contract terms, 50 percent reported that their position is not tenure-eligible and 50 percent reported that their position is tenured or tenure-eligible. The respondents include holders of academic positions everywhere, not exclusively within the U.S.

Table 3C shows employment status, by type of employer and Group of the department granting the degree, of the 1142 new doctorates. The results document patterns generally recognized anecdotally. For example, Table 3C shows that 85 percent of the new doctorates obtaining academic positions in Group I departments obtained their degree from a Group I department. Similarly, 85 percent of the new doctorates taking a position in a Group IV department obtained their degree from a Group IV department. New doctorates from a Group IV or a

TABLE 3C: Employment Status of 1990–1991 New Doctorates
by type of granting department

<table>
<thead>
<tr>
<th>TYPE OF EMPLOYER</th>
<th>TYPE OF DOCTORATE-GRANTING DEPARTMENT</th>
<th>TOTAL EMPLOYED BY TYPE OF EMPLOYER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group I Math</td>
<td>Group II Math</td>
</tr>
<tr>
<td>Group I</td>
<td>85</td>
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</tr>
<tr>
<td>Group II</td>
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<td>2</td>
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<tr>
<td>Masters</td>
<td>24</td>
<td>22</td>
</tr>
<tr>
<td>Bachelors</td>
<td>39</td>
<td>37</td>
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<tr>
<td>Two-year Colleges</td>
<td>3</td>
<td>4</td>
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<td>Research Institutes</td>
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</tr>
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<td>5</td>
<td>3</td>
</tr>
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<td>Business and Industry</td>
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<td>15</td>
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<td>Canada, Academic</td>
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<td>2</td>
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<tr>
<td>Foreign, Nonacademic</td>
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<td>2</td>
</tr>
<tr>
<td>Not seeking employment</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Not yet employed</td>
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<td>30</td>
</tr>
<tr>
<td>Unknown (U.S.)</td>
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</tr>
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<tr>
<td>TOTALS</td>
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<td>185</td>
</tr>
</tbody>
</table>

*Non-U.S. citizens who returned to their country of citizenship and whose status is reported as "unknown" or "still seeking employment".
Group V departments assume U.S. nonacademic positions in greater proportion than new doctorates from Groups I–V overall. The unemployment rates are different for each group. Excluding those whose employment status is unknown, the percentages who are reported to be still seeking employment are 10.8 percent for Group I, 17.2 percent for Group II, 15.0 percent for Group III, 6.0 percent from Group IV, 8.6 percent for Group V and 28.6 percent for Group VI (Canadian departments).

Table 3D shows the pattern of employment within broad job categories broken down by citizenship status for those new doctorates earned from U.S. institutions (Groups I–V). The citizenship status is known for 1029 of 1074 recipients of doctorates from U.S. institutions. The rate of unemployment is slightly higher for non-U.S. citizens (12.2 percent of those whose job status is known) than it is for U.S. citizens (10.4 percent). Understandably, a much higher percentage of the noncitizens are found in foreign academic positions. The percentage of U.S. citizens in U.S. nonacademic jobs is much higher than the percentage of noncitizens in the same category (18.2 percent of citizens versus 11.3 percent of noncitizens whose job status is known). U.S. citizens hold positions in U.S. academic doctorate-granting departments in lower proportion than do noncitizens (22.7 percent of citizens compared to 28.4 percent of noncitizens), while citizens hold positions in non doctorate-granting U.S. departments in substantially higher proportion than do noncitizens (41.0 percent of citizens compared to 20.6 percent of noncitizens); here all percentages exclude new doctorates whose job status is unknown.

<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>U.S. Academic, Ph.D. Department</td>
<td>96</td>
<td>149</td>
</tr>
<tr>
<td>U.S. Academic, non-Ph.D. Department</td>
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<td>106</td>
</tr>
<tr>
<td>U.S. Research Institute</td>
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<td>16</td>
</tr>
<tr>
<td>U.S. Nonacademic</td>
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<td>Foreign Academic</td>
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<td>109</td>
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<tr>
<td>Foreign Nonacademic</td>
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<td>10</td>
</tr>
<tr>
<td>Not seeking employment</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Unemployed and seeking employment</td>
<td>44</td>
<td>64</td>
</tr>
<tr>
<td>Unknown status (U.S. address)</td>
<td>28</td>
<td>4</td>
</tr>
<tr>
<td>Unknown status (foreign address)</td>
<td>28</td>
<td>51</td>
</tr>
</tbody>
</table>

totals 450 100% 579 100%** 1029 100%

* The adjusted total varies from that on Table 5 because the data are gathered on different surveys.
** Column percents are rounded to the nearest whole percent.

Acknowledgments

The Annual AMS-MAA Survey attempts to provide an accurate appraisal and analysis of various aspects of the academic mathematical scene for the use and benefit of the mathematics community. Every year, college and university departments in the United States and doctorate-granting departments in Canada 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 1991 Annual AMS-MAA Survey. I express special thanks to Monica Foulkes for her constant support and initiatives on all aspects of the Annual Survey. Jim Maxwell regularly offers insight and direction for the work of the Data Committee. Monica and Jim share credit for the companion articles on starting salaries of new doctorates and on faculty salaries. Don Loftsgaarden and Ed Connors contributed to the data analysis and bibliography.
Table 3E and the accompanying chart show how employment patterns have varied over time for the major categories of employment of new doctorates. See also Table 5 and the graph accompanying it for the corresponding longitudinal pattern of doctorate production by U.S. universities. (Table 3E includes doctorates granted by Canadian universities and Table 5 does not.) Note that all years prior to 1982–83 include doctorates granted by computer science departments.

Table 3E: Employment of New Doctorates in the Mathematical Sciences, 1977–78 to 1990–91

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
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<tr>
<td>U.S. academic</td>
<td>524</td>
<td>508</td>
<td>489</td>
<td>509</td>
<td>497</td>
<td>454</td>
<td>470</td>
<td>435</td>
<td>441</td>
<td>456</td>
<td>478</td>
<td>554</td>
<td>595</td>
<td>564</td>
</tr>
<tr>
<td>U.S. nonacademic</td>
<td>210</td>
<td>202</td>
<td>204</td>
<td>197</td>
<td>170</td>
<td>129</td>
<td>134</td>
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<td>140</td>
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<tr>
<td>Canadian</td>
<td>62</td>
<td>47</td>
<td>44</td>
<td>41</td>
<td>36</td>
<td>30</td>
<td>27</td>
<td>29</td>
<td>37</td>
<td>37</td>
<td>46</td>
<td>37</td>
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<td>Foreign</td>
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<td>98</td>
<td>93</td>
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<td>156</td>
<td>164</td>
<td>177</td>
<td>177</td>
<td>137</td>
<td>114</td>
</tr>
<tr>
<td>Total known employed</td>
<td>916</td>
<td>855</td>
<td>830</td>
<td>878</td>
<td>818</td>
<td>754</td>
<td>744</td>
<td>762</td>
<td>780</td>
<td>811</td>
<td>887</td>
<td>907</td>
<td>871</td>
<td></td>
</tr>
<tr>
<td>Total doctorates granted (fall counts)</td>
<td>952</td>
<td>889</td>
<td>858</td>
<td>904</td>
<td>860</td>
<td>792</td>
<td>792</td>
<td>769</td>
<td>801</td>
<td>845</td>
<td>856</td>
<td>958</td>
<td>991</td>
<td>1142</td>
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</table>

*1990–1991 employment status figures are fall counts; the entries for previous years are spring counts. 1990–1991 figures will be updated in the Second Report in a spring 1992 issue of Notices.
TABLE 4: Sex, Racial/Ethnic Group, and Citizenship of New Doctorates

July 1, 1990 — June 30, 1991

<table>
<thead>
<tr>
<th>U.S. DEGREES</th>
<th>MEN</th>
<th>WOMEN</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>RACIAL/ETHNIC GROUP</td>
<td>CITIZENSHIP</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>U.S.</td>
<td>Canada</td>
<td>Other</td>
</tr>
<tr>
<td>Asian, Pacific Islander</td>
<td>17</td>
<td>2</td>
<td>306</td>
</tr>
<tr>
<td>Black</td>
<td>7</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>American Indian, Eskimo, Aleut</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Mexican American, Puerto Rican, or other Hispanic</td>
<td>2</td>
<td>28</td>
<td>30</td>
</tr>
<tr>
<td>None of those above</td>
<td>299</td>
<td>12</td>
<td>120</td>
</tr>
<tr>
<td>Unknown</td>
<td>23</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>349</td>
<td>15</td>
<td>479</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CANADIAN DEGREES</th>
<th>MEN</th>
<th>WOMEN</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>RACIAL/ETHNIC GROUP</td>
<td>CITIZENSHIP</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>U.S.</td>
<td>Canada</td>
<td>Other</td>
</tr>
<tr>
<td>Asian, Pacific Islander</td>
<td>4</td>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td>Black</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>American Indian, Eskimo, Aleut</td>
<td>24</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Mexican American, Puerto Rican, or other Hispanic</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>None of those above</td>
<td>1</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td>Unknown</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1</td>
<td>28</td>
<td>28</td>
</tr>
</tbody>
</table>

Sex, Minority Group, and Citizenship of New Doctorates, 1990–1991

Table 4 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.

Of the 1074 doctorates awarded by U.S. universities, the citizenship is reported as known for 1061 recipients, with 461 reporting U.S. citizenship. The number of U.S. citizen new doctorates is 15 percent greater than in 1989–90 and is the highest count since 1981–82. Still, the number of U.S. citizens is substantially lower than it was throughout the 1970s. See Table 5 and the accompanying graphs.

At the same time that the number of U.S. citizens has increased, so has the number of noncitizen new doctorates. A total of 600 noncitizens were granted doctorates by U.S. universities in 1990–91. This represents an increase of 14 percent from the number in 1989–90. The number of noncitizen new doctorates has risen every year since 1978–79. The 1990–91 count is 121 percent greater than the number awarded by U.S. institutions ten years ago (272 in 1980–81).

The percentage increases in the numbers of U.S. citizen and noncitizen new doctorates parallel each other. As a consequence, the percentage that U.S. citizens represent of the total doctorates given by U.S. universities remains at the all-time low of 43 percent attained in 1989–90. Data for the period 1973–74 through 1990–91 are shown in Table 5.

Among the U.S. citizens receiving doctorates in the mathematical sciences, 10 were black (7 men, 3 women) and 6 were Mexican American, Puerto Rican or other Hispanic (2 men, 4 women).

Women account for 24 percent of the U.S. citizens receiving doctorates in the mathematical sciences from U.S. universities. This is equal to the highest percentage ever reported. In absolute numbers, the count of 112 U.S. citizen women earning doctorates is the highest number since the data on sex were first reported in 1973–74. See Table 6.

Note that in Table 5 and Table 6 all years prior to 1982–83 include doctorates granted by computer science departments.
### TABLE 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>
</tr>
</thead>
<tbody>
<tr>
<td>1973–1974</td>
<td>938</td>
<td>677</td>
<td>72</td>
</tr>
<tr>
<td>1974–1975</td>
<td>999</td>
<td>741</td>
<td>74</td>
</tr>
<tr>
<td>1975–1976</td>
<td>965</td>
<td>722</td>
<td>75</td>
</tr>
<tr>
<td>1976–1977</td>
<td>901</td>
<td>689</td>
<td>76</td>
</tr>
<tr>
<td>1977–1978</td>
<td>868</td>
<td>634</td>
<td>73</td>
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<tr>
<td>1978–1979</td>
<td>806</td>
<td>596</td>
<td>74</td>
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<tr>
<td>1979–1980</td>
<td>791</td>
<td>578</td>
<td>73</td>
</tr>
<tr>
<td>1980–1981</td>
<td>839</td>
<td>567</td>
<td>68</td>
</tr>
<tr>
<td>1981–1982</td>
<td>798</td>
<td>519</td>
<td>65</td>
</tr>
<tr>
<td>1982–1983</td>
<td>744</td>
<td>455</td>
<td>61</td>
</tr>
<tr>
<td>1983–1984</td>
<td>738</td>
<td>433</td>
<td>59</td>
</tr>
<tr>
<td>1984–1985</td>
<td>726</td>
<td>396</td>
<td>55</td>
</tr>
<tr>
<td>1985–1986</td>
<td>755</td>
<td>386</td>
<td>51</td>
</tr>
<tr>
<td>1986–1987</td>
<td>739</td>
<td>362</td>
<td>49</td>
</tr>
<tr>
<td>1987–1988</td>
<td>798</td>
<td>363</td>
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<tr>
<td>1988–1989</td>
<td>884</td>
<td>411</td>
<td>46</td>
</tr>
<tr>
<td>1989–1990</td>
<td>929</td>
<td>401</td>
<td>43</td>
</tr>
<tr>
<td>1990–1991</td>
<td>1061</td>
<td>461</td>
<td>43</td>
</tr>
</tbody>
</table>

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

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

#### 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>
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</thead>
<tbody>
<tr>
<td>1973–1974</td>
<td>677</td>
<td>618</td>
<td>59</td>
<td>9</td>
</tr>
<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>
</tr>
<tr>
<td>1976–1977</td>
<td>689</td>
<td>602</td>
<td>87</td>
<td>13</td>
</tr>
<tr>
<td>1977–1978</td>
<td>634</td>
<td>545</td>
<td>89</td>
<td>14</td>
</tr>
<tr>
<td>1978–1979</td>
<td>596</td>
<td>503</td>
<td>93</td>
<td>16</td>
</tr>
<tr>
<td>1979–1980</td>
<td>578</td>
<td>491</td>
<td>87</td>
<td>15</td>
</tr>
<tr>
<td>1981–1982</td>
<td>519</td>
<td>431</td>
<td>88</td>
<td>17</td>
</tr>
<tr>
<td>1982–1983</td>
<td>455</td>
<td>366</td>
<td>89</td>
<td>20</td>
</tr>
<tr>
<td>1983–1984</td>
<td>433</td>
<td>346</td>
<td>87</td>
<td>20</td>
</tr>
<tr>
<td>1984–1985</td>
<td>396</td>
<td>315</td>
<td>81</td>
<td>20</td>
</tr>
<tr>
<td>1985–1986</td>
<td>386</td>
<td>304</td>
<td>82</td>
<td>21</td>
</tr>
<tr>
<td>1986–1987</td>
<td>362</td>
<td>289</td>
<td>73</td>
<td>20</td>
</tr>
<tr>
<td>1987–1988</td>
<td>363</td>
<td>287</td>
<td>76</td>
<td>21</td>
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<tr>
<td>1988–1989</td>
<td>411</td>
<td>313</td>
<td>98</td>
<td>24</td>
</tr>
<tr>
<td>1989–1990</td>
<td>401</td>
<td>312</td>
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<td>22</td>
</tr>
<tr>
<td>1990–1991</td>
<td>461</td>
<td>349</td>
<td>112</td>
<td>24</td>
</tr>
</tbody>
</table>

Graph for Table 6: U.S. Citizen Doctorates, Male and Female

---

*Adjusted total of doctorates given by U.S. universities
*Total of doctorates who are U.S. citizens
Bibliography


The figures for 1991 were compiled from questionnaires sent to individuals who received a doctorate in the mathematical sciences during the 1990–91 academic year from universities in the United States and Canada.

Questionnaires requesting information on salaries and professional experience were distributed to 1242 recipients of degrees using addresses provided by the departments granting the degrees. 523 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 on 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. For more comprehensive information on the recipients of new doctorates granted last year in the mathematical sciences in the U.S. and Canada, see the preceding article by D. McClure.

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 horizontal line represents the median salary for 1990 in hundreds of dollars. The points plotted are the median salaries for each year converted to 1990 dollars using the implicit price deflator prepared annually by the Bureau of Economic Analysis, U.S. Department of Commerce. (Because the deflator is not yet available for this year, the 1991 figures do not appear on the graphs.) The boxes show the middle half of the population, where the quartile data are available.

Note that salaries for teaching, or teaching and research, have yet to return to their high point of 1970, although steady progress has been made since 1980. (For further details, see Donald Rung's article, "A Fifteen Year Retrospective on Academic Salaries of U.S. Doctorate Holding Faculty," in the November 1985 issue of Notices, pages 772-773.)

### Nine-Month Salaries

<table>
<thead>
<tr>
<th>Ph.D. Year</th>
<th>Min</th>
<th>Q1</th>
<th>Median</th>
<th>Q3</th>
<th>Max</th>
<th>Reported Median in 1990 $</th>
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</thead>
<tbody>
<tr>
<td>TEACHING OR TEACHING AND RESEARCH (188 men + 54 women)</td>
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<tr>
<td>1960</td>
<td>49</td>
<td>65</td>
<td>80</td>
<td>90</td>
<td>127</td>
<td>276</td>
</tr>
<tr>
<td>1965</td>
<td>70</td>
<td>80</td>
<td>105</td>
<td>110</td>
<td>128</td>
<td>311</td>
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<tr>
<td>1970</td>
<td>85</td>
<td>110</td>
<td>195</td>
<td>200</td>
<td>241</td>
<td>344</td>
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<td>90</td>
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<td>155</td>
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<td>1985</td>
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<td>396</td>
</tr>
<tr>
<td>1990</td>
<td>200</td>
<td>275</td>
<td>314</td>
<td>350</td>
<td>410</td>
<td>493</td>
</tr>
<tr>
<td>1991</td>
<td>200</td>
<td>300</td>
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<td>360</td>
<td>420</td>
<td>550</td>
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<table>
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<th>Ph.D. Year</th>
<th>Min</th>
<th>Q1</th>
<th>Median</th>
<th>Q3</th>
<th>Max</th>
<th>Reported Median in 1990 $</th>
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<tbody>
<tr>
<td>1998M</td>
<td>200</td>
<td>275</td>
<td>305</td>
<td>330</td>
<td>478</td>
<td>315</td>
</tr>
<tr>
<td>1998F</td>
<td>210</td>
<td>275</td>
<td>305</td>
<td>330</td>
<td>478</td>
<td>315</td>
</tr>
<tr>
<td>1999M</td>
<td>200</td>
<td>290</td>
<td>305</td>
<td>330</td>
<td>478</td>
<td>315</td>
</tr>
<tr>
<td>1999F</td>
<td>220</td>
<td>290</td>
<td>310</td>
<td>330</td>
<td>478</td>
<td>315</td>
</tr>
<tr>
<td>2000M</td>
<td>230</td>
<td>305</td>
<td>320</td>
<td>350</td>
<td>478</td>
<td>315</td>
</tr>
<tr>
<td>2000F</td>
<td>250</td>
<td>300</td>
<td>325</td>
<td>360</td>
<td>493</td>
<td>315</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ph.D. Year</th>
<th>Min</th>
<th>Q1</th>
<th>Median</th>
<th>Q3</th>
<th>Max</th>
<th>Reported Median in 1990 $</th>
</tr>
</thead>
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<tr>
<td>2001M</td>
<td>150</td>
<td>310</td>
<td>330</td>
<td>360</td>
<td>610</td>
<td>315</td>
</tr>
<tr>
<td>2001F</td>
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<td>310</td>
<td>332</td>
<td>360</td>
<td>650</td>
<td>315</td>
</tr>
</tbody>
</table>

One year or less experience (129 men + 43 women)

<table>
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<th>Min</th>
<th>Q1</th>
<th>Median</th>
<th>Q3</th>
<th>Max</th>
<th>Reported Median in 1990 $</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998M</td>
<td>150</td>
<td>316</td>
<td>333</td>
<td>360</td>
<td>578</td>
<td>315</td>
</tr>
<tr>
<td>1998F</td>
<td>260</td>
<td>314</td>
<td>325</td>
<td>349</td>
<td>475</td>
<td>315</td>
</tr>
</tbody>
</table>

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**Graphs**

- **Nine-Month Salaries**
  - **Teaching or Teaching and Research**
  - **One year or less experience (129 men + 43 women)**

---

**Note:** The tables and graphs provide a detailed overview of the salary survey for new recipients of doctorates, highlighting the median salaries and quartile figures for each academic year, as well as the progress in salaries over time.
### Nine-Month Salaries

**RESEARCH**

<table>
<thead>
<tr>
<th>Ph.D. Year</th>
<th>Min</th>
<th>Median</th>
<th>Max</th>
<th>Median in 1990 $</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>52</td>
<td>65</td>
<td>80</td>
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<tr>
<td>1965</td>
<td>71</td>
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<td>1970</td>
<td>78</td>
<td>105</td>
<td>160</td>
<td>329</td>
</tr>
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**TEACHING OR TEACHING AND RESEARCH**

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### Nine-Month Research

Graph omitted because sample size too small.

### Twelve-Month Salaries

**TEACHING OR TEACHING AND RESEARCH**

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### Twelve-Month Teaching or Teaching and Research

![Box plot for Twelve-Month Teaching or Teaching and Research]
### Twelve-Month Salaries

#### Ph.D. Year

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#### (25 men + 11 women)

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One year or less experience (22 men + 6 women)

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#### Twelve-Month Salaries

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#### (16 men + 4 women)

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One year or less experience (13 men + 2 women)

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### Faculty Salary Survey

The charts on the following pages display faculty salary data for Groups I–VI, 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 1991–92 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, and this information has been added to this year’s report. The salary intervals containing the quartiles are denoted by \(<n,n\>\).
### FACULTY SALARIES 1991–1992

**GROUP I — Doctorate-granting departments of mathematics (39)**

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**GROUP II — Doctorate-granting departments of mathematics (43)**

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Annual AMS-MAA Survey

FACULTY SALARIES 1991–1992
GROUP III — Doctorate-granting departments of mathematics (86)
67 usable responses (78%)

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FACULTY SALARIES 1991–1992
GROUP IV — Doctorate-granting depts. of statistics, biostatistics, biometrics (73)
57 usable responses of 73 (78%)

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FACULTY SALARIES 1991–1992

GROUP V – Doctorate-granting depts. of applied mathematics and operations research (34)
27 usable responses (79%)

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FACULTY SALARIES 1991–1992

GROUP VI – Canadian doctorate-granting departments (32)
20 usable responses (63%). Salaries reported in Canadian dollars

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<td>Full Professor</td>
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<td>&lt;65.70</td>
<td>&lt;70.75</td>
<td>68,837</td>
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### FACULTY SALARIES 1991–1992

#### GROUP M – Master's degree granting departments of mathematics (264)
152 usable responses (58%)

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<th>Rank</th>
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<th>Q3</th>
<th>Median</th>
<th>Q2</th>
<th>Mean</th>
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<td>Assistant Professor</td>
<td>730</td>
<td>&lt;30,35&gt;</td>
<td>&lt;30,35&gt;</td>
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<td>&lt;35,40&gt;</td>
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<td>&lt;40,45&gt;</td>
<td>42,444</td>
<td>&lt;45,50&gt;</td>
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<tr>
<td>Full Professor</td>
<td>946</td>
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<td>&lt;50,55&gt;</td>
<td>53,152</td>
<td>&lt;60,65&gt;</td>
<td>52,736</td>
</tr>
</tbody>
</table>

#### GROUP B – Bachelor's degree granting departments of mathematics (1012)
477 usable responses (47%)

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<th>Rank</th>
<th>No. Reported</th>
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<th>Q3</th>
<th>Median</th>
<th>Q2</th>
<th>Mean</th>
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<tr>
<td>Assistant Professor</td>
<td>1079</td>
<td>&lt;25,30&gt;</td>
<td>&lt;30,35&gt;</td>
<td>32,889</td>
<td>&lt;35,40&gt;</td>
<td>31,579</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>974</td>
<td>&lt;35,40&gt;</td>
<td>&lt;35,40&gt;</td>
<td>39,967</td>
<td>&lt;40,45&gt;</td>
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<tr>
<td>Full Professor</td>
<td>888</td>
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</tbody>
</table>
Doctoral Degrees Conferred 1990–1991

Arizona
Arizona State University (2)
MATHEMATICS
Cole, George R., Triangles all of whose sides and medians are rational.
Penrice, Stephen G., Techniques for coloring graphs with forbidden trees.

University of Arizona (10)
APPLIED MATHEMATICS
Bernstein, Lisa J., Quantum theories of self-localization.
Crowe, Kathleen M., A discrete size-structured competition model.
Gooley, Theodore Alan, Quantitative comparisons on statistical methods in image reconstruction.
Jakobsen, Per Kristen, Stability and instability of two laser models.
Mazer, Arthur A., Design and analysis of mixing machines.
Stapleton, David P., A technique for the analysis of the invariance of classical gauge field theory by means of functional equations.
Su, Yu, Mathematical theory and computer simulation of isoelectric focusing.
Wu, Chuntao, Percolation in half spaces and Markov fields on branching planes.

MATHEMATICS
Adongo, Harun Paulo Kasera, Isomorphism of automorphism groups of mixed modules over a complete discrete valuation ring.
Lee, June Bok, Integral solutions in arithmetic progression for elliptic curves.

California
California Institute of Technology (10)
APPLIED MATHEMATICS
Hobson, Dana D., Point vortex models for modon dynamics.
Mudkav, Vidyadhark Y., Numerical studies of nonlinear axisymmetric waves on vortex filaments.
Pham, Thu, Numerical studies of incompressible Richtmyer-Meshkov instability in a stratified fluid.

MATHEMATICS
Delatte, David Allen, Nonstationary normal forms for Anosov diffeomorphisms and skew product transformations.
Gursky, Matthew J., Compactness of conformal metrics with integral bounds on curvature.

Jakšić, Vojkan, Solutions to some problems in mathematical physics.
Mazorov, Moya Michelle, Extremal problems in codes, finite sets, and geometries.
Shih, Tanchu, Bounds of fixed point ratios of permutation representations of $GL_n(q)$ and groups of genus zero.
Yue, Chingbo, Rigidity of three measure classes on the ideal boundary of manifolds of negative curvature.
Zhang, Xiaodong, On spectral properties of positive operators.

Claremont Graduate School (2)
MATHEMATICS
Turner, Gregg H., Spectral conditions for oscillations and stabilization of systems of differential equations with piecewise constant arguments.

Naval Postgraduate School (1)
OPERATIONS RESEARCH

Stanford University (23)
ENGINEERING-ECONOMIC SYSTEMS
Beider, Perry Collin, All the good ones are taken: A search-theory analysis of multi-type marriage markets.
Courand, Gregory Joseph, Cooperation via justification-based consensus formation processes.
de Klerk, Antonie Machiel, Decision incentives in major systems acquisition.
Hagen, Brian Wayne, Constructing discrete marginal distributions via redundant probabilistic assessment.
Matheson, David Earnest, When should you reexamine your frame?
Poh, Hean Lee, A neural network approach for marketing strategies, research, and decision support.
Shi, Xia, Modeling the Chinese economy in a general equilibrium framework.

MATHEMATICS
Chuaqui, Martin, The Schwarzian derivative in Riemannian geometry and quasiconformal reflections in spheres.
Dai, Jiangang, Steady-state analysis of reflected Brownian motion.
Annual AMS-MAA Survey

Prewitt, Kathryn Ann, Weak convergence of Gaussian processes in nonparametric curve estimation.

University of California, Irvine (3)
MATHEMATICS
Barry, Ronald, Minimal and near-minimal resolution IV designs.
DeBonis, Mark Jude, Contributions to omega-stable groups.
Margulies, Caryl Ann, Existence of solutions to some semilinear equations.

Prewitt, Kathryn Ann, Weak convergence of Gaussian processes in nonparametric curve estimation.

University of California, Irvine (3)
MATHEMATICS
Barry, Ronald, Minimal and near-minimal resolution IV designs.
DeBonis, Mark Jude, Contributions to omega-stable groups.
Margulies, Caryl Ann, Existence of solutions to some semilinear equations.

University of California, Los Angeles (26)
BIOSTATISTICS
Fine, Gil David, Nonparametric estimation of the receiver operating characteristic curve.
Hemyari, Parichehr, Evaluating robustness of the quartiles of survival times, reliability, and regression coefficients when the distributional assumption is violated.
Nisenbaum, Rosane, Covariate measurement error in the exponential regression model.
Wanek, Leslie Ann, Multistage Markov modelling applied to malignant melanoma progression.

MATHEMATICS
Bisch, Dietmar Herbert, Subfactors, actions of groups and growth invariance.
Butler, David, Normal generation of vector bundles over a curve.
Chow, Richard Tso-hwa, Holomorphic motions on Riemann surfaces.
Celniker, Nancy Jeanne, Combinatorial properties of homogeneous product Lie groups.
Donat, Rosa, Propagation of error into regions of nonlinear approximations to hyperbolic equations.
Fatemi, Emad, Numerical solution of electron and hole transport.
Kitagawa, Koji, On standard p-adic L-functions of families of cusp forms.
Lafon, Frederic, Filtering methods for the Hamilton-Jacobi equation and hyperbolic systems of conservation laws.
Little, Richard E., Manifolds of almost negative Ricci curvature.
Liu, Xijian, Infinite reversible nearest particle systems in inhomogeneous and random environments.
McClanahan, Kevin Paul, C*-algebras generated by elements of a unitary matrix.
Radulescu, Florin, Fundamental group for von Neumann algebras associated to free groups.
Robins, Sinai, Arithmetic properties of modular forms.

Shors, Douglas, Deforming reducible representations of knot groups in SL2(C).
Soong, Tien-Lun, On the existence of an extremal function for J. Moser's inequality.
Tsui, Waikin, Domain decomposition of biharmonic and Navier-Stokes equation.
White, Tad P., The geometry of the outer space.
Wu, Xijian, Stability of difference approximations for initial boundary value problems.
Yeung, Wing, Essentially non-oscillatory method for Navier-Stokes type equations.

University of California, San Diego (10)
MATHEMATICS
Allen, Edward E., On a conjecture of Procesi and a new basis of graded left regular representation.
Celniker, Nancy Jeanne, Combinatorial properties of finite, upper half-planes and an improvement on the Tutte polynomial for coloring grey groups.
Garrett, Brett Taylor, Euclidean and hyperbolic surfaces determined by circle packings.
Kelly, Colleen Lauer, A test of the Markov assumption in DNA sequence evolution and a generalization of the model to allow the site to evolve under unequal rates.
Ram, Arun, Representation theory and character theory of centralizer algebras.
Sethuraman, Bharath, Construction of valued division algebras with applications to indecomposability and elementary abelian crossed products.
Shick, Johnathan, Quadratic forms over function fields of elliptic and hyperelliptic curves.
Thomas, Carolyn Ann, Extension of classical results in one complex variable to several complex variables.
Velasquez, Elinor Laura, The Radon transform on finite groups.

Wahlen, Bruce Edward, A non-parametric measure of independence.

University of California, Santa Barbara (7)
MATHEMATICS
Chang, Shu-Chu, Two-sided equivalence with respect to subgroups of the modular group.
Lee, Cheng, Approximating the average operator.
Miranda, Hector Fernando, G-Majorization, reflection groups and trace inequalities.
Putnam, Thomas Craig, Combinatorial Gray code and Hamiltonian circuits through certain Cayley graphs of the symmetric group.
So, Wasin, Exponential formulas and spectral indices.

STATISTICS AND APPLIED PROBABILITY
Chaturvedi, Prachi, Best approximations in insurance mathematics with respect to stop-loss distances.
Wan, Xinyuan, Inference for a semi parametric problem.

University of California, Santa Cruz (2)
MATHEMATICS
Fu, Xiang, Asymptotics of Toeplitz matrices with symbols of bounded variation.
Robinson, Stephen Bruce, Semilinear elliptic boundary value problems.

University of Southern California (1)
MATHEMATICS
Angelone, Maria E., Jones index for rings.

Colorado
Colorado State University (2)
STATISTICS
Khodadadi, Ahmad, Studies on a general distribution and censoring procedure in life testing.
Li, Junfang, Sequential and optimal single stage factorial designs, with industrial applications.

University of Colorado, Denver (4)
MATHEMATICS
Bradford, Bert Larue, Fast Fourier transforms for direct solution of Poisson's equation.
Henson, Van Emden, Fourier methods of image reconstruction.
Lett, Gregory Scott, Domain decomposition preconditioners for thin rectangular p-version finite elements.
Rasmussen, Craig W., Interval competition graphs of symmetric digraphs and two-step graphs of trees.
University of Colorado, Boulder (1)

APPLIED MATHEMATICS

Jones, Fred Byron, Property inherited by the two-dimensional unfoldings of one-dimensional.

Connecticut

University of Connecticut (10)

MATHEMATICS

Boman, Margaret Ann, A feasible algorithm to determine whether a 3-manifold is Haken.
Budney, Paul, Some applications of the P-X dual.
Chang, Maoli, Polyharmonic cardinal Hermite spline interpolation.
Her, Hyeyeong, Multiple periodic solutions in a hanging cable with periodic forcing.
Her, Min, Multilinear measure theory and its applications.
Hu, Shu-An, The numerical range of operators.
Liu, Guangyu, Some problems about joint ergodicity and uniform distributions.
Tsatsomeros, Michael, Reachability of non-negative and symbiotic states for linear differential systems.
Vinel, Gerard Francois, On Lie super-systems and symmetric supermanifolds.
Zou, Zhiming, Some results on jumps of splittings of recursively enumerable sets.

Wesleyan University (4)

MATHEMATICS

Hasfura-Buenaga, Julio Roberto, The equivalence theorem for $2^d$-actions of positive entropy.
Johann, Patricia, Complete sets of transformations for unification problems.
Kizanis, Ann, Epicompletions of archimedean lattice-ordered groups.
Trigos-Arrieta, Francisco Javier, Pseudocompactness on groups.

Yale University (6)

MATHEMATICS

Cockburn, Sally Patricia, The $\gamma$-filtration on the representation ring of a p-group.
Curtis-Budka, Cynthia Louise, A Casson-type invariant counting SO(3)-representations.
Dartnell, Pablo Ricardo, On the homology of groups of jets.
Gonzalez, Maria Jose, Uniformly perfect sets, Green functions, and fundamental domains.
Laeng, Enrico, Analysis of orthogonal expansions of functions.

STATISTICS

Sherman, Robert P., U-processes and semiparametric estimation.

Delaware

University of Delaware (2)

MATHEMATICAL SCIENCES

Hernandez, Jorge Eliezer, Global invertibility in smooth and nonsmooth analysis.
Mehrotra, Devan, Circularity diagnostics for repeated measures designs.

District of Columbia

American University (3)

MATHEMATICS AND STATISTICS

Awartani, Nehaya, The asymptotic behavior of linear regression $M$-estimators for censored data.
Chen, Ling, Estimation of the mean of positively skewed distributions to estimation of exposure to contaminated soils.
Winter, June Frances, Art and mathematics: Enhancing achievement through curricular design.

George Washington University (6)

OPERATIONS RESEARCH

Abel, Patricia, Information and the design of life tests.
Balana, Arturo, Stochastic monotonicity and comparison: Applications to provisioning in nonstationary repairable-item inventory systems.
Boukari, Djamel, Nonalgorithmic sensitivity analysis and bounds on the parameters of linear and nonlinear programs.
Hamed, Ammar Salah, Calculation of bounds on variables and underestimating convex functions for nonconvex functions.
Palocsay, Susan, Topics in nonconvex fractional programming.

STATISTICS, COMPUTER AND INFORMATION SYSTEMS

Palish, Yoko, K-group group multi-variate rank test and related estimators of group differences.

Florida

Florida State University (6)

MATHEMATICS

Choi, Junesang, Determinants of Laplacians and multiple gamma functions.
Raspopovic, Pedja, Incompressible surfaces in punctured Kleinbottle bundles.
Tajdari van der, Mohammad Sina, Singular complex periodic solutions of van der Pol's equation of uniform approximations for the solution of Lagerstrom's model problem.

Statistics

Kim, Ji-Hyun, Conditional bootstrap methods for censored data.
Norris, James, Estimation of the number of classes of objects through presence/absence data.
Young, Thomas, A new family of survival functions derived from a general cumulative damage threshold crossing model for evolving structural systems of improving components with biomedical and accelerated life testing applications.

University of Florida (4)

INDUSTRIAL AND SYSTEMS ENGINEERING

Uzsoy, Reha, Production scheduling algorithms for semiconductor test operations.

MATHEMATICS

Fujimoto, Ichiro, CP-convexity and its applications.
Manseur, Zohra Z., Decomposition and inversion of convolution operators.
McMillan, Timothy, Invariants of antisymmetric tensors.

University of Miami (1)

MATHEMATICS AND COMPUTER SCIENCE

Siler, John, Connecting the student and the computer: Development and implementation of a lab component for calculus I.

University of South Florida (5)

MATHEMATICS

Guan, Zhengyuan, On operators of monotone type in Banach spaces.
Kaplan, David, Applications of nonlinear analysis to the control of space with preassigned responses.
Pan, Kuochen Guoquan, Some extremal problems in approximation theory.
Shim, Jaedong, Optimal control problems in delay differential equations.
Weng, Xinlong, Approximation methods for solving nonlinear equations in Banach spaces.

Georgia

Emory University (2)

MATHEMATICS AND COMPUTER SCIENCE

Fletcher, Raymond, Unique path property digraphs.
Gersдорff, Graham, Singular nonlinear second order boundary value problems.

Georgia Institute of Technology (1)

MATHEMATICS

Postell, Floyd Vince, High order finite difference methods.
University of Georgia (4)
Mathematics
Ding, Li-Feng, Pairs of separating vectors and reflexivity.
Sligar, John Christopher, On the minimal v-degree of the generalized Jones polynomial.

Statistics
Su, Kuoliang, Law of large numbers and failure rate function estimation.
Wen, Miin-Jye, Single-stage multiple comparison procedures under heteroscedasticity.

Hawaii
University of Hawaii (2)
Mathematics
Zhou, Chiping, Maximum principles and Liouville theorems for elliptic partial differential equations.

Public Health Sciences
Khan, Mahmudul, Theoretical approach to the problem of record linkage: Maximizing the use of blocking.

Idaho
Idaho State University (1)
Mathematics
Siler, Josep R., Reflectors matrix-valued inner products, and partial orders of Hermitian-preserving linear transformations.

Illinois
Illinois Institute of Technology (1)
Mathematics
Maslanka, David J., A geometrical representation of the sets of pure states for quantum logics.

Illinois State University (1)
Mathematics
Lenney, Stephen, G.F.B. Riemann and Fourier series.

Northern Illinois University (1)
Mathematical Sciences
Dever, Mary Beth, Moebius transformations in several dimensions.

Northwestern University (3)
Mathematics
Dietz, Jill, Stable splittings of classifying spaces of metacyclic p-groups.
Haunsperger, Deanna, Projection and aggregation paradoxes in nonparametric statistical tests.

University of Illinois, Urbana-Champaign (2)
Mathematics
Khan, Mahmudul, Theoretical approach to the problem of record linkage: Maximizing the use of blocking.

Statistics
Su, Kuoliang, Law of large numbers and failure rate function estimation.
Wen, Miin-Jye, Single-stage multiple comparison procedures under heteroscedasticity.

University of Illinois, Chicago (8)
Mathematics, Statistics, and Computer Science
Bultman, William, Topics in the theory of machine learning and neural computing.
Hou, Xiang-dong, Covering radius of error-correcting codes.
Mbeng, Gaston Ngantchou, Optimum selection procedures for linear regression model.
Ramachandran, Mohan, Type II index theorems for manifolds with boundary.
Sompolski, Walter Robert, The second case of Fermat's Last Theorem for fixed irregular prime exponents.

University of Illinois, Urbana-Champaign (13)
Mathematics
Amir, Abdelmadjid, Strong concerence to diffusion processes with application to queueing theory.
Balmaceda, Jose, Multiplicity-free permutation representations of the alternating groups.
Chiappari, Stephen Anthony, Proper holomorphic mappings of positive codimension in several complex variables.
Kezdy, Andre, Studies of connectivity.
Kim, Houbum, Geometries and dynamical properties of Riemannian foliations.
McEachin, Raymond, Analysis of an inequality concerning perturbation of self-adjoint operators.
Rogers, Allen Dale, Theory and applications of a functional from metric geometry.
Sanders, Robin, Graphs on which dihedral, quaternion and abelian groups act vertex and/or edge transitively and applications to tensor products.
Scotfield, Paul David, Symplectic and complex foliations.
Seyfried, Michael, The zeta function of an order in a general algebra.
Wenzel, Christian, Classification of all parabolic subgroup schemes of a semi-simple linear algebraic group over an algebraically closed field of positive characteristic.
Zhang, Liang-Cheng, Some important continued fractions of Ramanujan and Selberg.

Indiana
Indiana University (2)
Mathematics
Promislow, Keith, Construction and application of approximate inertial manifolds for the Ginzburg-Landau partial differential equation.
Zou, Yi-Ming, Structure of some representations of quantum groups.

Purdue University (15)
Mathematics
Ban, Chun-sheng, Whitney stratification, equisingular family and the aureole of quasi-ordinary singularity.
Benjamin, Chen-Fang Liang, Fixed point indices, transfers, and path fields.
Cho, Sanghyun, On the extension of complex structures on compact pseudoconvex complex manifolds.

Dwyer, David John, The spectrum of the complex Laplacian for N-invariant pseudo-Kahlerian structures on C^n.

Hong, Bum Il, High-order regularity and approximation for Hamilton-Jacobi equations.

Huang, Weiming, Differential invariant properties of analytic spaces.

Li, Wei, Coverings of algebraic varieties and the tame version of Zariski's Conjecture.

Oh, Kyung-Ho, On topology of quasi-ordinary singularities.

Sastry, Pramathanath, Regular differentials and relative duality.

Xu, Jianming, On the lifetime of conditioned Brownian motion.

Bose, Sudip, Bayesian robustness with shape-constrained priors and mixture priors.

Huang, Su-Yun, Nonparametric density estimation by spline projection kernels.

Su, Yeong-Tzay, A sequential test for Markov dependence.

Tan, Ming, Shrinkage, GMANOVA, control varieties and their applications.

Ye, Keying, Noninformative priors in Bayesian analysis.

University of Notre Dame (7)

Mathematics

Bards, Emmanuel Theodore, The defect relation for meromorphic maps defined on covering parabolic manifolds.

Borberly, Albert, The Dirichlet problem at infinity and vanishing curved manifolds.

Dennee, Paul, Constant mean curvature cylinders with embedded ends.

Niebergall, Ross, Dupin hypersurfaces in R^3.

O'Shea, Julann, A defect relation for slowly moving target hypersurfaces.

Pilkington, Anne B., Normal subgroups of 4-dimensional hyperbolic orthogonal groups over arithmetic domains.

Szeko, Robert, Monge-Ampère models.

University of Iowa (12)

Applied Mathematical Sciences

Bernatz, Richard, Development of the finite analytic method for turbulent forced and free convection.

Mathematics

Catenillan-Clarens, Ximena, Canonically Koszul invertible, Koszul invertible, and quasi-normal pairs of operators on Hilbert space.

Chien, David, Piecewise polynomial collocation for integral equations on surfaces in three dimensions.

Espina, Carlos, Stability of equilibria in some epidemic models.

Ha, Kyung Soon Jung, On simple Lie algebras of characteristic p and l-filtilations.

Lee, Hsiae, Multigrid method for integral equations.

Levin, Rebecca, Generalizations of GCD-domains and related topics.

Olivares, Patricio, Exactness at the middle stage of the Koszul complex of commuting pairs of Hilbert space operators, with applications to 2-variable weighted shifts and triangular pairs.

Zhao, Pei-Yi, Invariant links for knotted graphs in 3-space.

Statistics

Anderson-Sprecher, Richard, The statistical analysis of wildlife radio-tracking data.

Galbiati-Risco, Jorge Mauricio, Estimation of choice models under endogenous/exogenous stratification.

Lee, Chang Soo, Time series models for the credibility estimation of insurance premiums.

Kansas State University (6)

Mathematics

Ghoreishi, Afshin, Positive solutions of interacting models in a heterogeneous environment under mixed boundary conditions.

Logan, Roger, A study of a two-species competing interaction model in mathematical biology.

Statistics

Hwang, Ching-Chang, Hypothesis testing in linear models hewing nested error structure.

Neogi, Debashis, Stochastic, fractal, and chaotic modeling of multiphase flow systems.

Ogunyeni, Theophilus Olabide, Simplified two-stage estimators and a Bayes type modification of maximum quasi-likelihood estimates.

Tashtoush, Suleiman, Small sample power of aligned rank transform tests in factorial experimental design.

University of Kentucky (6)

Mathematics

Branner, Frank, On the projective functor.

Buskirk, Robert, A universal completely regular curve and inverse limits of locally connected curves.


Yeomans, Charles, Quintic forms over finite and local fields.

Statistics

Fai, Hrong-Tai, Comparison of exact and approximate tests of hypotheses concerning the first-stage factor in unbalanced nested designs and the main plot factor in split-plot experiments with missing data.

Shen, Pao-Sheng, The study of efficiency of some planned unbalanced designs for estimation of quantitative genetic parameters.
Louisiana

Louisiana State University (6)

MATHEMATICS

Beaulieu, Patricia Wright, A new construction of subgroups inducing isomorphic representation.

Chen, Sheng, Exterior vertices in graphs and realization of plurality preference digraphs.

Gubser, Bradley, Problems in matroid theory.

Pfeffer, Carolyn, Harmonic analysis on solvable manifolds.

Stuart, Donna, A new conditions for arithmetic equivalence.

Tulane University (7)

MATHEMATICS

Calzada, Maria Eugenia, A combustion model for incompressible flows.

Huth, Michael Reiner, Projection-stable and zero dimensional domains.

Li, Xuefeng, A compressible vortex method for viscous gas dynamics and its numerical implementations.

Segalla, Gabriella, Approximation theorems for linear integro-differential equations in Banach spaces.

Song, Yu, Numerical methods for turbulent combustion problems.

Tran, Hong Thi, Boundary layer phenomena for a turbulent model.

Villarreal, Karen Mary Zeringue, Fibred products of homogeneous continua.

University of Southwestern Louisiana (7)

MATHEMATICS

Bourque, Anthony Keith, Matrices associated with classes of arithmetic functions.

Cobb, Shannon Sherlita, Quenching for parabolic mixed boundary-value problems.

Fung, Tai-Wai, Dead cores and quenching for semilinear reaction-diffusion systems.

Hu, Chenyi, Optimal preconditioners for the interval Newton method.

Vincent, Diana J., An inward harmonic continuation problem with biomedical application.

University of Maryland, Baltimore (2)

MATHEMATICS AND STATISTICS

Abbad, Mohammed, Perturbation and stability theory for Markov control problems.

Chen, Sy-Mien, Robust tests in statistical quality control.

Clemons, Curtis, Uniqueness results of semilinear elliptic equations.

Faulkenberry, Richard, On some interpolation problems for rational matrix-valued functions.

Fletcher, Charles, Multiscale periodic homogenization of certain elliptic equations using viscosity solution methods.

Heller, William Harold, Frames of exponentials and applications.

Huy, Takuya, A priori and a posteriori error estimates of finite element solutions of parametrized nonlinear equations.

University of Maryland, College Park (23)

MATHEMATICS


Law, Chun-Chung, Statistical methods for the analysis of interval censored data.

Kandil, Todd, Stability of travelling waves with applications to Ginzburg-Landau equations.

Karlovitz, Max, Some solutions to overdetermined boundary value problems on subdomains of spheres.

Kelly, James, Confidentiality protection in two and three-dimensional tables.

Kontsoukos, Antonis, Probabilities of moderate and large deviations of test statistics and estimators in the presence of nuisance parameters.

Lakey, Joseph David, Weighted norm inequalities for the Fourier transform.


Martin, Donald, Estimation of the period of periodically correlated random sequences.

McGowan, Jill F., Lower bounds on the diameters of space forms.

Miner, Robert Roland, Affine manifolds with dilations.

Riviera, William, Discrete dynamical systems modeled by difference equations with applications to digital filters and neural networks.


Stieglitz, Philip, Automorphisms of stable structures.

Sweet, William, The metamepletic case of the Weil-Siegel formula.


Trivedi, Hiren, Development of manpower planning models with known target size.

Anders, Takuya, A priori and a posteriori error estimates of finite element solutions of parametrized nonlinear equations.

Maryland

Johns Hopkins University (15)

BIOSTATISTICS

Karim, M. Rezaul, Generalized linear models with random effects.

Walsh, James, Rotation vectors for maps and flows on compact surfaces.

Whalen, Edward, The asymptotic distribution of magnitude trimmed sums and related results.

Boston University (7)

MATHEMATICS

Brown, John, Analysis of a model of a sigma-delta modulator with an arbitrary input signal.

Ramawamy, Ratna, Techniques for analyzing ordinal scaled data.

Sanchez-Morgado, Hector, Lefschetz formulas for Anosov flows.

Turpin, Mark, Rotation number properties of a class of annulus homeomorphisms with an invariant indecomposable cofinite.
Yu Kong, Wen Yuan, A general procedure for the specification, estimation, and graphical presentations of the hazard regression model.

Brandeis University (6)

MATHEMATICS
Boden, Hans, Representations of orbifold groups and parabolic bundles.
Fong, Lung-Ying, Studies on the degeneration of algebraic curves.
Hughes, James, Periperal link-homotopy invariants.
Kao, Shu-Jung, On values of Gauss maps of complete minimal surfaces on annular ends.
Lam, Ngau, A study of the geometry of algebraic curves and determinantal varieties.
Wu, Bing-Le, Isoparametric submanifolds of Lorentzian spaces.

Harvard University (27)

APPLIED SCIENCES
Beaver, Donald R., Security, fault-tolerance, and communication complexity for distributed systems.
Faybusovich, Leonid, Dynamical systems that solve eigenvalue and linear programming problems.
Feigin, Gerald E., Comparison methods for scheduling control of multiclass single server queues.
Hwang, Ten-Lee, Integrating visions modules for moving edge analysis.
Keefer, Kenneth C., Map representations and optimal encoding for image segmentation.
Kochhar, Sandeep, Cooperative computer-aided design: A paradigm for automating the design and modeling of graphical objects.
Lee, Morris, Moment methods for recovering affine transformation in computer vision.
Lyuu, Yuh-Dauh, An information dispersal approach to issues in parallel processing.
Markus, Joseph W., Automating the design of network diagrams.
Nitzberg, Mark, Depth from overlap.
Nowlin, William C., Tactile sensing with compliant manipulators.
Park, Frank C., The optimal kinematic design of mechanisms.
Sistare, Steven J., A graphical editor for 3-dimensional constraint-based geometric modeling.
Tam, Va-on, Transaction management in data migration systems.
Tsantilas, Athanasios, Communication issues in parallel computation.

MATHEMATICS
Abramovich, Dan, Subvarieties of abelian varieties and of Jacobians of curves.
Aiiken, Wayne, An arithmetic Riemann-Roch theorem for singular arithmetic surfaces.
Bomol, Jean-François, Weierstrass points on arithmetic surfaces.
Damon, Henri, Refined class number formulas for derivatives of L-series.
Frenkel, Edward, Affine Kac-Moody algebras at the critical level and quantum Drinfeld-Sokolov reduction.
McKernan, James, On the hyperplane sections of a variety in projective space.
Ramsay, Keith, Power-free values of polynomials.
Schwartz, Andrew D., Igusa towers over Hilbert modular surfaces.
Spencer, Philip, Yang-Mills connections with asymptotically constant curvature.

STATISTICS
Belin, Thomas Richard, Using mixture models to calibrate error rates in claim-linkage procedures, with application to computer matching for census undercount estimation.
Brown, Constance Marie, Assessing association within a bivariate time series.
Meng, Xiao-Li, Towards complete results for some incomplete-data problems.

Massachusetts Institute of Technology (34)

OPERATIONS RESEARCH
Ballman, Karla V., Cost-effectiveness of smart traffic signals.
Gau, Shih-Hwa, Server management in queueing systems.
Goemans, Michel X., Analysis of linear programming relaxations for a class of connectivity problems.
Nakazato, Daisuke, Transient distributional results in queues with applications to queueing networks.
Richetta, Octavio, Ground holding strategies for air traffic control under uncertainty.
van Ryzin, Garrett, Stochastic and dynamic vehicle routing in Euclidean service regions.
Venkatkeshwaran, C. S., Analysis and optimization of terminal area air traffic control operations.

MATHEMATICS
Biedrzycki, Witold R., Spinors over a cone Dirac operator and representations of Spin (4,4).
Colledge-Jedegral, Roberto, Algebraic treatment of the Whitney conditions.
Chen, William Y. C., On the combinatorics of plethysm.
Duvall, Arthur M., Simplicial posets: f-vectors and free resolutions.
Edelin, Dan S., Brill-Noether theory in codimension-two.
Grigni, Michelangelo, Structure in monotone complexity.
Grossberg, Michael D., Complete integrability and geometrically induced representations.

Northeastern University (6)

MATHEMATICS
Bassiaos, Yiannis, The validity of the bootstrap in the two-sample problem with right censoring.
Fang, Guangxiong, Stability and instability of open coverings.
Halverson, Kimberly J., Multiple recurrence, alpha type, and sequences of integers for transformations with infinite invariant measure.
Ji, Lizhen, The spectral degeneration for hyperbolic Riemann surfaces.
Kui, Johnny, Analysis of neural networks for pattern recognition and associative memory.
Piscitelle, Louis, Nested center manifolds for a set of weather equations.

Tufts University (1)

Mathematics

Hwang, Eunmi C., The number of projective representations of a finite group over an arbitrary field.

University of Massachusetts, Amherst (9)

Mathematics and Statistics

Fuller, Mark, Variational study of interstellar magnetic gas clouds: Theory, modeling, and computation.

Olubummo, Yewande, Axiomatic enumeration and the properties of their associated dual Banach spaces.

Wang, Kongming, Monge-Ampere and collinear censored data.

Xu, Zhong-Ling, Perron operators.

Zalarnea, Fernando, Representations of a finite group over an algebraically closed field.

Zang, Xin-Min, The number of projective quotient rings.

Michigan State University (10)

Mathematics

Cuckovic, Zeljko, Commutants of Toeplitz operators on the Bergman space.

Ding, Jiu, Local and global properties of elliptic equations on weighted norm spaces.

Gu, Dangsheng, Properties of multilinear polynomials.

Nah, Young-Chae, Dirichlet spaces on finitely connected domains.

Wang, Xiaoshen, Intersection theorems for hyperplanes.

Zalamea, Fernando, Axiomatic enumeration and parametrization: A category-theoretic approach.

Zhang, Xin-Min, Geometry of spherical minimal submanifolds.

Zhang, Sixiang, Markov properties of measure-indexed Gaussian random fields.

University of Michigan, Ann Arbor (37)

Biostatistics

Lee, Seungyoun, Testing for and adjusting for dependent censoring in survival analysis.

Petrovi, Olja, A class of two-sample test statistics and sample size calculations.

Schmaitz, Stephen, Inverse nonlinear estimation in the presence of measurement error.

Sereika, Susan, Techniques for analyzing censored data.

Industrial and Operations Engineering

Al-Sahab, Khaled, Nearest point problems: Theory and algorithms.

Arantes, Jose, Resolution of degeneracy in generalized networks.

Ben Kheder, Nejib, Economic lot-sizing in just-in-time procurement systems.

Bourland, Karla, Production planning and control for the stochastic economic lot scheduling problem.

Brown, Matthew, A mean-variance serial replacement decision model.

Cho, Myeong-Sig, Design and performance analysis of trip-based material handling systems.

Hahn, Juho, Economic lot production and delivery scheduling problem.

Hsiao, Hongwei, Posture preferences and postural behavior during static, seated, visual and manual tasks.

Kim, Deok-Soo, Cones on Bezier curves and surfaces.

Russe, Susan, Use of animated graphical instructions to present procedural instructions.

Park, Yunsun, Average optimality in infinite horizon optimization.

Rim, Suk-Chul, Circular layout problems in manufacturing systems.

Saldana, Norika, Design and performance analysis of a computer system operated by the workforce for the collection of perceived musculoskeletal discomfort: A tool for surveillance.

Ulman, Sheryl, Development of guidelines for the use of powered hand tools using psychophysical data.

Yang, Kai, New iterative methods for linear inequalities.

Mathematics


Chen, Xu-Ming, Groups related to generalized quadrangles.

Chen, Zhi-Hong, Reductions of graphs and spanning Euclidean subgraphs.

Cheng, Huan, Limit theorems for nonlinear vector functionals of vector Gaussian processes.

Chuan, Jung-Bum, Generalized spherical space forms.

Lee, Young-Chae, Weak convergence of measure-indexed Gaussian random fields.

Li, Zhang, Engineering models for categorical data.

Li, Wing, On polynomially bounded operators.

Li, Zhongyan, On spherical CR manifolds with positive Webster curvature.

Lou, Yu-Cai, Constructions and 3-deformations of 2-polyhedra.

Pan, Yifei, Proper holomorphic mappings in $\mathbb{C}^N$.

Seidel, Roger R., Slowly decreasing functions and closed ideals.

Soderberg, Nathan R., Quasiregular mappings and Royden algebras.

Stanoyevitch, Alexander, Geometry of Poisson domains.

Wang, Mei, Local limit theorems and occupation times for perturbed random walks.

Statistics

Sarkar, Jyotirmoy, Bandit problems with covariates: Sequential allocation of experiments.

Wayne State University (8)

Mathematics

Chen, Xu-Ming, Groups related to generalized quadrangles.

Chen, Zhi-Hong, Reductions of graphs and spanning Euclidean subgraphs.

Jeon, Tae-II, Limit theorems for nonlinear vector functionals of vector Gaussian processes.

Jiang, Jing-Lin, Existence and regularity of stochastic partial differential equations in Holder spaces.

Li, He, A generalized optimization problem with application to optimal design theory.

Wu, Wen-Jun, Unequal arm chemical balance weighing design.

Zhao, Guanghua, Banach*-algebras of completely bounded multilinear forms on locally compact groups.


Minnesota

University of Minnesota (26)

Mathematics

Barcelo, Bartolome, On the harmonic measure for nondivergence elliptic equations with lower order terms.

Piscitelle, Louis, Nested center manifolds for a set of weather equations.
Mississippi
University of Mississippi (1)
Mathematics
Norris, Paula Anell, Starlike functions with indicator B.

Missouri
St. Louis University (2)
Mathematics
Hopfinger, Mark M., Nearly simple modules for polycyclic-by-finite groups.
Ikeda, Yutaka, A generalized Toponogov comparison theorem.

University of Missouri, Columbia (4)
Mathematics
Easley, Kevin, Local existence of warped product metrics.
Leranoz, Maria Camino, Uniqueness of unconditioned bases in quasi-banach spaces.

Statistics
Kaiser, Mark, Statistical models for limiting factors in ecology.
Summerville, John, Conditional properties of some interval estimators.

Washington University (16)
Mathematics
Chen, Zhenhua, Boundary regularity of the \( \delta \)-equation on convex domains.
Fan, Dashan, Hardy spaces on compact Lie groups.
Gavosto, Estela Ana, Analysis on finite type domains.
Kellum, Mark, Uniformly quasiconformal foliations.
Lin, Nong, Galerkin method for the boundary integral equations of the Dirichlet problems of the Laplace equation in Lipschitz domains.
Ma, Daowei, Invariant metrics on domains.
Peloso, Marco Maria, Möbius invariant spaces on the unit ball.
Wu, Zhijian, Hankel and Toeplitz operators on Dirichlet spaces.
Zheng, Juneng, Some extremal problems involving \( n \) points on the unit circle.

Systems Science and Mathematics
Bouthillier, Paul, Analysis and design of discrete-time, linear time-varying systems.
Ganguly, Sugato, Discrete time nonlinear feedback method on robot arm control.
Geist, Daniel, Semantic control in continuous time: Applications to aerospace problems.
Maserang, Daniel, Estimating R&D spillovers in major defense contractors an application of nonlinear filtering.

Montana
Montana State University (1)
Mathematical Sciences
Fredenberg, Virgil, Computer generated graphics in calculus and effect on student achievement.

University of Montana (1)
Mathematical Sciences
Rummel, Steven, A procedure for obtaining a robust regression employing the greatest deviation correlation coefficient.

Nebraska
University of Nebraska (3)
Mathematics and Statistics
Jia, Bao Ping, Splitting of prime ideals and valuations.
Li, Yuanzhang, Robust Bayesian analysis.
Woerner, Edwin Louis, Self-similar solutions to the detonation equations in non-homogeneous media.

New Jersey
Princeton University (7)
Mathematics
Axelrod, Scott, Geometric quantization of Chern-Simons gauge theory.
Bertozzi, Andrea, Existence, uniqueness and a characterization of solutions to the contour dynamics equations.
Fractman, Gabriel, On the product formula for quadratic forms.
Schwartz, Richard, The limit sets of some infinitely generated Schottky groups.
Shu, Wei-Ton, Spin-field equations and Yang-Mills equation.
Steinke, John, The second variation of normal currents.
Sullivan, John, A crystalline approximation theorem for hypersurfaces.

Rutgers University, New Brunswick (10)
Mathematics
Caravella, Sandra, Nonsingular affine surfaces with unique \( C^* \) action.
Chua, Seng Kee, Extension and restriction theorems on weighted Sobolev spaces.
Fernandes, Jose C., Mean value and Har­
nack inequalities for a class of degenerate
parabolic equations.
Cupertino,
Holt, Linda, Singularities produced in cono­
mal wave interactions.
Huang, Yi-Zhi, On the geometric interpreta­
tion of vertex operator algebras.
Kuplinsky, Julio Mario, Hard-to-color graphs
and mixed and restricted colorings.
Lohrenz, Terry M., Determinants on CR
manifolds.
Wang, Yuan, Properties of the discontinuous
Galerkin method.
Jou, Hann-Chang, Assessing interrater agree­
tment and treatment effect when data is
New Mexico

New Mexico State University (2)

MATHEMATICAL SCIENCES
Combs, Randall, Weighted norm inequalities
with general weights for multipliers on
functions with vanishing moments.
El-Gawi, Saleh, Aspects of Fatou-Julia theory
for rational functions of degree one to four.

University of New Mexico (4)

MATHEMATICS AND STATISTICS
Engman, Martin Feeney, The spectrum of a
surface of revolution.
McCanna, Joseph E., Characterization of self­
dual graphs and related topics in graph
theory.
Porter, Thomas Dale, Partitions of graphs.
Robey, Thomas Howard, The mixed finite
element method.

New York

Adelphi University (1)

MATHEMATICS AND COMPUTER SCIENCE
Gusack, Russell, Mathematical models for the
epidemiology of AIDS.

CUNY, Graduate Center (9)

MATHEMATICS
Arcones, Miguel, On the asymptotic theory of
the bootstrap.
Danas, George, Crossed n-fold extensions and
cohomology.
Fung, Terry, Fundamental domains of modular
subgroups using isometric circles.
Jiang, Wei-Hua, On the dynamics of λ tan z.

Columbia University (11)

MATHEMATICS
Agboola, Adesisi, Abelian varieties and Ga­
ois module structure in global fields.
Jiang, Renfang, On free actions on R-trees.
Lee, Li, Freeness and discreteness of actions
on R-trees by finitely generated free groups.
Lisca, Paolo, On smoothly embedded tori in
four-manifolds.
Liu, Yingsheng, Commensurability groups of
uniform trees.
Qin, Zhenbo, Equivalence classes of ample
divisors and moduli spaces of stable rank-2
bundles on ruled surfaces.
Rogers, Michael Kevin, On a multiplicative­
additive Galois invariant and wildly ramified
extensions.
Zhang, Shouwu, Numerical criteria for am­
pleness of arithmetical line bundles.

New York University,
Courant Institute (19)

MATHEMATICS
Asch, Mark, Analysis and numerical solution
of a transport equation for pulse reflection in
a randomly layered medium.
Calderon, Pablo, On the macroscopic behavior
of a large stochastic system.
Coffey, Mark, The cell discretization algorithm
for partial differential equations.
Cohn, Steve, Resonance and long time
existence for the quadratically nonlinear
Schrödinger equation.
Coulter, Lisa Osternan, Piecewise smooth
spline interpolation and the numerical solu­
tion of the Riemann problem for materials
undergoing a phase transition.
Filippas, Stathis, Center manifold analysis for
a semilinear parabolic equation arising in
the study of the blow up Au = ∆u = |u|^p.
Firoozjaee, Nikan, Optimal translations and
relaxations of some multwell energies.
Lima, Paulo Cupertino, The renormalization
group in the local potential approximation.

BIOMETRICS
Feng, Ziding, Statistical inference using max­
imum likelihood estimation and the gener­
ralized likelihood ratio under nonstandard
conditions.

MATHEMATICS
Destrempes, Francois, Invariants of virtual
lattices over group rings with applications to
Galois module structure.
Friedman, Erich, First passage percolation on
a Poisson lattice.
Lieb, Gregory Stephen, Holomorphic motions
teichmüller spaces.
Luo, Xiaolong, High dimensional annihilating
branching random walks.
Petrie, Emily Ruth, Convergence of power
series invariants for families of p-adic Galois
representations.
Senappta, Anil, The Yang-Mills measure for
the two-sphere.
Stafford, Seth, Harmonic functions on mani­
folds of non-negative Ricci curvature.
Yakhis, Alexander, Game-theoretic semantics
for concurrent programs and their
specifications.
Yakhis, Vladimir R., Concurrent programs,
calculus of state-strategies and Gurevich­
Harrington games.

STATISTICS
Hsieh, Pushing, Performance of diagnostic
tests in a non-parametric setting.
Kane-Esrig, Yana, Information retrieval and
estimation with auxiliary information.
McGrattan, Kevin, A comparison of the potential and the Euler formulations of the equations of motion for transonic flow.

Morokoff, William, Quasi-Monte Carlo methods for numerical integration and simulation.

Puppo, Gabriella, Prandtl's equations: Numerical results about singularity formation and a numerical method.

Rybka, Piotr, Dynamical modeling of phase transitions in solids by means of viscoelasticity in many dimensions.

Schevermann, John, Tabular equations of state and their use in the solution of Riemann problems.

Smith, Barry, Domain decomposition algorithms for the partial differential equations of linear elasticity.

Tabu, Adib, Equivariant harmonic maps of the Minkowski space.

Wang, Xiaolong, Singular solutions for the nonlinear Schrödinger equation and Zatchanov equations.

Xin, Xue, Existence and stability of travelling waves in periodic media governed by a bistable nonlinearity.

Zingano, Paulo, Nonlinear stability analysis with decay rates of two classes of waves for conservation laws.

Zumbrun, Kevin, Asymptotic behavior for systems of nonconvex conservation laws.

Polytechnic University (4)

Mathematics

El-Achkar, Issam, Regularity of probability and deterministic measures and separation of lattices in classical statistical models.

Gnecco, Clare, Bayesian decision theoretic designs for estimation using arithmetic loss.

Siegel, Alan, Weak regularity of probability measures and of deterministic measurements in extended classical statistical models.

Whang, In-Hong, Lattice regular measures and associated outer measures.

Rensselaer Polytechnic Institute (7)

Decision Sciences and Engineering Systems

Gao, Zhengping, Performance analysis of contention protocols for local area networks.

Makuch, William, Optimizing the collection of delinquent consumer credit.

Rather, Laurie, Information requirements for integrated manufacturing planning and control: A theoretical model.

Mathematical Sciences

Gingrich, Ross, A free boundary problem for a discontinuous semi-linear elliptic equation.

Schmidt, Raymond, Adaptive quadtree discretization for fluid flow problems.

Schröder, William, Geometric triangulations with application to fully automatic 3-D generation.

Wu, Xiaolei, A computer software system for solving graph theory problems—graph pack.

SUNY at Albany (4)

Mathematics and Statistics

Bomash, Gregory, Random analytic functions, their zero sets and singular measures.

Kim, Seok-Chan, Properties of the family of analytic functions with subordination class determined by rotations.

Rajita, Abbas, A new class of nonparametric Hazard rate function estimates.

Weinraub, David, Cofinite induction and Noether's theorem for Hopf orders in group algebras.

SUNY at Binghamton (2)

Mathematical Sciences

Miliello, Robert, On the Cayley-Hamilton property in groups.

Moore, Theresa Engel, Deformation and rigidity along paths of manifolds.

SUNY at Buffalo (11)

Industrial Engineering

Dell, Robert Franklin, The development of equitable vehicle routes for overnight parcel deliveries.

Jamil, Mamnoon, The 1-center problem with queueing.

Krishnamurthy, Nirup Naidu, Modeling blocking in automated guided vehicle systems.

Mathematics

Chang, Wen-dong, Quasi-periodic and periodic motions of a heavy rigid body about a fixed point.

Chen, Bei-fang, Combinatorial studies of geometric measures on singular spaces.

A categorical study of affine geometry.

Gao, Wei-zheng, Threshold behavior in a class of semidiscrete dynamic systems.

Jiang, Hua-Qiong, Degenerate Hopf bifurcation and isolas of periodic solutions in an enzyme-catalyzed reaction model.

Lu, Yin, Existence of temperature plateau and existence of multiple solutions in combustion theory.

Tong, Mai, A strong modal set theory.

Statistics

Sankoh, Abdul, Some contributions to a Bayesian finite population model.

SUNY at Stony Brook (16)

Applied Mathematics and Statistics

Baus, Theresa A., A solution of the electromagnetic inverse scattering problem utilizing the generalized pulse spectrum technique.

Teng, Lichen L., The probability of correct classification conditional on distance from boundary.

Yang, Chin-Chun, A minimum modeling strategy in prediction outside the range of observations.

Zhang, Fenggang, On numerical methods for solving singular integral equations.

Mathematics

Gong, Guihua, Smooth extensions for finite CW complexes and index theory.

Hidalgo, Ruben, On Schottky groups with automorphisms.

Kasper, Brian, Examples of symplectic structures on fiber bundles.

Lam, Tsz Kin, Spaces of real algebraic cycles and homotopy theory.

Liu, Zhong-dong, Nonnegative Ricci curvature near infinity and geometry of ends.

McHugh, Andrew, The space of super light rays for complex conformal spacetimes.

Rong, Xiaochun, Collapsed 3-manifolds and rationality of limiting η-invariants.

Shen, Zhongmin, Finite topological type and vanishing theorems for Riemannian manifolds.

Tan, Delin, On generalizations of Jørgensen's inequality for Kleinian groups and some topics on quasiconformal extension.

Yu, Jinguo, The Euler equations of an incompressible ideal fluid in a high-dimensional bounded region.

Zeng, Xueqi, Clifford cohomology and Kähler geometry.

Zhu, Shun-hui, Bounding topology by Ricci curvature in dimension three.

Syracuse University (4)

Mathematics

Fatica, Vincent Edward, On edge-critical graphs and the notion of vertex independence in graphs.

Kantorowitz, Robert, Homomorphisms into Banach algebras of continuous vector-valued functions.

Novak, Carolyn, A study to determine possible trends between students' problems and successes and instructors' and teaching assistants' usage levels and concern stages implementing calculators into class.

Schembari, Nunzio P., Functions of generalized bounded variation, generalized absolute continuity and applications to Fourier series.

University of Rochester (9)

Mathematics

Barionuevo, Jose A., L^2 estimates for some Kakeya-type maximal functions.

Marhuenda, Francisco, Microlocal analysis of some isospectral problems.
Sanchis, Gabriela Raquel, Large deviations in function space: An extension of Cramer's theorem.

Silberbush, Paul, Suspension orders and the stable decomposition of iterated loops on spheres.

Wong, Shiu-chun, The fibre of the iterated Freudenthal suspension.

Statistics

Chen, Shande, Generalization of influence functions and their applications.

Dasu, Tamraparni, The proportional mean residual life model.

Smethurst, Philip, Generalized spacings and entropy: Some theory and applications.

Svoronou, Alexandra, Multivariate Markov processes via the Green's Function Method.

North Carolina

Duke University (11)

Mathematics

An, Lianjun, Loss of hyperbolicity in elastic-plastic material at finite strains.

Hsu, Lucas, Calculus of variations via the Griffiths formalism.


Poznanski, Jonathan, A meta-analytic approach to estimating item difficulties.

Shin, Insun, Diffusion with periodic obstacles and applications to intracellular diffusion.

Sun, Tien-Yu, A class of three dimensional steady water waves generated by localized pressure disturbances.

Wang, Feng, Numerical study of granular flow in a converging hopper.

Ye, Yun-Gang, Relative Brill-Noether theory and an infinitesimal version of the Harris-Mumford problem.

Zhang, Qi, Adjunction for vector bundles, characterizations of uniruled varieties, and small contraction mappings.

Zhang, Taiyan, Periodic limit of inverse scattering.

North Carolina State University, Raleigh (17)

Mathematics

Augustine, M. K., Monoids of Lie type and their congruences.

Han, Jun Cheol, Involutions in left Artinian rings.

James, Douglas, Conjugate gradient methods for constrained least squares.

Moneynun, Kay Marie, Isoclinisms in Lie algebras.

Talbardge, Andrew VanSickle, A geometric formulation of the Higgs mechanism via internal metric fields.

Terrell, William Jennings, Observability and external description of linear time varying singular control systems.

Operations Research

Al-Jazzaf, Mahdy I., Multiplier methods with partial elimination of constraints for nonlinear programming.

Jan, Gwo-Ming, A new variant of the primal affine scaling algorithm for linear programming.

Michael, David J., The optimal representation of activity networks as directed acyclic graphs.

Statistics

Fillohon, Thomas Gene, Improved curve estimation with smoothing splines through local cross-validation.

Fitz-Simons, Terence Rette, Fitting a lognormal distribution to air quality data observed with measurement error.

Hughes-Oliver, Jacqueline Mindy-Mae, Estimation using group-testing procedures: Adaptive iteration.

Khalil, Tarek Mohamed, A study of the doubly geometric processes, stationary cases and a non-stationary case.


Meier, Kristen Louise, Estimating rate equations using nonparametric methods.

Wisniewski, Michael Edward, Analysis of time series with missing values.

Yu, Yanan, A Leslie model, threshold function, and uncertainty for chemical control of corn earworm.

University of North Carolina, Chapel Hill (8)

Biostatistics

Atkinson, Susan Shearer, Analysis of categorical data for crossover design.

Davis, Vicki G., Subsampling strategies in large studies of chronic diseases.

Edwards, Lloyd Jerome, Errors in variables and properties of statistical inference.

Shemanski, Lynn Roberta, K-ratio tests with covariates.

Mathematics

Coan, Boyd, Top exterior powers over commutative rings.

Tendian, Sonny, Deformation of cones over curves of high degree.

White, Homer, Algorithmic complexity of trajectories of points in dynamical systems.

Operations Research

Liang, Huei-Mei, Retrial queues.

Ohio

Bowling Green State University (5)

Mathematics and Statistics

Mohanty, Supriya, Structure theory of limited codes.

Selvavel, Kandasamy, Statistical inference for truncation parameter families.

VanRie, Debra, Quasi-varieties of 1-metabelian lattice-ordered groups.

Varga, Tomas, Matrix variate elliptically contoured distributions: Stochastic representation and inference.

Weininger, David, Cartesian groups and their corresponding Bose-Mesner algebras.

Case Western Reserve University (6)

Operations Research

Araar, Abdelaziz, Optimization of queueing systems with service interruptions.

Benmerzouga, Ali, Optimal group replacement policies.

Biermann, Jeanette Aileen, An inquiry into the optimal loads on servers in a queueing network.

Dhamankar, Sunil Yashwant, An efficient group-theoretic algorithm for an assignment problem with a single knapsack constraint.

Kamrad, Bardia, A multinomial lattice option pricing methodology for valuing risky ventures: Multiple sources of uncertainty.

Singer, Ethan Lloyd, Modeling the mail survey response pattern and determining the optimal number of questionnaires: A Bayesian approach.

Kent State University (4)

Mathematics and Computer Science

Li, Xiezhang, An adaptive method for solving nonsymmetric linear systems involving application of SCPACK.

Masri, Ibrahim, Estimates for norms of multilinear Hankel operators and absolutely summing multipliers.

Shura, Thaddeus J., The Lambda property in normed linear spaces.

Sorensen, Timothy, Characters which vanish on all but three conjugacy classes.

Ohio State University (19)

Mathematics

Blanchard, John, Integral equation analysis of artificial dialectrics.

Druschel, Kimberly, Orbiford cobordism invariants.

Forrest, Alan, Recurrence in dynamical systems: A combinatorial approach.

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Iwakata, Yasushi, Subschemes of group association schemes.

Lari Lavassani, Ali, Multiparameter bifurcation with symmetry via singularity theory.

Manoharan, Palanivel, A study of Fréchet manifolds.

Mariasoussi, William, Approximation by multivariate polynomials of fixed length.

Prabaharan, Kanagarajah, Topics in ergodic theory: Existence of invariant elements and ergodic decompositions of Banach lattices.

Prieto-Cox, Juan Pablo, Representations of positive definite Hermitian forms.

Rodriguez-Villegas, Fernando, On the square root of special values of certain L-series.

Szabo, Laszlo, On ergodic and martingale theorems in Orlicz spaces.

Tam, Laying, The general Euler-Borel summability method.

Voon, Shu-nan, Genus of $SL_2(F_q)$.

Wang, Qi, Dynamics of viscoelastic slender free jets.

Xia, Yining, Farrell-Tate cohomology of the mapping class group.

Yan, Zhongde, On the prophet inequality for the transforms of processes.

Statistics

Kim, Dongjai, Distribution-free tests based on placements and partially sequential treatments versus control procedures.

White, Susan Elizabeth, Robust multiple comparison procedures.

Zhou, Xiaohua, Robust procedures in survival analysis and reliability.

Ohio University (2)

Mathematics

Al-Huzali, Abdullah, A study on the weak relative injectivity of rings and modules.


University of Cincinnati (2)

Mathematical Science

Guo, Lijia, Stabilized numerical solution for inverse heat conduction problems.

Quantitative Analysis and Information Systems

Roberts, Donna, Incorporating uncertainty into data envelopment analysis.

Oklahoma

Oklahoma State University (1)

Statistics

Maksum, Choiril, A new method for imputing missing values when the probability of response depends on the variable being imputed.

University of Oklahoma (1)

Mathematics

Davidson, James Ross, Disconjugacy criteria for a third-order linear differential equation.

Oregon State University (4)

Mathematics

Choi, In-Kyeong, On straight line representations of random planar graphs.


Hwang, Daesik, Large deviation principles for random measure.

Statistics

O'Donnell, Robert P., Fisher and logistic discriminant function estimation in the presence of collinearity.

University of Oregon (3)

Mathematics

Deck, Karin M., A Galois theory for transcendental field extensions.

Hollingsed, Thomas, The lattice of closed subgroups of a topological group.

Roehrle, Gerhard, Orbits in internal Chevalley modules.

Pennsylvania

Carnegie Mellon University (9)

Mathematics

Carrera, Maria-Cecilia Arce, A computational study of the set covering problem.

Hu, Xiaohua, Covolume techniques for anistropic media/application of spectral methods to a Cahn-Hilliard model of phase transition.

Struthers, Allan, Mobile phase boundaries in elastic media.

Statistics

Chen, Rong, Two classes of non-linear time series models.

Ding, Ye, Capture-recapture census with uncertain matching.

Etzioni, Ruth, Bayesian group-sequential sampling with applications to tax auditing.

Parmigiani, Giovanni, Optimal scheduling in inspections with an application to medical screening tests.

Peruggia, Mario, Iterated function systems and the propagation of rounding errors.

Wang, Lian, Topics in team decision theory.

Drexel University (1)

Mathematics and Computer Science

Sevy, Jonathan, Acceleration of convergence of sequences of simultaneous approximants.

Lehigh University (4)

Mathematics

Chen, Chaorong, Networks and nonlinear phenomena in oxygen transport to tissue.

Schultes, Carla Nelson, Characteristic classes of totally geodesic and Riemannian foliations.

Stoudt, Gary S., Sequence space properties related to the Wilansky property.

Wang, Jian-hua, Extended canonical transformations and their applications to systems of partial differential equations.

Pennsylvania State University (13)

Mathematics

Hajimirzaahmad, Mojdeh, The spectral resolution of Laguerre operators in right definite and left definite spaces.

Li, Wu, Continuous selections for metric projections in function spaces.

Lo, Wing Tai, On super theta functions, super elliptic functions, and the Weil representation.

Moriyoshi, Hitoshi, Chern characters and noncommutative Chern-Weil theory.

Movahedi-Lankarani, Hossein, Minimal Lipschitz embeddings.

Santa Gadea, Nicolas Alfredo, On the rank and the crank modular $8, 9,$ and $12$.

Santos, Jose Plinio de O., Computer algebra and identities of the Rogers-Ramanujan type.

Tom, Michael Mudi, Global well-posedness, local smoothing, and dispersive blow-up of some nonlinear dispersive equations.

Wei, Shi Yuan, On the combinatorics of representations of classical linear groups.

Statistics


Deng, Min, Differential geometry in statistical inference.

Liu, Zhijun, Some contributions to nonparametric estimation and robust estimation.

Serinko, Regis, The asymptotics of univariate K-mean and K-median clustering under some nonregular conditions.

Temple University (11)

Mathematics

Abeyesinge, Wadduwage, Reformulation and solution of some ranking problems.

Banh, Tong T., Fredholm maps and transversality.

Chandranathla, M. W. Leslie, Testing random walk hypothesis using variance ratios.

Hedrick, Paul J., Path covers and the Hamilton cover problem.

Lee, Min-Young, Bonferroni-type inequalities.

Lin, Xu-Sen, Exchangeability in extreme value theory and some Poisson limit theorems.

Shadur, Raphael, Poisson and Poisson related stochastic processes.
Statistics

Cheung, Siu Hung, On smoothing discrete bivariate densities with applications to two-way contingency tables.

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APPLIED GEOMETRY AND DISCRETE MATHEMATICS: THE VICTOR KLEE FESTSCHRIFT
Peter Gritzmann and Bernd Sturmfels, Editors

This volume, published jointly with the Association for Computing Machinery, comprises a collection of research articles celebrating the occasion of Victor Klee's sixty-fifth birthday in September 1990. During his long career, Klee has made contributions to a wide variety of areas, such as discrete and computational geometry, convexity, combinatorics, graph theory, functional analysis, mathematical programming and optimization, and theoretical computer science. In addition, Klee made important contributions to mathematics education, mathematical methods in economics and the decision sciences, applications of discrete mathematics in the biological and social sciences, and the transfer of knowledge from applied mathematics to industry.

In honor of Klee's achievements, this volume presents more than forty papers on topics related to Klee's research. While the majority of the papers are research articles, a number of survey articles are also included. Mirroring the breadth of Klee's mathematical contributions, this book shows how different branches of mathematics interact. It is a fitting tribute to one of the foremost leaders in discrete mathematics.

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Mathematics under Hardship Conditions in the Third World
Neal Koblitz
University of Washington, Seattle

The following article is adapted from an AMS-MAA Invited Address, delivered by Koblitz at the Joint Summer Meetings in Orono, Maine, on August 9, 1991.

This talk will be based largely on my experiences in Central America, Vietnam, and India. I’ve never made a systematic study of science in the Third World, so I’m not going to give you statistics, sociological analyses, or anything like a complete overall picture. Rather, what I say will be subjective and impressionistic. And some of what I say will be controversial.

If this were a lunch-time address, then it would be incumbent upon me not to say anything outrageous, so as not to interfere with anyone’s digestion. But since this is an early morning talk, my role is to wake you up, and be provocative.

First I’ll discuss mathematics education, particularly in Central America. Then I’ll talk about mathematical research in the Third World, where most of my observations are based on ten years of coordinating mathematical programs for a nongovernmental organization called the U.S. Committee for Scientific Cooperation with Vietnam.

Math Education

The most obvious thing to say is that throughout the Third World, most schools and universities suffer material deprivation far worse than anything we might complain about in the United States. Instructors generally receive extremely low salaries, and they have to teach in antiquated classrooms, without enough textbooks or basic reference books, with tiny chalkboards and no overhead projectors, with poor lighting, and frequent blackouts and brownouts. Most of the Third World is in the tropics, so during much of the school year it gets oppressively hot during the day; if the instructor and students are lucky, they have an overhead fan to at least keep the air circulating—provided that the electricity is working.

Despite all this, at its best, education in many Third World countries is impressively good. There are some advantages, as well as disadvantages, for secondary and higher education in Asia, Africa, and Latin America. Educational attainments, such as advanced degrees, carry more prestige in the Third World than in the U.S. People have a deeply felt belief in the importance of education as a way to attain a better life personally and also as a way to modernize their country. Students are better disciplined and more hardworking than their American counterparts. They are not jaded, spoiled, or distracted to the same extent.

In Vietnam, which is one of the poorest countries in the world, a network of city-wide, regional, and national high school math competitions has led to the selection of some excellent teams for the International Olympiads. In Australia in 1988, for example, Vietnam took fifth place, ahead of the sixth place U.S. team.

In the area of university education, an example of excellence is provided by the Indian Institute of Technology (IIT) with its five campuses in different major cities of India. Graduates of IIT are comparable to the best that leading U.S. universities can produce.

I’d like to insert a personal story here. When I was six years old, my family spent a year in Baroda, India. I attended the Catholic school, which was the only English-medium school in the city. The math standards there were higher than in American schools. The next year, when I returned to the U.S., I was so far ahead of my classmates that my teacher erroneously believed that I had a special gift for mathematics. Like other mistaken notions that teachers get into their heads, this sort of erroneous belief has a way of becoming a self-fulfilling prophecy. As a result of all the encouragement after my return from India, I was on my way toward becoming a mathematician. Thus, I have a special personal debt to India, and to its schools.

But in some countries, the approach to teaching mathematics is simply a disaster. Nicaragua is a case in point. Students are required to memorize bits and pieces of sophisticated mathematics without any understanding of what it’s all about or why it might be worthwhile. A colleague at the National Autonomous University in Managua said:

You can understand why so many of these [Nicaraguan] students are just terrorized by mathematics. For example, I found that all of my students knew the Euclidean algorithm, but only in a mechanical way, with no understanding. It turned out that they had been required to memorize the Euclidean algorithm as the way to find the least common denominator when adding two fractions.
Here I have an audience of a few hundred mathematicians. I'd like to ask: How many of you have ever in your lives added two fractions by first applying the Euclidean algorithm to the denominators?

This isn't an isolated example. The same colleague told me of passing a classroom and hearing the students repeat in unison after the professor: "An equivalence relation is a relation that is reflexive, symmetric, and transitive." What these words mean, why equivalence relations are important, under what circumstances in their life in Nicaragua they might have occasion to use the definition of an equivalence relation—all of this remained a mystery to the students.

This story reminded me again of my school in India. Every morning in the bus to school we children would recite the Lord's Prayer: "...Forgive us our trespasses, as we forgive those who trespass against us...the Father, the Son, and the Holy Ghost, Amen." In Nicaragua, which is a Catholic country, the incantation of the Holy Trinity is a familiar ritual to the children. Then when they grow older, they learn that there is a second Holy Trinity whose incantation also has a special mystical significance: "...Reflexive, Symmetric, and Transitive!"

But it would be unfair to blame the Catholic Church for the sorry state of mathematical education in Nicaragua. The real culprits in this case were the mathematical communities in North America and Europe, which in the 1960s pushed for the abstract, formalistic "New Math" approach that came to dominate mathematical pedagogy in most of the world. And the drawbacks that by now are well known in the U.S.—boring material, unmotivated, unrelated to real life, often taught by teachers who can't understand it themselves—all of this is magnified to absurd proportions in the impoverished countries of the Third World, such as Nicaragua.

Math majors in their last two years at the National Autonomous University of Nicaragua are required to spend thirty hours per week in math classes. The syllabus, taken unaltered from European universities by the higher education bureaucracy, uses textbooks that would be considered too advanced for undergraduates in any U.S. university. The students are required to memorize long lists of definitions, theorems, and proofs, none of which they could realistically be expected to understand conceptually. Moreover, most of the material is not even understood by their Nicaraguan professors, whose own mathematical background is typically that of a weak B.A. degree. The result is what I'm tempted to call "Mathematics as a form of oppression."

The hoops Nicaraguan math students are made to jump through to get their degree bring to mind more a fraternity hazing than an education: If they endure the pain and get through it, then they get their degree, join the club, and pass from being the oppressed to being the oppressors of the next generation of Nicaraguan students.

The lack of competent Nicaraguan math instructors is a result of one of the many tragic ironies of Nicaraguan history. As you know, in 1979 the Sandinista movement succeeded in overthrowing the Somoza dynasty and installing a government based on such ideals as free medical care, universal literacy, and greatly increased access to higher education. The democratization of higher education was a noble objective, but there was a problem that was ignored by the Sandinistas in their reformist zeal. Nicaragua had few qualified professors, and a significant fraction of the best-trained people—especially those coming from the wealthy classes—had fled to Miami after the Revolution. Even more of the educated middle class left the country as the Reagan Administration's contra war and economic sabotage took its toll on the quality of life in Nicaragua. Thus, the large increase in the size of Nicaraguan universities in the 1980s occurred despite the small and diminishing number of Nicaraguans who were competent to be instructors.

But I don't want to leave you with an entirely negative impression of Nicaragua. Despite the desperate material conditions of their lives and the cruelly incompetent methods of teaching mathematics, the Nicaraguan math students I met were intelligent, hard-working, and eager to learn. They asked me good questions and listened carefully to everything I said. They did not have a short attention span, they did not expect to be entertained, and they never complained about my accent in Spanish—or that of any of the other foreign visitors or instructors. So the impression I have is that, in many respects, Nicaraguan students are more mature than their U.S. counterparts.

It is not only in Nicaragua that the imported "New Math" pedagogy made an already difficult situation even worse. When I was in El Salvador recently, I discussed some questions in math education with the Academic Dean, René Zelaya of the Jesuit University Universidad Centroamericana, which is known by the acronym UCA. Zelaya used to be chairman of the math department, and was moved up to his present position as Academic Dean when his predecessor, the distinguished psychologist Father Ignacio Martín-Baró, was murdered. (Recall that in the middle of the night of November 16, 1989, a squad from the First Brigade of the Salvadoran Army, which was trained and equipped by the U.S., invaded the UCA campus and killed Martín-Baró, five other leading intellectuals of UCA, their housekeeper, and her daughter.) The UCA professors, such as Zelaya in the area of math education, are running a special risk, because UCA has historically been a center of efforts for peace and in opposition to U.S. military aid. The Jesuit professors are hated by the military.

René Zelaya recounted to me how, when he graduated from the University of El Salvador in 1968, the "New Math" was just being introduced in the country. The curriculum shifted to an emphasis on set-theoretic and ring-theoretic abstractions, even in the primary grades. He said that the teachers were completely unprepared, and the Salvadoran school system is still in the process of trying to recover from the misguided "reform" of 1968. When I was in San Salvador two months ago, the newspaper that was slipped under my hotel door every morning was running a series of articles on the confusion in elementary math education in El Salvador caused by the dispute over whether or not to
continue focusing on set theory.

The pedagogical dilemmas now facing Nicaragua and El Salvador are consequences of the damage done by the “New Math” craze of the 1960s when it spread from the U.S. and France to the developing countries. Of course, these days, complaining about the failure of the New Math movement is like beating a dead horse. Nevertheless, there’s a lesson here: We should try not to colonize the Third World with every half-baked educational fad that sweeps through North America and Europe.

I promised you some controversy this morning. So, instead of beating a dead horse, I’d like to beat a horse that's very much alive: the so-called computer revolution in math education. In the U.S., I think it’s fair to say that computers have been shamelessly oversold as a panacea for the problems of math education. Despite all the hype, it’s hard to tell at this point whether the introduction of computers in grade school through college has had, on balance, a positive or negative effect on math education. The primary measurable effect, as far as I’m aware, has been to bring in a lot of money to computer hardware and software companies. In the words of Michael Fellows, a leading computer scientist who is active in grade school educational reform, “It would, in many (if not most) schools, be better to put the machines in the dumpster.”

Despite the acute lack of money for education in developing countries, to some extent the computer craze has spread to the Third World. In February 1986, a major conference called “Informatics and the Teaching of Mathematics in Developing Countries” was held in Tunisia. Participants came in large numbers from Northern Africa, and many came from the universities, institutes, and educational establishments of other regions of the Third World. I received a copy of the proceedings of that conference. All of the mathematicians and math educators, without exception, sang the praises of computers and plopped for the rapid introduction of computers into their school systems. Not a single troubling question was even raised, let alone explored in depth.

So, what’s going on? I really like this chart, and find it useful to look at from time to time. If I ever start to feel demoralized because of the stinginess of the Washington State legislature in keeping our University of Washington salaries below those of most other state universities, all I have to do is think of how my Vietnamese colleagues are producing world-class mathematical research on a salary of $4 per month, and my morale is restored!

Clearly, Vietnamese mathematicians cannot use their salaries to buy books: A single book would cost a year’s wages! How do they equip their libraries? Well, there are several ways: (1) donations from friends in other countries, mainly the U.S. and France; (2) book purchases the Vietnamese make when they have a post-doc or visiting professorship in Europe or North America; (3) journal exchanges (in which they can offer a subscription to the main Vietnamese math journal, Acta Mathematica Vietnamica). (If you would like to get a subscription to Acta Mathematica Vietnamica for your library, please contact me, and I can help you arrange it.)

It’s not only the geographical isolation and lack of books and journals that make it difficult for Vietnamese mathematicians to keep in touch with current developments. In most fields, they are not part of the informal network of researchers that communicates by means of letters, phone

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1. But Mexico and Cuba, the two Third World countries closest to the United States, do have many research mathematicians. In the case of Cuba, the severe U.S. government restrictions on travel to Cuba and visas for Cuban scientists have been an obstacle to contact between the two countries' mathematical communities. For more information about this regrettable situation, see Seymour Schuster's article in The Mathematical Intelligencer, Vol. 10, No. 4, 1988.
calls, email, and casual conversations at conferences. There have been several cases of promising young mathematicians returning to Vietnam from graduate school in Europe, only to become demoralized by the harsh material conditions and the isolation and then abandon research. But the remarkable thing is that, in most cases, the Vietnamese manage to continue working at a high level, despite the obstacles. A list of publications of the members of the Hanoi Math Institute runs to over sixty pages. Most of the publications appeared in European and North American journals. The list is comparable in quantity and quality to the list of publications by faculty members that one would expect to find at a large state university in the U.S.

If we want to understand how the Vietnamese have been able to produce impressive accomplishments in mathematical research and education under adverse conditions, we need to talk with some of their senior mathematicians about their own lives and the development of mathematics in Vietnam. In January 1989, I conducted a series of interviews with the then Director of the Hanoi Mathematical Institute, Professor Hoàng Tụy. Much of what he said was published in The Mathematical Intelligencer in an issue with the words “Mathematics in Vietnam” on the cover (Vol. 12, No. 3, 1990).

Hoàng Tụy grew up in the south of Vietnam during a turbulent period when many Vietnamese intellectuals, including his family, were deeply involved in the struggle for independence from France. He was largely self-educated and became a high school teacher in one of the “liberated zones” in the late 1940s, during the height of the anti-colonial war that was being waged by the Viet Minh guerrillas. In 1949, he wrote a high school geometry textbook in Vietnamese. It was published by the Viet Minh press—perhaps the first math book ever published by a guerrilla movement.

Two years later, Hoàng Tụy decided to leave home to study and teach in a rudimentary university that the Viet Minh guerrilla organization had set up in the far north. As Hoàng Tụy relates:

In 1949, with Hanoi occupied [by the French] and the university closed, some classes in university mathematics had been established in the liberated zones in the mountains near the Chinese border... The trek north took three months... We did everything possible to lighten our load. We carried only rice and salt for food. Before I left, I had taken my math books, removed the covers, and cut out the margins on every page so that they would be lighter for the journey north.

In our discussions, Hoàng Tụy recounted some amazing things about his own life and the history of mathematics in Vietnam—please contact me if you would like me to send you a copy of the full interview.

I'm emphasizing this interview with Hoàng Tụy to such an extent because, unfortunately, it's one of the few things that have been published about the history of mathematical institutions and personalities in the Third World. Little work has been done in this area, and when something is written in this field, it is not easy to find a publisher.

One can't help noticing a strong Eurocentric bias in the publishing world. How many biographical articles, full-length biographies, and histories have you seen about Third World mathematicians? (Okay, several books have been written about Ramanujan. But what about the others?) For example, all of the mathematicians whose interviews were included in the two volumes, Mathematical People and More Mathematical People, live in Europe or North America. And, to be frank, I found some of the interviews almost put me to sleep. If I had been editor, I would have been tempted to toss out the more soporific interviews and replace them with some oral history of mathematical people from other parts of the world.

Browsing through the stacks of any university math library, you can easily find quite a few full-length autobiographies of prominent white American mathematicians that are real snoozers yet had no trouble finding publishers. But I have not yet been able to find a publisher for a proposed collection of reminiscences I would like to edit about the development of mathematics in Vietnam during the war years. In addition to recollections of Vietnamese mathematicians, the collection would contain an English translation of the unpublished 1967 report by the great French mathematician Grothendieck, who gave a short course on abstract algebraic geometry in the jungles of North Vietnam, where the university had been evacuated during the bombing.

Here I'd like to put in a word of appreciation for the late Walter Kaufmann-Buhler, who was one of the rare editors willing to take risks and publish unconventional things. He was math editor at Springer-Verlag when The Mathematical Intelligencer was started. That journal has carried on in the tradition of Kaufmann-Buhler, and is one place where historical and cultural articles about the Third World can get published.

Just as most publishers ignore the Third World in their publications on the history of mathematics, they also ignore the needs of Third World mathematicians in their pricing of books and journals. As far as I know, there are no major commercial publishers that offer special discounts to math libraries in the Third World. This is unfortunate, and hard to understand, because even from a narrow financial point of view it would be in the interest of the publishers to offer such discounts. The important thing to remember is that such arrangements would not cut into regular-price sales (unlike discount arrangements for mathematicians in the wealthier countries). Hence, the financial aspect should be computed on the basis of the marginal cost of the copies for the Third World—not including the fixed costs of producing the book or journal. I once talked about this with Walter Kaufmann-Buhler, who was very sympathetic and optimistic about doing something. But we were unable to do anything before his untimely death.

In a few places—mainly China and India—some publishers license local publishing houses to reprint books at greatly reduced cost. However, this system operates in only a handful of countries and it covers a relatively small number of books.
Another topic I'd like to address here is the “brain drain”—a fundamental problem faced by almost all developing countries. The term “brain drain” refers to the loss of mathematicians, scientists, and other professionals, who, after receiving most of their education in their own country (usually through the undergraduate level), emigrate to a developed country (usually the U.S.) in search of a better life. The “brain drain” is in fact an important source of skilled professionals for the U.S., and for this reason the U.S. recently amended its immigration laws so as to make it easier for professionals to move here. Not long ago, I read of a British study that attempted to put a dollar value on the benefit to the U.S. of the brain drain. The conclusion was that the total of all U.S. foreign aid is slightly less than the total aid the U.S. receives in the form of well-educated immigrants. Of course, with any attempt to attach a dollar figure to something that’s not really quantifiable, there are flaws in this study. It seems to me that, most likely, the study underestimates the benefit to the U.S. and understates even more the damage to the Third World of the brain drain. In fact, one can argue that the loss to the country of origin is much greater than the gain to the U.S. of Institute members who had saved up portions of the salary from post-docs or visiting professorships in the West. The mathematicians were proud that such a large sum had been raised by purely voluntary contributions.

The second example concerns the algebraic topologist Hüynh Mùi, now a professor at Hanoi University. Exiled from South Vietnam in the 1960s, he spent most of the war years in Japan, where he received his graduate training and his first job. Despite the horrible material conditions in Vietnam following the war, Mùi returned to Hanoi in the late 1970s to found a small school of algebraic topology. One of the problems he faced was the lack of any living accommodations for his students and protegés from other parts of the country. To overcome this obstacle, he had some friends from Japan send him a top-of-the-line bicycle, which he was able to sell for a handsome sum. (Bicycles are the main form of transportation in Vietnam.) Mùi then used the money from selling the bicycle to finance the construction of a small guesthouse in the outskirts of Hanoi.

Hüynh Mùi is one of a small but important group of mathematicians who were trained in the wealthy countries and then decided to return to Vietnam and dedicate themselves to training the next generation of Vietnamese mathematicians. This flow of mathematicians back to Vietnam has been a sort of “brain drain in reverse.”

Another representative of this group is the algebraist Hoàng Xuân Sính, whose work in category theory was partly inspired by Grothendieck’s 1967 visit. She received her docteur d’état in France about 20 years ago—she actually wrote most of her thesis in Vietnam during the height of the bombing—and has since been teaching at the Hanoi Pedagogical Institute. Professor Sính was also the first woman full professor of any scientific subject in Vietnam. She is a vice-president of the Vietnam Women’s Union and has played a key role in encouraging young Vietnamese women to study mathematics.

A large number of the mathematicians in Vietnam received all or part of their advanced training in the Soviet Union or Eastern Europe. And until recently, Vietnamese math libraries could receive Soviet journals at nominal charge. Both forms of assistance have now dried up. In fact, when I was in Hanoi last January, I was told that the Russians now expect the Vietnamese to pay full price in dollars for Soviet journals. Of course, in practice this means that the Vietnamese will have to drop all of their subscriptions to Soviet journals. The sudden vanishing of assistance from the Soviet Union and Eastern Europe is one of the reasons why help is badly needed from mathematicians in the West.

I’d like to make a few general comments on mathematicians in the Third World have some things going for them as well. For example, mathematics does not require the infrastructure and material investment that most branches
of science need in order to function at a high level. Thus, in many developing countries—Vietnam, China, and India, for example—mathematics seems to be the strongest area of science, with the most prestige and clout. In Vietnam, in fact, mathematicians are often consulted by the political leaders of the country. This contrasts with the U.S., where mathematicians tend to have less clout in Washington than other scientists.

In addition, many developing countries have ancient traditions in mathematics. We now know that a number of basic mathematical ideas and techniques were first discovered in China, India, and the Middle East. An example of early mathematical work in another part of the world, namely Central America, is found among the Mayans, who developed mathematical astronomy to an extent that was not duplicated in Europe until centuries later. As you probably know, the Mayans had excellent success predicting eclipses.

If we adopt a broad understanding of what constitutes mathematical ideas, we find that mathematical thinking has a long history in many indigenous cultures throughout the Third World. This area of history of mathematics is often called “ethnomathematics”—a term coined by the Brazilian mathematician Ubiratan d’Ambrosio. The further study and popularization of ethnomathematics could lead to a greater consciousness of the contributions to world mathematics that have been made in Asia, Africa, and Latin America. This realization could inspire a greater self-confidence among math students in developing countries, and a determination to leave behind the legacy of colonialism and once again become major participants in world mathematical culture.

I’d like to conclude with a list of things we can do to support our colleagues in the Third World.

- We could develop sabbatical-like programs for Third World mathematicians so that they could spend, say, one out of every five or six years in a developed country. That way, active researchers in developing countries would not be faced with the either-or choice: to emigrate to the U.S. or to remain in their native country forever isolated from the main centers of research.

- We should make every effort to keep contact with our former students who return to their countries of origin. The simple act of regular correspondence can go a long way to keep them from being overcome by isolation.

- We could donate books and journals to institutes and universities in developing countries. Dumping one’s old books and moldy copies of Notices is not helpful. Rather, we should find out what they really want and try to get it for them. In particular: (1) the AMS and the MAA should make all of their books and journals available at nominal cost to libraries in the Third World; and (2) we should approach the commercial math publishers in an organized way and ask them to offer steeply discounted sales to libraries in developing countries.

- Publishers should be more open-minded about possible publications on the culture and history of mathematics in the Third World.

- Mathematical institutions and individual mathematicians should limit their ties to only the best known research centers. It is unfortunate that in India, for example, the university system is often neglected by foreign visitors, who traditionally have most of their ties with the various research institutes (especially the Tata Institute in Bombay).

- Finally, on an individual basis, one can cultivate relations with one or two math departments or institutes in the Third World. I’m not suggesting becoming a one-person foreign aid program or spreading oneself too thin. Rather, choose a place where you have a former student, or where you know of a mathematician with similar research interests, or a region where you have family ties, or a country where you have a longstanding cultural or political interest, or where you like the food and climate. Escape the New England winter every year by giving a January “short course” of lectures in sunny Madras, Maputo, or Montevideo!

Why should we go to the trouble? Not for reasons of altruism. Speaking personally, I find that what one gets out of contacts with colleagues in the Third World is much more valuable than whatever time, money, and energy one puts into it. You meet some tremendous people, you get a useful perspective on your own professional life in the U.S., and you get a sense of having a real impact on the development of our science in some far-flung part of the world.

One feature of mathematics of which we can be justifiedly proud is that it is the most international of all academic disciplines. Despite all the cultural differences—and all the material differences between rich and poor—we really are on the same wavelength. We are interested in the same research problems and the same problems of mathematics education. When we strengthen our ties with and organize support for our colleagues in the Third World, we are contributing to the future vitality of the worldwide mathematical profession.

- In the case of the AMS, the Committee on Service to Mathematicians in Developing Countries, which in the past has distributed books and journals to some countries on an ad-hoc basis, would be the appropriate group to coordinate the systematic distribution of AMS publications.
Some Observations about the Hiring Situation in Mathematics

Steven G. Krantz and Guido L. Weiss
Washington University

The academic year 1990-1991 was a bleak one in the job market for young mathematicians. An informal poll conducted by the American Mathematical Society between April and early May revealed that among twenty-eight top Ph.D.-producing math departments, only 48% of their new Ph.D.s seeking U.S. academic positions had accepted a position as of the reporting. Furthermore, we estimated that, based on a number of anecdotal reports at the time, as many as 500 mathematicians, new and otherwise, were still seeking employment. At many good mathematics departments, including our own, we find ourselves turning to our new Ph.D.s and saying “we're sorry, we don’t understand why the job market is so bad.”

As a stopgap measure, we can keep some of these students in the graduate program for an extra year (in many cases without support), but this is no solution to the problem. And what is the problem?

The analysis made by the two David Reports (in 1984 and in 1989) was based on a situation that has been drastically changed by the enormous influx of excellent mathematicians from both China and eastern Europe. Many of these immigrants are among the best in modern mathematics. Who wouldn’t move heaven and earth (and in the process short-change our obligation to young scientists) in order to grab one of these stars? But it is short-sighted and simplistic to think that this is the only, or even the main, cause of the problem.

Of course, in the short run, the economic slump figures large in explaining the lack of jobs. Many states—including California, Maryland, Massachusetts, North Carolina, Pennsylvania, and Virginia—are experiencing sizeable shortfalls in revenues. The upshot is that many state universities, which expected last fall to have a few “line” positions and several instructorships, in the end had no positions at all. Most private universities have been less severely affected, but the bad news will trickle down to them in a year or two.

To make a long story short, in the academic year 1990-1991 there were many more job candidates in mathematics than usual and many fewer jobs. However, we maintain that there are long term trends in the hiring policies of mathematics departments—trends that have been developing over the last twenty years—that have been eroding our ability to hire good people and our ability to place our new Ph.D.s. Let us describe what some of these are.

There have been significant increases in the last five to ten years in the total number of instructorships and “postdoc” positions available. In any given year, a large number of the new Ph.D.s land postdoc positions. Generally speaking, most of these positions are handed out quickly in January and February. What becomes of the remaining new Ph.D.s? That is the rub. By convention, almost nobody hires new Ph.D.s as Assistant Professors anymore. We want to hire either a “proven product” coming off a two or three year postdoc or an Associate Professor at the beginning tenure level. So this other half of the new crop of mathematicians—the ones who do not get postdocs—ends up with jobs in non-research departments or in industry or, perhaps worst of all, with one-year make-do instructorships (there has been an alarming increase in the number of one year jobs in the last few hiring seasons—this in spite of sanctions against that practice by the AAUP).

Part and parcel of the syndrome described in the last few paragraphs is the superstar mentality that we have all developed. Rather than hiring a promising young mathematician fresh out of school and watching the candidate for six years to see how he/she develops, we want to hire a proven product. Tenure decisions are unpleasant and nobody wants to face them. More to the point, we all want to hire stars.

Here is the crux: In every hiring season for the last five or six years, about half a dozen candidates—each about
four the best departments go after these same people. The end result is a circus. Each candidate ends up with so many offers that—due to a combination of lack of experience, immaturity, and hubris—he/she can no longer make an informed decision. Moreover, all the job searches at the thirty or forty schools involved are tied up until these few candidates make up their minds. By the time the dust clears, it is the end of April and everyone throws in the towel on hiring for that year. So a great many other deserving candidates are left high and dry. [Even in the disastrous season 1990-1991, a great many openings were left unfilled due to the inefficiency of our hiring system.] It sounds silly to commit these words to print, but they are true: We do not want to hire fresh Ph.D.s, certainly not as Assistant Professors, and yet we are all bemoaning the fact that our own Ph.D. students cannot find jobs. We would be the first to admit that our own department has been guilty of participating in this syndrome.

To carry this point to an extreme, there has been considerable mobility among senior mathematicians in their late thirties and early forties in the last few years. Many hiring programs have been skewed in an attempt to make attractive offers to these famous people. Six figure salaries are the norm in these situations. Five figure discretionary funds and reduced teaching loads are of course expected. Jobs for spouses, in-laws, and offspring are often part of the package. In some universities, graduate student positions and junior faculty positions have been eliminated in order to amass the resources necessary to make these fabulous offers. The end result, obviously, is fewer opportunities for young people.

We are suggesting that the lack of jobs, and the difficulty in placing our own students, is not just a function of demographics (Chinese and eastern Europeans) and not just a function of shortfalls in state budgets. It is in fact a corollary of the sociology of mathematics. And this is a sociology that is recently evolved. Thirty-five years ago mathematicians were comfortable with waiting seven to ten years for tenure—just like everyone else. Now we have to give tenure to people who are four years out if we want to be competitive. Of course, we cannot expect these people to direct theses or serve on committees or even know how to teach well; after all, they are only four years from the Ph.D. But that is beside the point. We have to be competitive so we can attract the stars.

This is not the way that hiring is done in the medical profession, nor even in chemistry or physics or computer science. In medicine, the national professional organizations help to orchestrate the hiring process. It works well. And while some young physicians do not get the position of their choice, they at least all get a position. Most good computer science departments do not perform “star searches” to fill their positions. They look over the dossiers that come in and they pick somebody. If he/she does not work out, then the candidate does not get tenure.

All of the problems described above have been exacerbated (and understandably so) in recent years because each candidate sends out so very many applications. In the early 1970s, applying to forty or so schools was considered more than sufficient (and there weren’t any jobs then either). But now there are word processors and a candidate thinks nothing of applying to 200 or more schools. And since jobs are so tough to get, it makes sense to apply to a lot of places. Many good math departments received between 600 and 1200 applications this year. How can the members of the hiring committee possibly evaluate all this information? Of course they cannot, so they get on the telephone and the good old boy network comes into play. Again, this loop only aggravates the travails suffered by most job seekers.

We would like to encourage the American Mathematical Society to explore ways in which it can help to organize, and to act as a clearing house for, the job seeking process for people who are zero to three years from the Ph.D. Fields Medalists and Congress speakers need not be affected by this service. But the rest of the mathematics community will benefit enormously from a reevaluation of our value system and, particularly, of our hiring practices. There are no doubt other devices that should be explored for alleviating the present hiring difficulties in mathematics. We wish to focus attention in this essay on what the AMS might do to help.

The Forum article by Don Lewis that appeared in the April 1991 issue of Notices, pages 296-297, advocates that strong measures be taken to increase the number of postdocs available in any given year. This may be a partial solution to the problems described here. We urge the American Mathematical Society and other organizations to explore means by which the total number of postdocs may be increased.

The present hiring situation, which shows no sign of immediate improvement, will serve only to discourage young people from going into mathematics. The number of American students entering the profession is already alarmingly small. In our hiring efforts, we must take into account not only the immediate needs and prestige of our own departments, but the infrastructure of the profession. Most of us were hired at a time when mathematics departments were less star-struck. There is no reason to believe that the current hiring system is any improvement. In fact, it has instead created an atmosphere in which everyone is always looking to move. As a result, mathematicians, during their most vigorous and productive years, tend to have no commitment to their own departments. The long term effects of such an attitude are bound to be calamitous. We owe it to ourselves and to our profession to rethink the hiring program in academic mathematics.

Editor’s Note: The first report of the 1991 Annual AMS-MAA Survey, which includes the 1991 survey of new doctorates, starting salaries of new doctorates, faculty salaries, and a list of names and thesis titles for members of the 1990-1991 Ph.D. class, starts on page 1086 of this issue of Notices.
Rigor in the Undergraduate Calculus Curriculum
William G. McCallum
University of Arizona

About two years ago, I signed up on a five year odyssey to reform the calculus curriculum, known as the Harvard Calculus Consortium. We have so far survived the hazards of despair and disension, but I see ahead clashing rocks between which we must pass: Scylla, the Student, protesting we demand too much mathematical reasoning, and Charybdis, the Colleague, wailing that we have abandoned it. This article is an attempt to appease Charybdis; I haven’t yet figured out what to do about Scylla.

In thinking about teaching mathematics, I find it useful to have in mind the following rough hierarchy of the sorts of things we teach: First, mathematical methods, second, intuition and analysis, and third, abstraction and rigor. Mathematical methods form the lowest level, consisting of rules and procedures which are useful even if not fully understood, such as the quadratic formula or the chain rule. The next level, that of intuition and analysis, consists of modes of reasoning that enable the student to use the methods; for example, a sufficient understanding of infinitesimals to set up definite integrals that compute various physical quantities. The highest level, that of abstraction and rigor, is the level where intuition and analysis are refined into mathematics as we know it today. For example, once the student has a sufficient intuitive grasp of the definite integral, he or she is ready for the formal definition of the Riemann integral.

About the first level, I don’t have much to say. The specific methods to be taught may vary with time; methods of integration may become less important, interpolation methods more so, and there will from time to time be arguments about which methods should be dropped and which admitted. But I don’t think it is too hard for us to come to some agreement on this. Also, the main obstacle to teaching mathematical methods, at least in calculus, is that our incoming students lack basic skills. This problem, which is admitted, is not too hard for us to bear in mind that among these same students, there are those, the better ones, who are expert in “taking the derivative using the definition” and who can faultlessly reproduce the $\epsilon - \delta$ definition of a limit. The trouble is that, from their point of view, there is no distinction between this sort of ability and the ability to use the chain rule; as far as they are concerned, all mathematics is method, regardless of meaning.

A case in point: In a traditional calculus course, we successfully teach a fair number of students how to interpret the symbols

$$f'(x) = \lim_{h \to 0} \frac{f(x + h) - f(x)}{h}$$

in the special case $f(x) = x^2$ to derive $f'(x) = 2x$. However, we never bother to check if they realize, in any practical sense, that the derivative is a limit of difference quotients. For an example of just how far their understanding is from what you think you are teaching, try asking your class for $f''(2)$ when $f(x) = x^2$. What’s shocking is not so much that half of them will answer 4, through a false application of the power rule, but that they are utterly unconvinced when you pull out a calculator and compute

$$\frac{2.001^{2.001} - 2^2}{.001} = 6.779.$$ 

Another example: I asked my students to analyze the one parameter family of functions $e^{-x^2/a}$ in two stages. First, they were to use a computer graphics program to sketch the graph of $e^{-x^2/a}$ for various different values of $a$, and describe the effect of varying $a$ (Answer: The bell-shaped curve is wide when $a$ is large, narrow when $a$ is small). Then they were to find the inflection points (they are at $x = \pm \sqrt{a}/2$), and relate their discovery to the effect they observed on the computer. Most students had no trouble with the first part; however, in the second part, many failed to use the product rule in calculating the second derivative, and concluded that there was only one inflection point, at $x = 0$. I wasn’t surprised at the error, but I was profoundly disturbed that they chose the evidence of their calculation over the evidence of their own eyes.

I am sure that most mathematicians who teach calculus either surreptitiously relax their standards of rigor and concentrate more on developing intuition, in spite of the textbooks, or employ a double standard, pretending to teach rigor without demanding any true mathematical reasoning from their students. Most of the textbook questions dealing with the abstract part of the course, are, in fact, as formulaic as drill problems about the chain rule: find the $c$ such that $f(b) - f(a) = f'(c)(b - a)$; construct the Riemann sum with 4 subdivisions (do not evaluate!).

As a result, we produce students who believe that mathematics is, in its essence, a matter of blind rules and procedures; their main reaction to being asked to reason mathematically is “When are we going to stop fooling around with these ‘thought’ questions and return to real mathematics?”
problem correctly. All too often I hear my colleagues shrug their shoulders and say “What can you do? They don’t learn anything in high school (watch too much TV, are idiots).” In fact, I think that we bear at least part of the blame.

I said above that teachers “surreptitiously” develop their student’s intuition, and I think that’s the right word. Despite the fact that we use it all the time ourselves, we seem to feel obliged to tell our students repeatedly that they shouldn’t trust intuition, that intuitive arguments using infinitesimals may look appealing, but that they are a snare and a delusion. The fact of the matter is that intuitive arguments using infinitesimals work pretty well most of the time, and the few pitfalls (using infinitesimal cylinders rather than frustra to compute surfaces of revolution, for example) are instructive, not disastrous.

Consider the following problem, which I have just set on the final exam of an experimental calculus class.

(a) There is a function used by statisticians, called the error function, which is written \( y = \text{erf}(x) \). Suppose your calculator has a button for this function. Playing with your calculator, you find that

\[
\text{erf}(0) = 0 \\
\text{erf}(1) = .84270079 \\
\text{erf}(.1) = .11246292 \\
\text{erf}(0.1) = .01128342.
\]

Using this information alone, give an estimate for \( \text{erf}'(0) \). Give as many decimal places as you feel reasonably sure of, and explain why you gave that many.

(b) Suppose that you go back to your calculator, and find that

\[ \text{erf}(0.01) = .00112838. \]

With this extra information, would you refine the answer you gave in (a)?

I will give two examples my students produced (without prodding from me) that I think are in the right spirit.

First, in answering the question about \( e^{-x^2/a} \) that I described above, some who failed to correctly find the second derivative nonetheless recognized that fact, and came up with the following analysis, which avoided any discussion of inflection points: They observed that when \( a \) was large, the bell curve was flatter. They then looked at the first derivative

\[
f'(x) = \frac{-2x}{a} e^{-x^2/a}
\]

and pointed out that when \( a \) was large, the derivative had smaller values; this explained the flatness of the curve.

Another problem I gave my students was to explain why, for a smooth function \( f \), the local extrema of \( f' \) coincide with the inflection points of \( f \). Most students demonstrated their attachment to simple but false rules by answering that both coincided with the zeroes of \( f'' \). But a couple gave the following answer, still only partially correct but much more encouraging. They said that it was geometrically obvious that inflection points occur at the steepest part of the graph, and that these correspond to the points where the absolute value of the derivative is at a maximum, hence the derivative is at an extreme. Of course, they forgot that inflection points can also occur at the least steep part of the graph, but I think this argument shows a geometric understanding that should be encouraged.

I suspect that there is enormous room for disagreement among mathematicians on the demarcation between intuition and rigor, and on the correct mixture. One of my colleagues wondered how “we build confidence at level 2 [intuition and analysis] without venturing into level 3 [abstraction and rigor]”, whereas another “firmly believe[s] that traditional rigor has no place in the introductory calculus sequence.” However, I think this is clear: A calculus course, with or without rigor, should be built from the ground up, adding what is necessary for understanding only as the necessity for it becomes clear. By contrast, the curriculum we use now looks like it was dismantled from the top down: It is a reliquary for pieces of the True Calculus, full of proofs bowdlerized beyond common sense.

Before trying to teach students the sophisticated proof, we should make sure they grasp the naive one. We should not abandon to mindless symbolic manipulation those students who can’t or won’t follow the rigorous approach. We should come up with probing questions that test for good intuition, and do our students the favor of both demanding and learning to recognize mathematical thought in their arguments, flawed as they may be from a strict point of view.
Edited by Keith Devlin

This month’s column
Computer-assisted proofs are the theme of this month’s feature article, by William Farmer and Javier Thayer of the MITRE Corporation. This is followed by two software reviews. Larry Riddle reviews *Plot* and Tevian Dray describes his experiences with the two programs *Cube* and *Tess*.

Editor’s address:
Professor Keith Devlin
Department of Mathematics
and Computer Science
Colby College
Waterville, Maine 04901
Correspondence by electronic mail is preferred, to:
kjdevlin@colby.edu

Two Computer-Supported Proofs in Metric Space Topology*
William M. Farmer and F. Javier Thayer
*The MITRE Corporation*

1. Introduction
Every mathematician will agree that the discovery, analysis, and communication of theorems and proofs is at the heart of his or her discipline. A number of computer programs (such as *Maple* or *Mathematica*) assist mathematicians in testing conjectures and proving certain kinds of theorems, typically identities involving rational functions or trigonometric polynomials. These systems, however, were never intended for some of the most critical parts of the mathematical process: formulation of concepts and theories and rigorous proof of general theorems.

There are other programs, less well known in the mathematical community, that are designed to provide computer support for the actual theorem proving process. These programs, usually called theorem provers, tend to be very specialized tools, aimed at discovering or checking proofs in languages or logical systems not ordinarily used by mathematicians. Nevertheless, some theorem provers have been used to produce fully machine-checked proofs of mathematically significant results; for examples, see [1, 2, 3, 8, 9].

In this article we discuss two proofs that were created with the help of a computer theorem proving system called IMPS (Interactive Mathematical Proof System), which is currently being developed at The MITRE Corporation. The fact that these results were proven using a computer is not in itself noteworthy. However, it is significant that the proof itself can be organized in a way which is at the same time comprehensible to a mathematically trained person and recognizably valid to the computer. We want to conclude from this that computers can indeed support the standard techniques of mathematics and can provide strong organizational, as well as computational, assistance for theorem proving.

The two theorems proved are the following elementary results about the topology of metric spaces:

**Theorem 1.** Let \( f \) be a continuous mapping from a metric space \( M \) to a metric space \( N \). If \( A \subseteq M \) is connected, then \( f(A) \) is likewise connected.

**Theorem 2.** Let \( f \) be a continuous mapping from a metric space \( M \) to a metric space \( N \). If \( A \subseteq M \) is sequentially compact,\(^1\) then \( f(A) \) is likewise sequentially compact.

In Section 2, we shall discuss some of the facets of IMPS that make it particularly suitable for formulating and reasoning about mathematics. Then in Section 3 we shall describe the formal theory in which the theorems are stated and proved. The proofs of the two theorems are given in Section 4. The final section, Section 5, contains a short conclusion.

2. IMPS
The IMPS system is intended to provide computational support for rigorous mathematical reasoning in a style that closely conforms to conventional practice. It can be used to formulate axiomatic theories and to prove theorems in them. The major goal of the system is to provide users with the means to develop machine-checked proofs that are convincing and intelligible to a wide audience.

\(^1\)We define a set to be sequentially compact if each one of its countable open covers has a finite subcover.

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For a detailed overview of the IMPS system see [6]. In the rest of this section, we shall describe three aspects of IMPS that facilitate the construction of intelligible proofs: its logic, its support for the axiomatic method, and its style of proof.

2.1 Logic
In IMPS all concept formulation, calculation, and inference is performed with respect to a formal logic that is a version of classical higher-order predicate logic. This logic provides strong support for specifying and reasoning about functions. In particular, functions may be higher order (have arguments which are themselves functions) and partial (not defined on all arguments). In addition, formulas may contain arbitrary quantification (universal or existential) over functions. Partial functions are handled in a direct manner, without introducing special error elements. This means that some terms, such as 2/0, have no value assigned to them. A direct approach to partial functions is very convenient for formalizing mathematics in which partial functions play a prominent role. This is especially true for analysis where partial higher-order functions, such as the differentiation operator on functions, occur naturally.

The IMPS logic is equipped with a hierarchy of objects called sorts which denote classes of elements. Sorts are used to help specify the value of an expression and to restrict quantification. They are especially useful for reasoning with respect to overlapping domains. For example, suppose \( \mathbb{Z} \) and \( \mathbb{R} \) are sorts denoting the integers and the real numbers, respectively. Then the Archimedean principle for the real numbers can be expressed quite naturally as

\[
\text{for every } a : \mathbb{R} \text{ for some } n : \mathbb{Z} \quad a < n.
\]

For more information on the IMPS logic, see [4, 5, 7].

2.2 Axiomatic Method
The axiomatic method comes in two basic styles. There is the "big theory" style in which all reasoning is carried out within one theory—usually some highly expressive theory, such as Zermelo-Fraenkel set theory. There is also the "little theories" style in which results are proven in small abstract theories and then used in more concrete theories. This latter style of the axiomatic method is employed extensively in standard practice. For example, if a mathematician needed a fact about multiplication over the nonzero elements in a field, he would usually not prove it in the context of fields if he could get away with proving it as a general result in group theory. That is, he would prove a general result in group theory, notice that multiplication over the nonzero elements has the structure of a group, and then appropriately instantiate the general result to obtain the desired fact. In other words, a mathematician will typically prove a result in a context free of unnecessary details, so that the result can be used freely in a variety of more specialized contexts.

Most theorem provers today support only the big theory style of the axiomatic method. In contrast, IMPS provides a number of facilities for using the axiomatic method in the little theories style. Users of IMPS can freely formulate multiple axiomatic theories. Each theory consists of a formal language—specified by a set of atomic sorts and constants—and a set of axioms expressed in the language. Theories are related to each other by theory interpretations. A theory interpretation is a syntactic device for translating the language of a theory \( T \) to the language of a theory \( T' \) with the property that each theorem of \( T \) is translated to a theorem of \( T' \). Theory interpretations thus provide a mechanism for "transporting" theorems from abstract theories to more concrete theories.

The IMPS theory and theory interpretation mechanisms should be useful in much of mathematical analysis, where reasoning is typically done at various levels of abstraction. For example, the proof of the Picard-Lindelöf existence theorem for ordinary differential equations is often proved in textbooks by applying the fixed point principle for contractive mappings on a complete metric space. In the terminology of IMPS, that approach requires the construction of a theory interpretation in which a metric space is interpreted as a space of continuous functions on an interval. The real work here consists of showing that this instantiation is valid, which involves among other things, reasoning about integrals of real-valued functions on intervals.

2.3 Proofs
IMPS produces formal proofs, but they are very different from the formal proofs that are described in logic textbooks. Usually a formal proof is a tree or graph constructed in a purely syntactic way from axioms, previously proved theorems, and a small number of low-level rules of inference. Formal proofs of this kind tend to be composed of an enormous number of small logical steps and for this reason are usually exceedingly hard to understand. In contrast, the steps in an IMPS proof can be very large, and most low-level inference in the proof is performed by an expression simplification routine. Since inference is described at a high level, proofs constructed in IMPS resemble informal proofs, but unlike an informal proof, all the details of an IMPS proof are machine-checked.

In IMPS, there are several devices for compressing complex deductions into single units. Expression simplification carries out myriad low-level inferences in one step using algebraic manipulation, term rewriting, and special algorithms for checking the definedness of terms. Theorem assumption allows one to assume intermediate assertions that have been proved independently, either in the home theory of the proof or in some appropriate outside theory. Collections of theorems can be automatically applied, in an organized manner, to a conjecture using macetes. Strategies call rules of inference—including simplification, theorem assumption, and macete application—in useful patterns; they are akin to what are called tactics in other systems.

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1 A proof of this latter result has been carried out in IMPS by Bob Givan.

2 In Portuguese, a macete is a clever trick.
These devices for packaging inferences help the IMPS user to raise the essential ideas of a proof to the surface, while suppressing the details that would normally not appear in a written presentation of the proof. They also give the user the means to initiate and control machine deduction.

### 3. The Formal Theory

The formal proofs of Theorems 1 and 2 are carried out in a theory of metric space pairs. Before describing this theory, we need to describe two other basic theories that serve as building blocks for this theory.

#### 3.1 Higher-Order Real Arithmetic

The IMPS theory of higher-order real arithmetic, called h-o-real-arithmetic, axiomatizes the real number system as a complete ordered field and characterizes the integers and rationals as imbedded structures. This is a fairly extensive theory, so we only describe it informally here. The language constants of this theory are of two kinds:

- The function constants $+$, $\ast$, $\div$, $\sub$, $\preceq$, $\preceq\preceq$, $\leq$, $\preceq$ that denote the arithmetic operations of addition, multiplication, division, exponentiation, subtraction, negation, and the binary predicates less than and less than or equal to, respectively.

- An infinite set of individual constants, one for each rational number.

The atomic sorts of the language are $\mathbb{Z}$, $\mathbb{Q}$, $\mathbb{R}$ denoting the integers, rationals, and reals. Other constants and sorts can be added by definitions.

The axioms of this theory are the usual field and order axioms as well as the completeness axiom which states that any predicate which is non-vacuous and bounded above has a least upper bound. This theory also contains the full second-order induction principle for the integers as an axiom. One can prove in this theory the basic facts about real numbers such as the archimedean principle stated above.

#### 3.2 Metric Spaces

The theory metric-spaces is a formal theory of a single metric space. It is sufficiently expressive to formulate the basic concepts of metric spaces, such as open and closed sets, connectedness, sequential compactness (equivalent to compactness for separable metric spaces), and continuity of real-valued functions. Results proven in this theory can be transported, for example, to the theory of higher-order real arithmetic. The theory is defined in IMPS by the two forms (or s-expressions) given below. The first of these forms defines the language (i.e., the atomic sorts and constants which constitute the vocabulary of the theory), and the second form essentially just lists the axioms of the theory.

```plaintext
/language-from-definition
'metric-spaces-language
 (embedded-languages h-o-real-arithmetic)
 (base-types points)
 (constants
  (dist (points points rr))))
```

These forms say the following:

- The theory metric-spaces includes h-o-real-arithmetic as a subtheory (which, in particular, means completeness arguments can be freely used).

- The underlying sort of the metric space is denoted by the sort points. The function constant dist denotes the distance between two points in the metric space. (Note: the sort $\mathbb{R}$ is entered at the keyboard by $rr$.)

#### 3.3 Metric Space Pairs

The relevant theory for stating and proving Theorems 1 and 2 is called metric-space-pairs. The theory of a single metric space is insufficient to formulate a completely general theory of continuous functions between metric spaces, one that will include for instance continuous mappings between $\mathbb{R}^3$ to $\mathbb{R}^2$ as a special case of the general theory. IMPS has a theory replication mechanism which allows users to automatically create a new theory which contains a fixed number of imbedded copies of a given theory. By an imbedding we mean a theory interpretation as explained earlier in the paper.

Theory replication is essential for doing interesting mathematics because most often one considers several instances of the same structure and mappings between these structures. Thus, ordinarily mathematicians think of “ring theory” not as a formal theory of a single ring (which does not provide much material for mathematical development) but at the very least as a theory of rings and morphisms between them. The theory replication is specified in IMPS by the following form:

```plaintext
/poly-replicate-theory-with-definitions
metric-spaces
(list 'first 'second
  'metric-space-pairs)
```

The theory metric-space-pairs includes h-o-real-arithmetic plus the following additional components:

- The additional atomic sorts (i.e., the atomic sorts of the theory’s language other than those in h-o-real-arithmetic) are first.points and second.points.
• The additional constants are \textit{first.dist} and \textit{second.dist}.
• The additional axioms of the theory are the metric distance axioms (triangle inequality, symmetry, etc.) for the functions \textit{first.dist} and \textit{second.dist}.

The procedure \textit{poly-replicate-theory-with-definitions} also creates a pair of translations from \textit{metric-spaces} to \textit{metric-space-pairs}. Moreover, defined constants in the theory \textit{metric-spaces} are automatically translated in two different ways to similarly defined constants in the theory \textit{metric-space-pairs}. For example, the predicate \textit{open} which is defined in the theory \textit{metric-spaces} is translated as two predicates \textit{first_open} and \textit{second_open}, corresponding to the property of being an open subset of \textit{first.points} and \textit{second.points}, respectively.

3.4 Indicators
So far we have not discussed how to quantify over sets of points in a way which would allow us to define connectedness or sequential compactness. One possibility is to imbed the theory of metric space pairs in a larger theory such as Zermelo-Fraenkel set theory. This approach is quite feasible but has the disadvantage that it requires a certain amount of preparatory work in set theory. Moreover, results in this larger theory can only be transported to other theories which are similarly imbedded in set theory. This considerably restricts the flexibility with which results can be moved around from theory to theory.

In our development of metric spaces, we have adopted the more direct approach of conceptually identifying a set \( S \) with a function \( f \) which takes on a fixed value (say the number 1) on \( S \) and is undefined everywhere else. We call such functions \textit{indicators}. We have developed several “generic” theories involving indicators which allow us to prove theorems about sets, covers, and inverse images in a very abstract setting. Since these theories have no axioms, theorems proved in them can quite easily be transported to other theories.

The following is an example of a useful fact (named \textit{direct-image-subset-conversion}) which can be proved in one of these generic theories. It allows us to replace, in certain cases, statements involving direct images with statements involving inverse images.

\[
\text{for every } f : \text{ind}_1 \rightarrow \text{ind}_2, a : \text{sets[ind}_1], b : \text{sets[ind}_2] \\
\text{implication} \\
• \text{total}(f, [\text{ind}_1 \rightarrow \text{ind}_2]) \\
• f(a) \subseteq b \iff a \subseteq f^{-1}(b).
\]

This is a useful result, since inverse images have nicer properties than direct images. We make use of this result and similar results in our computer-assisted proofs of Theorems 1 and 2.

3.5 Definitions
Theories can be enriched by sort and constant definitions. The definitions we need to formulate Theorems 1 and 2 all define predicate constants which denote boolean-valued functions. Our definitions of the requisite topological predicates are very close to the conventional ones adopted in most textbooks. For example, the following expression is the condition for \( x \) to be a connected subset of \textit{points}.

\[
\text{for every } a, b : \text{sets[points]} \\
\text{implication} \\
• \text{conjunction} \\
• o \text{ open}(a) \\
• o \text{ open}(b) \\
• o \text{ empty?}\{a \cap b \cap x\} \\
• o x \subseteq a \cup b \\
• \text{disjunction} \\
• o x \subseteq a \\
• o x \subseteq b.
\]

The condition for a function \( f : \text{first.points} \rightarrow \text{second.points} \) to be continuous can be given in several equivalent ways, but for our purposes, the most convenient one is

\[
\text{for every } v : \text{sets[second.points]} \\
\text{implication} \\
• \text{second_open}(v) \\
• \text{first_open}(f^{-1}(v)).
\]

Of course one can show in \textit{IMPS} (with a certain amount of user assistance) that this condition is equivalent to the usual \( \epsilon, \delta \) condition for continuity.

4. The Proofs
We describe in this section formal proofs of Theorems 1 and 2 produced with \textit{IMPS}. A proof in \textit{IMPS} is represented by a data structure called a \textit{deduction graph}. A deduction graph is a directed graph with nodes of two kinds, representing formulas and inferences respectively. The formulas appearing in a deduction graph are actually \textit{sequents} consisting of a single formula called the \textit{assertion} together with a set of assumptions called the \textit{context}. A sequent is considered to be true if its context implies its assertion.

There are two basic routines in \textit{IMPS} for presenting the information contained in a deduction graph in a \TeX format. One routine describes each logical inference recorded in the deduction graph. The other routine is prescriptive: It presents the deduction graph in terms of the user commands (i.e., rules of inference, macetes, and strategies) that were used to construct the deduction graph. This is analogous to how proofs are given in a lecture or in a textbook. Few details are provided by the lecturer, who limits him or herself to giving the information on how to reconstruct the proof. The proofs in the section are presented using this latter routine.

The formal statement of the first theorem is:

\textbf{Theorem 1}

\text{for every } f : \text{first.points} \rightarrow \text{second.points}, o : \text{sets[first.points]} \text{ implication} \\
• \text{conjunction} \\
• o \text{ continuous}(f) \\
• o \text{ total}(f, [\text{first.points} \rightarrow \text{second.points}]) \\
• o \text{ first.connected}(o) \\
• o \text{ second.connected}(o).

We present the proof of Theorem 1 as it is actually formatted by \textit{IMPS} using the prescriptive proof presentation...
routine. In this particular proof, the full deduction graph consists of 18 sequent nodes.

Before presenting the proof, we give the intuitive idea behind it. The proof begins by expanding all definitions at the top level of the expression. In this case, the defined constants are the predicates first_connected, second_connected, and continuous. Since these constants are defined as $\lambda$-expressions (a $\lambda$-expression is a fancy name for a term of the form "the function which carries $x, y, \ldots$ to the expression $blah$"), expanding the definitions merely replaces these constants with their defining $\lambda$-expressions. We next have to apply the rule of $\beta$-reduction, which essentially plugs in values to the expressions which define the functions. This leaves us with an assertion which contains several subexpressions of the form $f(a) \subseteq b$. We now apply a user-defined macete which applies repeatedly a number of generic (and very easy to prove) results on indicators, such as the direct-image-subset-conversion lemma mentioned above. Application of this macete turns these subexpressions into subexpressions of the form $a \subseteq f^{-1}(b)$ and also uses the preservation properties of $f^{-1}$. To complete the proof, we use an ending strategy. An ending strategy attempts to find a proof of a goal sequent by successively applying rules of inference from a fixed list (depending on the strategy) and backtracking when a particular branch fails.

**Proof.** Apply the strategy DEFINITION-EXPANSION to the claim of the theorem. This yields the following new subgoal:

**Sequent 1.**

For every $f : \text{first_points} \rightarrow \text{second_points}, o : \text{sets[first_points]}$ implication

- conjunction
  - $\forall \xi : \text{sets[second_points]} \cdot \text{second.open}(\xi) \supset \text{first.open}(f^{-1}(\xi))$ (f)
  - $\forall \xi : \text{sets[second_points]} \cdot \text{second.open}(\xi) \supset \text{first.open}(f^{-1}(\xi))$ (f)
  - $\forall \xi : \text{sets[second_points]} \cdot \text{second.open}(\xi) \supset \text{first.open}(f^{-1}(\xi))$ (f)
- $\forall \xi : \text{sets[second_points]} \cdot \text{second.open}(\xi) \supset \text{first.open}(f^{-1}(\xi))$ (f)

Apply the inference rule BETA-REDUCTION to the previous sequent. This yields the following new subgoal:

**Sequent 2.**

For every $f : \text{first_points} \rightarrow \text{second_points}, o : \text{sets[first_points]}$ implication

- conjunction
  - $\forall \xi : \text{sets[second_points]} \cdot \text{second.open}(\xi) \supset \text{first.open}(f^{-1}(\xi))$ (f)
  - $\forall \xi : \text{sets[second_points]} \cdot \text{second.open}(\xi) \supset \text{first.open}(f^{-1}(\xi))$ (f)
  - $\forall \xi : \text{sets[second_points]} \cdot \text{second.open}(\xi) \supset \text{first.open}(f^{-1}(\xi))$ (f)
- $\forall \xi : \text{sets[second_points]} \cdot \text{second.open}(\xi) \supset \text{first.open}(f^{-1}(\xi))$ (f)

Apply the macete DIRECT-IMAGE-TO-INVERSE-IMAGE-CONVERSION-MACETE to the previous sequent. This yields the following new subgoal:

**Sequent 3.**

- for every $f : \text{first_points} \rightarrow \text{second_points}, o : \text{sets[first_points]}$ implication
  - conjunction
    - $\forall \xi : \text{sets[second_points]} \cdot \text{second.open}(\xi) \supset \text{first.open}(f^{-1}(\xi))$ (f)
    - $\forall \xi : \text{sets[second_points]} \cdot \text{second.open}(\xi) \supset \text{first.open}(f^{-1}(\xi))$ (f)
    - $\forall \xi : \text{sets[second_points]} \cdot \text{second.open}(\xi) \supset \text{first.open}(f^{-1}(\xi))$ (f)
- $\forall \xi : \text{sets[second_points]} \cdot \text{second.open}(\xi) \supset \text{first.open}(f^{-1}(\xi))$ (f)

Apply the strategy PROVE-BY-LOGIC-AND-SIMPLIFICATION to the previous sequent. This completes the proof.

The formal statement of the Theorem 2 is almost identical to that of the previous theorem except that "connected" is replaced with "sequentially compact." Moreover, the sequence of user commands required to prove Theorem 2 is identical to that of Theorem 1. Of course, the actual T$\forall$X form of the proof is different because the goal formula and all intermediate formulas are different. We omit the details.

**Conclusion.**

In this article we presented computer-supported proofs of two theorems in metric space topology. The theorems were stated within an axiomatic theory of metric space pairs using familiar topological concepts such as open set and continuous function which were defined in a very direct and natural way. The proofs were constructed within a version of predicate logic with the help of the IMPS theorem proving system. Each proof was fully machine-checked and required only four commands from the user.

The theorems and proofs were developed in the little theories style of the axiomatic method. This approach benefited our proofs in two ways. First, both proofs utilized results proved outside of the theory of the proof, specifically results about converting statements involving direct images into statements involving inverse images. These results were proved in a theory about abstract mappings, and the system determined on its own how and where to apply them. Second, the two theorems can be transported to any theory that contains structures which are metric spaces. For example, they can be transported to the theory h-or-real-arithmetic by interpreting the two metric spaces of metric-space-pairs as $\mathbb{R}^3$ and $\mathbb{R}^2$.

The everyday practice of mathematics involves proving numerous elementary, but not entirely trivial results, which are similar in complexity to Theorems 1 and 2. In fact, many substantial theorems are proved by just skillfully combining elementary facts. Systems such as IMPS, which can be effectively used to formulate, prove, and apply elementary theorems, thus have the potential to play a significant role in mathematics research. Moreover, they offer mathematicians a new technology for organizing, checking, and reusing their work.
References


Plot

Reviewed by Larry Riddle*

Plot is primarily a two-dimensional plotter for Cartesian, polar, or parametric functions, with additional capabilities for three-dimensional plots, implicit graphs, and differential equations. It was developed by Richard Parris, a teacher at Phillips Exeter Academy. I have used Plot extensively in precalculus and calculus courses and found it excellent for classroom exploration and student use on homework and laboratory projects.

Plot requires an IBM compatible PC with an appropriate graphics card (such as CGA, EGA, VGA, or Hercules, for example). It will take advantage of a math coprocessor if one is available, but I was able to run the software quite nicely, if a bit slowly, on an 8088 based clone. On a 386 machine the graphs and surfaces are drawn very quickly. The program comes configured to print to the standard dot-matrix printers as well as the HP PaintJet and LaserJet. The entire program, documentation and drivers fit on one 360K floppy.

Graphing software as a pedagogical tool for teaching mathematics in the classroom or computer laboratory should handle many different kinds of questions and problems. On the one hand, the program should be useful for investigating the behavior of a particular function, while on the other hand, we might want to use it to study a family of functions and ask, for example, about the shape of quadratic functions or periodic functions as different parameters are varied. Plot integrates both approaches in a way that is easy for students to learn and use.

The program is organized around a sequence of keyboard activated menus. Many options for exploring an individual graph are available from the Main Menu (see Figure 1). In addition to drawing the graph of a function, the user can display next to the graph a table of numerical values, locate zeros of Cartesian functions, or obtain the coordinates of local extreme points. In the menu for the latter option, a search interval restricts the independent variable, but one can search for the extreme values of different coordinates. For Cartesian graphs, this is the coordinate of the dependent variable. For polar graphs of the form $r = f(q)$, one can search for extreme values of the radius $r$, or extreme values for either $x$ or $y$. With parametric equations, one can search for the extreme values of either $x$ or $y$. When Extremes is pressed for the first time, the program finds and displays the coordinates for the first extreme point that it detects and displays the graphic cursor at this point on the graph (see Figure 2 next page). Pressing any key releases the program to find the next extreme point or to quit that menu. When there are extreme points that are too close together for both to be detected in the first pass, pressing Extremes again will break the search interval into more subintervals thereby increasing the likelihood that the extreme points will be separated. You can also manually restrict the search interval if you are looking for a particular extreme point. The Intersection command in the Zeros menu works the same way as the Extreme command. Through these two menu items students can quickly determine the roots of a function or solve max-min problems.

*Larry Riddle is an Assistant Professor of Mathematics at Agnes Scott College, Decatur, GA 30030 where he is involved in integrating technology into the mathematics curriculum. His email address is riddle@mathcs.emory.edu.
the screen or sent to the printer.

In [1] E. Paul Goldenberg discusses lessons learned about how students work with and interpret graphical representations of functions. Several of his thirteen lessons address design features that are important for a graphing tool used for educational purposes. His first lesson is that it must be easy to modify functions to make it convenient to perform experiments in which students modify a single parameter (coefficient or exponent) within a given form in order to study the effect. This can be done in Plot in several ways. Individual functions may be edited from several menus. Functions may be entered with parameters whose values can be quickly changed from a popup menu. Alternatively, the Family of Curves menu allows one to graph several curves with a common equation form that differ only with respect to one or more parameters. The value of a parameter may be changed without editing the function. It is also possible in this menu to have the parameter is automatically incremented in even steps between a specified beginning value and ending value.

Goldenberg’s second lesson is that an educational graphing program should facilitate the comparison of functions so that “comparing the graphs of two functions with the graph of their sum, difference, product, quotient, or composition, [students] must be spared the time it takes to retype each form.” In Plot all five of these operations can be performed directly from the 2-Function Menu (see Figure 3). Moreover, the 1-Function Menu allows the user to graph curves obtained from the current example by simple variable substitutions. For example, once the function $f$ has been defined, one can plot $y = f(x - 1)$ by specifying the variable $X$ and asking for the substitution $X - 1$, and have the new graph immediately drawn. Similarly, one can change the variable to $F$ and specify the substitution abs($F$) to draw the graph of $y = f(x)$. To facilitate the comparison of graphs even further, the user can create up to four side-by-side popup windows. Windowing and graphing commands are applied to whichever of the windows is currently active.

The twelfth lesson maintains that students need experience controlling scale: “students need experience with strictly metric controls (e.g. specifying the exact borders of the region of the plane they wish to examine) and with visual, primarily nonmetric controls (e.g. stretching or shrinking an image without having to compute window border values in $x$ and $y$)” Plot specifies the viewing window in two ways. The user can specify either the center and width of the window or the extreme values along each axis. There are several ways to zoom. One is to simply change the window’s width. To zoom in, one can use a movable zoom window that zooms equally in both directions by a factor of 10, or one can use a flexible zoom window to specify opposite corners for the new window. One can also stretch or shrink just the vertical scale relative to the scale along the horizontal axis. The only problem with zooming is that you may lose the coordinate axes display, which can make it difficult at times to get a feel for the new scale or location of points. It is possible, however, to bring up a graphic cursor that displays the coordinates of its center as you move the cursor around the window. By employing the popup windows, one can also start with identical graphs in two windows and then use one window to preserve the original display while zooming in the other.

Goldenberg’s second lesson is that an educational graphing program should facilitate the comparison of functions so that when “comparing the graphs of two functions with the graph of their sum, difference, product, quotient, or composition, [students] must be spared the time it takes to retype each form.” In Plot all five of these operations can be performed directly from the 2-Function Menu (see Figure 3). Moreover, the 1-Function Menu allows the user to graph curves obtained from the current example by simple variable substitutions. For example, once the function $f$ has been defined, one can plot $y = f(x - 1)$ by specifying the variable $X$ and asking for the substitution $X - 1$, and have the new graph immediately drawn. Similarly, one can change the variable to $F$ and specify the substitution abs($F$) to draw the graph of $y = f(x)$. To facilitate the comparison of graphs even further, the user can create up to four side-by-side popup windows. Windowing and graphing commands are applied to whichever of the windows is currently active.

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Plot has many additional options for drawing implicitly defined curves, graphs of derivatives (up through order four), surfaces in Cartesian, polar, or parametric form, and parametric space curves. Intersections of Cartesian graphs can be found using the 2-Function Menu, while intersections of other types of graphs can be approximated using the zoom feature in conjunction with the graphic cursor. Plot can also draw slope fields and trajectories for differential equations, and, finally, the Animation menu allows one to create images that are stored in memory and displayed in rapid succession.

The author has put considerable thought into making the program complete and easy to use. There is an extensive
library of built-in functions, including a join function for easy construction of piecewise defined graphs and an iteration function \( \text{iter}(n,f(x)) \) for plotting the \( n \)th iterate of \( f \). The user can also save his or her own specially built library of functions on disk. When the program is waiting for non-menu-specific input, a box will open on the screen to let the student know that some information must be entered. Numerical input may be entered in non-decimal form, such as \( \text{sqr}(3) \) or \( 2\pi \), for example. It is even possible to add text to the plots.

This program has many features and menus, and a student will need some guidance on where commands are located. Fortunately, most of the basic graphing operations are found in the opening two menus. The minimal documentation for the program is two ascii files that come on the disk. The files describe all the features but have no table of contents or index. One can, however, view the documentation files from within \textit{Plot} and search for text strings.

\textit{Plot} is available free of charge by sending a formatted disk and return mailer with postage to Richard Parris, Phillips Exeter Academy, Exeter, NH 03833.

\textbf{Reference}


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\textbf{Cube and Tess}

\textbf{Reviewed by Tevian Dray*}

A square has 4 “faces”, each of which is a line. A cube has 6 faces, each of which is a square. A (4-dimensional) hypercube has 8 “faces”, each of which is a cube. Divide the square into 9 equal squares and you get a tic-tac-toe board. As we all know, the center square is different from the others, because it shares a “face” (edge) with the most neighbors. A similar division of the cube into 27 equal cubes results in the Rubik cube. Again, different cubes (“cubies”) have different properties depending on their location. Divide a hypercube similarly into 81 equal hypercubes and what do you get?

\textit{Cube} and \textit{Tess} are two Macintosh programs (distributed together by Atlantic Software for \$39.95) which model the Rubik cube and its 4-dimensional generalization, the “Rubik hypercube”, respectively. I ran them on a Mac SE, but Atlantic Software claims that the programs will run on any Mac.

\textit{Cube} gives the \( 3 \times 3 \times 3 \) Rubik cube in a 2-dimensional representation consisting of three \( 3 \times 3 \) squares. A 3-dimensional representation is also given. Faces are rotated by clicking on the center “square” (really a cube) of the face and then clicking on an arrow indicating the direction of rotation.

\textit{Cube} is really just a prelude to \textit{Tess} (short for Tesseract, another name for a hypercube), which gives the \( 3 \times 3 \times 3 \times 3 \) generalization of the Rubik cube, displayed as three \( 3 \times 3 \times 3 \) cubes. Again, clicking on the center “cube” of a “face” (really a hypercube and a cube, respectively), produces three axes with arrows, so that the corresponding “face” (cube) can be rotated.

Although the instructions do not discuss the hypercube itself in any detail, careful thought (draw pictures!) should enable the mathematically inclined to determine how the given 3-dimensional representation corresponds to the 4-dimensional “reality”.

The programs come with very good directions, including a section for Mac hackers giving the defaults and how to change them. Both programs use virtually identical commands. One of the nicest features of the programs is that one can define (and save) macros, which are called Processes. Anyone who has ever played with a Rubik cube will appreciate the desirability of this feature! Other nice
features are the abilities to Undo the previous move (but only one), to Scramble to a random starting configuration, and, of course, to Restore the original configuration. Numerous exercises with solutions on disk are provided.

It is highly recommended that one try Cube first, as this provides good practice with the format of the programs and thus prepares one for Tess.

I am reasonably competent with the (original) Rubik cube—it takes me 5-10 minutes to unscramble a cube. Nevertheless, my first effort with Cube took well over an hour. The reason for this is that it is not simple to turn the entire cube around (see previous page), so that I had difficulty figuring out where I was. However, this merely indicates that the ability to visualize in 3-dimensions is not necessarily helpful when solving a 2-dimensional puzzle! With practice, my time did improve somewhat, although I never did develop a 2-dimensional intuition for what I was doing; this was at least partly due to lack of time on my part.

A minor criticism of Cube is that rotation of the right and left faces is counterintuitive, as it does not correspond to the “obvious” rotations of the 3-dimensional cube, but rather to their inverses. For instance, having selected the right face, clicking on the right portion of the arrow produces a counterclockwise rotation (as seen from the right, which is the displayed perspective of the cube) instead of the expected clockwise rotation. Although there is a detailed example given in the instructions, which should be carefully studied, I can find no reason why the opposite convention couldn’t have been chosen, which I believe would merely correspond to swapping the displayed positions of the upper and lower layers in the 2-dimensional representation.

A minor criticism of both programs is that the Quit command is not self-explanatory: A dialog box appears, with “Save state before quitting” checked, with a similar box for processes. If you want to simply quit, without saving anything, it is necessary to first uncheck these boxes, then confirm. A yes/no decision would have been both faster and more obvious.

There are precisely $n$ axes in $n$ dimensions parallel to which one can slice an $n$-dimensional cube into $(n-1)$-dimensional cubes. One such slicing is given originally, and the Reslice command allows you to choose any of the others. Unfortunately, the action of the Reslice command is very hard to visualize, so that it may be hard to predict exactly what the result of a given reslicing will be. However, some trial and error should result in the desired reslicing being achieved. Since it is usually (there is one exception) necessary to use Reslice if you wish to rotate the entire (hyper)cube, this does mean that it is difficult to perform a particular rotation quickly. Furthermore, Reslice reverses the orientation of the cube, e.g. the 3-dimensional Reslice command performs an operation which is impossible with a Rubik cube. While these are not major drawbacks, it does mean that one’s experience with the Rubik cube may or may not prove helpful—I at least am constantly turning the whole Rubik cube around when I work with it. In fact, once I figured out how to write simple macros to rotate the entire cube about any of the three axes (only one of these rotations is built into Cube), I made progress much more quickly. The examples of the Reslice command in the instructions merit careful study.

Overall, I recommend these two programs highly to all Mac users who enjoy the Rubik cube, as well as anyone interested in learning more about 4-dimensional geometry.
Inside the AMS

The AMS Marketing Division and the Nineties

Jeremy Soldevilla
Director of Marketing

Over the last several years, the AMS has been growing at a rapid pace. New publications, cutting edge technologies, and increasing involvement with mathematicians on a global scale have created new demands on the Society's role as a leader in the mathematics community and a shaper of the future. The confluence of these mandatory and evolutionary changes has resulted in some exciting challenges and opportunities for the AMS, its membership, and the mathematics community in general.

The primary umbrella under which these challenges and opportunities lie can be called "communication." Through the efforts of the newly formed Marketing Division, we plan to open wider the channels of communication into, out of, and within the AMS. We want to be more sensitive and responsive to the needs and concerns of our members and customers. We will ask questions and listen at meetings. We will mail surveys. We will enhance our customer service program and use improved order inquiry systems. And we will use vehicles like Notices and other publications, both print and electronic, to solicit ideas and suggestions. Similarly, many of our programs will be geared to increasing and improving communications from the AMS to the wider community. Workshops, as well as other forms of communications, will be used to promote public awareness of the Society's programs, products, and of mathematics in general.

The Database Services Department will reach out to the mathematics community through workshops and direct mail to increase the understanding and use of our growing selection of electronic products such as MathSci and e-MATH.

The Membership Department will explore new and better ways to enhance our programs and benefits. It will also develop strategies to attract more new members from an even broader universe of students, educators, and professionals, both nationally and internationally.

One of the most exciting developments within the AMS is the expanded publications program. With the new A.E.D. for Publications, Samuel Rankin, in place, the AMS will be publishing a selection of books, journals, and electronic documents which will have an even broader appeal than our current list.

The Marketing Division and the Publications Group are already working very closely in conjunction with the production staff to identify new publishing opportunities and technologies.

In order to attract more authors and to reach a more diverse audience, the promotional program is being revamped. Our newly formed Promotions Department has already begun to reach out to new customers. For instance, an incentive program to encourage bookstore sales has been instituted. International marketing is being broadened. A reciprocity program is about to be initiated whereby members of other professional and scientific societies, including engineers, biologists, and physicists, will be encouraged to purchase journals, books and other AMS products as well as to join the Society. Furthermore, efforts are underway to reach non-members with announcements of our new publications through direct mail and space advertising.

In the 90s, education and the sciences will experience many advances as increasing attention is focused in these areas and as fascinating new technologies emerge at an even faster rate. The information age is upon us. The need and desire for research and information have never been stronger.

At the AMS we are at the forefront of this exciting movement. The expanding base of users of our CD Rom product, MathSci Disc, the growing interest in e-MATH, and the AMS' involvement with the fledgling Science Television Network are just a few of the testaments to our leadership.

Communications will be the key to success. The increased level of communications will not only contribute to a better dissemination of information within and outside of the Society, but will also enhance the responsiveness of the AMS to the needs and technological demands of the world's mathematical community. The Marketing Division, through its new structure, is positioned to contribute to the Society's efforts.

These new developments and programs won't take place overnight, and they won't happen in a vacuum. To be successful we must plan carefully, depend upon a strong staff of professionals, solicit and harness the help of our members, and then carry out our mission. Our plans are
already falling into place. Our new Marketing Division staff is excellent and committed. Now we need to talk to and listen to the ideas of our members and customers and get your help in actively participating in and promoting the Society and mathematics in general.

You’ll be hearing from us. And we want to hear from you.

**e-MATH and Electronic Publishing**

The e-MATH service is about one year old. As the consequence of increased publicity and expanded services, usage has grown from 350 accesses per week to over 1,000. e-MATH staff members have worked to understand developments in the rapidly expanding field of electronic publication, and to initiate programs which will enable the AMS to participate in this expansion.

These efforts have included extensive communication with other organizations active in this field, as well as a substantial development effort to produce an application that can support on-line editing for journal production and can also evolve into a system for collaborative creation and production of a refereed journal. The application is based on an international standard for document architecture (SGML) and an industry-standard language for retrieval (SQL). It supports arbitrary document types, revision control and annotation, and grammar-based bi-directional SGML-TeX processing. Work continues with support by the National Science Foundation.

A first product of these development efforts will be electronic distribution, via e-MATH, of the *Bulletin of the AMS*, beginning with the 1992 issue year. This product will be introduced in parallel with moderated conferences covering several active topics of mathematical research.

**Accessing e-MATH**

e-MATH can be accessed via telnet (telnet e-math.ams.com or telnet 130.44.1.100). Login and password are e-math. The requirements for a successful connection to e-MATH are:

- a connection to an INTERNET host.
- VT100 connectivity in communications software and host operating system.
- terminal tabs set at every eight columns.

To access the e-MATH Combined Membership List (CML) name look-up service, type the following:

telnet 130.44.1.100 2050 (UNIX hosts)
telnet 130.44.1.100/port=2050 (VMS hosts)

At the “Enter Name” prompt, enter the last name of the person you would like to look up in the CML database. First names may be given in the following manner: “Last:First”, with no spaces around the “:”. The search wildcard “*” may be used in the name string.

For further information, or for assistance accessing and using e-MATH services, send email to:

support@e-math.ams.com.


Raviart Receives Prize
Le Comité du Rayonnement Français has awarded its Prix des Sciences Physiques et Mathématiques for 1991 to Pierre Arnaud Raviart, professor of mathematics at l'Ecole Polytechnique.

Professor Raviart was recognized for building an exceptional body of work in numerical analysis. The citation for the prize noted that his work has been useful to engineers and researchers and possesses an aesthetically pleasing clarity and simplicity. His work concerns the theory of finite element methods, parabolic problems, and nonlinear hyperbolic equations.

Professor Raviart's influence on the discipline has been profound, not only because of his own research but also because of his mentorship of a group of young numerical analysts who have gone on to research centers and industries in France and around the world.

Le Comité du Rayonnement Français was founded in 1893 and its purpose is to recognize and illuminate the achievements of French researchers, artists, and writers. This committee awards a range of prizes each year in various fields of endeavor. Le Prix des Sciences Physiques et Mathématiques of 50,000 FF is awarded each year to an outstanding researcher in mathematics or one of the physical sciences, including physics, chemistry, earth science, and astronomy.

Lida Barrett Takes NSF Position
Lida K. Barrett, Dean of the College of Arts and Sciences at Mississippi State University, has taken a position as Senior Advisor on Precollege Education at the National Science Foundation (NSF). In this newly-created position, Barrett will serve as primary advisor to the Assistant Director for Education and Human Resources (EHR), Luther Williams, to provide analysis and coordination of NSF educational programs.

The position is aimed at two goals: first, to examine the range of NSF educational programs and formulate an overview of what’s being done and what gaps there might be, and second, to act as a facilitator to ensure that the various EHR programs complement and enhance one another.

Barrett says that one of her first projects will be a report on existing school programs. “There are a lot of problems in education, but there are also a lot of answers,” she notes. She will be analyzing the components of school programs in mathematics and science to determine the ingredients that make them successful. “We need to see what makes them work, how dependent they are on a particular setting, whether they are translatable to other settings.”

She will also be looking at networking programs that link teachers, schools, and organizations and trying to determine how such programs can be used to disseminate information about educational projects. Electronic communications will likely play a key role in this area.

The EHR staff now has a substantial representation in mathematics. “There is as much mathematics as science at the school level, so we ought to be heavily represented,” she remarks. “I would say that half the staff should be in mathematics, but that’s me talking as a mathematician!” She also encouraged those in the mathematical sciences community who have an interest in education to get in touch with EHR, to inquire about serving as rotators, reviewers, or members of reviewing panels.

Barrett’s position also involves coordination and cooperation with other Washington organizations that deal with education. For example, she has attended meetings of a Congressional committee that’s examining standards for educational testing. She will act as a liaison with the National Governor’s Association, which has been active in educational matters in the past couple of years. In addition, she will keep abreast of activities at the Department of Education and the National Research Council (NRC), particularly the Mathematical Sciences Education Board and the NRC’s newly-created Coordinating Council on Education.

Barrett’s prior positions include serving as dean at Mississippi State University and as associate provost at Northern Illinois University. She was on the mathematics faculty of the University of Tennessee at Knoxville for nineteen years, serving as department chair from 1973 to 1980. She was president of the Mathematical Association of America during 1989 and 1990.

The timing of the creation of her NSF position is linked with the large increases in funding the education directorate has received from Congress over the last few years. Part of the motivation of creating this position, Barrett says, is to figure out “how to best use the interest and fiscal support coming from Congress.” As for grumblings from the NSF research divisions over
the increases EHR has received, Barrett comments that “the research divisions and EHR are working well together, especially in mathematics . . . In the long run, this attention to education will help everyone.”

**Mathematics Staff in NSF’s Education Directorate**
The Directorate for Education and Human Resources (EHR) of the National Science Foundation sponsors a range of programs that support educational projects in mathematics, science, and engineering. Listed below are the names and telephone numbers of those EHR program officers whose field is in the mathematical sciences or mathematics education. These individuals can provide information about the programs they oversee, as well as information about other EHR programs of interest to mathematicians.

**Young Scholars Program, Division of Research Career Development**
William Geeslin, 202-357-7538

**Course and Curriculum Program, Division of Undergraduate Science, Engineering, and Mathematics Education**
James Lightbourne, 202-357-7051

**Faculty Enhancement Program, Division of Undergraduate Science, Engineering, and Mathematics Education**
William Haver, 202-357-7051

**Instructional Materials Development Program, Division of Materials Development, Research, and Informal Science Education**
Margaret Cozzens, 202-357-7066

**Teacher Enhancement Program, Division of Teacher Preparation and Enhancement**
Marjorie Enneking, 202-357-7751

**Teacher Preparation Program, Division of Teacher Preparation and Enhancement**
Miriam Leiva, 202-357-7069

The EHR administrative staff includes:
Office of the Assistant Director for EHR
Lida K. Barrett, Senior Advisor on Precollege Education, 202-357-7926

**Materials Development, Research, and Informal Science Education**
Joan Leitzel, Division Director
202-357-7073

EHR now has a substantial cadre of mathematicians on its staff. Among the incoming visiting scientists are Lida K. Barrett, Dean of the College of Arts and Sciences, Mississippi State University. She will serve in a newly created position of Senior Advisor to the Director of EHR, Luther Williams (see accompanying news item in this section of Notices).

Other incoming staff this year are Geeslin from the University of New Hampshire, Lightbourne from West Virginia University, Cozzens from Northeastern University, Enneking from Portland State University, and Leiva from the University of North Carolina-Charlotte.

The community expresses its thanks for a job well done to outgoing rotators Thomas Berger, who has returned to the University of Minnesota; John (“Spud”) Bradley, who is now associate executive director of AMS and managing editor of Notices; Joan Ferrini-Mundy, who has returned to the University of New Hampshire; Christian Hirsch, who has returned to Western Michigan University; and Glenda Lappan, who has returned to Michigan State University.

Program officers in EHR can be reached through electronic mail. To form an individual’s address, take the first initial and last name, and append @nsf.gov for Internet, or @nsf for Bitnet. For example, to contact William Geeslin on the Internet, use the address wgeeslin@nsf.gov.

The mailing address is Directorate for Education and Human Resources, National Science Foundation, 1800 G Street, NW, Washington, DC 20550.

**Open Letter on Proposal Format Changes**
What follows is an excerpt from an open letter sent to mathematical sciences departments in the U.S.

Dear Colleague:

Early in the fall of 1990 you and your institution were informed about changes in the format of NSF proposals through the National Science Foundation Important Notice 107, issued August 29, 1990. These format revisions of Important Notice 107 were fully implemented on January 1, 1991 and will be in effect for research proposals submitted for the coming fiscal year.

Processing of proposals and continuing increments will be significantly delayed if items are missing or in an inappropriate format for review. Two distinct components were implemented on January 1, 1991:

1. All renewal proposals, as part of the summary of progress under prior awards, must contain a statement about the impact on education and human resource development of the NSF-supported project; all progress reports on continuing awards must contain a similar statement;

2. For all proposals, the format for the biographical sketch that accompanies the proposal has been revised.

The expectations of the Division of Mathematical Sciences with respect to these changes were outlined in the Dear Colleague letter of December 1990. To assist principal investigators in their proposal preparation, this letter encloses an abbreviated Checklist for the Preparation of Disciplinary Research Proposals for submission to the Division of Mathematical Sciences. All principal investigators should examine Grants for Research and Education in Science and Engineering, An Applications Guide (NSF90-77, August 1990) for greater detail on proposal preparation.

Sincerely,

Judith S. Sunley, Director
Division of Mathematical Sciences
August 1991

The Checklist to which this letter refers was sent to all mathematical sciences departments in the U.S. Copies of the Checklist are also available upon request from the Division of Mathematical Sciences, Room 339, National Science Foundation, 1800 G Street, NW, Washington, DC 20550.

Those intending to send proposals to DMS should be aware that the changes in proposal format are quite
substantive. In particular, the 1991 changes require that:

- proposers provide a list of suggested reviewers (and preferred non-reviewers) for the proposal (otherwise, the principal investigators will be asked for such information when the proposal is received);
- those submitting renewal proposals include an education and human resource impact statement and a list of graduate students involved in the project;
- proposers limit publication lists to the five publications most relevant to the research proposed and up to five additional publications; no other publication lists should be included in the proposal. With regard to other biographical information, faculty-level investigators must list their own graduate and postdoctoral advisors, their co-authors over the past forty-eight months and long-time collaborators, and anyone who might benefit if the proposal leads to an award.

Proposals that do not meet the format guidelines will be returned as unacceptable. To avoid unnecessary delays, proposers are urged to carefully follow the new guidelines.

**News from the Geometry Center**

**University of Minnesota**

This is the first year of the National Science and Technology Research Center for Computation and Visualization of Geometric Structures. It is funded at the rate of about $2 million per year by the National Science Foundation, Department of Energy, Minnesota Technology, Inc., and the University of Minnesota. The Center will support mathematics and computer science research, mathematics education and communication, and software development in support of research and education. The principal investigators/permanent faculty of the Center are: Fred Almgren (Princeton), Jim Cannon (Brigham Young), Bernard Chazelle (Princeton), John Conway (Princeton), David Dobkin (Princeton), Adrien Douady (Orsay), David Epstein (Warwick), Michael Freedman (UCSD), Pat Hanrahan (Princeton), John Hubbard (Cornell), Harvey Keynes (Minnesota), Benoit Mandelbrot (IBM and Yale), Albert Marden (Minnesota), John Milnor (Stony Brook), David Mumford (Harvard), Charles Peskin (Courant), Jean Taylor (Rutgers), William Thurston (Berkeley), Allan Wilks (AT&T Bell Labs). Albert Marden is Director, William Thurston is Codirector, Richard McGehee is Science Advisor, and Harvey Keynes is Education Director. Full time technical staff are Scott Bertilson, Charlie Gunn, Silvio Levy, Stuart Levy, Tamara Munzner, and Mark Phillips.

The visitor program in research will involve theoretical and practical issues related to computation and visualization. Mathematicians or computer scientists interested in organizing small working “teams” to consider particular problems concerning the organization, implementation, or development of algorithms and software (including related theory) in mathematics or computer science are invited to apply for funding.

The Center also supports curriculum development (including courseware). Small “teams” focused on particular projects in education are invited to apply for funding as well.

Elsewhere in this issue please find the advertisement for the Center listing available positions.

For the current year, the following two special programs are being organized. For information about participation, please contact the organizer. **Computational Crystal Growers Workshop**, February 24-29, 1992. The organizer is Jean Taylor, Rutgers University, taylor@geom.umn.edu. Computational models are playing a central role in the analysis of crystal growth, whether the approach is from mathematics, materials science, or physics. Indeed, computational methods have led to theoretical advances and vice versa. The intent of this workshop is to get together many of the people, from each of the three disciplines, that are actively working on various computational models for various types of crystal growth, and thereby to facilitate the exchange of ideas, algorithms, and results.

It is planned that there be no scheduled talks, apart from an initial introductory round of five-minute talks the first day. Rather, the large number of Geometry Center desks, workstations (NeXTs, Sun Sparcs, Irises and two MacIIs), small and large conference rooms, whiteboards, and video equipment plus the open layout of the Center will be used to promote one-on-one and small group interactions. We hope that participants will be able to demonstrate their programs in action, either on the workstations or on videotape, and to discuss issues of modeling, programming, etc.

**Visualization of Invariant Sets for Symplectic Maps in Dimension 4**, March 9-20, 1992. The organizer is Richard McGehee, University of Minnesota, mcgehee@geom.umn.edu. Most questions about the dynamics of symplectic maps in dimension 4 remain unanswered. Even the basic problem of determining the stability of an elliptic fixed point is unresolved, a problem which is rooted in the classic question of the stability of the solar system. This workshop will bring together researchers interested in exploring these questions through computer simulation and visualization. Talks will be limited to two hours per day; most of the time will be devoted to informal discussions centered around computer simulations of symplectic maps.

Topics will include: (1) The breakdown of invariant two-dimensional tori. (2) The computation of Arnold’s “whiskered tori”, which, in this case, are invariant circles. (3) The computation of stable and unstable manifolds for hyperbolic periodic orbits and for hyperbolic invariant circles. Committed participants include Michael Herman and Jürgen Moser.

The Geometry Center has a good collection of graphics workstations running locally developed visualization software. There is an ongoing development of software specific to the visualization of invariant two-dimensional manifolds in $R^4$. It is expected that this project will stimulate and be stimulated by the participants of the workshop.
News from the
Institute for Mathematics
and Its Applications
University of Minnesota
The 1991-1992 academic year program at the IMA is Applied Linear Algebra. The Coordinators for this program are R.A. Brualdi, G. Cybenko, A. George, G. Golub, M.B. Luskin and P. Van Dooren. The Advisory Committee is A. Bjorck, T. Kailath, V. Klee, J. McKenna, and R. Ward. Fall quarter activities, presently underway, are concentrating on Discrete Matrix Analysis with emphasis on the mathematical analysis of sparse matrices and combinatorial structure.

The winter quarter Applied Linear Algebra program will concentrate on Matrix Computations with special emphasis on iterative methods for solving systems of linear equations and computing the eigenvalues of sparse, possibly structured matrices.

During January 13-17 there will be a Workshop Linear Algebra, Markov Chains, and Queueing Models organized by John McKenna, Robert J. Plemmons and G. W. Stewart. Markov chains and queueing models are playing an increasing role in the understanding of complex systems such as computer, communication, and transportation systems. Three areas are important in the construction and numerical solution of these problems: linear algebra, Markov chains, and queueing network models. The object of this workshop is to bring together experts from these three areas to share their different points of view of the subject.

The workshop Iterative Methods for Sparse and Structured Problems organized by Gene Golub, Anne Greenbaum, and Mitchell Luskin, will be held February 24-March 1. Large systems of matrix equations arise frequently in applications and they have the property that they are sparse and/or structured. Important applications await techniques for solving large nonsymmetric systems of linear equations and eigenvalue problems. The purpose of this workshop is to bring together researchers in numerical analysis and various application areas to discuss where such problems arise and possible methods of solution. Methods that are particularly efficient on modern computer architectures will be emphasized. The meeting is sponsored jointly with the Minnesota Supercomputer Institute. The last day of the workshop will be a celebration dedicated to Gene Golub on the occasion of his sixtieth birthday. This activity is being arranged by Jack Dongarra and Paul van Dooren.

The IMA 1992 summer program will be Environmental Studies: Mathematical, Computational and Statistical Analysis, July 6-31. The Organizing Committee is Mary Wheeler (Chair), Julius Chang, Michael Gil, David McTigue, John Seinfeld and Paul Switzer. More details concerning the Environmental Studies program and the rest of the Applied Linear Algebra program will appear in future issues of Notices.

Important sources for IMA academic and summer programs are program proposals and ideas for proposals submitted by members of the research community. If you are interested in submitting a proposal for a future IMA program please contact the Director, Avner Friedman.

For more information about IMA activities, see the Meetings and Conferences section of this issue or contact the IMA at the University of Minnesota, 514 Vincent Hall, S.E., Minneapolis, MN 55455-0436; 612-624-6066; or ima_staff@ima.umn.edu.

Call for Nominations for d'Alembert Prize
Every two years, the Société Mathématique de France awards the Prix d’Alembert for a popularization of mathematics aimed at the general public. The prize may be for an article, book, television or radio broadcast, film, or other project that promotes increased understanding of mathematics and recent mathematical developments.

Only French-language works are eligible for the prize. Nominations may be made by the candidates themselves or by others and must be received by December 31, 1991. The prize of 15,000FF will be awarded in May 1992.

For more information, contact: SMF (Prix d’Alembert), ENS, Tour L, 1 rue Maurice Arnoux, 92120 Montrouge; telephone (1)40-84-80-54.

New Upgrades in \TeX Software from AMS
The AMS has made available new versions of three software products that utilize the \TeX typesetting language. \texttt{ams\-\TeX}, \texttt{ams\-\LaTeX}, and AMSFonts have all been upgraded to incorporate several enhancements.

\texttt{ams\-\LaTeX} 2.1 The \texttt{ams\-\LaTeX} macro package provides advanced mathematics typesetting capabilities, as well as easy access to an extended set of math fonts (see AMSFonts below) which are not typically available with normal \TeX installations. Version 2.1 fixes bugs reported in version 2.0, and adds a new file, \texttt{amsplt.tex}, that provides backward compatibility with documents written with \texttt{amsspt.sty} version 1.

\texttt{ams\-\LaTeX} 1.1 The \texttt{ams\-\LaTeX} macro package provides advanced mathematics typesetting capabilities to users familiar with the \LaTeX environment, as well as easy access to the AMSFonts. Also provided are two documentstyles (\texttt{amsart} and \texttt{amsbook}), which are based on the standard \LaTeX article and book styles, but with AMS specifications. Version 1.1 fixes bugs reported in version 1.0.

**AMSFonts 2.1** The AMSFonts font set is a collection of fonts suitable for use with \TeX and any output device. Fonts provided include Cyrillic, Euler (including German (Fraktur)), extra math symbols, and additional point sizes of some Computer Modern math fonts. Version 2.1 has several enhancements. One of these is an improvement in the bold Euler fonts that makes them darker and more extended and therefore more easily distinguishable from the regular, non-bold fonts. Version 2.1 also fixes many bugs reported in version 2.0, and, because of the nature of these bug fixes, users are strongly encouraged to upgrade to version 2.1.

There are two ways to obtain the new versions of these software products. For many users, the easiest way is by anonymous FTP from the Society’s Internet node e-MATH.ams.com...
In addition to the three software packages, Metafont sources for all AMSFonts and guidelines for preparing electronic manuscripts in \TeX{} and in \LaTeX{} are also on e-MATH. For assistance on how to transfer files from e-MATH using FTP, see your local support personnel or send electronic mail to support@e-math.ams.com.

For those who do not have FTP access, the software can be obtained on Macintosh or IBM high-density 5.25 inch diskettes (special orders for 3.5 inch or low-density diskettes will also be accepted). The Metafont sources are also available on diskette. The prices for the software on diskettes have been substantially reduced: \TeX{}, \LaTeX{}, and Metafont sources now have a list price of $15 and a member price of $13; AMSFonts is $25 list, $22 for members. In addition, until April 1, 1992, present users of \TeX{}, \LaTeX{}, and AMSFonts can obtain free upgrades on diskette; there is a shipping and handling charge of $8 per request. For more information, contact Customer Services, American Mathematical Society, P.O. Box 6248, Providence, RI 02940-6248; or call toll-free 1-800-321-4AMS (321-4267).

What Do You Know About China's Contribution to Probability Theory?

Probability Theory and its Applications in China, edited by Yan Shi-Jian, Yang Chung-Chun, and Wang Jia-Gang, offers you the answer. With Probability Theory and its Applications in China, a new 1991 title in the series Contemporary Mathematics, you will benefit with the latest news on these 18 topics:

1. stochastic analysis
2. stochastic differential equations
3. Dirichlet forms
4. Brownian motion and diffusion
5. potential theory
6. geometry of manifolds
7. semi-martingales
8. jump Markov processes
9. interacting particle systems
10. entropy production of Markov processes
11. renewal sequences and p-functions
12. multi-parameter stochastic processes
13. stationary random fields
14. limit theorems
15. strong approximations
16. large deviations
17. stochastic control systems
18. probability problems in information theory

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1. Call 800 321-4267 in the continental United States and Canada (VISA and MasterCard).
2. Write: American Mathematical Society, Post Office Box 1571, Annex Station, Providence, Rhode Island 02901-1571

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AMERICAN MATHEMATICAL SOCIETY
Funding Information
for the Mathematical Sciences

**NSF Revamps PYI Program**

The National Science Foundation (NSF) has established two new programs for young researchers: NSF Young Investigators (NYI) and Presidential Faculty Fellows (PFF). Together, these two activities replace the Presidential Young Investigator Program (PYI) that operated from 1984 to 1991.

NYI and PFF will operate independently, will have separate submission deadlines, and will require separate nominations. The PFF awards will be made first, and successful nominees who have also been nominated for the NYI competition will have their nominations administratively withdrawn from the latter.

(At the time of this writing, the program announcements for the NYI and PFF programs were not in final form. Those interested in these programs are urged to consult the Federal Register or obtain a program announcement from the address listed below.)

**NSF Young Investigators.** The NYI awards are intended to recognize outstanding young faculty in science and engineering, to enhance the academic careers of recent doctorates by providing flexible support for research and teaching, and to foster contact and cooperation between academia and industry. Approximately 150 new NYI awards will be made in this year's competition. Because these awards are intended to develop teaching as well as research, NYI awardees are expected to maintain standard teaching responsibilities.

Only department chairs or analogous administrative officials may nominate faculty members for the NYI awards. Each award will be for up to five years and will consist of an annual base grant of $25,000 from NSF plus up to $37,500 of additional funds per year on a dollar-for-dollar matching basis from industrial and not-for-profit sources, resulting in total annual support of up to $100,000.

**Presidential Faculty Fellows.** These awards will recognize and support the scholarly activities of outstanding young science and engineering faculty members. The Fellows will use the awards to undertake self-designed, innovative research and teaching projects, to establish research and teaching programs, and to pursue other activities appropriate for outstanding faculty.

The awards will carry a grant from NSF of $100,000 per year for five years, subject to availability of funds. Thirty awards are planned, of which fifteen will be in engineering and fifteen in science. Nominations must be submitted by the president or chief academic officer of the nominating institution.

For further information, contact Mary F. Sladek, Program Manager, PFF/NYI Programs, National Science Foundation, 1800 G Street, NW, Washington, DC 20550; telephone 202-357-7536. Email requests for the program announcement may be sent to pubs@nsf.gov (Internet) or pubs@nsf (Bitnet); request publication NSF91-112 for the NYI announcement and NSF91-103 for the PFF announcement. It will be mailed out within two days of the receipt of the request.
1992 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 two years is to be filled in the election of 1992. 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 new members will be elected in a preferential ballot. The President will name at least four candidates for these three places, among whom may be candidates nominated by petition in the manner described in the rules and procedures.

The candidate's assent and petitions bearing at least 100 valid signatures are required for a name to be placed on the ballot. In addition, several other rules and operational considerations, described below, should be followed.

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 1992.

2. The name of the candidate must be given as it appears in the Combined Membership List. If the name does not appear in the list, as in the case of a new member or by error, it must be as it appears in the mailing lists, for example on the mailing label of the Notices. If the name does not identify the candidate uniquely, append the member code, which may be obtained from the candidate's mailing label or the Providence office.

3. The petition for a single candidate may consist of several sheets each bearing the statement of the petition, including the name of the position, and signatures. The name of the candidate must be exactly the same on all sheets.

4. On the next page is a sample form for petitions. Copies may be obtained from the Secretary; however, petitioners may make and use photocopies or reasonable facsimiles.

5. A signature is valid when it is clearly that of the member whose name and address is given in the left-hand column.

6. The signature may be in the style chosen by the signer. However, the printed name and address will be checked against the Combined Membership List and the mailing lists. No attempt will be made to match variants of names with the form of name in the CML. A name neither in the CML nor on the mailing lists is not that of a member. (Example: The name Robert M. Fossum is that of a member. The name R. Fossum appears not to be.)

7. When a petition meeting these various requirements appears, the Secretary will ask the candidate whether he is willing to have his name on the ballot. Petitioners can facilitate the procedure by accompanying the petitions with a signed statement from the candidate giving his consent.
NOMINATION PETITION FOR 1992 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
CALL FOR SUGGESTIONS

There will be a number of contested seats in the 1992 AMS elections. Your suggestions are wanted by

THE NOMINATING COMMITTEE
for vice-president, trustee, and five members-at-large of the council
and by

THE PRESIDENT
for three Nominating Committee members and two Editorial Boards Committee members

In Addition

THE EDITORIAL BOARDS COMMITTEE
requests suggestions for appointments to various editorial boards of Society publications.

Send your suggestions for any of the above to:

Robert M. Fossum, Secretary
American Mathematical Society
Department of Mathematics
University of Illinois
1409 West Green Street
Urbana, IL 61801
Please refer to the Preliminary Announcement for this meeting which begins on page 951 of the October 1991 issue of 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.

**AMS Invited Addresses**
The first two Colloquium Lectures by Robert P. Langlands are titled AUTOMORPHIC FORMS AND HASSE-WEIL ZETA-FUNCTIONS, and the third lecture is titled FINITE MODELS FOR PERCOLATION.

The title of William Browder’s Retiring Presidential Address is IN SEARCH OF SYMMETRY.

By invitation of the AMS Program Committee for National Meetings there will be an additional invited address by I. Gelfand, Rutgers University.

**Other AMS Sessions**
Committee on Education Panel: In the last few years there has been a growing awareness that serious effort is needed from the mathematics community in seeking solutions to the crisis in mathematics education which confronts the nation. What role should the AMS play in these efforts?

There are many choices, depending on the view one takes of the proper mix of the Society’s activities between its various missions, e.g., serving research; education; and public information. There are also many challenges in creating lasting partnerships with different players in the mathematics enterprise, and to bring these partnerships to bear on creative solutions that will benefit the nation’s youth. The panel discussion will center around a discussion of these issues, with adequate time for questions from the audience. It is hoped that an active dialogue will result.

**Other AMS Events**
There will be a reception in honor of reviewers (past and present) for Mathematical Reviews (MR) on Friday, January 10, 6:00 p.m. to 7:00 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 MR editorial staff will be present to discuss MR’s editorial policies and other items of interest (and amusement) to reviewers and users of MR. Refreshments will be provided.

**MAA Invited Addresses**
The Invited Address by David H. Carlson is titled Teaching LINEAR ALGEBRA; MUST THE FOG ALWAYS ROLL IN?

The Invited Address by James W. Demmel is titled Linear algebra, geometry, and supercomputing.

**MAA Minicourses**
The times for Minicourse #7, Using NETPAD software to teach and learn about graphs, have been changed. Part A has been moved from Thursday morning to Thursday evening, 7:00 p.m. to 9:00 p.m., and Part B from Saturday morning to Saturday afternoon, 1:00 p.m. to 3:00 p.m.

**Other MAA Sessions**
The Student Workshop on Environmental mathematics is being organized by B. A. Fusaro, Salisbury State University.

**Other MAA Events**
The Reception for Elementary School Teachers has been cancelled.
Meetings

The display of John von Neumann memorabilia and photographs from the Vonneuman family has been canceled.

AMS-MAA Events
Social for First-time Attendees: The correct spelling of the name of the Chairman of the MAA Committee on Membership is Susan Forman.

Activities of Other Organizations
The Association for Women in Mathematics Emmy Noether Lecture given by Nancy Kopell is titled Oscillators and networks of them: which differences make a difference?.

The AWM panel discussion on graduate education will be moderated by Carol Wood, Wesleyan University.

The Board on Mathematical Sciences' panel discussion, Educating mathematicians, is now cosponsored by the AMS. It has been moved from Wednesday morning to Friday afternoon, 2:00 p.m. to 3:30 p.m.

The National Association of Mathematicians' session on Presentations by recent doctoral recipients has been moved from Friday morning to Saturday afternoon, 1:00 p.m. to 3:00 p.m.

The NAM panel discussion on Friday morning, The fate of minority mathematics students, is now cosponsored by MAA.

Social Events
Ramesh A. Gangolli, University of Washington, Seattle, will be the featured speaker at the Banquet to Honor 25-year Members of the AMS on Saturday evening. The title of his talk is Mathematics education: challenge or temptation?; The AMS in the garden of delights.

The menu for the NAM luncheon on Friday includes soup du jour, grilled flank steak with sherry sauce, potato, vegetable, rolls and butter, and double chocolate mousse. Tickets are $22 each; the price includes tax and gratuity.

Joint Meeting with the London Mathematical Society

Preliminary information
Cambridge, England, June 29–July 1, 1992

The two Societies are very gratified by the interest that has been shown in the Joint Meetings to be held in Cambridge, England, from Monday, June 29, to Wednesday, July 1, 1992. It seems possible that more people will wish to attend the meeting than had been originally expected. Whilst this is welcomed, it might cause problems in Cambridge both with housing and with lecture room accommodation. The first announcement of the meeting, with details of the scientific program, will appear in the January 1992 Notices. It will specify preregistration by 1 May 1, 1992. All participants must preregister in advance of the meeting. Intending participants are urged to preregister at the earliest opportunity. If the number of preregistrations approaches the greatest number that the Local Organizing Committee feels can be accommodated in Cambridge, then the two Societies might have to consider closing preregistration.
1992 Summer Seminar in Applied Mathematics

Exploiting Symmetry in Applied and Numerical Analysis
Colorado State University, July 26 – August 1

The twenty-second AMS-SIAM Summer Seminar in Applied Mathematics will be held July 26 – August 1, 1992, at Colorado State University, Fort Collins, Colorado. The seminar will be sponsored by the American Mathematical Society, the Society for Industrial and Applied Mathematics and the Department of Mathematics at Colorado State University. It is anticipated that it will be supported by grants from federal agencies. The proceedings of the seminar will be published by the American Mathematical Society in the Lectures in Applied Mathematics series.

The aim of the conference is to provide a wide-ranging survey of the exploitation of symmetry in applied and numerical analysis. The seminar will have both an entry level summer school component intended for young researchers and a frontier level research aspect. A number of the anticipated participants will be experts from foreign countries.

A purpose of the seminar is to stimulate interaction between aspects of Applied Mathematics (e.g., PDE's, integral equations, bifurcation), Numerical Mathematics (e.g., numerical linear algebra, boundary and finite element methods), Pure Mathematics (e.g., representation theory of groups), and Classical Physics (e.g., Taylor and Bénard problems).

The Organizing Committee consists of Martin Golubitsky, University of Houston; Klaus W. Kirchgässner, University of Stuttgart, Germany; Peter J. Olver, University of Minnesota; and the local organizers Eugene L. Allgower (Co-chairman), Kurt Georg (Co-chairman), and Rick Miranda (Co-chairman), Colorado State University.

Those interested in attending the Seminar should send the following information to Donna Salter, Conference Coordinator, American Mathematical Society, P.O. Box 6887, Providence, R.I. 02940, email: DLS@MATH.AMS.COM, before May 6, 1992. Please type or print the following:

1. Full name;
2. Mailing address;
3. Telephone number and area code for office and home;
4. Email address if available;
5. Anticipated arrival and departure dates;
6. Your scientific background relevant to the topic of the seminar;
7. Financial assistance requested (please estimate cost of travel), indicate if support is not required, and if interested in attending even if support is not offered.

Participants who wish to apply for a grant-in-aid should so indicate; however, funds available for the seminar are very limited and individuals who can obtain support from other sources should do so. Graduate students who have completed at least one year of graduate school are encouraged to participate.

QUANTUM LINEAR GROUPS

Brian J. Parshall and Jian-pan Wang • Memoirs of the AMS, Volume 439

This volume begins with a general discussion of the theory of quantum groups. The authors view the theory as a natural extension of the theory of affine group schemes. They establish a number of foundational results, including the theory of induced representations and spectral sequences for quantum group cohomology. They then apply these results to give a detailed study of the quantum general linear group and its representation theory. Some of the central topics included are a development of quantum determinants, Frobenius kernels and their representation theory, high weight theory, and the generalization of various important theorems concerning the cohomology of vector bundles on the flag manifold. Finally, the authors use the theory to give a treatment of q-Schur algebras, proving, for example, that q-Schur algebras are quasi-hereditary.

1980 Mathematics Subject Classifications: 20, 14
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NOVEMBER 1991, VOLUME 38, NUMBER 9 1155
Joint Summer Research Conferences in the Mathematical Sciences

Mount Holyoke College, South Hadley, Massachusetts, June 13 to July 24, 1992

The 1992 Joint Summer Research Conferences in the Mathematical Sciences will be held at Mount Holyoke College, South Hadley, Massachusetts, from June 13 to July 24. It is anticipated that the series of conferences will be supported by grants from the National Science Foundation and other agencies.

There will be nine conferences in nine different areas of mathematics. The topics and organizers for the conferences were selected by the AMS, 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 use 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 nominal registration and social fees.

Those interested in attending one of the conferences should send the following information to the Summer Research Conference Coordinator, Meetings Department, American Mathematical Society, Post Office Box 6887, Providence, RI 02940 or by email: CAK@MATH.AMS.COM on the 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, home and electronic-mail 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 2, 1992. Requests to attend will be forwarded to the Organizing Committee for each conference for consideration after the deadline of March 2. All applicants will receive a formal invitation, Brochure of Information, notification of financial assistance, and a tentative scientific program (if the Chairman has prepared one in advance; otherwise programs will be distributed at registration) from the AMS by April 15. 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 Chairman 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 members of minority groups 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 1992 conferences: John A. Burns, Fan R. K. Chung, Leonard Evens, Martin Golubitsky, Anthony W. Knapp, Peter W. K. Li, Emanuel Parzen, Stewart B. Priddy, 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.
Many-particle Hamiltonians: Spectra and Scattering

edited by R. A. Minlos

This collection of papers deals with several different topics related to the construction and spectral analysis of Hamiltonians of various systems arising in mathematical physics. You will benefit from these topics:

- Disposition and character of resonances for certain operators
- Perturbation of Hamiltonians in fermion systems
- Construction of the Hamiltonian for three different pointwise interacting quantum particles
- Lower branches of the Hamiltonian of the lattice model for chromodynamics
- Problems related to the spectrum of finite-particle lattice Hamiltonians.


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Joint Summer Research Conferences

Saturday, June 13 to Friday, June 19
Conformal field theory, topological field theory, and quantum groups
Moshe Flato (University de Dijon), Co-Chair
James Lepowsky (Rutgers University), Co-Chair
Paul Sally (University of Chicago), Co-Chair

Saturday, July 4 to Friday, July 10
Commutative algebra: Syzygies, multiplicities and birational algebra
William Heinzer (Purdue University), Co-Chair
Craig Huneke (Purdue University), Co-Chair
Judith D. Sally (Northwestern University), Co-Chair

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Many-particle Hamiltonians: Spectra and Scattering

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- Lower branches of the Hamiltonian of the lattice model for chromodynamics
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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.

Baltimore, MD, January 1992
Please refer to the first announcement beginning on page 951 in the October Notices, as well as updated information on this meeting elsewhere in this issue.

Springfield, MO, March 1992
Alexander Eremenko Peter J. Olver Julia Knight Ernst A. Ruh

Tuscaloosa, AL, March 1992
Jane M. Hawkins Serge Ochanine Charles A. Micchelli Peter M. Winkler

Bethlehem, PA, April 1992
Jean-Luc Brylinski Edward Y. Miller Ingrid Daubechies Douglas C. Ravenel

Cambridge, England, June 1992
John M. Ball pulling Hitchin
Lawrence Craig Evans Edward Witten Benedict H. Gross

Dayton, OH, October 1992
Martin Golubitsky Louis H. Kauffman Jonathan I. Hall J. T. Stafford

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.

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 Notices went to the printer. The section below entitled Information for Organizers describes the timetable for announcing the existence of Special Sessions.

January 1992 Meeting in Baltimore, Maryland
Associate Secretary: Lance W. Small
Deadline for organizers: Expired
Deadline for consideration: Expired

Please refer to the first announcement beginning on page 951 in the October Notices, as well as updated information elsewhere in this issue.

March 1992 Meeting in Tuscaloosa, Alabama
Southeastern Section
Associate Secretary: Joseph A. Cima
Deadline for organizers: Expired
Deadline for consideration: December 12, 1991

Richard C. Brown, Spectral theory of ordinary and partial differential operators
Jon M. Corson, Martyn Russell Dixon, Martin J. Evans and Frank Roehl, Infinite groups and group rings
Dwight A. Duflou and Peter M. Winkler, Combinatorial problems on partially ordered sets
Jane M. Hawkins, Karma Kajani, Karl Petersen and Mate Wierdl, Theory and dynamical systems
Vo Thanh Liem and Bruce S. Trace, Geometric topology
Kai-Ching Lin, Harmonic analysis and related topics
Charles A. Micchelli and R. A. Zalik, Approximation theory: modern methods

March 1992 Meeting in Springfield, Missouri
Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: Expired
Deadline for consideration: December 12, 1991

Nakhle Habib Asmar and Stephen John Montgomery-Smith, Harmonic analysis
Margaret M. Bayer, Combinatorics and discrete geometry
Wenxiang Chen and Shou Chuan Hu, Partial differential equations
Invited Addresses and Special Sessions

William J. Heinzer, Craig Hunecke and Kishor M. Shah, \textit{Commutative algebra}
Luis Hernandez and Ernst A. Ruh, \textit{The geometry of connections}
Jerry A. Johnson and Benny D. Evans, \textit{Microcomputers in the upper division and graduate curriculum}
Niky Kamran and Peter J. Olver, \textit{Lie algebras, cohomology, and new applications to quantum mechanics}
Ellen Maycock Parker, \textit{C*-algebras and algebraic topology}
Boris M. Schein, \textit{Semigroups}
Vera B. Stanojevic, \textit{Fourier analysis}
Xingping Sun and Xiang Min Yu, \textit{Approximation theory}
David Wright, \textit{Automorphisms of affines spaces}

\textbf{April 1992 Meeting in Bethlehem, Pennsylvania}
\textit{Eastern Section}
Associate Secretary: W. Wistar Comfort
Deadline for organizers: Expired
Deadline for consideration: January 2, 1992
Edward F. Assmus, Jr. and Jennifer D. Key, \textit{Finite geometry}
Grahame Bennett, Jeffrey S. Connor and Andrew K. Snyder, \textit{Sequence spaces}
Jean-Luc Brylinski and Dennis A. McLaughlin, \textit{Characteristic classes, algebraic K-theory and field theory}
Donald M. Davis and Douglas C. Ravenel, \textit{Homotopy theory}
David L. Johnson and Penny D. Smith, \textit{Geometric analysis}
Xiao-Song Lin, Tavan T. Trent, James Li-Ming Wang and Zhijian Wu, \textit{New invariants of links and 3-manifolds}
Lee J. Stanley, \textit{Set theory}
Joseph E. Yukich, \textit{Stochastic processes}

\textbf{June 1992 Meeting in Cambridge, England}
(Joint Meeting with the London Mathematical Society)
Associate Secretary: Robert M. Fossum
Deadline for organizers: Expired
Deadline for consideration: February 7, 1992
Béla Bollobás and Ronald L. Graham, \textit{Probabilistic combinatorics}
John Coates, \textit{Number theory}
Richard D. James, \textit{The microstructure of crystals}
W. B. Raymond Lickorish, \textit{Geometric topology in low dimensions}
William M. Kantor and Jan Saxl, \textit{To be announced}

\textbf{October 1992 Meeting in Dayton, Ohio}
\textit{Central Section}
Associate Secretary: Andy R. Magid
Deadline for organizers: January 30, 1992
Deadline for consideration: July 13, 1992
Joanne M. Dombrowski and Richard Mercer, \textit{Operator theory and operator algebras}
Anthony B. Evans and Terry A. McKee, \textit{Combinatorics and graph theory}
Louis H. Kauffman, \textit{Knots and topological quantum field theory}

\textbf{January 1993 Meeting in San Antonio, Texas}
Associate Secretary: W. Wistar Comfort
Deadline for organizers: April 13, 1992
Deadline for consideration: September 17, 1992

\textbf{March 1993 Meeting in Knoxville, Tennessee}
\textit{Southeastern Section}
Associate Secretary: Joseph A. Cima
Deadline for consideration: To be announced

\textbf{April 1993 Meeting in Salt Lake City, Utah}
\textit{Western Section}
Associate Secretary: Lance W. Small
Deadline for consideration: To be announced

\textbf{May 1993 Meeting in DeKalb, Illinois}
\textit{Central Section}
Associate Secretary: Andy R. Magid
Deadline for consideration: To be announced

\textbf{August 1993 Meeting in Vancouver, British Columbia, Canada}
Associate Secretary: Lance W. Small
Deadline for consideration: To be announced

\textbf{October 1993 Meeting in College Station, Texas}
\textit{Central Section}
Associate Secretary: Andy R. Magid
Deadline for consideration: To be announced

\textbf{January 1994 Meeting in Cincinnati, Ohio}
Associate Secretary: Joseph A. Cima
Deadline for consideration: To be announced

\textbf{March 1994 Meeting in Lexington, Kentucky}
\textit{Southeastern Section}
Associate Secretary: Joseph A. Cima
Deadline for consideration: To be announced

\textbf{March 1994 Meeting in Manhattan, Kansas}
\textit{Central Section}
Associate Secretary: Andy R. Magid
Deadline for consideration: To be announced

\textbf{January 1995 Meeting in Denver, Colorado}
Associate Secretary: Andy R. Magid
Deadline for consideration: To be announced

\textbf{March 1995 Meeting in Chicago, Illinois}
\textit{Central Section}
Associate Secretary: Andy R. Magid
Deadline for consideration: To be announced

\textbf{January 1996 Meeting in Orlando, Florida}
Associate Secretary: Lance W. Small
Deadline for consideration: To be announced

\textbf{Information for Organizers}
Special Sessions at Annual and Summer Meetings are held under the supervision of the Program Committee for National Meetings are held
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 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 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 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 92033
  - Electronic mail: g_small@math.ams.com
  - (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.com
  - (Telephone 405-325-6711)

- **Eastern Section**
  - W. Wistar Comfort, Associate Secretary
  - Department of Mathematics
  - Wesleyan University
  - Middletown, CT 06457
  - Electronic mail: g_comfort@math.ams.com
  - (Telephone 203-347-9411)

- **Southeastern Section**
  - Joseph A. Cima, Associate Secretary
  - Department of Mathematics
  - University of North Carolina, Chapel Hill
  - Chapel Hill, NC 27599-3002
  - Electronic mail: g_cima@math.ams.com
  - (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 June 29-July 1, 1992, meeting in Cambridge, England, only, should be sent to Professor Fossum at the Department of Mathematics, University of Illinois, Urbana, IL 61801, Telephone: 217-244-1741, Electronic mail: rmf@math.ams.com

**Information for Speakers**

A great many of the papers presented in Special Sessions at meetings of the Society are invited papers, but any member of the Society who wishes to do so may submit an abstract for consideration for presentation in a Special Session, provided it is received in Providence prior to the special early deadline announced above and in the announcements of the meeting at which the Special Session has been scheduled. Contributors should know that there is a limitation in size of a single Special Session, so that it is sometimes true that all places are filled by invitation. Papers not accepted for a Special Session are considered as ten-minute contributed papers.

Abstracts of papers submitted for consideration for presentation at a Special Session must be received by the Providence office (Meetings Department, American Mathematical Society, P. O. Box 6887, Providence, RI 02940) by the special deadline for Special Sessions, which is usually three weeks earlier than the deadline for contributed papers for the same meeting. The Council has decreed that no paper, whether invited or contributed, may be listed in the
Invited Addresses and Special Sessions

program of a meeting of the Society unless an abstract of the paper has been received in Providence prior to the deadline.

Electronic submission of abstracts is available to those who use the \TeX\ typesetting system. Requests to obtain the package of files may be sent electronically via the Internet to abs-request@math.ams.com. Requesting the files electronically will likely 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, Publications Division, P.O. Box 6248, Providence, RI 02940, USA. When requesting the abstracts package, users should be sure to specify whether they want the plain \TeX, \AMSTeX, 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.

Selfadjoint and Nonselfadjoint Operator Algebras and Operator Theory

Robert S. Doran, Editor

This book contains papers presented at the NSF/CBMS Regional Conference on Coordinates in Operator Algebras, held at Texas Christian University in Fort Worth in May 1990. During the conference, in addition to a series of ten lectures by Paul S. Muhly (which will be published in a CBMS Regional Conference Series volume), there were twenty-eight lectures delivered by conference participants on a broad range of topics of current interest in operator algebras and operator theory. This volume contains slightly expanded versions of most of those lectures. Participants were encouraged to bring open problems to the conference, and, as a result, there are over one hundred problems and questions scattered throughout this volume. Readers will appreciate this book for the overview it provides of current topics and methods of operator algebras and operator theory.

1991 Mathematics Subject Classification: 22, 46, 47; 05, 06, 18, 20, 57
ISBN 0-8218-5127-6, LC 91-19767, ISSN 0271-4132; 215 pages (softcover), July 1991
Individual member $29, List price $49, Institutional member $39
To order please specify CONM/120NA

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 continental U.S. and Canada to charge with Visa or MasterCard. Please add 7% GST to all orders being shipped to Canada.
Winter Meeting of the
Canadian Mathematical Society
December 7–10, 1991
Tentative Program

The Canadian Mathematical Society (CMS) and the University of Victoria cordially invite all mathematicians to the 1991 Winter Meeting of the Society. All events will take place at the Victoria Convention Centre/Empress Hotel complex in downtown Victoria, British Columbia.

Scientific Program

Principal Speakers
The names and affiliations of the principal speakers and the tentative days and times they will talk are as follows:
- **Andrew J. Casson**, University of California, Berkeley, Sunday, 2:00 p.m. - 3:00 p.m.;
- **Stephen Grossberg**, Boston University, Sunday, 9:00 a.m. - 10:00 a.m.;
- **Ian G. Macdonald**, Queen Mary College, Monday, 9:00 a.m. - 10:00 a.m.;
- **Benjamin Muckenhoupt**, Rutgers University, Tuesday, 2:00 p.m. - 3:00 p.m.;
- **Marc A. Rieffel**, University of California, Berkeley, Tuesday, 9:00 a.m. - 10:00 a.m.

Coxeter-James Lecture
The Coxeter-James Lecture will be given by **Kumar Murty**, University of Toronto, on Monday, December 9, at 2:00 p.m.

Symposia
Special Sessions in five domains will take place with session organizers and invited speakers as follows:

- **Applied non-linear differential equations**, Reinhard Illner and Pauline Van Den Driessche, University of Victoria, co-organizers;
- **Stavros N. Busenberg**, Harvey Mudd College; **John M. Chadam**, McMaster University; **Herbert I. Freedman**, University of Alberta; **John G. Heywood**, University of British Columbia; **Josef Hofbauer**, University of Vienna; **Charles D. Levermore**, University of Arizona; **Robert M. Miura**, University of British Columbia; **Michael Shearer**, North Carolina State University; **Marshall Slemrod**, University of Wisconsin, Madison; **Hal L. Smith**, Arizona State University; **C. Sulem**, University of Toronto;
- **Classical analysis** (in honour of P. G. Rooney's 65th birthday), **David W. Boyd**, University of British Columbia; and **Mourad E. H. Ismail**, University of South Florida, co-organizers;
- **Kenneth F. Andersen**, University of Alberta; **Richard Askey**, University of Wisconsin, Madison; **David W. Boyd**, University of British Columbia; **Charles Dunkl**, University of Virginia; **John J. F. Fournier**, University of British Columbia; **George Gasper, Jr.**, Northwestern University; **Hans P. Heintz**, McMaster University; **Mourad E. H. Ismail**, University of South Florida; **Paul G. Rooney**, University of Toronto; **Eric T. Sawyer**, McMaster University;
- **Discrete aspects of Lie theory**, **Arturo Pianzola**, University of Alberta, organizer;
- **Harmonic analysis/operator algebras**, **Anthony T. Lau**, University of Alberta, organizer;
- **Lawrence W. Baggett**, University of Colorado; **Ching Chou**, SUNY at Buffalo; **Edward G. Effros**, University of California, Los Angeles; **Brian E. Forrest**, University of Waterloo; **F. Ghahramani**, University of Manitoba; **John E. Gilbert**, University of Texas, Austin; **Colin Graham**, Lakehead University; **Edmond E. Granirer**, University of British Columbia; **Kathryn E. Hare**, University of Waterloo; **Paul Milnes**, University of Western Ontario; **Ole E. Nielsen**, Queen’s University; **Alan L. T. Paterson**, University of Mississippi; **Arlan B. Ramsay**, University of Colorado; **Keith F. Taylor**, University of Saskatchewan; **Martin E. Walter**, University of Colorado;
- **Low dimensional topology**, **Steven P. Boyer**, Université du Québec, Montréal, organizer;
- **David M. Austin**, University of British Columbia; **Steven A. Bleiler**, Portland State University; **Charles D. Frohman**, University of Iowa; **David Gabai**, California
Institute of Technology; C. M. Gordon, University of Texas, Austin; Joel Hass, University of California, Davis; David Darren Long, University of California, Santa Barbara; Erhard Luft, University of British Columbia; Andrew J. Nicas, McMaster University; D. Rolfsen, University of British Columbia; Martin G. Scharlemann, University of California, Santa Barbara; Denis Sjerve, University of British Columbia; Kevin Walker, Mathematical Sciences Research Institute; Xingru Zhang, University of British Columbia;

A session on Mathematics education has been organized by Katherine Heinrich, Simon Fraser University.

Contributed papers of 15 minutes’ duration are invited.

**Hotel Accommodations**

Rooms have been booked at the Empress Hotel at a cost of $93.50 CDN (single or twin) excluding applicable taxes. Rates are given in Canadian dollars. **Reservations should be made directly with the Empress Hotel.** Reservation cards for the Empress will be sent to you with your confirmation of registration or can be obtained from the CMS Office, 577 King Edward, Ottawa, Ontario, Canada K1N 6N5. The telephone number for the Empress is 604-384-8111.

**Miscellaneous Information**

**Social events** include a welcoming reception with cash bar at the Plaza Prefunction Area of the Convention Centre on Saturday, December 7th, beginning at 7:00 p.m., and a banquet at the Crystal Ballroom of the Empress on Monday, December 9th, beginning at 7:00 p.m.

**Air travel:** Victoria International Airport is about 25 km north of downtown Victoria and is served by both Air Canada and Canadian Airlines connector flights. Busses meet each flight and the cost of bus transportation to downtown Victoria is $10. Taxi fare for the same trip is about $40. One may also fly from Seattle to the airport via Horizon Air and from Seattle to the inner harbour of Victoria (adjacent to the Empress) via Lake Union Air Service.

**Car and/or passenger ferry travel:** There is frequent ferry service (approximately every two hours) provided by B. C. Ferries between Tsawassen, which is just south of Vancouver, and Schwartz Bay, which is just north of Victoria. Victoria may also be reached from Anacortes, Washington, via the Washington State Ferries, and from Port Angeles, Washington, via the Black Ball ferry Coho. The Victoria Clipper provides daily passenger ferry service between Seattle and Victoria. There is also bus service from Vancouver/Vancouver Airport to downtown Victoria, including the ferry trip, provided by Pacific Coach Lines.

**Weather:** Weather in Victoria in December is cool with the average high/low being 7°C/3°C, and may also be damp with an average December rainfall of 111 mm.

**Preliminary activities** will be held at the Empress Hotel/Convention Centre on December 6 and 7 as follows:

**December 6**
- 2:30 p.m. CMS Executive Meeting
  Empress Hotel Board Room

**December 7**
- 9:30 a.m. CMS Executive Meeting
  (if necessary)
  Empress Hotel Board Room
- 2:30 p.m. CMS Executive Meeting
  Empress Hotel Board Room
- 6:00 p.m. - 9:00 p.m.
  Evening Registration
  Convention Centre Plaza Prefunction Area
- 7:00 p.m.
  Convention Centre Plaza Prefunction Area

**Scientific Programme Committee**

Kee Y. Lam, University of British Columbia (Chairman);
David W. Boyd, University of British Columbia; Steven P. Boyer, Université du Québec, Montréal; Reinhard Illner, University of Victoria; Mourad E. H. Ismail, University of South Florida; Anthony Lau, University of Alberta; Pauline Van Den Driessche, University of Victoria.

Further information and registration forms may be obtained from C. R. Miers, Local Organizer, Department of Mathematics and Statistics, University of Victoria, Victoria, British Columbia, V8W 3P4; telephone 604-721-7463; FAX 604-721-8962; email: CRMIEERS@UVVM.UVIC.CA.

**Registration Fees (in Canadian dollars)**

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(The one day fee is intended for anyone who wishes to take part for only one day of the meeting. All fees except the one day fee include a ticket to the Monday night banquet.)
Mathematical Sciences
Meetings and Conferences

This section contains announcements of meetings and conferences of interest to some segment of the mathematical public, including ad hoc, local, or regional meetings, and meetings or symposia devoted to specialized topics, as well as announcements of regularly scheduled meetings of national or international mathematical organizations. (Information on meetings of the Society, and on meetings sponsored by the Society, will be found inside the front cover.)

An announcement will be published in Notices if it contains a call for papers, and specifies the place, date, subject (when applicable), and the speakers; a second full announcement will be published only if there are changes or necessary additional information. Once an announcement has appeared, the event will be briefly noted in each issue until it has been held and a reference will be given in parentheses to the month, year, and page of the issue in which the complete information appeared. Asterisks (*) mark those announcements containing new or revised information.

In general, announcements of meetings and conferences held in North America carry only date, place of meeting, names of speakers (or sometimes a general statement on the program), deadlines for abstracts or contributed papers, and source of further information. Meetings held outside the North American area may carry more detailed information. In any case, if there is any application deadline with respect to participation in the meeting, this fact should be noted. All communications on meetings and conferences in the mathematical sciences should be sent to the editor of Notices, care of the American Mathematical Society in Providence.

Deadlines for entries in this section are listed on the inside front cover of each issue. In order to allow participants to arrange their travel plans, organizers of meetings are urged to submit information for these listings early enough to allow them to appear in more than one issue of Notices prior to the meeting in question. To achieve this, listings should be received in Providence six months prior to the scheduled date of the meeting.

Effective with the 1986 volume of Notices, the complete list of Mathematical Sciences Meetings and Conferences will be published only in the September issue. In all other issues, only meetings and conferences for the twelve-month period following the month of that issue will appear. As new information is received for meetings and conferences that will occur later than the twelve-month period, it will be announced at the end of the listing in the next possible issue. That information will not be repeated until the date of the meeting or conference falls within the twelve-month period.


Chairman: R. Murty (McGill Univ.), previously incorrectly listed as J. Arthur. Invited Speakers: J. Arthur (Univ. of Toronto) will be the principle speaker (Aisenstadt Chair) during the Spring of 1992.


November 1991
1-2. Sixth Annual Pi Mu Epsilon Regional Undergraduate Mathematics Conference, St. Norbert College, DePere, WI. (Sep. 1991, p. 834)
4-8. Second SIAM Conference on Geometric Design, Tempe, AZ. (Nov. 1990, p. 1289)
9-10. Western Section, University of California, Santa Barbara.

Information: W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

11-15. IMA Workshop on Combinatorial and Graph-Theoretic Problems in Linear Algebra, University of Minnesota, Minneapolis, MN. (Oct. 1990, p. 1140)

December 1991
Fourth International Conference on Numerical Combustion, St. Petersburg, FL. (Feb. 1991, p. 146)
Meetings and Conferences

2-9. SIAM Conference on Combustion, St. Petersburg, FL. (Nov. 1990, p. 1289)
6-7. The Midwest Conference on Differential Equations, University of Iowa, Iowa City, IA. (Jul./Aug. 1991, p. 642)

PROGRAM: A second principle speaker has been added to the Holiday Symposium. J.S. Devitt of the University of Saskatchewan will join J.L. Selfridge of Florida Atlantic University in presenting the symposium.

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1992

IMACS International Conference on Computational Physics, University of Colorado, Boulder, CO. (Oct. 1990, p. 1141)

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January 1992

*3-6. Short Conference on Topology, Kansas State University, Manhattan, KS.

PROGRAM: Professor A.V. Arhangelskii of Moscow Univ. will give four-hour lectures on “The concept of cleavability of a topological space”. This is a relatively new concept that should be of interest to many topologists, especially those at the early stages of their research careers. The conference will also feature talks by other participants on a wide range of topics in topology. It has been timed to immediately proceed the Joint Mathematics Meetings of the AMS and MAA to be held in Baltimore, January 8–11, 1992.


3-7. Seventh Texas International Symposium on Approximation Theory, Austin, TX. (Sep. 1991, p. 835)
5-8. Second Caribbean Conference on the Fluid Dynamics, University of the West Indies, St. Augustine, Trinidad. (Jan. 1991, p. 51)
8-11. Joint Mathematics Meetings, Baltimore, MD. (including the annual meetings of the AMS, AWM, MAA and NAM)

INFORMATION: H. Daly, AMS, P.O. Box 6248, Providence, RI 02940.

13-17. IMA Workshop on Linear Algebra, Markov Chains, and Queuing Models, University of Minnesota, Minneapolis, MN. (Oct. 1990, p. 1141)
15-17. Workshop on Stochastics and Analysis, Universität Zürich, Zürich, Switzerland. (May/Jun. 1991, p. 475)

PROGRAM: The conference language is English. The scientific program will consist of invited and contributed talks. There will be morning and afternoon lectures of 60 minutes for invited lectures and 20 minutes for contributed papers.

ORGANIZING COMMITTEE: S. O. Fatunla (Benin-City, Nigeria), B. Russell (Burnaby, Canada), J. Pryce (Swindon, UK).
CONFERENCE TOPICS: Ordinary differential equations, partial differential equations, parallel methods, interval arithmetic, computational fluids, nonlinear dynamical systems and chaos, numerical software, seismic analysis, supercomputing, computational meteorology, computer algebra.
INVITED SPEAKERS: CANADA: J. Verner (Kingston), B. Russell (Burnaby), P. Sharp (Kingston); ENGLAND: J. Pryce (Swindon); SCOTLAND: S. McKee (Glas-
Meetings and Conferences

February 1992


* 3–7. Twenty-third Southeastern International Conference on Combinatorics, Graph Theory, and Computing, Florida Atlantic University, Boca Raton, FL.

INVITED SPEAKERS: L. Babai, Eotvos Univ. and Univ. of Chicago; P. Erdős, Hungarian Academy of Sciences; D. Gorenstein, Rutgers Univ. and DIMACS; K. O'Hara, Univ. of Iowa; and D. Stinson, Univ. of Nebraska.

CALL FOR PAPERS: There will be fifteen-minute sessions for contributed papers. Please submit the title and an abstract (10–20 lines single spaced) of a paper by January 17, 1992.

INFORMATION: F. Hoffman, Dept. of Math., Florida Atlantic Univ., Boca Raton, FL 33431; 407-367-3345 or 407-367-3341 or via email: hoffman@fauxvax.bitnet or hoffman@acc.fau.edu. For registration information, contact the Division of Continuing Education, at 407-367-3090.


March 1992


* 2–6. Workshop on Interfaces between Physics and Mathematics, University of Vienn, Austria.


INFORMATION: H. Narnhofer, Institute of Theoretical Physics, University of Vienna, Boltzmanngasse 5, A-1090 Wien, Austria.


(Jul./Aug. 1991, p. 644)


13–14. Southeastern Section, University of Alabama, Tuscaloosa, AL.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.


PROGRAM: The purpose of this conference is to bring together researchers in all fields of supercomputing, high performance computing, and parallel computing for an effective exchange of ideas and discussion of recent developments and future directions of research.

ORGANIZERS: M. Paprzycki (Univ. of Texas), F. Khorasani (Univ. of Texas), M. Melander (SMU).

INVITED SPEAKERS: Tentative: C. Bischof (ANL), I. Diaz (Univ. of Tulsa), L. Gladwell (SMU), D. Kincaid (Univ. of Texas), G. MacMachan (Univ. of Texas), R. Plemmons (Wake Forest Univ.), D. Sorensen (Rice Univ.), R. van de Geijn (Univ. of Texas).

FOR CALLS: Three copies of detailed abstract (not to exceed 1000 words) should be received by December 20, 1991.

INFORMATION: Conference Chairman, M. Paprzycki, Dept. of Math. and Comp. Sci., UT Permian Basin, Odessa, TX 79762; 915-367-2244; Fax: 915-367-2215; email: m_paprzycki@utpb.bitnet or m_paprzycki@utpb.pb.utexas.edu


20–21. Central Section, Southwest Missouri State University, Springfield, MO.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6248, Providence, RI 02940.


Meetings and Conferences


CONFERENCE TOPICS: Coding theory, quantization theory, parallel compression algorithms and hardware, lossless and lossy compression algorithms for specific types of data (including text, images, video, speech, music, maps, instrument data, graphics, animation, and bit-maps), data compression standards, bi-level coding, transform methods, wavelet and fractal techniques, string searching and manipulation, closet-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 archives.

CALL FOR PAPERS: Submit 4 copies of an extended abstract of 8 to 10 pages (please include your affiliation, address, telephone number, fax number, and email address) by November 15, 1991 to the address below.

INFORMATION: M. Cohn, Comp. Sci. Dept., Brandeis Univ., Waltham, MA 02254; 617-736-2705; FAX: 617-736-2741; email: martyr@cs.brandeis.edu.


PURPOSE: To bring together researchers and students from diverse areas with a common interest in Hamiltonian systems.

PROGRAM: There will be plenary addresses and contributed papers. The proceedings will be published in the IMA Volumes in Mathematics and its Applications.


CONFERENCE TOPICS: Recent advances in bifurcation theory, heteroclinic orbits, reduction, properties of area preserving mappings, integrable systems, stability, Nekhoroshev theory, with applications to physics and celestial mechanics will be presented at the conference.

INFORMATION: K. Meyer, Institute for Dynamics, Dept. of Math. Sci.,Univ. of Cincinnati, Cincinnati, OH 45221-0025; Fax: 513-556-3417.

27-28. Eighth South-Eastern Analysis Meeting (SEAM VIII), University of Tennessee, Knoxville, TN. (Sep. 1991, p. 836)


29-April 5. Sixth International Conference on Geometry, University of Haifa, Israel (postponed from March 1991 because of the Gulf War). (Jul./Aug. 1991, p. 644)


INFORMATION: A.H. Christier, Dept. of Math. and Comp. Sci., Univ. of Salford, Lancs., M5 5WT, UK; or L.C. Thomas, Dept. of Business Studies, Univ. of Edinburgh, William Robertson Building, 50 George Square, Edinburgh, EH8 9JY, UK.


April 1992


* 3-4. 1992 Illinois Number Theory Conference, University of Illinois, Urbana, IL.

INVITED SPEAKERS: P.T.D.A. Elliot (Colorado), F. Garvan (Dalhousie/Florida), A. Granville (Georgia).


MISCELLANEOUS: Hotel Reservations: A block of rooms has been reserved at the University Inn, 302 E. John St., Champaign, 217-384-2100. Contact the hotel directly for reservations, mentioning the conference for 552/night rate. Deadline: March 3, 1992.

Dinner: A dinner is scheduled Friday April 3, at the University Inn costing under $20.00. Make reservations with the conference organizers. Deadline: March 3, 1992.

INFORMATION: H.G. Diamond, UIUC Math., Dept., 1409 West Green St., Urbana, IL 61801; 217-333-0379; Fax: 217-333-9576; diamond@symcom.math.uiuc.edu.


6-10. IMA Workshop on Linear Algebra for Signal Processing, University of Minnesota, Minneapolis, MN. (Oct. 1990, p. 1141)

* 6-10. Forty-fourth British Mathematical Colloquium, University of Strathclyde, Glasgow, Scotland, UK.

INVITED SPEAKERS: C. McA. Gordon (Austin), E.H. Lieb (Princeton), J.H. van Lint (Eindhoven), I. Anderson (Glasgow), L.N. Baker (Imperial College), S. Brenner (Liverpool), J. Carr (Herriot-Watt), E. Cusack (BT Labs), E.B. Davies (King’s College), S.J. Gardiner (Univ. College), J. Greenlees (Sheffield), J. Hawkes (Swansea), J.M. Howie (St. Andrews), M-N. Huxley (Cardiff), P.B. Kronheimer (Oxford, M.A.H. MacCallum (QM), D. MacHale (Cork), D.B. Pearson (Hull), R.M. Thomas (Leicester), J. Truss (Leeds), P.M.H. Wilson (Cambridge).

INFORMATION: A.C. McBride, Dept. of Math., Univ. of Strathclyde, Livingstone Tower, 26 Richmond St., Glasgow G1 1XH, Scotland, UK; tel: 041-552-4400, ext. 3647; email: caa03@uk.ac.strath.vaxa

7-10. Twentieth Annual Iranian Mathematics Conference, Razi University, Bakhtaran, Iran. (Sep. 1991, p. 836)

* 7-10. Statistics in Public Resources and Utilities, and in Care of the Environment (SPRUCE), Lisbon, Portugal.

INFORMATION: V. Barnett, Dept. Prob. and Stat., The University, Sheffield S3 7RH, UK.


11-12. Eastern Section, Lehigh University, Bethlehem, PA.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.


26-28. Conference on Applied Statistics in Agriculture, Kansas State University, Manhattan, KS.


30-May 1. Twenty-third Annual Pittsburgh Conference on Modeling and Simulation,
Meetings and Conferences

May 1992


PROGRAM: The purpose of this symposium is to bring together researchers and developers who work on secure computer systems. The symposium will address advances in the theory, design, implementation, evaluation and application of secure computer systems.

CONFERENCE TOPICS: Secure systems, network security, database security, authentication, privacy issues, formal models, access controls, data integrity, information flow, viruses and worms, security verification and validation, auditing and intrusion detection.

CALL FOR PAPERS: Send six copies of your paper, panel session proposal, and position papers to J. McLean at address below. Deadline: November 8, 1991.

INFORMATION: D. Cooper, General Chair, Unisys Corp., 5731 Slauson Ave., Culver City, CA 90230; 213-338-3772; cooper@culv.unisys.com; T. Lunt, Vice Chair, SRI International, EL245, 333 Ravenswood Ave., Menlo Park, CA 94025; 415-859-6106; lunt@csl.sri.com; J. McLean, Program Co-Chair, Naval Research Lab., Code 5543, Washington, DC 20375; 202-767-3852; mclean@itd.nrl.navy.mil; R. Kemmerer, Program Co-Chair, Comp. Sci. Dept., Univ. of California, Santa Barbara, CA 93106; 805-893-4232; kemmer@cs.ucsb.edu; J. Jacob, European Contact, Oxford Univ. Computing Lab., 1 Keble Rd., Oxford, England OX1 3QD; ++44 865 272562; Fax: ++44 865-273839; Jeremy.jacob@prg.oxford.ac.uk; D. Bailey, Cipher Editor, USDOE, WOQ, P.O. Box 5400, Albuquerque, NM 87115; 505-845-4600; db@ianl.gov.


CONFERENCE TOPICS: process simulation, device modelling, circuit analysis, physical aspects, computational techniques, mathematical analysis, Monte Carlo simulations, quantum effects, energy transport models, code validation against real devices and processes.

CALL FOR PAPERS: For papers: Potential contributors should submit an abstract (one page, 500 words maximum) which must clearly state the purpose of the work, the specific results obtained and their significance. For sessions: Potential organizers should submit the title(s) of the sessions they propose. A typical session consists of six 20-minute papers.

INFORMATION: J. Miller, NASECODE Secretariat, 26 Temple Lane, Dublin 2, Ireland; Telefax: (+353-1) 679-2469; Tel: (+353-1) 679-7655; email: jml@vax1.tcd.ie; telex: 30547 SCHN EI (Ref: NASECODE).

18–23. Second European Conference on Computer Vision, Santa Margherita Ligure, Italy. (Jul./Aug. 1991, p. 645)


* 20–June 5. Workshop on Automorphic Forms and L-Functions, Institute for Advanced Studies, Hebrew Univ. of Jerusalem, Israel.

PROGRAM: One or two lectures a day. Invited participants include J. Bernstein, R. Howe, D. Kazhdan, and others.

INFORMATION: S. Kudla, Dept. of Math., Weizmann Institute of Science, Rehovot, Israel; email: mgeltzar@weizmann, Israel; Piatetski-Shapiro, Dept. of Math., Yale Univ., New Haven, CT 06520; email: july@lom1.math.yale.edu.


June 1992


1–5. IMA Workshop on Linear Algebra for Control Theory, University of Minnesota, Minneapolis, MN. (Oct. 1990, p. 1141)


CONFERENCE TOPICS: Geometry and topology of low dimensional manifolds.


INFORMATION: Y. Moriah, B. Wajnryb, Dept. of Math., Technion, Haifa, Israel; email: mgeltzar@technion.bitnet; Fax: 972-4-324-654; C. Gordon, 512-471-7711; email: combs@math.utexas.edu.


* 13–16. Conference in Geometric Group Theory, Ohio State University, Columbus, OH.

PROGRAM: This conference is part of a special seminar in Geometric Group Theory.


CONFERENCE TOPICS: Hyperbolic groups, automatic and combable groups, group actions on R-trees, complexes of groups and spaces of non-positive curvature.
14–20. Fifth International Symposium on Statistical Decision Theory and Related Topics, Purdue University, West Lafayette, IN. (Sep. 1990, p. 938)


INFORMATION: Canadian Applied Mathematics Society Conference, Applied Mathematics Institute, Univ. of Alberta, Edmonton, Alberta, Canada T6G 2G1.


*15–19. Sixth International Conference on Domain Decomposition Methods in Science and Engineering, Como, Italy.

PROGRAM: The conference will host about 30 invited lectures, as well as about 30 contributed presentations and a poster session. Domain decomposition is an increasingly important part of scientific computing. Algorithms based on this approach have attracted the attention of many numerical analysts and computational scientists. Parallel computing systems are rapidly becoming more powerful and they already offer cost effective alternatives to supercomputers for solving many problems in the natural and engineering sciences. Domain decomposition methods appear to offer the best promise for the effective use of this powerful new technology.

CONFERENCE THEMES: Numerical analysis of domain decomposition, block and substructuring methods, multilevel methods, domain decomposition for time dependent problems, interface conditions for heterogeneous domain decomposition, parallel implementation, multibody dynamics, decomposition methods in microelectronics, environmental sciences, applications in science and engineering.


CALL FOR PAPERS: Extended abstracts of a maximum of 1000 words on topics related to the conference are invited by December 1, 1991.

INFORMATION: Sixth Domain Decomposition Conference, I.A.N.-C.N.R., Palazzo dell'Universita', Corso Carlo Alberto, 5, 27100 Pavia, Italy; Fax: +39-382-28079; email: domdec6@ipvian.bitnet.


*21–July 10. Summer Geometry Institute, Park City, Utah.

SPONSORS: Univ. of Illinois at Chicago, Univ. of Texas at Austin, Univ. of Utah, Rice Univ., and Univ. of Washington.

PROGRAM: The Institute, sponsored by the NSF, is a multi-university endeavor to integrate the subject of geometry, from high school education to advanced research. To this end, the three week institute will bring together geometers from all sectors of geometry education and research, in a unique and congenial setting.

The program is designed to foster communication and deeper insight into geometry at all levels. The conference will consist of four programs operating concurrently: high school teachers of geometry, undergraduate students, graduate students and postdoctorates, and researchers in geometry.

CONFERENCE TOPICS: The topic for the graduate/postdoctorate Summer School will be nonlinear partial differential equations in differential geometry. Topics for the research program will be related. Undergraduate topics will cover classical geometry and use of computers in mathematics.

GRADUATE SUMMER SCHOOL LECTURERS: L. Caffarelli (Inst. for Advanced Study), A. Chang (UCLA), R. Schoen (Stanford), L. Simon (Stanford), M. Sirowe (ETH Zurich).

APPLICATIONS: A limited number of fully funded slots will be available in the three programs open to applicants in 1992.

APPLY EARLY! Application forms will be available after November 15, 1991 by phone, mail, or email. Recommendation letters will be required for undergraduate and graduate students, and postdoctorates. Applications and recommendation letters may be submitted via email. Deadline: February 15, 1992.

INFORMATION: H. Clemens, Institute Director, L. Hitchens, Institute Coordinator, Summer Geometry Institute, Dept. of Math., 210 JWB, Univ. of Utah, Salt Lake City, Utah 84112; 801-585-3488; Fax: 801-581-4148; email: rgj@math.utah.edu.


*22–27. Seventh Annual Conference on Structure in Complexity Theory, Boston University, Boston, MA.


CONFERENCE TOPICS: All areas of computational complexity theory, including: Structure of complexity classes, relativizations, independence results, applications of recursion theory, descriptive complexity, interactive proof systems, cryptographic complexity, parallel complexity classes, and circuit complexity.

CALL FOR PAPERS: Send 9 copies of an extended abstract or a full draft paper to the program chair: T. Long, Dept. of Comp. Sci., New Mexico State Univ., Box 30001/Dept. 3CU, Las Cruces, NM 88003-0001; Deadline: January 21, 1992.

INFORMATION: J. Royer, Dept. of Comp. and Inf. Sci., Syracuse Univ., Syracuse, NY 13244; structures@top.cis.syr.edu.

*22–26. Fifth International Meeting on Statistical Climatology (SIMSC), Toronto, Canada.

INFORMATION: F.W. Zwiers, Numerical Modeling Division, Canadian Climate Centre, 4905 Dufferin St., Downsview, Ontario, Canada M3H 5T4.


INFORMATION: P. Mielke, Jr., Dept. of Stat., Colorado State Univ., Fort Collins, CO 80523.
Meetings and Conferences


Program: The purpose of the conference is to bring together research workers with a common interest in differential equations and their applications. The conference will also honor the mathematical contributions that Douglass Jones has made to acoustics, electromagnetic theory and generalized functions. Particular attention will be focused on recent developments in the theory of nonlinear differential equations and their applications to biological phenomena, wave propagation and dynamical systems.


Information: R.J. Jarvis, Dept. of Math. and Comp. Sci., The University, Dundee DD1 4HN, Scotland, UK; email: rjjarvis@uk.ac.dund.mcs.


Information: H. Daly, American Mathematical Society, Post Office Box 6248, Providence, Rhode Island 02940.


July 1992


5-August 1. NSF Regional Geometry Institute: Computational Algebraic Geometry, Amherst College, Amherst, MA. (Oct. 1991, p. 1010)


6-10. Mathematical Conferences in Perth, University of Western Australia. (Sep. 1991, p. 838)


Information: K. Vijayan, Dept. of Math., University of Western Australia, WA 6009, Australia; email: vijayan@madvax.maths.uwa.oz.au.

6-10. Thirty-Sixth Annual Meeting of the Australian Mathematical Society, Perth, Western Australia.

Information: W.S. Perriman or P.F. Siew, School of Math. and Stat., Curtin Univ. of Technology, Bentley, WA 6102, Australia; email: tsiewp@cc.curtin.edu.au.


6-August 14. Summer Program in Mathematical Physics, Mathematical Sciences Research Institute, Berkeley, CA. (Sep. 1991, p. 838)


26-August 1. Variationsrechnung, Oberwolfach, Germany. (Feb. 1991, p. 147)

26-August 1. AMS-SIAM Summer Seminar on Exploiting Symmetry in Applied and Numerical Analysis, Colorado State University, Fort Collins, CO.

Information: D.L. Salter, AMS, P.O. Box 6887, Providence, RI 02940.

August 1992

August 1992. The International Conference Lobachevsky and Modern Geometry devoted to the 200th Anniversary of Lobachevsky’s birthday, Kazan, USSR. (Feb. 1991, p. 147)


3-7. Sixth Workshop on Lie-Admissible Formulations, Clearwater, FL. (Mar. 1991, p. 244)


3-7. Second Meeting of the International Linear Algebra Society (ILAS), University of Lisbon, Portugal. (Sep. 1991, p. 839)


16-22. Reelle Analysis, Oberwolfach, Germany. (Jul./Aug. 1991, p. 646)

*17-21. The Sixth International Conference on Boundary and Interior Layers—Computational and Asymptotic Methods (BAIL VI), Summit County, Colorado.

Conference Topics: Stiff systems of ordinary differential equations, numerical and asymptotic methods for boundary and interior layers, singular perturbations, shocks, multiphase problems, solitary waves, bifurcation, chaos, singular perturbations in biology, chemistry, control theory, engineering, mathematics and physics.

Call for Papers: For papers: Potential contributors must submit an abstract (one page, 500 words maximum) which must clearly state the purpose of the work, the specific results obtained and their significance. For sessions: Potential organizers must submit the title(s) of the sessions they propose. A typical session consists of six 20-minute papers.

Information: J. Miller, BAIL, Secretariat, 26 Temple Lane, Dublin 2, Ireland; Telefax: (+353-1) 679-2469; Tel: (+353-1) 679-2469.
1) 679-7655; email: jmiller@vax.1.tcd.ie; telex: 30547 SCHN EI (Ref. BAIL).

*17–21. The Alan Day Conference on Lattices and Algebras, McMaster University, Hamilton, Ontario, Canada.

PURPOSE: This conference is being held to honor the memory of Dr. Alan Day. The conference will provide an international forum for the exchange of ideas and results in lattice theory, universal algebra, and related topics.


INFORMATION: W. Lampe, Dept. of Math., Univ. of Hawaii, Honolulu, HI 96822.

17–23. Seventh International Congress on Mathematical Education (ICME-7), Université Laval, Quebec, Canada.


*19–26. World Congress of Nonlinear Analysis, Melbourne, FL. (Please note additions to Nov. 1990, p. 1289)


10-11)


14–18. Twentieth European Meeting of Statisticians, Bath, UK.

INFORMATION: R. Sibson, School of Mathematics, University of Bath, Claverton Down, Bath BA2 7AY, UK.

16–18. Second SIAM Conference on Control in the 90s, Minneapolis, MN. (Feb. 1991, p. 148)


October 1992


30–November 1. Central Section, Right State University, Dayton, OH.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

November 1992


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.

1993


PROGRAM: Emphasis will mainly be on Schrödinger operators. Application deadline for postdoctoral fellowships: April 1, 1992 to the Mittag-Leffler Institute, Auroraen 17, S-182 62 Djursholm, Sweden.


January 1993

*25–29. IMA Workshop on Robotics, In-
Meetings and Conferences

Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN.

* 15-19. IMA Workshop on Systems and Control of Movement, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN.

* 1-3. IMA Minisymposium on Biological Control Theory for Power Systems, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN.

* 12-16. IMA Workshop on Adaptive Control, Filtering, and Signal Processing, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN.

* 19-20. IMA Minisymposium on Fuzzy Control, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN.


* 14-18. IMA Workshop on Mathematical Finance, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN.

* 7-11. IMA Tutorial: Mathematical Theory which Has become an Integral Part of Modern Financial Economics, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN.

* 3-7. IMA Tutorial: Verification Issues in Discrete Event Systems, as well as Performance and Control, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN.


* 5-9. IMA Tutorial: Design and Analysis of Adaptive Systems, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN.

* 12-16. IMA Workshop on Adaptive Control, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN.
A MANUAL FOR TRANSLATORS OF
MATHEMATICAL RUSSIAN, REVISED
EDITION
S. H. Gould
Revised Edition Edited by R. P. Boas

This manual is intended for mathematicians who are fairly well acquainted with Russian and have a need to translate mathematical materials into English. Both of the editors worked extensively with such translations and, in the process of their work, kept records of problems, both grammatical and stylistic, that commonly turned up. The main part of the booklet presents typical examples: First the Russian text is given, then the faulty translation, an acceptable translation, and usually some comments. Although such a manual cannot be exhaustive, it does deal with many common mistakes and misconceptions. The examples are taken from the mathematical literature, making the manual of particular interest to mathematicians; however, it should also be useful to physicists, chemists, engineers, and anyone else concerned with the translation of scientific Russian into English.

Contents
Introduction; Part One: General remarks on grammar and style; Part Two: Russian words and phrases; Part Three: English words and phrases; English index; Russian index; Cyrillic transliteration table.

1991 Mathematics Subject Classifications: 01-00; 00A20
ISBN 0-8218-0172-4, LC 91-20605
42 pages (softcover), December 1991
Individual member $12, List price $20, Institutional member $16
To order, please specify MTR/N

SUBFACTORS AND KNOTS
Vaughan Jones

This book is based on a set of lectures presented by the author at the NSF-CBMS Regional Conference, Applications of Operator Algebras to Knot Theory and Mathematical Physics, held at the U.S. Naval Academy in Annapolis in June 1988. The audience consisted of low-dimensional topologists and operator algebraists, so the speaker attempted to make the material comprehensible to both groups. He provides an extensive introduction to the theory of von Neumann algebras and to knot theory and braid groups. The presentation follows the historical development of the theory of subfactors and the ensuing applications to knot theory, including full proofs of some of the major results. The author treats in detail the Homfly and Kauffman polynomials, introduces statistical mechanical methods on knot diagrams, and attempts an analogy with conformal field theory. Written by one of the foremost mathematicians of the day, this book will give readers an appreciation of the unexpected interconnections between different parts of mathematics and physics.

Contents
von Neumann algebras; Group actions and subfactors; Values of the index, Virasoro algebra; Construction of examples, further structure; The braid group and its representations; Knots and links; The knot polynomial $V_k$; Knots and statistical mechanics; The algebraic approach.

1991 Mathematics Subject Classifications: 16S99, 46L10, 57M55, 61P05, 81R10; 46L37, 46L40, 57M15, 81T05.
ISBN 0-8218-0729-3, LC 91-24438, ISSN 0160-7642
113 pages (softcover), November 1991
All individuals $26, List price $43
To order, please specify CBMS/80N

INVERSE SCATTERING AND APPLICATIONS
David Sattinger, Editor

This book contains the proceedings of an AMS-IMS-SIAM Summer Institute on Inverse Scattering and Applications, held in Amherst, Massachusetts in June 1990. The papers cover the current state of the art in inverse conductivity problems, applications of inverse scattering theory to integrable systems, three-dimensional inverse scattering, inverse monodromy problems, and nonlinear waves, among other topics. Intended for researchers working in inverse scattering theory, inverse conductance problems, and completely integrable systems, this book presents results by some of the major experts in the field.

Contents

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.

1991 Mathematics Subject Classifications: 34B25, 35P25, 35R30
ISBN 0-8218-5129-2, LC 91-26094, ISSN 0271-4132
133 pages (softcover), November 1991
Individual member $23, List price $41,
Institutional member $33
To order, please specify CONM/122N

DIFFERENTIAL OPERATORS AND HIGHEST WEIGHT REPRESENTATIONS
Mark G. Davidson, Thomas J. Enright, and Ronald J. Stanke
(Memoirs of the AMS, Number 455)

This work concerns the representation theory of semisimple Lie groups. From the algebraic perspective, the theory of unitarizable highest weight modules is highly developed. The classification was given in 1981, and, more recently, even the character and nilpotent cohomology formulas have been determined for $G$ of classical type. However, from the analytic point of view, as originally presented by Harish-Chandra, unitarizable highest weight modules occur as subspaces of certain spaces of vector-valued polynomials, or, equivalently, as subspaces of holomorphic sections for vector bundles on $G/K$. The main result of this book offers a characterization of unitary highest weight representations as solutions to systems of differential operators.

Contents
Vector bundles and algebraic conventions; Conjugate pairings and reproducing kernels; $\ell^\infty$-irreducibility of the system of differential operators; $\mathfrak{p}_+-$cohomology for the exceptional groups; Notational conventions and a lemma; The cone decomposition; The oscillator representation, harmonic polynomials and associated affine varieties; Young products and a refinement of the factorization theorem; The fundamental system of differential operators; Explicit forms of the systems of differential operators for the classical groups; The ladder representation examples; $K_C$-orbits in $\mathfrak{p}_+$, and the Wallach representations.

1991 Mathematics Subject Classifications: 22E45, 22E47, 20G05, 32M15
ISBN 0-8218-2509-7, LC 91-27904, ISSN 0065-9266
108 pages (softcover), November 1991
Individual member $12, List price $20,
Institutional member $16
To order, please specify MEMO/455N

COMBINATORIAL PATTERNS FOR MAPS OF THE INTERVAL
Michal Misiurewicz and Zbigniew Nitecki
(Memoirs of the AMS, Number 456)

In recent years, motivated by Sharkovskii's theorem, researchers have realized that a good deal of information about the dynamics of a map on the interval can be deduced from the combinatorial structure of its periodic orbits. This data can be formulated as a "forcing" relation between cyclic permutations (representing "orbit types" of periodic orbits). The present study investigates a number of new features of this relation and its generalization to multicyclic permutations (modelling finite unions of periodic orbits) and combinatorial patterns (modelling finite invariant sets). A central theme is the role of reductions and extensions of permutations. Results include:

(i) a "combinatorial shadowing theorem" and its application to approximating permutations by cycles in the forcing relation;
(ii) the distribution of different representatives of a given cycle in one (adjusted) map; (iii) characterization of the forcing-maximal permutations and patterns of fixed degree; and (iv) a calculation of the asymptotic growth rate of the maximum entropy forced by a permutation of given degree.

Contents
Adjusted maps; Equivalence and essential patterns; Reductions and extensions of patterns; Irreducible patterns and Markov graphs; Horseshoe patterns and fold type; Extensions of cycles; Combinatorial shadowing; Transitive patterns; Representations of cycles; Forcing and degree; Entropy estimates.

1991 Mathematics Subject Classifications: 58F20, 54H20, 26A18
ISBN 0-8218-2513-5, LC 91-27263, ISSN 0065-9266
120 pages (softcover), November 1991
Individual member $13, List price $21,
Institutional member $17
To order, please specify MEMO/456N

MULTIPlicative HOMology OPERATIONS AND TRANSFER
Norihiko Minami
(Memoirs of the AMS, Number 457)

In this work, the author presents a completely new treatment of the homology operations $Q^0$. This approach employs the Burnside rings and produces results that are much sharper than previous results. As an application, the author improves Tsujiya's claim and generalizes Pridy's multiplicative Kahn-Pridy theorem to apply to any prime.

1991 Mathematics Subject Classifications: 55P47, 55P91, 55S12
ISBN 0-8218-2518-6, LC 91-28757, ISSN 0065-9266
80 pages (softcover), November 1991
Individual member $11, List price $18,
Institutional member $14
To order, please specify MEMO/457N

LYAPunov THEOREMS FOR OPERATOR ALGEBRAS
Charles A. Akemann and Joel Anderson
(Memoirs of the AMS, Number 458)

In 1940, A. A. Lyapunov published his celebrated discovery that the range of a nonatomic vector-valued measure is convex and compact. This book presents the results of a systematic generalization of Lyapunov's theorem to the setting of operator algebras. The authors' point of view follows that of Lindenstrauss, so that, in their terminology, Lyapunov's theorem asserts that if $\Psi$ is a weak* continuous map of a nonatomic abelian von Neumann algebra $\mathcal{A}$ into $\mathbb{C}^n$, and $B$ denotes the positive part of the unit ball of $\mathcal{A}$, then for each $a \in B$ there is an extreme point $p$ of $B$ (i.e., a projection) with $\Psi(p) = \Psi(a)$. We begin
by studying an affine map $\Psi$ of a convex subset $Q$ of a linear space $X$ into a linear space $Y$. If $\Psi(E) = \Psi(Q)$, where $E$ denotes the extreme points of $Q$, we say a Lyapunov theorem of type 1 holds. If $\Psi$ is a normed space, we say a Lyapunov theorem of type 2 (resp. type 3) holds if $\Psi(E)$ is norm dense (resp. $\epsilon$-dense) in $\Psi(Q)$. Roughly speaking, a Lyapunov theorem of type 4 asserts that $\Psi$ maps at least one element of $E$ "away from the boundary." Results of all four types are obtained. In some cases (notably, when $\Psi$ is a nonatomic von Neumann algebra), $Q$ may be a face of $B$, or the entire unit ball of $X$. If $\Psi$ is a singular map and $\Psi$ is a purely infinite, countably decomposable von Neumann algebra, then the range of $\Psi$ may be infinite-dimensional.

Contents

An abstract Lyapunov theorem; Lyapunov theorems for nonatomic von Neumann algebras; Lyapunov theorems for $C^*$-algebras; Lyapunov theorems for atomic von Neumann algebras; Simultaneous approximations; Lyapunov theorems for singular maps; Noncommutative range; Applications to the paving problem.

1991 Mathematics Subject Classifications: 46L05, 46L30, 46L10; 28B05, 46B99, 46G10, 49E15, 52A20, 60A10, 93C15
ISBN 0-8218-2516-X, LC 91-28166, ISSN 0065-9266
96 pages (softcover), November 1991
Individual member $11$, List price $19$, Institutional member $15$
To order, please specify MEMO/458N

Finiteness Theorems for Limit Cycles
Yu. S. Il'Yashenko
(Translations of Mathematical Monographs, Volume 94)

This book is devoted to the following finiteness theorem: A polynomial vector field on the real plane has a finite number of limit cycles. To prove the theorem, it suffices to note that limit cycles cannot accumulate on a polycycle of an analytic vector field. This approach necessitates investigation of the monodromy transformation (also known as the Poincaré return mapping or the first return mapping) corresponding to this cycle. To carry out this investigation, this book utilizes five sources: The theory of Dulac, use of the complex domain, resolution of singularities, the geometric theory of normal forms, and superexact asymptotic series. In the introduction, the author presents results about this problem that were known up to the writing of the present book, with full proofs (except in the case of results in the local theory and theorems on resolution of singularities).

Contents

Decomposition of a monodromy transformation into terms with noncomparable rates of decrease; Function-theoretic properties of regular functional cochains; The Phragmén-Lindelöf theorem for regular functional cochains; Superexact asymptotic series; Ordering of functional cochains on a complex domain.

1991 Mathematics Subject Classifications: 34-02, 34C05, 34C20, 34C35, 57R25, 14E15, 41A60
ISBN 0-8218-4554-3, LC 91-27853, ISSN 0065-9282
251 pages (hardcover), November 1991
Individual member $82$, List price $136$, Institutional member $109$
To order, please specify MMONO/95N

COMBINED MEMBERSHIP LIST

This CML is a comprehensive directory of the membership of the AMS, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics. The list is distributed on request as a privilege of membership to AMS members in even-numbered years and the MAA members in odd-numbered years. The CML is an invaluable reference for keeping in touch with colleagues and for making connections in the mathematical sciences community in the United States and abroad.

There are two lists of individual members. The first is a complete alphabetical list of all members in all three organizations. For each member, the CML provides his or her address, title, department, institution, and telephone number (if available), electronic address (if indicated), and also indicates the mathematical organizations to which the individual belongs. The second lists individual members according to their geographic locations. In addition, the CML lists all academic and institutional members and provides addresses and telephone numbers of mathematical sciences departments.

1991 Mathematics Subject Classification: 00
ISBN 0-8218-1070-8
584 pages (softcover), November 1991
Individual member $27$, List price $45$, Institutional member $36$
To order, please specify CML/91/92N
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Bylaws of the American Mathematical Society

Article I

Officers

Section 1. There shall be a president, a president-elect (during the even-numbered years only), an ex-president (during the odd-numbered years only), three vice-presidents, a secretary, four associate secretaries, a treasurer, and an associate treasurer.

Section 2. It shall be a duty of the president to deliver an address before the Society at the close of the term of office or within one year thereafter.

Article II

Board of Trustees

Section 1. There shall be a Board of Trustees consisting of eight trustees, five trustees elected by the Society in accordance with Article VII, together with the president, the treasurer, and the associate treasurer of the Society ex officio. The Board of Trustees shall designate its own presiding officer and secretary.

Section 2. The function of the Board of Trustees shall be to receive and administer the funds of the Society, to have full legal control of its investments and properties, to make contracts, and, in general, to conduct all business affairs of the Society.

Section 3. The Board of Trustees shall have the power to appoint such assistants and agents as may be necessary or convenient to facilitate the conduct of the affairs of the Society, and to fix the terms and conditions of their employment. The Board may delegate to the officers of the Society duties and powers normally inhering in their respective corporative offices, subject to supervision by the Board. The Board of Trustees may appoint committees to facilitate the conduct of the financial business of the Society and delegate to such committees such powers as may be necessary or convenient for the proper exercise of those powers. Agents appointed, or members of committees designated, by the Board of Trustees need not be members of the Board.

Nothing herein contained shall be construed to empower the Board of Trustees to divest itself of responsibility for, or legal control of, the investments, properties, and contracts of the Society.

Article III

Committees

Section 1. There shall be nine editorial committees as follows: committees for the Bulletin, for the Proceedings, for the Colloquium Publications, for the Journal, for Mathematical Surveys and Monographs, for Mathematical Reviews; a joint committee for the Transactions and the Memoirs; a committee consisting of the representatives of the Society on the Board of Editors of the American Journal of Mathematics; and a committee for Mathematics of Computation.

Section 2. There shall be a Science Policy Committee.

Section 3. There shall be a communications committee called the Committee to Monitor Problems in Communication.

Section 4. The size of each committee shall be determined by the Council.

Article IV

Council

Section 1. The Council shall consist of fifteen members-at-large and the following ex officio members: the officers of the Society specified in Article I, except that it shall include only one associate secretary, the chairman of each of the editorial committees and of the communications committee and of the Science Policy Committee, any former secretary for a period of two years following the terms of office, and members of the Executive Committee (Article V) who remain on the Council by the operation of Article VII, Section 4.

The chairman of any committee designated as a Council member may name a deputy from the committee as substitute. The associate secretary shall be the one charged with the scientific program of the meeting at which the Council meets except that at a meeting associated with no scientific meeting of the Society the secretary may designate the associate secretary.

Section 2. The Council shall formulate and administer the scientific policies of the Society and shall act in an advisory capacity to the Board of Trustees.

Section 3. In the absence of the secretary from any meeting of the Council, a member may be designated
as acting secretary for the meeting, either by written authorization of the secretary, or, failing that, by the presiding officer.

Section 4. All members of the Council shall be voting members. Each member, including deputies and the designated associate secretary, shall have one vote. The method for settling matters before the Council at any meeting shall be by majority vote of the members present. If the result of a vote is challenged, it shall be the duty of the presiding officer to determine the true vote by a roll call. In a roll call vote, each Council member shall vote only once (although possibly a member of the Council in several capacities).

Section 5. Any five members of the Council shall constitute a quorum for the transaction of business at any meeting of the Council.

Section 6. Between meetings of the Council, business may be transacted by a mail vote. Votes shall be counted as specified in Section 4 of this Article, "members present" being replaced by "members voting." An affirmative vote by mail on any proposal shall be declared if, and only if, (a) more than half of the total number of possible votes is received by the time announced for the closing of the polls, and (b) at least three-quarters of the votes received by then are affirmative. If five or more members request postponement at the time of voting, action on the matter at issue shall be postponed until the next meeting of the Council, unless either (1) at the discretion of the secretary, the question is made the subject of a second vote by mail, in connection with which brief statements of reason, for and against, are circulated; or (2) the Council places the matter at issue before the Executive Committee for action.

Section 7. The Council may delegate to the Executive Committee certain of its duties and powers. Between meetings of the Council, the Executive Committee shall act for the Council on such matters and in such ways as the Council may specify. Nothing herein contained shall be construed as empowering the Council to divest itself of responsibility for formulating and administering the scientific policies of the Society.

Section 8. The Council shall also have power to speak in the name of the Society with respect to matters affecting the status of mathematics or mathematicians, such as proposed or enacted federal or state legislation; conditions of employment in universities, colleges, or business, research or industrial organizations; regulations, policies, or acts of governmental agencies or instrumentalities; and other items which tend to affect the dignity and effective position of mathematics.

With the exception noted in the next paragraph, a favorable vote of two-thirds of the entire membership of the Council shall be necessary to authorize any statement in the name of the Society with respect to such matters. With the exception noted in the next paragraph, such a vote may be taken only if written notice shall have been given to the secretary by the proposer of any such resolution not later than one month prior to the Council meeting at which the matter is to be presented; and the vote shall be taken not earlier than one month after the resolution has been discussed by the Council.

If, at a meeting of the Council, there are present twelve members, then the prior notification to the secretary may be waived by unanimous consent. In such a case, a unanimous favorable vote by those present shall empower the Council to speak in the name of the Society.

The Council may also refer the matter to a referendum by mail of the entire membership of the Society, and shall make such reference if a referendum is requested, prior to final action by the Council, by two hundred or more members. The taking of a referendum shall act as a stay upon Council action until the votes have been canvassed, and thereafter no action may be taken by the Council except in accordance with a plurality of the votes cast in the referendum.

Article V

Executive Committee

Section 1. There shall be an Executive Committee of the Council, consisting of four elected members and the following ex officio members: the president, the secretary, the president-elect (during even-numbered years), and the ex-president (during odd-numbered years).

Section 2. The Executive Committee of the Council shall be empowered to act for the Council on matters which have been delegated to the Executive Committee by the Council. If three members of the Executive Committee request that any matter be referred to the Council, the matter shall be so referred. The Executive Committee shall be responsible to the Council and shall report its actions to the Council. It may consider the agenda for meetings of the Council and may make recommendations to the Council.

Section 3. Each member of the Executive Committee shall have one vote. An affirmative vote on any proposal before the Executive Committee shall be declared if, and only if, at least four affirmative votes are cast for the proposal. A vote on any proposal may be determined at a meeting of the Executive Committee, but it shall not be necessary to hold a meeting to determine a vote.

Article VI

Executive Director

Section 1. There shall be an Executive Director who shall be a paid employee of the Society. The Executive Director shall have charge of the central office of the Society, and shall be responsible for the general administration of the affairs of the Society in accordance with the policies that are set by the Board of Trustees and by the Council.

Section 2. The Executive Director shall be appointed by the Board of Trustees with the consent of the Council. The terms and conditions of employment shall be fixed by the Board of Trustees.

Section 3. The Executive Director shall work under the immediate direction of a committee consisting of the president, the secretary, and the treasurer, of which the president shall be chairman ex officio. The Executive Director
shall attend meetings of the Board of Trustees, the Council, and the Executive Committee, but shall not be a member of any of these bodies. The Executive Director shall be a voting member of the Committee to Monitor Problems in Communication but shall not be its chairman.

Article VII

Election of Officers and Terms of Office

Section 1. The term of office shall be one year in the case of the president-elect and the ex-president; two years in the case of the president, the secretary, the associate secretaries, the treasurer, and the associate treasurer; three years in the case of vice-presidents and members-at-large of the Council, one vice-president and five members-at-large retiring annually; and five years in the case of the trustees. In the case of members of the editorial committees and appointed members of the communications committees, the term of office shall be determined by the Council. The term of office for elected members of the Executive Committee shall be four years, one of the elected members retiring annually. All terms of office shall begin on February 1 and terminate on January 31 with the exception that the officials specified in Articles I, II, III, IV, and V (excepting the president-elect and ex-president) shall continue to serve until their successors have been duly elected or appointed and qualified.

Section 2. The president-elect, the vice-presidents, the trustees, and the members-at-large of the Council shall be elected by written ballot. An official ballot shall be sent to each member of the Society by the secretary on or before October 10, and such ballots, if returned to the secretary in envelopes bearing the name of the voter and received within thirty days, shall be counted. Each ballot shall contain one or more names proposed by the Council for each office to be filled, with blank spaces in which the voter may substitute other names. A plurality of all votes cast shall be necessary for election. In case of failure to secure a plurality for any office, the Council shall choose by written ballot among the members having the highest number of votes. The secretary, the associate secretaries, the treasurer, and the associate treasurer shall be appointed by the Council in a manner designated by the Council. Each committee named in Article III, Section 1 or 3, shall be appointed by the Council in a manner designated by the Council. Each such committee shall elect one of its members as chairman in a manner designated by the Council.

Section 3. The president becomes ex-president at the end of the term of office and the president-elect becomes president.

Section 4. On or before February 15, the secretary shall send to all members of the Council for a mail vote a ballot containing two names for each place to be filled on the Executive Committee. The nominees shall be chosen by a committee appointed by the president. Members of the Council may vote for persons not nominated. Any member of the Council who is not an ex officio member of the Executive Committee (see Article V, Section 1) shall be eligible for election to the Executive Committee. In case a member is elected to the Executive Committee for a term extending beyond the regular term on the Council, that person shall automatically continue as a member of the Council during the remainder of that term on the Executive Committee.

Section 5. The president and vice-presidents shall not be eligible for immediate re-election to their respective offices. A member-at-large or an ex officio member of the Council shall not be eligible for immediate election (or re-election) as a member-at-large of the Council.

Section 6. If the president of the Society should die or resign while a president-elect is in office, the president-elect shall serve as president for the remainder of the year and thereafter shall serve the regular two-year term. If the president of the Society should die or resign when no president-elect is in office, the Council, with the approval of the Board of Trustees, shall designate one of the vice-presidents to serve as president for the balance of the regular presidential term. If the president-elect of the Society should die or resign before becoming president, the office shall remain vacant until the next regular election of a president-elect, and the Society shall, at the next annual meeting, elect a president for a two-year term. If the ex-president should die or resign before expiration of the term of office, the Council, with the approval of the Board of Trustees, shall designate a former president of the Society to serve as ex-president during the remainder of the regular term of the ex-presidency. Such vacancies as may occur at any time in the group consisting of the vice-presidents, the secretary, the associate secretaries, the treasurer, and the associate treasurer shall be filled by the Council with the approval of the Board of Trustees. If a member of an editorial or communications committee should take temporary leave from duties, the Council shall then appoint a substitute. The Council shall fill from its own membership any vacancy in the elected membership of the Executive Committee.

Section 7. If any elected trustee should die while in office or resign, the vacancy thus created shall be filled for the unexpired term by the Board of Trustees.

Section 8. If any member-at-large of the Council should die or resign more than one year before the expiration of the term, the vacancy for the unexpired term shall be filled by the Society at the next annual meeting.

Section 9. In case any officer should die or decline to serve between the time of election and the time to assume office, the vacancy shall be filled in the same manner as if that officer had served one day of the term.

Article VIII

Members and Their Election

Section 1. Election of members shall be by vote of the Council or of its Executive Committee.

Section 2. There shall be four classes of members, namely ordinary, contributing, corporate, and institutional.
Section 3. Application for admission to ordinary membership shall be made by the applicant on a blank provided by the secretary. Such applications shall not be acted upon until at least thirty days after their presentation to the Council (at a meeting or by mail), except in the case of members of other societies entering under special action of the Council approved by the Board of Trustees.

Section 4. An ordinary member may become a contributing member by paying the dues for such membership. (See Article IX, Section 3.)

Section 5. A university or college, or a firm, corporation, or association interested in the support of mathematics may be elected a corporate or an institutional member.

Article IX

Dues and Privileges of Members

Section 1. Any applicant shall be admitted to ordinary membership immediately upon election by the Council (Article VIII) and the discharge within sixty days of election of the first annual dues. Dues may be discharged by payment or by remission when the provision of Section 7 of this Article is applicable. The first annual dues shall apply to the year of election, except that any applicant elected after August 15 of any year may elect to have the first annual dues apply to the following year.

Section 2. The annual dues of an ordinary member of the Society shall be established by the Council with the approval of the Trustees. The Council, with the approval of the Trustees, may establish special rates in exceptional cases and for members of an organization with which the Society has a reciprocity agreement.

Section 3. The minimum dues for a contributing member shall be three-halves of the dues of an ordinary member per year. Members may, upon their own initiative, pay larger dues.

Section 4. The minimum dues of an institutional member shall depend on the scholarly activity of that member. The formula for computing these dues shall be established from time to time by the Council, subject to approval by the Board of Trustees. Institutions may pay larger dues than the computed minimum.

Section 5. The privileges of an institutional member shall depend on its dues in a manner to be determined by the Council, subject to approval by the Board of Trustees. These privileges shall be in terms of Society publications to be received by the institution and of the number of persons it may nominate for ordinary membership in the Society.

Section 6. Dues and privileges of corporate members of the Society shall be established by the Council subject to approval by the Board of Trustees.

Section 7. The dues of an ordinary member of the Society shall be remitted for any years during which that member is the nominee of an institutional member.

Section 8. After retirement from active service on account of age or on account of long term disability, any ordinary or contributing member who is not in arrears of dues and with membership extending over at least twenty years may, by giving proper notification to the secretary, have dues remitted. Such a member shall receive the Notices and may request to receive Bulletin as privileges of membership during each year until membership ends.

Section 9. An ordinary or contributing member shall receive the Notices and Bulletin as privileges of membership during each year for which dues have been discharged.

Section 10. The annual dues of ordinary, contributing, and corporate members shall be due by January 1 of the year to which they apply. The Society shall submit bills for dues. If the annual dues of any member remain undischarged beyond what the Board of Trustees deems to be a reasonable time, the name of that member shall be removed from the list of members after due notice. A member wishing to discontinue membership at any time shall submit a resignation in writing to the Society.

Section 11. Any person who has attained the age of 62 and has been a member for at least twenty years may become a life member by making a single payment equal to five times the dues of an ordinary member for the coming year. Insofar as there is more than one level of dues for ordinary membership, it is the highest such dues that shall be used in the calculation, with the exception for members by reciprocity noted in the following paragraph. A life member is subsequently relieved of the obligation of paying dues. The status and privileges are those of ordinary members. (This section does not affect those persons who became life members before October 25, 1941. They remain life members with the status and privileges of ordinary members. When the class of them is empty, this parenthetical remark is to be removed.)

A member of the Society by reciprocity who has reached the age of 62, has been a member for at least 20 years, has been a member by reciprocity for at least 15 of those 20 years and asserts the intention of continuing to be a member by reciprocity may purchase a life membership by a one-time payment of a special rate established by the Council, with the approval of the Trustees.

Article X

Meetings

Section 1. The annual meeting of the Society shall be held between the fifteenth of December and the tenth of February next following. Notice of the time and place of this meeting shall be mailed by the secretary or an associate secretary to the last known post office address of each member of the Society. The times and places of the annual and other meetings of the Society shall be designated by the Council. There shall be a business meeting of the Society at the annual meeting and at the summer meeting. A business meeting of the Society shall take final action only on business accepted by unanimous consent, or business noticed to the full membership of the Society in the call for the meeting, except that the business meetings held at either the annual meeting or the summer meeting may take
final action on business which has been recommended for consideration by the Council and has been accepted by the vote of four-fifths of the Society present and voting at such a meeting. Such notification shall be made only when so directed by a previous business meeting of the Society or by the Council.

Section 2. Meetings of the Executive Committee may be called by the president. The president shall call a meeting at any time upon the written request of two of its members.

Section 3. The Council shall meet at the annual meeting of the Society. Special meetings of the Council may be called by the president. The president shall call a special meeting at any time upon the written request of five of its members. No special meeting of the Council shall be held unless written notice of it shall have been sent to all members of the Council at least ten days before the day set for the meeting.

Section 4. The Board of Trustees shall hold at least one meeting in each calendar year. Meetings of the Board of Trustees may be called by the president, the treasurer, or the secretary of the Society upon three-days’ notice of such meetings mailed to the last known post office address of each trustee. The secretary of the Society shall call a meeting upon the receipt of a written request of two of the trustees. Meetings may also be held by common consent of all the trustees.

Section 5. Papers intended for presentation at any meeting of the Society shall be passed upon in advance by a program committee appointed by or under the authority of the Council; and only such papers shall be presented as shall have been approved by such committee. Papers in form unsuitable for publication, if accepted for presentation, shall be referred to on the program as preliminary communications or reports.

Article XI
Publications

Section 1. The Society shall publish an official organ called the Bulletin of the American Mathematical Society. It shall publish four journals, known as the Journal of the American Mathematical Society, the Transactions of the American Mathematical Society, the Proceedings of the American Mathematical Society, and Mathematics of Computation. It shall publish a series of mathematical papers known as the Memoirs of the American Mathematical Society. The object of the Journal, Transactions, Proceedings, Memoirs, and Mathematics of Computation is to make known important mathematical research. It shall also cooperate in the conduct of the American Journal of Mathematics. It shall publish a news periodical known as the Notices of the American Mathematical Society, containing programs of meetings, items of news of particular interest to mathematicians, and such other materials as the Council may direct.

Section 2. The editorial management of the publications of the Society listed in Section 1 of this article, with the exception of the Notices, and the participation of the Society in the editorial management of the American Journal of Mathematics shall be in the charge of the respective editorial committees as provided in Article III, Section 1. The editorial management of the Notices shall be in the hands of a committee chosen in a manner established by the Council.

Article XII
Communications

The Committee to Monitor Problems in Communication shall perform such tasks in the field of communication of mathematics as are assigned to it by the Council.

Article XIII
Indemnification

Any person who at any time serves or has served as a trustee or officer of the Society, or as a member of the Council, or, at the request of the Society, as a director or officer of another corporation, whether for profit or not for profit, shall be indemnified by the Society and be reimbursed against and for expenses actually and necessarily incurred in connection with the defense or reasonable settlement of any action, suit, legal or administrative proceeding, whether civil, criminal, administrative or investigative, threatened, pending or completed, to which that person is made a party by reason of being or having been such trustee, officer or director or Council member, except in relation to matters as to which the person shall be adjudged in such action, suit or proceeding to be liable for negligence or misconduct in the performance of official duties. Such right of indemnification and reimbursement shall also extend to the personal representatives of any such person, and shall be in addition to and not in substitution for any other rights to which such person or personal representatives may now or hereafter be entitled by virtue of the provisions of applicable law or of any other agreement or vote of the Board of Trustees, or otherwise.

Article XIV
Amendments

These bylaws may be amended or suspended on recommendation of the Council and with the approval of the
Bylaws of the American Mathematical Society

membership of the Society, the approval consisting of an affirmative vote by two-thirds of the members present at a business meeting or of two-thirds of the members voting in a mail ballot in which at least ten percent of the members vote, whichever alternative shall have been designated by the Council, and provided notice of the proposed action and of its general nature shall have been given in the call for the meeting or accompanies the ballot in full.

As amended December 1990

AMS Funds, Prizes, Officers and Lecturers

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<td>Irving Fisher, 1929</td>
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</table>

| E. B. Wilson, 1930 |
| P. W. Bridgman, 1931 |
| R. C. Tolman, 1932 |
| Albert Einstein, 1934 |
| Vannevar Bush, 1935 |
| H. N. Russell, 1936 |
| C. A. Kraus, 1937 |
| Theodore von Kármán, 1939 |
| Sewall Wright, 1941 |
| Harry Bateman, 1943 |
| John von Neumann, 1944 |
| J. C. Slater, 1945 |
| S. Chandrasekhar, 1946 |
| F. M. Riesz, 1947 |
| Hermann Weyl, 1948 |
| Norbert Wiener, 1949 |
| G. E. Uhlenbeck, 1950 |
| Kurt Gödel, 1951 |
| Marston Morse, 1952 |
| Wassily Leontief, 1953 |
| K. O. Friedrichs, 1954 |
| J. E. Mayer, 1955 |
| M. H. Stone, 1956 |
| H. J. Muller, 1958 |
| J. M. Burgers, 1959 |
| Julian Schwinger, 1960 |
| J. J. Stoker, 1961 |
| C. N. Yang, 1962 |
| C. F. Shannon, 1963 |
| Lars Onsager, 1964 |
| D. H. Lehmer, 1965 |
| Martin Schwarzschild, 1966 |
| Mark Kac, 1967 |
| E. P. Wigner, 1968 |
| R. L. Wilder, 1969 |
| W. H. Munk, 1970 |
| E. F. F. Hopf, 1971 |
| F. J. Dyson, 1972 |
| J. K. Moser, 1973 |
| Paul A. Samuelson, 1974 |
| Fritz John, 1975 |
| Arthur S. Wightman, 1976 |
| Joseph B. Keller, 1977 |
| Donald E. Knuth, 1978 |
| Martin D. Kruskal, 1979 |
| Kenneth G. Wilson, 1980 |
| Cathleen S. Morawetz, 1981 |
| Elliott W. Montroll, 1982 |
| Samuel Karlin, 1983 |
| Herbert A. Simon, 1984 |
| Michael O. Rabin, 1985 |
| L. E. Scriven, 1986 |
| Thomas C. Spencer, 1987 |
| David P. Ruelle, 1988 |
| Elliot H. Lieb, 1989 |
| George B. Dantzig, 1990 |
| Michael F. Atiyah, 1991 |
In 1923 an Endowment Fund was collected to meet the greater demands on the publication program of the Society, demands caused by the ever-increasing number of important mathematical memoirs. Of this fund, which amounted to approximately $94,000 in 1960, a considerable proportion was contributed by members of the Society. In 1961, upon the death of the last legatees under the will of the late Robert Henderson—for many years a Trustee of the Society—the entire principal of the estate was received by the Society, thereby bringing the total of the Endowment Fund to approximately $648,000.

Prize Funds

The Bôcher Memorial Prize

This prize was founded in memory of Professor Maxime Bôcher with an original endowment of $1,450. It is awarded every five years for a notable research memoir in analysis that has appeared during the past five years. Either the recipient is a member of the Society or the Memoir is published in a recognized North American journal; this provision, introduced in 1971, is a liberalization of the terms of the award.


Eighth award, 1953: To Norman Levinson for his contributions to the theory of linear, nonlinear, ordinary, and partial differential equations contained in his papers of recent years.

Ninth award, 1959: To Louis Nirenberg for his work in partial differential equations.


Twelfth award, 1974: To Donald S. Ornstein in recognition of his paper, Bernoulli shifts with the same entropy are isomorphic, Advances in Mathematics, volume 4 (1970), pp. 337-352.


Fourteenth award, 1984: To Luis A. Caffarelli for his deep and fundamental work in nonlinear partial differential equations, in particular his work on free boundary problems, vortex theory and regularity theory.

Fifteenth award, 1984: To Richard B. Melrose for his solution of several outstanding problems in diffraction theory and scattering theory and for developing the analytical tools needed for their resolution.


The Frank Nelson Cole Prize in Algebra

The Frank Nelson Cole Prize in Number Theory

These prizes were founded in honor of Professor Frank Nelson Cole on the occasion of his retirement as secretary of the American Mathematical Society after twenty-five years of service and as editor-in-chief of the Bulletin for twenty-one years. The original fund was donated by Professor Cole from moneys presented to him on his retirement, was augmented by contributions from members of the Society, and was later doubled by his son, Charles A. Cole. The present endowment is $2,250. The prizes are awarded at five-year intervals for contributions to algebra and the theory of numbers, respectively, under restrictions similar to those for the Bôcher Prize.


Fifth award, 1944: To Oscar Zariski for four papers on algebraic varieties published in the American Journal of Mathematics, volumes 61 (1939) and 62 (1940), and in the Annals of Mathematics, Series 2, volumes 40 (1939) and 41 (1940).


Eighth award, 1951: To Paul Erdős for his many papers in the theory of numbers, and in particular for his paper, On a new method in elementary number theory which leads to an elementary proof of the prime number theorem, Proceedings of the National Academy of Sciences, volume 35 (1949), pp. 374-387.

Ninth award, 1954: To Harish-Chandra for his papers on representations of semisimple Lie algebras and groups, and particularly for his paper, On some applications of the universal enveloping algebra of a semisimple Lie algebra, Transactions of the American Mathematical Society, volume 70 (1951), pp. 28-96.


Eleventh award, 1960: To Serge Lang for his paper, Unramified class field theory over function fields in several variables, Annals of Mathematics, Series 2, volume 64 (1956), pp. 285-325; and to Maxwell A. Rosenlicht for his papers, Generalized Jacobian varieties, Annals of Math-

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Twenty-First award, 1985: To George Lusztig for his fundamental work on the representation theory of finite groups of Lie type. In particular for his contributions to the classification of the irreducible representations in characteristic zero of the groups of rational points of reductive groups over finite fields, appearing in Characters of reductive groups over finite fields, Annals of Mathematics Studies, volume 107, Princeton University Press, 1984.


The Oswald Veblen Prize in Geometry

This prize was established in 1961 in memory of Professor Oswald Veblen through a fund contributed by former students and colleagues. The fund was later doubled by the widow of Professor Veblen, bringing the fund to $2,000. The first two awards of the prize were made in 1964 and the next in 1966; thereafter, an award will ordinarily be made every five years for research in geometry or topology under conditions similar to those for the Böcher Prize.


Third award, 1966: To Stephen Smale for his contributions to various aspects of differential topology.

Fourth award, 1966: To Morton Brown and Barry Mazur for their work on the generalized Schoenflies theorem.


Seventh award, 1976: To William P. Thurston for his work on foliations.

Eighth award, 1976: To James Simons for his work on minimal varieties and characteristic forms.

Ninth award, 1981: To Mikhail Gromov for his work relating topological and geometric properties of Riemannian manifolds.

Tenth award, 1981: To Shing-Tung Yau for his work in nonlinear partial differential equations, his contributions to the topology of differentiable manifolds, and for his work on the complex Monge-Ampère equation on compact complex manifolds.

Eleventh award, 1986: To Michael H. Freedman for his work in differential geometry and, in particular, the solution of the four-dimensional Poincaré conjecture.

Twelfth award, 1991: To Andrew J. Casson for his work on the topology of low-dimensional manifolds, and to Clifford H. Taubes for his foundational work in Yang-Mills theory.

The George David Birkhoff Prize in Applied Mathematics

This prize was established in 1967 in honor of Professor George David Birkhoff. The initial endowment of $2,066 was contributed by the Birkhoff family and there have been subsequent additions by others. It is normally awarded every five years, beginning in 1968, for an outstanding contribution to "applied mathematics in the highest and broadest sense." The award is made jointly by the American Mathematical Society and the Society for Industrial and Applied Mathematics. The recipient must be a member of one of these societies and a resident of the United States, Canada, or Mexico.

First award, 1968: To Jürgen K. Moser for his contributions to the theory of Hamiltonian dynamical systems, especially his proof of the stability of periodic solutions of Hamiltonian systems having two degrees of freedom and his specific applications of the ideas in connection with this work.

Second award, 1973: To Fritz John for his outstanding work in partial differential equations, in numerical analysis, and, particularly, in nonlinear elasticity theory; the latter work has led to his study of quasi-isometric mappings as well as functions of bounded mean oscillation, which have had impact in other areas of analysis.

Third award, 1973: To James B. Serrin for his fundamental contributions to the theory of nonlinear partial differential equations, especially his work on existence and regularity theory for nonlinear elliptic equations, and applications of his work to the theory of minimal surfaces in higher dimensions.

Fourth award, 1978: To Garrett Birkhoff for bringing the methods of algebra and the highest standards of mathematics to scientific applications.

Fifth award, 1978: To Mark Kac for his important contributions to statistical mechanics and to probability theory and its applications.

Sixth award, 1978: To Clifford A. Truesdell for his outstanding contributions to our understanding of the subjects of rational mechanics and nonlinear materials, for his efforts to give precise mathematical formulation to these classical subjects, for his many contributions to applied mathematics in the fields of acoustic theory, kinetic theory, and nonlinear elastic theory, and the thermodynamics of mixtures, and for his major work in the history of mechanics.

Seventh award, 1983: To Paul R. Garabedian for his important contributions to partial differential equations, to the mathematical analysis of problems of transonic flow and airfoil design by the method of complexification, and to the development and application of scientific computing to problems of fluid dynamics and plasma physics.

Eighth award, 1988: To Elliott H. Lieb for his profound analysis of problems arising in mathematical physics.

The Norbert Wiener Prize in Applied Mathematics

This prize was established in 1967 in honor of Professor Norbert Wiener and was endowed by a fund amounting to $2,000 from the Department of Mathematics of the Massachusetts Institute of Technology. The prize is normally awarded every five years, beginning in 1970, for an outstanding contribution to "applied mathematics in the highest and broadest sense." The award is made jointly by the American Mathematical Society and the Society for Industrial and Applied Mathematics. The recipient must be a member of one of these societies and a resident of the United States, Canada, or Mexico.

First award, 1970: To Richard E. Bellman for his pioneering work in the area of dynamic programming, and for his related work on control, stability, and differential-delay equations.

Second award, 1975: To Peter D. Lax for his broad contributions to applied mathematics, in particular, for his work on numerical and theoretical aspects of partial differential equations and on scattering theory.

Third award, 1980: To Tosio Kato for his distinguished work in the perturbation theory of quantum mechanics.

Fourth award, 1980: To Gerald B. Whitham for his broad contributions to the understanding of fluid dynamical phenomena and his innovative contributions to the methodology through which that understanding can be constructed.
Fifth award, 1985: To Clifford S. Gardner for his contributions to applied mathematics in the areas of supersonic aerodynamics, plasma physics and hydromagnetics, and especially for his contributions to the truly remarkable development of inverse scattering theory for the solution of nonlinear partial differential equations.

Sixth award, 1990: To Michael Aizenman for his outstanding contribution of original and non-perturbative mathematical methods in statistical mechanics by means of which he was able to solve several long open important problems concerning critical phenomena, phase transitions, and quantum field theory; and to Jerrold E. Marsden for his outstanding contributions to the study of differential equations in mechanics: he proved the existence of chaos in specific classical differential equations; his work on the momentum map, from abstract foundations to detailed applications, has had great impact.

The Leroy P. Steele Prizes

These prizes were established in 1970 in honor of George David Birkhoff, William Fogg Osgood, and William Caspar Graustein, and are endowed under the terms of a bequest from Leroy P. Steele. From 1970 to 1976 one or more prizes were awarded each year for outstanding published mathematical research; most favorable consideration was given to papers distinguished for their exposition and covering broad areas of mathematics. In 1977 the Council of the AMS modified the terms under which the prizes are awarded. Since then, up to three prizes have been awarded each year in the following categories: (1) for the cumulative influence of the total mathematical work of the recipient, high level of research over a period of time, particular influence on the development of a field, and influence on mathematics through Ph.D. students; (2) for a book or substantial survey or expository-research paper; (3) for a paper, whether recent or not, that has proved to be of fundamental or lasting importance in its field, or a model of important research.


1976, 1977, 1978: No awards were made.

January 1979: To Salomon Bochner for his cumulative influence on the fields of probability theory, Fourier analysis, several complex variables, and differential geometry.


August 1979: To Antoni Zygmund for his cumulative influence on the theory of Fourier series, real variables, and related areas of analysis.


August 1980: To André Weil for the total effect of his work on the general course of twentieth century mathematics, especially in the many areas in which he has made fundamental contributions.


August 1980: To Gerhard P. Hochschild for his significant work in homological algebra and its applications.

August 1981: To Oscar Zariski for his work in algebraic geometry, especially his fundamental contributions to the algebraic foundations of this subject.


August 1982: To Fritz John for the cumulative influence of his total mathematical work, high level of research over a period of time, particular influence on the development of a field, and influence on mathematics through Ph.D. students.

August 1983: To Paul R. Halmos for his many graduate texts in mathematics and for his articles on how to write, talk and publish mathematics.


August 1983: To Shiing-Shen Chern for the cumulative influence of his total mathematical work, high level of research over a period of time, particular influence on the development of the field of differential geometry, and influence on mathematics through Ph.D. students.


August 1984: To Joseph L. Doob for his fundamental work in establishing probability as a branch of mathematics and for his continuing profound influence on its development.


August 1985: To Hassler Whitney for his fundamental work on geometric problems, particularly in the general theory of manifolds, in the study of differentiable functions on closed sets, in geometric integration theory, and in the geometry of the tangents to a singular analytic space.


January 1986: To Rudolf E. Kalman for his two fundamental papers: *A new approach to linear filtering and prediction problems*, Journal of Basic Engineering, volume 82, (1960), pp. 35-45; and *Mathematical description of linear dynamical systems*, SIAM Journal on Control and Optimization, volume 1 (1963), pp. 152-192; and for his contribution to a third paper, (with R. S. Bucy) *New results in linear filtering and

**January 1986**: To Saunders Mac Lane for his many contributions to algebra and algebraic topology, and in particular for his pioneering work in homological and categorical algebra.

**August 1987**: To Martin Gardner for his many books and articles on mathematics and particularly for his column "Mathematical Games" in *Scientific American*.


**August 1987**: To Samuel Eilenberg for his fundamental contributions to topology and algebra, in particular for his classic papers on singular homology and his work on axiomatic homology theory which had a profound influence on the development of algebraic topology.


**August 1988**: To Deane Montgomery for his lasting impact on mathematics, particularly mathematics in America. He is one of the founders of the modern theory of transformation groups and is particularly known for his contributions to the solution of Hilbert’s fifth problem.


**August 1989**: To Irving Kaplansky for his lasting impact on mathematics, particularly mathematics in America. By his energetic example, his enthusiastic exposition, and his overall generosity, he has made striking changes in mathematics and has inspired generations of younger mathematicians.

**August 1990**: To Raoul Bott for having been instrumental in changing the face of geometry and topology, with his incisive contributions to characteristic classes, K-theory, index theory, and many other tools of modern mathematics.


**August 1991**: To Eugenio Calabi for his fundamental work on global differential geometry, especially complex differential geometry.

**August 1991**: To Armand Borel for his extensive contributions in geometry and topology, the theory of Lie groups, their lattices and representations and the theory of automorphic forms, the theory of algebraic groups and their representations and extensive organizational and educational efforts to develop and disseminate modern mathematics.

**The Delbert Ray Fulkerson Fund**

Gifts of friends of the late Professor Fulkerson have provided a fund in excess of $7,000. Part or all of the proceeds is to be used jointly by the Mathematical Programming Society and the American Mathematical Society for the award of one or more prizes in discrete mathematics at regular intervals.


The Ruth Lyttle Satter Prize in Mathematics
The prize was established in 1990 using funds donated by Joan S. Birman in memory of her sister, Ruth Lyttle Satter. Professor Birman requested that the prize be established to honor her sister’s commitment to research and to encouraging women in science. The prizes are awarded every two years to recognize an outstanding contribution to mathematics research by a woman in the previous five years.

First award, 1991: To Dusa McDuff for her outstanding work during the past five years on symplectic geometry.

Award for Distinguished Public Service
To provide encouragement and recognition to those individuals who contribute their time to public service activities in support of mathematics, the Council of the Society established the Award for Distinguished Public Service. The award was established in response to a recommendation by the Society’s Committee on Science Policy. The award is presented every two years to a research mathematician who has made a distinguished contribution to the mathematics profession during the preceding five years.

First Award, 1990: Kenneth M. Hoffman

Citation for Public Service
To provide encouragement and recognition for contributions to public service activities in support of mathematics, the Council of the Society established the Citation for Public Service. The award was established in response to a recommendation by the Society’s Committee on Science Policy. One to three citations are presented each year for notable contributions to the mathematics profession through public service.

First award, 1991: Andre Z. Manitius

Special Funds
AMS Centennial Fellowship Fund
This fund was established by the Society in 1973 and provides one-year Research Fellowships awarded each year in March. The number of fellowships granted each year depends on the contributions the Society receives, matched by a contribution from the Society of not more than $30,000. Through the academic year 1983-1984, this was a postdoctoral fellowship, restricted to persons only a few years past the Ph.D. In the competition of January 1984, it was changed to an early mid-career fellowship, for persons five to ten years past the Ph.D. At the same time, the stipend was substantially increased. For the 1988 award, the name of the fellowship was changed from AMS Research Fellowship to AMS Centennial Fellowship in honor of the Society’s Centennial.

First award, 1974-1975: Fred G. Abramson and James Li-Ming Wang.


Thirteenth award, 1986-1987: Dinakar Ramakrishnan

Fourteenth award, 1987-1988: Richard Hain and Bill Jacob

Fifteenth award, 1988-1989: Stephen R. Bell, Don M. Blasius, and David Gabai


The Levi L. Conant Fund
Levi L. Conant bequeathed a sum of $9,500 which the Trustees incorporated with the permanent endowments for prize funds.

The Karl Menger Fund
The family of the late Karl Menger were the major contributors to a fund established at Duke University totalling $40,000. The majority of the income from this fund is to be used by the Society for annual awards at the International Science and Engineering Fair.

The Eliakim Hastings Moore Fund
This fund was donated in 1922 in honor of Professor Eliakim Hastings Moore on the occasion of the twenty-fifth anniversary of the Chicago (Western) section of the Society. The fund is $2,575 and the income from the fund is to be used at the discretion of the Council for the publication of important mathematical books and memoirs and for the award of prizes.

The C. V. Newsom Fund
In 1990 the Society received a bequest of $100,000 from the estate of Carroll V. Newsom. The bequest was made to memorialize John von Neumann and his accomplishments. The income from this fund is to be used to support a quadrennial symposium, called the von Neumann Symposium, that will focus on fundamental concepts in the forefront of mathematics.

The Joseph Fels Ritt Memorial Fund
From the estate of Estelle F. Ritt, the income from a fund of $22,500 is available for the publication of works in the field of mathematics as shall be determined by the governing bodies of the Society.

The Waldemar J. Trjitzinsky Fund
A bequest of $189,000 was received in 1988 from the estate of Barbara G. Trjitzinsky to establish a fund in memory of her husband, Waldemar J. Trjitzinsky. The income from this fund is to be used for needy students studying in the field of mathematics.

Friends of Mathematics Fund
A Friends of Mathematics Fund has been created to incorporate monetary gifts to the Society of a general nature. The principle of this fund is now $123,572. The proceeds of the fund are a part of the invested assets of the Society. The following gifts are components of this fund: $1,000 from the estate of Professor Ernest William Brown; $1,000 from the estate of Genevra B. Hutchinson; $3,000 from Solomon A. Joffe; $650 from the estate of Professor Helen A. Merrill; $23,600 from the estate of Dean Marion Reilly; $1,000 from the estate of James K. Whittemore; and $2,700 from an anonymous donor.

Several Complex Variables and Complex Geometry
Eric Bedford, John P. D'Angelo, Robert E. Greene, and Steven G. Krantz, Editors
(Proceedings of Symposia in Pure Mathematics, Volume 52)

This three-volume set contains the proceedings of the Summer Research Institute on Several Complex Variables and Complex Geometry, held at the University of California at Santa Cruz in July 1989. The institute explored recent developments in the geometry and function theory of several complex variables. An attempt was made to stimulate interactions among the different methodologies in the subject, such as differential geometry, algebraic geometry, partial differential equations, harmonic analysis, and classical methods. The topics covered include function theory, complex geometry, partial differential equations, functional analysis, and analysis in manifolds. With contributions by some of the world's top experts in several complex variables and complex geometry, this book provides readers with insight into the current state of this field.

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Miscellaneous

Personals
Alberto Seeger, of the University of Barcelona, Spain, has accepted the position of Professor of Mathematics at the University of Avignon, France.

Deaths
Albert Carson, of Dayton, Ohio, died on March 17, 1990, at the age of 82. He was a member of the Society for 54 years.

Nancy Cole, Associate Professor Emeritus of Syracuse University, died on July 7, 1991, at the age of 89. She was a member of the Society for 62 years.

Allen Byron Cunningham, of West Virginia University, died on May 3, 1991, at the age of 79. He was a member of the Society for 50 years.

Monroe D. Donsker, of New York University–Courant Institute, died on June 8, 1991, at the age of 66. He was a member of the Society for 46 years.

John M. Reiner, of Denver, Colorado, died on July 19, 1991, at the age of 71. He was a member of the Society for 26 years.

Visiting Mathematicians

Supplementary List

Farag Attia, (Egypt and Kuwait), Portland State University, Statistics, 8/90-8/92.

Yunping Cheng, (People’s Republic of China), Portland State University, Computational Mathematics, 1/91-12/91.

Hai-gon Je, (Korea), Portland State University, Real Analysis and Measure Theory, 12/91-12/92.

Kwang-Bok Lee, (Korea), Portland State University, Analytic Functions, 12/91-12/92.

V. Pestov, (USSR), University of Victoria, Topological Algebra, Model Theory, and Mathematical Physics, 9/91-5/92.

Gao Qixian, (People’s Republic of China), Portland State University, Biostatistics, 10/91-4/92.

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• Recursive function theory and mathematical logic
• Boolean functions

Volume 5
Reliability of Computer and Communication Networks
Frank Hwang, Clyde Monma, and Fred Roberts, Editors

This workshop, held at Rutgers University, emphasized the latest trends and important open problems concerning the reliability of increasingly complex modern systems of telecommunications, information transmissions, transportation, and distribution. Participants of the workshop included theoretical mathematicians, computer scientists, and electrical engineers from academia and industry. The success of the workshop in fostering many new interactions among researchers and practitioners is reflected in the proceedings, which provide an exciting look at some of the major advances at the forefront of this important field of research.

1991 Mathematics Subject Classifications: 05, 68, 90, 94
New Members of the AMS

ORDINARY MEMBERS
Aaron Abrams, San Jose, CA
LekeSh M Aggarwal, Staten Island, NY
Ahmed M Al-Ghabban, Manhattan, KS
Pablo Sebastian Armas, Buenos Aires, Argentina
Mercedes Arribas, Univ de Zaragoza, Spain
George Arvanitopoulos, Athens, Greece
Bruce Allen Babcock, Mount Laurel, NJ
Anne-Marie J Balboni, Glocester, RI
Line Baribeau, Univ of Laval, Quebec, Canada
Ahmed M Al-Ghabban, Manhattan, NY
George Arvanitopoulos, Athens, Greece
William C Hiester, Lawrence Livermore National Laboratory, CA
Natalio H Gonzalez, Buenos Aires, Argentina
Erik Bell, Arden, NC
Yu M Berezanskii, Ukrainian Academy of Sciences, Kiev, USSR
Bassarn Abbas Bamieh, Rice Univ
William C Hiester, Lawrence Livermore National Laboratory, CA
Incorporated, Cambridge, MA
Bosco Garcia-Archilia, Univ of Guadalajara, Mexico
Kumar Bissu, Udaipur, India
Hector Garcia, Univ of Arizona, Tucson
Harry Caplan, Danville, CA
V A Jia-Ding Cao, Fudan Univ
M L Blank, USSR Academy of Science, Moscow
Sushil Kumar Bissu, Sakhadia Univ, Udaipur, India
Virco LeBlond, New Delhi, India
Gary L Gray, Univ of Wisconsin, Madison
Ji-Shen Guo, Pace Univ, New York, NY
Benjamin P Carter, Manhattan Beach, CA
Dario Castellanos, Valencia, Venezuela
John Brian Clifford, Fort Walton Beach, FL
James Maurice Cobb, Wheeling, WV
Herbert E Cohen, Randallstown, MD
John Bryant Collings, Alamosa, CO
Ronald A Collins, Riverdale, MD
Robert C Cox, Round Rock, TX
John William Craig, Fort Walton Beach, FL
James A Dare, Fort Wayne, IN
Rhonda LaVerne Datcher, College Park, MD
Zhen Xi Dong, Peking Univ
Beijing, People's Republic of China
Douglas A Drake, Hebron, NE
Theresa Mary DuRapax, New Orleans, LA
Richard Timothy Eakin, Austin, TX
Ejecheveria, Univ of Pais Vasco, San Sebastian, Spain
Frances A Elliott, North Barrington, IL
Nathan Elliott, Livingston Univ, AL
Elaine Cook Ensign, College, AK
Rosemary Carroll Farley, Youngstown, OH
Leonard Feldman, Berkeley, CA
Juan C Ferrando Perez, Univ Politecnica de Valencia, Spain
Jeffrey J Fleetman, Bangor, PA
Daniel Alberto Figueroa, Santiago, Chile
John L Flanagan, New York, NY
Kevin J Francis, Worth, IL
Bosco Garcia-Archilia, Univ of Valladolid, Spain
Constantinos Georgiou, Univ of Patras, Greece
Richard G Gibson, Berkeley, CA
E Paul Goldenberg, Educational Development Center, Newton, MA
Donald I Good, Austin, TX
David Lee Gordon, Tokyo, Japan
Per O Grape, Stockholm, Sweden
Gary L Gray, Univ of Wisconsin, Madison
William E Gipsermer, Kindred Public School, ND
Aaron Gross, Univ of California Santa Barbara
Natalio H Guezeznvaig, Buenos Aires, Argentina
Oretha W Hargro, Vacaville, CA
David B Hartvigsen, Northwestern Univ, Evanston, IL
James F Hartzell, Scarsdale, NY
Eugene J Hebert Jr, Philadelphia, PA
Eduardo A Hernandez, Univ of Santiago, Chile
James Logan Higgins, Wichita, KS
James Alan Hoffman, Catoosa, OK
Jeff David Hoft, Iowa City, IA
Lori G Holcombe, Chico, CA
David Holland, McMaster Univ
Hamilton, Ontario Canada
Ali Hoooshvar, Univ of Texas at Dallas, Richardson
Sharyn Nancy Hoover, Charlotte, NC
Mary Ann Horn, Univ of Virginia, Charlottesville
Eric Hughes, Berkeley, CA
Ann Marie Huntz, Woburn, MA
Cullen L Inman, Newton, NJ
James N Issos, Tallahassee, FL
Adrien C Jami, Paris, France
Sherry Anne Jacques, Bolivar, NY
Michael Joseph Johnson, Endwell, NY
Kathy Jones, Pasadena, MD
Gregory Singh Juneja, Framingham, MA
Alexander Karsen, Beckman Instruments, Brea, CA
Constantine Kelesoglou, Marathon Oil, Littleton, CO
Alaa M Khalil, Cinncinnati, OH
Paula Kim, Santa Clara, CA
Peter H Kleban, Univ of Mainz, Germany
Yukio Kobayashi, Fayetteville, AR
Albert Erik Kolman, Saint Mary's College, Winona, MN
B G Konopelchenko, Institute of Nuclear Physics, Novosibirsk, USSR
Kenneth William Koput, Univ of California Berkeley
Michele Louise Kosinskiemi, Tucson, AZ
Kenneth K Kovacs, Ann Arbor, MI
Vadim D Kryakov, Rostov-on-Don, USSR
Ratnesh Kumar, Univ of Kentucky, Lexington
Nguyen Anh Ky, Bulgarian Academy of Science, Sofia
Harold L Lark II, Rochester, NY
Johan M Lammens, SUNY at Buffalo, NY
Richard C LeBorne, San Diego, CA
Miriam A Leiva, Washington, DC
Javny M Y Leung, Univ of Arizona, Tucson
Jin Kun Lin, Nankai Univ, Tianjin, China
People's Republic of China
O Lipovou, Timisoara, Romania
Mu Lan Liu, Academia Sinica, Beijing, People's Republic of China
Shu Lin Liu, Academia Sinica, Beijing, People's Republic of China
Estela S Linas, Univ of Pittsburgh Greensburg, Greensburg, PA
John E Long, Minneapolis, MN
Thomas Kojo Maude, Whittier, CA
Lakshminarayanam Mahadevan, Stanford Univ, CA
Babak Mahbod, Computer, Portland, OR
Tinyaw Mak, Indiana Univ of Pennsylvania, Indiana, PA
Rafael Maradiaga, Tegucigalpa, Honduras
Leandro Marin-Munoz, Murcia, Spain
Wilfredo Martinez, Rio Grande, PR
Cameron Mashayekhi, Sandy, UT
January August May Jr, Muncie, IN
John Paul Timothy Menard, Danville, CA
Jill Menzies, Auburn, AL
David John Michael, Raleigh, NC
John-Paul Timothy Menard, Danville, CA
Joseph Michels, Mililani, HI
Ashish J Modhera, Wilmington, DE
Jan Montgomery, Camp Hill, PA
Augusto Moraes, Troy, NY
New Members of the AMS

John J Morgan, Huntington Beach, CA
Mohammad Mozaffari, Houston, TX
Barbara Lee Maddoff, Skokie, IL
Kathleen Denise Naylor, Kettering, OH
David W Newhouse, Amarillo, TX
Thomas Edward Nordahl, Davis, CA
Mikhail Nikolajewitsch Novikov, Bowling Green, KY
Carroll Jay Nunn, Chapel Hill, NC
Julianne September Nuzman, Aberdeen, MD
Julie K Orr, College Park, MD
Jennifer Steichen Ortiz, San Jose, CA
Pamela L Overfelt, Inyokern, CA
Anangyros Papageorgiou, City College (CUNY), New York, NY
Young-June Park, Seoul, Korea
Mark James Paton, Buckinghamshire, England
Karen Whitney Patterson, Salisbury State Univ, MD
Christopher Bishop Pedonesi, Tampa, FL
John C Peterson, Knoxville, TN
Karen D Phillips, Tuscaloosa, AL
Michel Plathey, Thorey-en-Plaine, France
Karen Whitney Patterson, Salisbury State Univ, MD
Mark James Paton, Buckinghamshire, England
Karen Whitney Patterson, Salisbury State Univ, MD
John C Peterson, Knoxville, TN
Karen D Phillips, Tuscaloosa, AL
Michel Plathey, Thorey-en-Plaine, France
Anthony Joseph Plozai, Marquette, WI
Wayne N Polyzou, Univ of Iowa, Iowa City
Daniel B Pouquet-Barthez, Avranches, France
Alexander A Premet, Academy of Sciences of the Belorussian SSR, Minsk, USSR
Cam Van Quach-Hongler, Gland, Switzerland
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Maziar Shirvani, Univ of Alberta, Edmonton, Canada
Jitimie A Simion, Jackson Heights, NY
Karen L Simmons, Bonneau, SC
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Carole P Sokolowski, Merrimack, MA
George Robert Spahl, Jacksonville, FL
Sandra Linck Spain, Hampton, VA
Russel L Staey, Deer Park, TX
John David Starrett, Denver, CO
Michael Stettin, Northwestern Univ, Evanston, IL
Jurgen Olivier Stiger, Delft, Netherlands
Douglas J Strand, Westborough, MA
Karl Srehn, MLU
Halle-Wittenberg, Germany
Hasagawa Takemitsu, Fukui Univ, Japan
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Chan-Nhu Trinh, Collinssville, IL
Daniel Joseph Tucker, James Madison Univ, Harrisonburg, VA
Dorothy I Tyczczyszyn, Bayonne, NJ
Roy F Unger, Depford, NJ
Mary Vasconcelos, Miami, FL
Ellen Venable, Santa Cruz, CA
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Österreichische Mathematische Gesellschaft
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University of Colorado, Boulder
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Weiming Zhang
University of Montana
Peiyong Qu
University of Oregon
Jon M Clauss
University of Regina
Chenkuan Li
Western Illinois University
Ming Xu
We anticipate having two or more tenure track positions at the Assistant Professor or possibly higher rank available for fall 1992. Primary consideration will be given to filling positions in the areas of Discrete Geometry and Harmonic Analysis. If we fail to find highly qualified applicants in these areas or more positions become available we will give secondary consideration to applicants in the areas of Set Theory, Dynamical Systems, and Analysis. Successful applicants will have earned a Ph.D. degree in Mathematics and have demonstrated potential for teaching and ability to do research in these areas. We will begin our selection process on January 1, 1992.

Send vita and have three letters of recommendation sent to George Kozlowski, Head, Department of Foundations, Analysis, and Topology, Auburn University, AL 36849-5310. Minorities and women are encouraged to apply. Auburn University is an Equal Opportunity/Affirmative Action Employer.

AUBURN UNIVERSITY
Department of Algebra, Combinatorics and Analysis

Applicants in combinatorics are sought for a tenure-track appointment at the rank of assistant professor expected to be made in beginning September 1992. Preference given to candidates in discrete optimization, coding theory, cryptology, extremal set theory, or association schemes.

Some temporary one-year appointments at the rank of assistant professor are also expected beginning September 1992. Preference given to applicants in differential equations. Those in algebra, analysis, combinatorics, linear algebra or probability considered. Research interest compatible with current faculty.

Ph.D. and excellence in both teaching and research required for all positions. Send resume and arrange for at least three letters of recommendation to be sent to James R. Wall, 120 Math Annex, Auburn University, AL 36849-5307. Minorities and Women are encouraged to apply. Auburn University is an Equal Opportunity/Affirmative Action Employer.

THE UNIVERSITY OF ALABAMA
AT BIRMINGHAM
Department of Mathematics

Applications are invited for tenure-track positions at all levels to begin September 1992. Applicants for a junior level position should have strong research potential as well as a commitment to teaching undergraduate and graduate students. Applicants with post-doctoral experience are especially welcome. Applicants for senior level positions with tenure should have an exceptional record in research including research grants and a record of good teaching. Preference will be given to candidates whose research is compatible with that of our current faculty: this includes dynamical systems, differential geometry, mathematical physics, non-linear analysis, partial differential equations including numerical p.d.e., and topological dynamics. To apply please send a curriculum vitae, selected reprints, and at least three letters of reference. Senior applicants may request that the Search Committee contact the references—please make that clear in the cover letter. Send applications to the following address:

Search Committee
Department of Mathematics
University of Alabama at Birmingham
Birmingham, AL 35294-2060

For full consideration applications should be received by February 15, 1992. UAB is an Affirmative Action/Equal Opportunity Employer.

NORTHERN ARIZONA UNIVERSITY
Flagstaff, Arizona

The Department of Mathematics announces tenure-track openings for Fall 1992. Ordinary Differential Equations. Assistant Professor with specialty in the geometric theory of dynamical systems supporting work of our existing special research focus, especially planar systems with polynomial right hand sides and bifurcation theory.

Mathematics Education. Professor with commensurate record of research, leadership at the university and national level, and experience with teacher education programs.

Statistics. Assistant Professor with strong theoretical background and interest in intramural consulting; with preference given to those with actuarial expertise. Each requires a doctorate, demonstrated potential for a productive, quality research program, and substantial evidence of high quality teaching.

Flagstaff is located in the cool pine forests of Northern Arizona; near high mountains and numerous natural attractions. NAU has an on-campus enrollment of approximately 14,000. The Department of 31 faculty offers Bachelor’s and Master’s degree programs.

Send vita, direct three letters of reference to Screening Committee, Department of Mathematics, P.O. Box 5717, NAU, Flagstaff, AZ 86011. The searches will remain open until the positions are filled; however, the Screening Committee will begin reviewing applications on January 3, 1992. Northern Arizona University is an Equal Opportunity/Affirmative Action Institution. Women and minorities are encouraged to apply.

NORTHERN ARIZONA UNIVERSITY
Department Chair

The Department of Mathematics seeks a dynamic individual to lead a progressive depart-

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ment with a balanced teaching-research-service mission in a growing comprehensive university. Qualifications include an earned doctorate in mathematics, or mathematics through the doctoral qualifying level plus a doctorate in mathematics education or statistics; a record of high quality university teaching and research; extensive professional service including leadership roles; excellent administrative skills; excellent communication and interpersonal skills; recent, extensive experience in a mathematics department; and broad knowledge of academic mathematics, mathematics education and statistics. The starting date is July 1, 1992.

The department of 32 permanent faculty offers degree programs through the master's level with emphasis in mathematics, mathematics education, statistics and actuarial science. Our programs have experienced consistent strong growth during the last several years. Faculty have active research interests in algebra, analysis, combinatorics, geometry, mathematics education, statistics and topology. Special research concentrations have recently been established in combinatorics and dynamical systems. In addition, the department is actively involved in initiatives of regional and national interest including calculus reform, use of technology and participation of minorities.

NAU has a current on-campus enrollment of about 14,600 students. It lies on the southern edge of Flagstaff, a city of about 45,000, at an altitude of 7000 feet. The setting is mountainous, pine-forested and cool, with four distinct seasons, a relatively dry climate, abundant blue skies and generous winter snows. Nearby attractions include spectacular canyons, national forests, high mountains, large recreation areas, numerous national parks and monuments, and Indian ruins.

To apply, send letter of application, vita and statement of academic philosophy and direct four letters of reference to: Mathematics Chair Screening Committee, College of Arts and Sciences, P.O. Box 5621, Northern Arizona University, Flagstaff, AZ 86011-5621. The search will remain open until the position is filled; however, the screening committee will begin reviewing applications on December 13, 1991.

NAU IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION INSTITUTION. WOMEN AND MINORITIES ARE ENCOURAGED TO APPLY.

UNIVERSITY OF ARIZONA
Department of Mathematics
Tucson, Arizona 85721

The Mathematics Department at the University of Arizona is happy to announce several positions which will be available beginning Fall 1992.

Tenure-track positions. Excellent research record or potential, strong commitment to teaching required. Fields should complement but not duplicate existing department research strengths in algebra, arithmetic geometry, computational science, differential equations, dynamical systems, fluid mechanics, differential geometry, mathematical physics, nonlinear analysis, nonlinear science, number theory, and probability.

Postdoctoral Fellowships (Research Associate). Applicants with strengths in all areas compatible with department interests are encouraged to respond. In addition, special Center of Excellence Awards in nonlinear optics and fluid mechanics are available.

The Mathematics Department will also have several visiting positions for next year.

We encourage early application. Deadline date will be December 15, 1991 or whenever positions are filled. Women and minority applicants are especially welcome. Send application, which should include a letter of interest, curriculum vitae with a list of publications, and a minimum of three (3) letters of recommendation (enclose or arrange to be sent), to:

Alan C. Newell, Chairman
Personnel Committee
Department of Mathematics
University of Arizona
Tucson, Arizona 85721, USA

The University of Arizona is an Affirmative Action/Equal Opportunity Employer.

CALIFORNIA POLYTECHNIC STATE UNIVERSITY

Tenure-Track Position, Mathematics Department. Salary commensurate with qualifications and experience. Available (pending funding) for the 1992-93 academic year. Teaching load is 12 units per quarter plus 3 units of instructionally related responsibilities. Doctorate in mathematics required. Strong commitment to both teaching and research expected. Closing date: January 1, 1992. Additional information or application, contact Screening Committee Chair, Mathematics Department, CAL POLY, San Luis Obispo, CA 93407. AA/EOE.

CALIFORNIA INSTITUTE OF TECHNOLOGY
Applied Mathematics

Postdoctoral positions as Research Fellow for one or possibly two years doing joint research under the direction of senior faculty are available. The research is sponsored and frequently involves large scale computations in some areas of continuum mechanics and fluid dynamics. Research in numerical analysis and parallel computing is also active. Current salaries are about $30,000 for 11 months. Send detailed vita, bibliography and three letters of reference to The Executive Officer, Applied Mathematics 217-50, Caltech, Pasadena, CA 91125. Caltech is an Equal Opportunity/Affirmative Action Employer. Women and minorities are encouraged to apply.

CALIFORNIA STATE POLYTECHNIC UNIVERSITY
Pomona, CA

The College of Science invites applications and nominations for the position of Chair of the Mathematics Department. Doctorate in Mathematics or equivalent degree. Record of successful administrative, teaching and scholarly research required. Evidence of commitment to promoting teaching, research, and other scholarly activities. Application, resume, copy of transcripts and three current letters of reference to be received by 12/15/91. For additional information or to apply contact: Search Committee, Mathematics Department, California State Polytechnic University, 3801 W. Temple Ave., Pomona, CA 91768-4033. (714) 869-3487. EOE/AA

MILLS COLLEGE
Department of Mathematics
and Computer Science
Oakland, California 94613

Mills College is seeking outstanding candidates for two tenure-track positions, commencing Fall 1992. The first is Assistant Professor of Computer Science. A Ph.D. in Computer Science is required. The second is Assistant Professor of Computer Science and Director of the Interdisciplinary Computer Science Master's Degree Program. A strong computer science back-
STANFORD UNIVERSITY
Department of Mathematics

Assistant Professorships in honor of Gabor Szegő.

The Department of Mathematics expects to make one or more appointments in 1992-1993 for these special two-year positions. Applicants are expected to show outstanding promise in research and clear evidence of achievement. They should have received the Ph.D. prior to the start of the appointment but not before 1990. 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. Solomon Feferman, Chairman, Dept. of Mathematics, Stanford University, Stanford, CA 94305-2125, by January 1, 1992. Stanford is an Equal Opportunity, Affirmative Action Employer, and welcomes applications from women and minorities.

STANFORD UNIVERSITY
Department of Mathematics

The department expects to make at least one tenure-track or tenured appointment beginning September 1992, among the following fields: (1) analysis, (2) geometry or topology, (3) algebra, number theory, or logic, (4) applied mathematics or probability; in the last case there are also possibilities for joint appointments with other departments. At the tenured level, preference would go to individuals in the early years of their ranks, though a more senior appointment may be possible for an extremely well-qualified individual. Candidates should send a letter of application and a curriculum vitae with a list of publications, and arrange to have three letters of recommendation and some evidence of commitment to teaching sent to Prof. Solomon Feferman, Department of Mathematics, Stanford University, Stanford, CA, 94305-2125 by January 1, 1992. Stanford is an Equal Opportunity, Affirmative Action Employer, and welcomes applications from women and minorities.

UNIVERSITY OF CALIFORNIA
AT BERKELEY
Department of Mathematics
Berkeley, CA 94720
Tenured Position

We invite applications for one or more positions effective July 1, 1992 at tenured level (Associate or full Professor), subject to budgetary approval, in the areas of algebra, analysis, applied mathematics, foundations, or geometry and topology. Demonstrated leadership in research is expected of applicants. Applicants should send a curriculum vitae, a list of publications, a few selected reprints or preprints, and the names of three references to The Vice Chair for Faculty Affairs at the above address. We should receive this material no later than January 15, 1992. The University of California is an Equal Opportunity, Affirmative Action Employer.

UNIVERSITY OF CALIFORNIA
AT BERKELEY
Department of Mathematics
Berkeley, CA 94720
Assistant Professorships

We invite applications for one or more positions effective July 1, 1992, at the tenure-track Assistant Professor level, subject to budgetary approval, in the areas of algebra, analysis, applied mathematics, foundations, or geometry and topology. Applicants are expected to have demonstrated outstanding research potential, normally including major contributions beyond the doctoral dissertation. Applicants should send a resume, and reprint or preprints, and/or dissertation abstract, and ask three people to send letters of recommendation to The Vice Chair for Faculty Affairs at the above address. We should receive this material no later than January 15, 1992. The University of California is an Equal Opportunity, Affirmative Action Employer.

UNIVERSITY OF CALIFORNIA
AT BERKELEY
Department of Mathematics
Berkeley, CA 94720
Charles B. Morrey, Jr.
Assistant Professorships

We invite applications for these special two-year (nontenure-track) positions effective July 1, 1992. Applicants should have a recent Ph.D. in the areas of algebra, analysis, applied mathematics, foundations, or geometry and topology, and should have demonstrated superior research potential. Applicants should send a resume, reprints, preprints and/or dissertation abstract, and ask three people to send letters of recommendation to Charles B. Morrey, Jr., Department of Mathematics, University of California, Berkeley, CA 94720. We should receive this material no later than January 15, 1992. The University of California is an Equal Opportunity, Affirmative Action Employer.

STANFORD UNIVERSITY
Department of Mathematics

Assistants or Associate Professors in number theory, analysis, probability, or logic. The Department of Mathematics seeks to make a number of permanent appointments beginning September 1, 1992. Experience and qualifications are expected to show outstanding promise in research and clear evidence of achievement. Salary will depend on experience and qualifications. The initial contract will be for three years, subject to final administrative approval. Please send vita, and direct three letters of reference, to: Chair, Computer Science Search Committee Mills College Oakland, California 94613

The deadline for applications is January 10, 1992. Mills College is an Equal Opportunity Employer.

STANFORD UNIVERSITY
Department of Mathematics

The Department of Mathematics expects to make one or more appointments in 1992-1993 for these special two-year positions. Applicants are expected to show outstanding promise in research and clear evidence of achievement. They should have received the Ph.D. prior to the start of the appointment but not before 1990. 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. Solomon Feferman, Chairman, Dept. of Mathematics, Stanford University, Stanford, CA 94305-2125, by January 1, 1992. Stanford is an Equal Opportunity, Affirmative Action Employer, and welcomes applications from women and minorities.

STANFORD UNIVERSITY
Department of Mathematics

The department expects to make at least one tenure-track or tenured appointment beginning September 1992, among the following fields: (1) analysis, (2) geometry or topology, (3) algebra, number theory, or logic, (4) applied mathematics or probability; in the last case there are also possibilities for joint appointments with other departments. At the tenured level, preference would go to individuals in the early years of their ranks, though a more senior appointment may be possible for an extremely well-qualified individual. Candidates should send a letter of application and a curriculum vitae with a list of publications, and arrange to have three letters of recommendation and some evidence of commitment to teaching sent to Prof. Solomon Feferman, Department of Mathematics, Stanford University, Stanford, CA, 94305-2125 by January 1, 1992. Stanford is an Equal Opportunity, Affirmative Action Employer, and welcomes applications from women and minorities.

STANFORD UNIVERSITY
Department of Mathematics

The department expects to make at least one tenure-track or tenured appointment beginning September 1992, among the following fields: (1) analysis, (2) geometry or topology, (3) algebra, number theory, or logic, (4) applied mathematics or probability; in the last case there are also possibilities for joint appointments with other departments. At the tenured level, preference would go to individuals in the early years of their ranks, though a more senior appointment may be possible for an extremely well-qualified individual. Candidates should send a letter of application and a curriculum vitae with a list of publications, and arrange to have three letters of recommendation and some evidence of commitment to teaching sent to Prof. Solomon Feferman, Department of Mathematics, Stanford University, Stanford, CA, 94305-2125 by January 1, 1992. Stanford is an Equal Opportunity, Affirmative Action Employer, and welcomes applications from women and minorities.

STANFORD UNIVERSITY
Department of Mathematics

The department expects to make at least one tenure-track or tenured appointment beginning September 1992, among the following fields: (1) analysis, (2) geometry or topology, (3) algebra, number theory, or logic, (4) applied mathematics or probability; in the last case there are also possibilities for joint appointments with other departments. At the tenured level, preference would go to individuals in the early years of their ranks, though a more senior appointment may be possible for an extremely well-qualified individual. Candidates should send a letter of application and a curriculum vitae with a list of publications, and arrange to have three letters of recommendation and some evidence of commitment to teaching sent to Prof. Solomon Feferman, Department of Mathematics, Stanford University, Stanford, CA, 94305-2125 by January 1, 1992. Stanford is an Equal Opportunity, Affirmative Action Employer, and welcomes applications from women and minorities.
utational 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, 1992.

(3) Subject to administrative approval, one or two Adjunct Assistant Professorships in the Program in Computing (PIC). Applicants must show very strong promise in teaching and research, preferably in the general area of logic and computation. Teaching load: four quarter programming courses and an advanced quarter course of the candidate's choice per year. Two-year appointment, possibly renewable once. Salary range $39,600--$47,000. Preference will be given to applications completed by February 1, 1992.

(4) Subject to administrative approval, 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: five quarter programming courses per year. One-year appointment, possibly renewable up to five 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, 1992.

(5) Subject to administrative approval, a few Adjunct Assistant Professorships. One year appointments, probably renewable once. Strong research and teaching background required. Salary $39,900--$40,500. Teaching load: five quarter courses per year.

(6) Subject to administrative approval, several positions for visitors and lecturers.

To apply, write to Thomas M. Liggett, Chair, Department of Mathematics, University of California, Los Angeles, CA 90024-1555. Attn: Staff Search. UCLA is an equal opportunity/affirmative action employer.

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**UNIVERSITY OF CALIFORNIA, SANTA BARBARA**

Department of Mathematics

Applications are invited for the KY FAN ASSISTANT PROFESSORSHIP. The Ky Fan assistant professorship is a special two-year non-renewable position which carries a research stipend. Appointment is effective July 1, 1992. Candidates must possess a Ph.D by September 1992. Selection will be based primarily on demonstrated research achievement. Teaching experience is desirable. Teaching load will consist of four quarter courses per year. To apply send vita and publication list, and arrange to have 3 letters of recommendation sent to: Ky Fan Faculty Search Committee, Department of Mathematics, University of California, Santa Barbara, CA 93106. All applications received by January 10, 1992 will be given thorough consideration. UCSB is an Equal Opportunity/Affirmative Action employer. Proof of U.S. citizenship or eligibility for U.S. employment will be required prior to employment (Immigration Reform and Control Act of 1986).

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**UNIVERSITY OF CALIFORNIA, SANTA CRUZ**

Department of Mathematics

The Mathematics Department at the University of California, Santa Cruz, expects to have J. W. T. Youngs Assistant Professorships in Mathematics beginning Fall 1992. These recently established Assistant Professorships in Mathematics are named in honor of our founding chairman, J. W. T. Youngs. Applicants will be expected to teach, pursue their research, and perform some department or university service. These positions are available for a two-year period with the possibility of an extension for a third year. Minimum Qualifications: Ph.D. in Mathematics and a demonstrated excellence in research and teaching or potential for excellence. Salary Range: $35,900--$37,400 commensurate with qualifications and experience. Available: Fall 1992. Application Deadline: December 15, 1991. Please refer to position #T91-04. Applicants should send vita, three letters of reference, and information about their teaching and research experience to: Recruitment Committee, Mathematics Department, University of California, Santa Cruz, CA 95064. UCSC is an affirmative action/equal opportunity employer.

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**UNIVERSITY OF SOUTHERN CALIFORNIA, LOS ANGELES**

The Department of Mathematics has available several tenure-track or tenured positions at the Assistant and/or Associate Professor level. Applicants must show strong research promise and possess excellent communications skills for teaching undergraduate mathematics courses. Visiting positions (at all levels) and postdoctoral appointments will also be available.

The Department of Mathematics also seeks to fill at least one tenured position at the senior level. Successful applicants will have an outstanding record of mathematical research and scholarship, and proven administrative skills for academic leadership. Applications should be mailed to: Chair of Appointments Committee, Department of Mathematics, DNB 155, University of Southern California, Los Angeles, CA 90089-1113. USC is an Equal Opportunity/Affirmative Action employer. Women and minorities are especially encouraged to apply.

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**CONNECUT**

FAIRFIELD UNIVERSITY

Department of Mathematics and Computer Science

North Benson Rd.

Fairfield, CT 06430-7524

Asst. Prof. Math; tenure-track; 9 hours teaching per week plus research; start Sept. 1992; Ph.D. in Math required with teaching competence in Statistics desirable; salary competitive; full consideration until Feb. 1, 1992; vita and 3 letters of reference to Joseph B. Dinnin, Chair of Department. Fairfield is a Jesuit University 60 minutes from New York University.

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**DISTRICT OF COLUMBIA**

TRINITY COLLEGE

Division of Mathematics and Natural Science

Washington, D.C. 20017

Tenure-track position at the Assistant Professor level beginning Fall 1992 (subject to funding appropriations). Qualifications include a Ph.D., with specialization in analysis or statistics preferred. Strong interest in teaching necessary. Send letter of application with vita, transcripts and three letters of recommendation to Dr. Marlene Lawson, Division of Mathematics and Natural Science, Trinity College, Washington, D.C. 20017. Trinity College is a liberal arts college for women under Catholic auspices. Applications from women and minorities are strongly encouraged. AA/EOE.

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**FLORIDA**

STETSON UNIVERSITY

Department of Mathematics and Computer Science

Applications are invited for a tenure track position in mathematics at the Assistant Professor level beginning Fall 1992. A Ph.D. in mathematics is required. Applicants should have a strong commitment to undergraduate teaching in a liberal arts environment. Teaching load: 9-10 hrs/wk. Responsibilities include teaching...
mathematics courses at all levels of the undergraduate curriculum, and continuing scholarly activity. The department currently has 10 full-time faculty members. Stetson University, located in Central Florida, is a small, private, comprehensive university of 2500 students. Its three schools—the College of Arts and Sciences, the School of Business, and the School of Music—are dedicated to excellence in teaching and are united by a commitment to the liberal arts. Send vitae and three letters of recommendation to: Professor Dennis Ketzling, Department of Mathematics and Computer Science, Stetson University, DeLand, Florida 32720. Deadline for applications is December 31, 1991, or until position is filled. Stetson University is an Equal Opportunity Employer and enthusiastically solicits applications from women and minority candidates.

GEORGIA

EMORY UNIVERSITY
ATLANTA, GA 30322
Department of Mathematics
and Computer Science

The Department of Mathematics and Computer Science has three openings in mathematics to begin September 1, 1992. The positions are at the level of tenure-track assistant professor. Applicants must have a Ph.D. in mathematics and a strong record (or promise) of research.

The areas of geometric analysis, algebra and combinatorics are of particular interest to us. The teaching load is 6 hrs./wk, including graduate and undergraduate courses.

Please send vita and names of three references to the above address, and have reference letters forwarded to us. Screening of applications will begin Jan. 20, 1992.

Emory University is an equal opportunity/affirmative action 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 1992. 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. Georgia Tech, a member of the University System of Georgia, is an Equal Opportunity/Affirmative Action Employer.

SOUTHERN COLLEGE OF TECHNOLOGY

MATHEMATICS-The Mathematics Department of the Southern College of Technology seeks applicants for one or more tenure-track positions at the rank of Assistant Professor. The Department desires faculty who can contribute to the newly created B.S. program in Mathematics. Ph.D. in mathematics required. Research is desirable but is neither required nor heavily weighted.

The ideal candidate will show a strong mastery of the discipline, a commitment to professional growth and development, an ability for and commitment to excellence in teaching, and the potential and desire to enhance the college’s intellectual community.

The Mathematics Department has sixteen tenure-track positions. There is a new B.S. in Mathematics, dual major programs with other departments, and several minor programs. The bulk of the teaching is in service courses.

Southern Tech is a state supported senior college in the University System of Georgia. Situated on a 530 acre site 15 miles northwest of Atlanta, the college enrolls about 4,000 students in technologically oriented programs through the Master’s level.

A complete application consists of a letter of application, a curriculum vitae, transcripts of all college work, and a minimum of two letters of reference. The deadline for applications is February 1, 1992; applications not completed by that date will not be considered. Applications with less than Ph.D. in mathematics, or strong research and teaching records or potential, should be addressed to:

Dr. James C. Krop}
Mathematics Department
Southern College of Technology
Manetta, Georgia 30060-2986

Southern College of Technology is an equal opportunity/affirmative action employer.

ILLINOIS

ELMHURST COLLEGE

Tenure-track position beginning fall 1992 (pending approval of the Board of Trustees). Qualifications desired: Ph.D. in mathematics, interest in continued scholarship, and a strong commitment to undergraduate teaching in a liberal arts college. Teaching load: 6 courses per year. Elmhurst College is a four-year private institution located in the western suburbs of Chicago. Applications should include a current vitae and three letters of reference. Please send to:

Dr. Jon L. Johnson, Dept. of Mathematics, Elmhurst College, Elmhurst, IL 60126. Elmhurst College is an Equal Opportunity Employer.

NORTHEASTERN UNIVERSITY
Department of Mathematics
Evaston, Illinois 60206-2730

Applications are invited for one or more anticipated full-time positions starting September 1993. Priority will be given to young, exceptionally qualified mathematicians (no more than several years after the Ph.D.). However, more senior candidates with very exceptional credentials may be considered for a tenure 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, so women and minority candidates are especially encouraged to apply. Candidates should arrange that at least three letters of recommendation be sent to Prof. D. G. Saari, 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 February 5, 1993. Hiring is contingent upon eligibility to work in the United States.

UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN
Department of Mathematics

Applications are invited for one or more tenure-track or tenured faculty positions commencing in August 1992. We are particularly interested in hiring in the areas of applied mathematics, combinatorics, optimization, and 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 1992-93 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:

Dr. Ward Henson, Chair
Department of Mathematics
University of Illinois at Urbana-Champaign
1409 W. Green St.
Urbana, Illinois 61801
Tel. (217)333-3522

In order to ensure full consideration, all application materials including letters of reference should be received by December 2, 1991. Interviews may be conducted prior to December 2, but completed applications received by that date will receive full consideration. Candidates are expected to present evidence of excellence, or potential for excellence, in research and teaching. Applications from women and minority candidates are especially encouraged. The University of Illinois is an Affirmative Action/Equal Opportunity Employer.

INDIANA

INDIANA UNIVERSITY- PURDUE UNIVERSITY AT INDIANAPOLIS (IUPUI)
Department of Mathematical Sciences

The Department of Mathematical Sciences at IUPUI is seeking applicants for three tenure-track positions to begin in August 1992. Rank and duties are open and depend on qualifications. Applicants should have an earned doctorate by the starting date.
UNIVERSITY OF IOWA

The Mathematics Department of the University of Iowa invites applications for the following positions:

1. One tenure-track appointment at the Assistant or beginning Associate Professor level starting in the 1992-93 academic year. The position is to be filled by a specialist in some aspect of harmonic analysis/representation theory, probability theory/stochastic analysis, or topology of manifolds/dynamical systems. Selection will be based on evidence of outstanding research accomplishments or potential, and teaching ability. A Ph.D. or equivalent training is required.

2. Pending availability of funds, one or more visiting positions for all or part of the 1992-93 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 current faculty.

Women and minority candidates are especially urged to apply for the above positions. The University of Iowa enters the employment of highly-qualified 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 January 2, 1992. To apply, send a complete vita and have three letters of recommendation sent to:

Professor Richard Randell, Chair
Department of Mathematics
University of Iowa
Iowa City, Iowa 52242

The University of Iowa is an Equal Employment Opportunity and Affirmative Action Employer.

IOWA STATE UNIVERSITY
Department of Mathematics

Subject to the availability of funds, the Department of Mathematics of Iowa State University expects to fill one tenure-track position at the assistant professor level in applied partial differential equations for the 1991-92 academic year. Start up funds will be available for the successful applicant. The successful candidate is expected to have a strong interest in teaching at both the graduate and undergraduate level and maintain an active research program.

Iowa State is the closest member institution to the NSF Institute for Mathematics and its Applications in Minneapolis. The Department strongly encourages its faculty and graduate students to participate in the Institute's programs and provides direct and indirect support for them to do so.

We will begin screening applications January 15, 1992. However, we shall continue to accept applications until the positions are filled.

Applications and letters of recommendation should be sent to Howard A. Levine, Chair, Department of Mathematics, Iowa State University, Ames, Iowa 50011.

UNIVERSITY OF KANSAS
Department of Mathematics

Applications are invited for tenure-track positions at the assistant or associate professor level and for visiting positions at the assistant professor level (pending on funding), beginning August 17, 1992 or as negotiated. Field is unrestricted but preference will be given to candidates whose specialties mesh well with those already represented in the department. Candidates must have a Ph.D. or its requirements completed by August 15, 1992. Postdoctoral experience for tenure-track positions is preferred but optional.

Applications, detailed resume with description of research, and three recommendation letters should be sent to: C. J. Himmelberg, Chairman, Department of Mathematics, 405 Snow Hall, University of Kansas, Lawrence, KS 66045-2142.

Deadlines: December 1, 1991 for first consideration, then monthly until August 1, 1992. The University of Kansas is an equal opportunity/affirmative action employer.

LOUISIANA
XAVIER UNIVERSITY OF LOUISIANA
College of Pharmacy

A nontenured track faculty position at the rank of assistant professor in biostatistics is available immediately. Competitive salary and fringe benefits. A Ph.D. in biostatistics or other related statistical area is required with preference given to those with specialization in experimental design, computational statistics, and/or data analysis and data collection procedures. The appointee will be expected to conduct independent research, serve as a consultant to pharmacy faculty, and teach biostatistic course(s) to pharmacy students. Letter of application, a current vita, and three letters of recommendation should be sent to: Chairman, Division of Basic Pharmaceutical Sciences, Xavier University College of Pharmacy, New Orleans, LA 70125. Xavier University, a historically Black Catholic University, is an Equal Opportunity Employer.

MARYLAND
THE JOHNS HOPKINS UNIVERSITY
Department of Mathematical Sciences

Applications are invited for a faculty position in OPERATIONS RESEARCH or OPTIMIZATION to begin in Fall 1992. Within these areas, either a stochastic or a deterministic emphasis is of interest. Applicants at all levels will be considered.

Selection is based on demonstration and promise of excellence in research, teaching, and innovative application. AA/EOE.

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 be sent to:
John C. Wierman, Chair
Department of Mathematical Sciences
244 Maryland Hall
The Johns Hopkins University
Baltimore, MD 21218-2689

THE JOHNS HOPKINS UNIVERSITY
Department of Mathematics
Applications are invited for a position beginning Fall 1992 at the Associate or Assistant Professor level in partial differential equations or related areas. Outstanding research accomplishments and commitment to teaching are required. Applications will be considered from candidates who have received a Ph.D. in mathematics prior to 12/89.

Minority and women candidates are strongly encouraged to apply. The Johns Hopkins University is an Affirmative Action/Equal Opportunity Employer.

Applications and recommendation letters should be sent to: PDE Search Committee, Department of Mathematics, The Johns Hopkins University, Baltimore, MD 21218.

MASSACHUSETTS
WELLESLEY COLLEGE
Department of Mathematics
Wellesley, MA 02181

Two or three tenure-track positions at the Asst. Professor level beginning Fall 1992. The teaching load is currently four courses per year. Requirements include a Ph.D. in mathematics (completed, or expected by June 1992), excellence in and commitment to both undergraduate teaching and mathematical research in a liberal-arts environment. Candidates with research interests in any area of mathematics will be considered. Applicants should send a curriculum vitae and arrange for at least three letters of recommendation that address both teaching and research. Applications and recommendation letters should be sent to: WSC, Department of Mathematics, Wellesley College, Wellesley, MA 02181. Wellesley College is an Equal Opportunity/Affirmative Action Employer and particularly encourages applications from women and minority candidates.

MICHIGAN STATE UNIVERSITY
Department of Mathematics
East Lansing, MI 48824-1027

The Department is seeking applicants for several tenure-track positions; openings are available at each of the Assistant, Associate, and Full Professor levels. Excellence in research and teaching is essential and applicants in all areas of research will be considered. Please send a resumé and arrange to have three letters of recommendation sent to Professor Richard E. Phillips, Chair, Department of Mathematics, Michigan State University, East Lansing, MI 48824-1027; email 21144CHR@MSU.BITNET. It would be helpful if resumé includes appropriate Mathematics Subject Classification number(s) and (if possible) electronic address. Applications received by January 4, 1992 will be given more attention.

MSU is an Affirmative Action/Equal Opportunity Institution.

MICHIGAN STATE UNIVERSITY
Mathematical Sciences Department
East Lansing, MI 48824-1027

The Department is seeking applicants for a position beginning Fall 1992 at the Assistant Professor level in Partial Differential Equations or related areas. Excellent research accomplishments and commitment to teaching are required. Applications will be considered from candidates who have received a Ph.D. in mathematics prior to 12/89.

Minority and women candidates are strongly encouraged to apply. The Michigan State University is an Affirmative Action/Equal Opportunity Employer.

Applications and recommendation letters should be sent to: PDE Search Committee, Department of Mathematics, Michigan State University, East Lansing, MI 48824-1027; email 21144CHR@MSU.BITNET. It would be helpful if resumé includes appropriate Mathematics Subject Classification number(s) and (if possible) electronic address. Applications received by January 4, 1992 will be given more attention.

MSU is an Affirmative Action/Equal Opportunity Institution.

MICHIGAN TECHNOL OgICAL UNIVERSITY
Mathematical Sciences Department
East Lansing, MI 48824-1027

The Department is seeking applicants for a position beginning Fall 1992 at the Assistant Professor level in Partial Differential Equations or related areas. Excellent research accomplishments and commitment to teaching are required. Applications will be considered from candidates who have received a Ph.D. in mathematics prior to 12/89.

Minority and women candidates are strongly encouraged to apply. The Michigan State University is an Affirmative Action/Equal Opportunity Employer.

Applications and recommendation letters should be sent to: PDE Search Committee, Department of Mathematics, Michigan State University, East Lansing, MI 48824-1027; email 21144CHR@MSU.BITNET. It would be helpful if resumé includes appropriate Mathematics Subject Classification number(s) and (if possible) electronic address. Applications received by January 4, 1992 will be given more attention.

MSU is an Affirmative Action/Equal Opportunity Institution.

MICHIGAN TECHNOLOGICAL UNIVERSITY
Mathematical Sciences Department
Department of Mathematical Sciences
The Department of Mathematical Sciences is seeking a tenure-track faculty member in the area of Functional Analysis. The department is seeking a person with a Ph.D. in Mathematics and experience in teaching at the undergraduate level. The position will begin in the Fall of 1992.

Applications and recommendation letters should be sent to: Search Committee, Department of Mathematical Sciences, Michigan Technological University, 1400 Townsend Drive, Houghton, MI 49931-1295. Applications will be accepted until September 30, 1992. A good funding record and experience with Ph.D. students is required. The position starts in September 1992.

MD
SAINT LOUIS UNIVERSITY
Department of Mathematics
and Computer Science
Saint Louis, MO 63103

One or more tenure-track appointments, to begin in the Fall of 1992. Candidates should have a Ph.D. in mathematics and be committed to teaching and research. Preference given to researchers in analysis, especially harmonic analysis, Lie group representations, and functional analysis. If more than one appointment is made, researchers in the area of group theory will also be given preference. The Department currently has 15 members, all of whom are active in research. Representatives of the Department will be present at the joint mathematics meetings in Baltimore. Deadline for full consideration is 9/15/92. Send vita (with email address if available) and three letters of reference to Bradley Currey, Chair, Faculty Search Committee, email: curreybn@svlucas.stlouis.edu. Saint Louis University is an equal opportunity employer; minorities and women are encouraged to apply.

NEVADA
UNIVERSITY OF NEVADA, RENO
Department of Mathematics
Chair Wanted

Do you have what it takes to lead a Math Department boldly into the future? Would you welcome the opportunity to make an impact on an entire state? If you answered "yes" to these questions, then UNR invites your application!

The Department of Mathematics is seeking a dynamic, well-rounded individual to be its Chair. Currently the department has 15 faculty. Among these are three recipients of distinguished teaching awards and one outstanding researcher's award. More faculty members will be added in the near future, and the chair will play a key role in making those hires.

We offer B.A., M.S., and M.A.T.M. degrees in mathematics. We are committed to excellence in teaching at all levels, especially in the university wide core curriculum math courses. We are also

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working to increase the quantity and quality of our research output.

We intend that this position be filled by someone with the qualifications of a full professor, so an applicant must have a substantial and continuing record of scholarly achievement, research, and demonstrated interest in teaching. Salary will be competitive and commensurate with qualifications of the applicant.

Applications should include biographical information and names, addresses (including email, if appropriate), and telephone numbers of five references. Please send to Don Pfaff, Department of Mathematics, University of Nevada, Reno, Reno, NV 89557, [(702) 784-6775; email address: don@cs.unr.edu; FAX: 702-784-1478].

Review of applications will begin November 15, 1991; the search will continue until the position is filled.

The University of Nevada, Reno is an Equal Opportunity, Affirmative Action employer and does not discriminate on the basis of race, creed, color, sex, age, national origin, veteran status or handicap in any program or activity it operates. The University of Nevada empowers only United States citizens or aliens lawfully authorized to work in the United States.

NEW MEXICO

NEW MEXICO STATE UNIVERSITY
Las Cruces, New Mexico
Department of Mathematical Sciences

Possible visiting and tenure-track positions in pure and applied mathematics and statistics for 1992-93, primarily assistant professor level. Strong commitment to both research and teaching required. Applications from women and members of minority groups welcome. Applications kept on file through hiring period. Arrange for vita, short research description, and three reference letters to be sent to: Hiring Committee, Department of Mathematical Sciences, New Mexico State University, Las Cruces, NM 88003. Equal Opportunity/Affirmative Action Employer.

NEW YORK

COLLEGE OF STATEN ISLAND (CUNY)
Department of Mathematics

A tenure-track position in mathematics is available for Fall 1992. Requirements: Ph.D., strong commitment to undergraduate teaching and to a productive research program. All mathematics research areas will be considered with special preference given to areas of strength within the department. These areas include probability, group theory, and applied mathematics. The position is budgeted at the assistant professor level. The College of Staten Island is a senior college in CUNY. Send resume and three letters of reference to Dr. Jane Coffee, Chairperson, Mathematics Department, College of Staten Island, 130 Stuyvesant Place, Staten Island, N. Y. 10301, by January 15, 1992. AA/EOE Employer.

SUNY COLLEGE AT BROCKPORT
Brockport, NY 14420
Department of Mathematics

Tenure-track assistant professorship in Mathematics available September 1992. Ph.D. in Mathematics (or Ph.D. in Statistics with strong math component), one year of teaching experience, demonstrated ability to carry out and publish scholarly research in the discipline required. Expertise in Prob/Stat, Discrete Math, or Applied Math preferred; other areas considered. Strong commitment to teaching a culturally diverse student body at undergraduate and master's levels. For further details: call N. Bloch, Chair, at (716)395-2194. Send application, transcripts, resume, and three letters of reference by November 25, 1991 to: Office of Faculty/Staff Relations, SUNY College of Brockport, Brockport, NY 14420. Letters of reference are kept on file until position is filled. AA/EOE.

STATE UNIVERSITY OF NEW YORK
AT BUFFALO
Department of Mathematics

The Department of Mathematics at Buffalo anticipates the appointment of several tenured or tenure-track faculty members beginning September 1, 1992. Salary will be competitive. We seek applicants in all areas with excellent research accomplishments/potential and a strong commitment to teaching.

Applicants should send supporting information, including their relevant primary and secondary AMS subject classification numbers, and have four letters of recommendation sent to:

Dr. Lewis A. Coburn
Search Committee Chairman
Department of Mathematics
SUNY/Buffalo
106 Diefendorf Hall
Buffalo, New York 14214.

The deadline for applications is December 1, 1991. Late applications will be considered until positions are filled.

SUNY/Buffalo is an Equal Opportunity/Affirmative Action Employer. We are interested in identifying prospective minority and women candidates. No person, in whatever relationship with the State University of New York at Buffalo, shall be subject to discrimination on the basis of age, creed, color, handicap, national origin, race, religion, sex, marital or veteran status.

NORTH CAROLINA

NORTH CAROLINA STATE UNIVERSITY
Department of Mathematics
Research Instructor - Mathematical Physics

The Department of Mathematics at North Carolina State University is soliciting nominations and applications for a Research Instructor in Mathematical Physics. The position is available for 2 years beginning in the Fall of 1992. The applicant should not have received his/her doctorate prior to 1990. The position requires a strong commitment to research and no more than 6 credit hours of teaching per semester. The applicant’s research interests should be compatible with those of the department’s existing Mathematical Physics group. An international symposium will be held at the University honoring Cornelius Lanczos during the candidate’s tenure in December 1993. To ensure full consideration candidates should send a vita, a description of research, visa status, and at least 3 letters of recommendation, one of which discusses his/her teaching qualifications, to Professor R. O. Fulp, Dept. of Mathematics, Box 8205, N. C. State University, Raleigh, NC 27695-8205 on or before January 15, 1992. For foreign candidates the offer of employment is contingent upon an appropriate visa status. Women and minorities are especially encouraged to apply. NCSU is an AA/EOE.
Applications are invited for one faculty appointment effective Fall 1992. Rank and salary depend on qualifications and budget considerations. Ph.D. in mathematics highly preferred, exceptionally strong research program and commitment to excellent teaching required. Send curriculum vitae, abstract of current research program and four letters of recommendation to Search Committee Chairman, Math. Dept., CB #3250 Phillips Hall, UNC at Chapel Hill, Chapel Hill, NC 27599-3250. EO/AA Employer. Women and minorities are encouraged to identify themselves voluntarily. Completed applications received by February 15, 1992 are assured of full consideration.

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**UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL**
**Department of Mathematics**
Chapel Hill, NC 27599-3250

Columbus, Ohio 43210. Review of résumés will begin immediately.

The Ohio State University is an Equal Opportunity/Affirmative Action employer. Qualified women and minority candidates are encouraged to apply.

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**THE OHIO STATE UNIVERSITY**
**Department of Mathematics**
**Research Instructorships in Mathematics**

The Department of Mathematics of The Ohio State University hopes to have available a few research instructor positions for the academic year 1992–93. Candidates should hold a Ph.D. (or equivalent) in mathematics and show strong research promise.

Please send credentials and have letters of recommendation sent to Professor Dijen Ray-Chaudhuri, Department of Mathematics, The Ohio State University, 231 W. 18th Avenue, Columbus, Ohio 43210. The Ohio State University is an Equal Opportunity/Affirmative Action employer.

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**OHIO**
**INSTITUT DE CALCUL MATHEMATIQUE**
**KENT STATE UNIVERSITY**

B. Beauzamy, P. Enflo and P. Wang wish to develop their research group on Quantitative estimates for polynomials in one or several variables and they encourage applications for Ph.D. studies (These) in this direction.

The topic has direct applications to Analysis (Fourier Analysis, Harmonic Analysis), to Number Theory, and Computer Science (Symbolic Computation, Massively Parallel Programming). It is supported by the National Science Foundation (U.S.A.), the C.N.R.S. (France), the Ministry of Defense (France), and DIGITAL Eq. Corp.

The applicants should be citizens either of the U.S. or of one of the countries of the European Community. They will have to work either in Paris or in Kent, and may have to travel between both places.

Please write to: Prof. Bernard Beauzamy, Institut de Calcul Mathematique, Université de Paris 7, 2 Place Jussieu, 75251 Paris Cedex 05, France, or to Prof. Per Enflo, Prof. Paul Wang, Department of Mathematical Sciences, Kent State University, Kent, Ohio 44242, U.S.A.

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**THE OHIO STATE UNIVERSITY**
**Department of Mathematics**

The Department of Mathematics of The Ohio State University hopes to have available several positions, both visiting and permanent, effective Autumn Quarter 1992. Candidates in all areas of applied and pure mathematics, including those with demonstrated interest in pedagogical matters, are invited to apply. Significant mathematical research accomplishments or exceptional promise, and evidence of good teaching ability, will be expected of successful applicants.

Please send credentials and have letters of recommendation sent to Professor Dijen Ray-Chaudhuri, Department of Mathematics, The Ohio State University, 231 W. 18th Avenue, Columbus, OH 43210. Review of résumés will begin immediately.

The Ohio State University is an Equal Opportunity/Affirmative Action employer. Qualified women and minority candidates are encouraged to apply.

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**OHIO UNIVERSITY**
**Department of Mathematics**

The Department of Mathematics anticipates the appointment of one tenure-track assistant, associate or full professor beginning September 1, 1992. Salary (at least $30,000 per year) and rank dependent on candidate's qualifications and experience. The appointment of associate full professor rank may be contingent on budgetary constraint. Applicants must have a Ph.D. in Mathematics before September 1, 1992 and have research interests in general topology or set theory with possible applications to topology. Only exceptionally well-qualified individuals will be considered for the associate or full professor rank. Send resume and have three letters of recommendation sent to Shih-Liang Wen, Chairman, Department of Mathematics, Ohio University, Athens, Ohio 45701. The deadline for applications is January 1, 1992. Ohio University is an Equal Opportunity/Affirmative Action Employer.

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**OKLAHOMA**
**OKLAHOMA STATE UNIVERSITY**
**Department of Mathematics**

Several tenure-track, postdoctoral, and visiting positions are anticipated for Fall 1992.

Normal duties include research and at most six hours teaching per semester. Minimum qualifications are a Ph.D. in Mathematics or a related field, evidence of research achievement or potential, and a commitment to teaching.

For the tenure-track positions all areas are under consideration; we especially encourage applicants in Differential Geometry, Algebraic Geometry, Algebra and Geometric Topology, Several Complex Variables, and Harmonic Analysis. Postdoctoral experience is desirable, but not essential.

For the postdoctoral and visiting positions we especially encourage, in addition to the above areas, applicants in Number Theory, Functional Analysis and Banach Spaces, Lie Groups and Representation Theory, Numerical Analysis and Approximation Theory.

For full consideration, send a resume and arrange to have three confidential letters of reference sent by December 15, 1991 to Robert Myers, Appointments Committee Chairman, Department of Mathematics, Oklahoma State University, Stillwater, OK 74078-0613. OSU is an affirmative action equal opportunity employer committed to multicultural diversity.

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**PENNSYLVANIA**
**COMMUNITY COLLEGE OF PHILADELPHIA**
**Department of Mathematics**

Mathematics Dept. invites applications for a tenure-track Asst. Professorship position beginning Fall 1992. The Dept. is actively engaged in courses development. It has recently received grants from NSF and CASE. Teaching load is 12 credit hours per semester. Candidates must have a Ph.D. or Master’s +3 years teaching in Mathematics, and a commitment to quality teaching, both remedial and college level. Demonstrated strength in course development is essential. Candidates should provide clear evidence of strong background in Mathematics, together with ability to bring to the first 2 years, mathematical topics usually delayed until later. Outstanding benefits. Send curriculum vitae with 3 letters of recommendation by January 31, 1992 to: Head, Dept. of Mathematics, COMMUNITY COLLEGE OF PHILADELPHIA, 1700 Spring Garden St., Phila., PA 19130. AA/EOE.

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**LEHIGH UNIVERSITY**
**Department of Mathematics**

The Department of Mathematics at Lehigh University invites applications for two tenure-track positions beginning with the Fall Semester 1992. Both positions are at the level of Assistant Professor. Preference will be given to researchers in the continuum from algebraic topology through differential geometry and global analysis and in algebra, specifically in an area overlapping combinatorics, discrete mathematics, and computational algebra.

Candidates for the positions must have an earned doctorate in mathematics and an excellent record in teaching and research. Applicants should send a curriculum vitae, list of published papers (or accepted for publication), and at least three letters of recommendation to Search Committee, Department of Mathematics (Bldg. 14), Lehigh University, Bethlehem, PA 18015. Applications from minorities and women are strongly encouraged. The selection process
will begin in January 1992, and continue until the positions are filled. Lehigh University is an equal opportunity and affirmative action employer.

Muhlenberg College
Truman Koehler Professorship of Mathematics

Mathematics Department seeks nominations/applications for this tenure track professorship beginning August 1992. Requirements include doctorate in mathematics sciences, minimum five years college/university teaching, publication record and demonstrated competence in teaching and student research/independent study. Please send application letter, resume, and names of three references to Dr. John Meyer, Head, Dept. of Mathematics, Muhlenberg College, Allentown, PA 18104. Screening begins in early January, with preliminary interviews possible at Baltimore meetings. EOE.

Pennsylvania State Harrisburg

Statistics—Penn State Harrisburg. The Mathematical and Computer Science program of Penn State Harrisburg solicits applications for a tenure-track position in Statistics. Applicants should have a Ph.D. in statistics; a specialization in one or more of the following areas: linear and nonlinear regression, experimental design, industrial engineering, and quality control; a strong interest in teaching; and a willingness to teach a variety of courses. Promotion and tenure criteria include teaching effectiveness, research, scholarship, and service. Penn State Harrisburg, an upper division and graduate college with an enrollment of approximately 2000 undergraduates and 1500 graduate students, is located in a suburban setting near the state capital. The program offers undergraduate degrees in mathematical sciences, both undergraduate and graduate degrees in computer science, and service courses for undergraduate and graduate students in engineering, business, and education. Send resume, copies of college transcripts, and three letters of reference by 15 January 1992 to Statistics Search Committee, c/o Ms. Sandra Jackson, Penn State Harrisburg, 777 W Harrisburg Pike, Middletown, PA 17057-4896. AN AFFIRMATIVE ACTION/EQUAL OPPORTUNITY EMPLOYER. WOMEN AND MINORITIES ARE ENCOURAGED TO APPLY.

Temple University
Department of Mathematics
Faculty Position

The Mathematics Department anticipates a tenure-track position opening at the junior level beginning Fall 1992. Preferred fields are several Complex Variables and Geometry/Topology. Vita and three letters of reference should be sent by December 31, 1991 to Search Committee, Department of Mathematics, Temple University, Philadelphia, PA 19122.

Women and Minorities are especially encouraged to apply. Temple University is an Affirmative Action/Equal Opportunity Employer.

University of Pittsburgh
Department of Mathematics and Statistics

The department invites applications for the following positions, which will be available for September 1992 if funding permits.

1. Assistant Professor in pure mathematics. We have a significant interest in someone in algebra, topology, or geometry.

2. Visiting Assistant Professor in mathematical biology. Here we have a preference for an individual with a strong computational aspect to their research. There is a possibility that the person appointed to this position will be considered for a tenure-track position for the following year.

Requirements include outstanding research accomplishment and potential commensurate with experience, and ability and interest in excellent teaching.

Applicants should send 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.

The University of Pittsburgh is an equal opportunity/affirmative action employer. Women and minorities are especially encouraged to apply.

Winthrop College
Department of Mathematics

Winthrop College is seeking a tenure-track faculty member at the associate or assistant level. Applicants in the area of applied statistics are encouraged to apply. Special consideration will be given to applicants with documentation of teaching excellence. Winthrop is a state supported comprehensive college of 5000 students, located approximately 20 miles south of Charlotte, NC, with an enrollment of 5000 students. An application, vita, and three letters of recommendation are required. The reviewing of applications will begin February 3, 1992. Winthrop College is an EO/AAE. Applications are to be sent to: Dr. Ron C. Goolsby, Chair, Department of Mathematics, Winthrop College, Rock Hill, SC 29733

Tennessee

University of Tennessee, Mathematics Department
Knoxville, TN 37996-1300

The Mathematics Department of the University of Tennessee, in an effort to significantly improve its research position, seeks to fill a tenure-track assistant professorship in harmonic analysis, several complex variables, function theoretic operator theory, differential geometry, numerical mathematics, theoretical probability and stochastic processes. Employment begins August 1992. Substantial research as well as dedication to teaching are paramount. Interested applicants should arrange to have a vita, three reference letters, and a research statement sent to Professor John B. Conway, Mathematics, University of Tennessee, TN 37996-1300.
VANDERBILT UNIVERSITY
Department of Mathematics
1326 Stevenson Center
Nashville, TN 37240

ASSISTANT PROFESSOR. Specialization in approximation theory, computer-aided design, or numerical analysis. This position is intended for a person whose primary research involves computing. It is an initial 3 year appointment beginning Fall 1992. It is renewable and tenure track. Outstanding research potential and evidence of effective teaching is required. Have vita and 4 letters of recommendation (including one about teaching) sent to Professor Glenn Webb, Chair.

VANDERBILT UNIVERSITY IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER

RICE UNIVERSITY
Griffith Conrad Evans
Department of Mathematics
Postdoctoral appointments for two to three years for promising research mathematicians with research interests in common with the active research areas at Rice, particularly geometric topology, geometric analysis, differential geometry, mathematical physics and ergodic theory. Duties will include research and classroom teaching. Applications received by December 31, 1991 will receive full consideration. Rice 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 level and a junior level tenure-track position, with employment beginning in Fall 1992. The applicants must be active researchers, have a strong commitment to undergraduate teaching and must be ready to teach advanced courses in the doctoral program in applied mathematics, numerical analysis and scientific computation. The senior applicants must have research interests in applied mathematics, must be ready to supervise doctoral dissertations, and must have a strong grant record. The junior applicants must be active in research in numerical analysis. The standard teaching load is two courses (six hours) per semester.

Departmental research interests include fluid mechanics, numerical analysis of differential equations, mathematical software, asymptotic and perturbation methods, nonlinear waves, bifurcation theory, combustion theory, dynamical systems, and mathematical biology. Thirteen of the sixteen faculty are applied or numerical mathematicians. Senior faculty include W. E. Ferguson (numerical partial differential equations), I. Gladwell (mathematical software), R. Haberman (nonlinear waves), G. W. Reddien (numerical bifurcation theory), D. A. Reinelt (fluid mechanics), and L. F. Shampine (numerical ordinary differential equations). Southern Methodist University has a 20 processor Sequent Symmetry for research use.

The application deadline is January 15, 1992. Send a letter of application and a vita to: Professor I. Gladwell, Chairman, Department of Mathematics, Southern Methodist University, Dallas, Texas 75275 (Tel. (214) 692-2506). Applications should be sent to Professor I. Gladwell.

SMU is an equal opportunity/affirmative action Title IX employer.

Texas

Rice University

Department of Mathematics

Applications are invited for a tenure-track assistant professor position. There is a possibility of an upgrade to associate or full professorship for an exceptional senior candidate. Candidates must have an extremely strong research background and good teaching skills. Preference will be given to applicants in geometric topology, geometric analysis, partial differential equations, and algebraic geometry. Duties will include research and classroom teaching.

Please send a curriculum vitae and at least 3 letters of recommendation to: Appointments Committee, Department of Mathematics, Rice University, P.O. Box 1892, Houston, TX 77251. Applications received by December 31, 1991 will be assured full consideration.

Rice University is an Equal Opportunity/Affirmative Action Employer.

Southern Methodist University

Department of Mathematics

Applications are invited for an anticipated tenure track assistant professorship faculty position in Applied Mathematics or Statistics beginning Fall 1992. Ph.D. in relevant field is required. Applicants must demonstrate research potential. Particular fields of interest are inverse scattering, robust statistics, systems and control, signal processing and statistical computing. Responsibilities include research, teaching, and direction of Ph.D. dissertations. Excellent computing facilities. Salary competitive. Applicants should send a curriculum vitae and at least three letters of reference (indication of sex and ethnicity for Affirmative Action purposes is requested but not required) to: The University of Texas at Dallas, Academic Search #2003, P. O. Box 830688, Richardson, Texas 75083-0688. Applications accepted until 2/1/92, or later if position not filled. The University is an Affirmative Action/Equal Opportunity employer.

The University of Texas at Dallas

Faculty Position in Mathematical Sciences

Applications are invited for an anticipated tenure track assistant professorship position in Applied Mathematics or Statistics beginning Fall 1992. Ph.D. in relevant field is required. Applicants must demonstrate research potential. Particular fields of interest are inverse scattering, robust statistics, systems and control, signal processing and statistical computing. Responsibilities include research, teaching, and direction of Ph.D. dissertations. Excellent computing facilities. Salary competitive. Applicants should send a curriculum vitae and at least three letters of reference (indication of sex and ethnicity for Affirmative Action purposes is requested but not required) to: The University of Texas at Dallas, Academic Search #2003, P. O. Box 830688, Richardson, Texas 75083-0688. Applications accepted until 2/1/92, or later if position not filled. The University is an Affirmative Action/Equal Opportunity employer.

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THE UNIVERSITY OF TEXAS AT DALLAS

Inquiries and applications should be addressed to: The Chair, Department of Mathematics, Rice University, PO Box 1892, Houston, TX 77251-1892.
Selection will be based upon a proven record of research and teaching ability. Applications will be accepted until 1 February 1992. Please send a curriculum vitae and have three letters of reference sent to: Donald W. Robinson 292 TMCB Brigham Young University Provo, UT 84602 BYU is an Equal Opportunity/Affirmative Action employer.

MARY WASHINGTON COLLEGE
Department of Mathematics

Applications are invited for at most two tenure-track Assistant Professor positions effective 8/15/92. Candidates should have a Ph.D. in Mathematics and be committed to teaching. Those who also desire to continue their research (in any area) or to make significant service contributions (to the Department and College) are particularly encouraged to apply. The Department has ten full-time faculty. The usual teaching load is four courses per semester with 25 students per lower-level course and 14 students per upper-level. Mary Washington College is a small (~ 3500) undergraduate liberal arts college, and the Department has 70+ majors. Areas of faculty (research) activity include semigroups, graph theory, topology, number theory, and differential geometry. Send vita to:

Marie Sheckels
Department Search Committee
Dept. of Mathematics
Mary Washington College
Fredericksburg, VA 22401

The review of applicants will begin in November 1991, and will continue until the positions are filled. Mary Washington College is an Equal Opportunity/Affirmative Action Employer.

VIRGINIA POLYTECHNIC INSTITUTE
AND STATE UNIVERSITY
Department of Mathematics

The Department of Mathematics at Virginia Tech is seeking qualified applicants for a tenure-track position at the rank of Assistant Professor in the area of Computational Mathematics/Numerical Analysis. The position should be available beginning with the 1992-93 academic year. A Ph.D. and strong research potential are required.

The Department currently includes a large group of Applied Mathematicians including a number of numerical analysts and computational scientists. Also, through the Interdisciplinary Center for Applied Mathematics, members of the Department have developed close collaborations with numerous scientists and engineers throughout the University. We seek applicants who will be able to interact with the present staff and aid in the further development of the Computational Mathematics/Numerical Analysis program in the Department. The position involves teaching duties of approximately six hours per week; thus, there should be strong indications that an applicant is or will become an effective teacher.

The deadline for applications is March 15, 1992; after that date, applications will be entertained only if the position remains unfilled. A curriculum vitae, description of research interests, and a synopsis of the dissertation, three letters of recommendation and any other supporting materials should be sent to Max D. Gunzburger, Department of Mathematics, Virginia Tech, Blacksburg, VA 24061-0123. Women and minorities are encouraged to apply. Virginia Tech is an Equal Opportunity/Affirmative Action Employer.

VIRGINIA POLYTECHNIC INSTITUTE
AND STATE UNIVERSITY
Department of Mathematics

Applications are invited for a tenure-track appointment at the level of Assistant Professor in the general area of Dynamical Systems beginning with the 1992-93 academic year. A Ph.D. and strong research potential are required. A likelihood of productive interaction with current senior faculty members, such as the group in partial differential equations and continuum mechanics, would be helpful. Since the position involves teaching duties of approximately six hours per week, there should be strong indications that the candidate is or will become an effective teacher. Applicants should send a vita and arrange to have three letters of reference submitted to Konneth B. Hannsgen, Chair, Dynamical Systems Search Committee, Department of Mathematics, Virginia Tech, Blacksburg, VA 24061-0123. Applications will be accepted for as long as a position remains available but no later than May 1, 1992.

Virginia Tech is an Equal Opportunity, Affirmative Action Employer. In keeping with Virginia Tech’s commitment to providing equal opportunity for all, women, minorities, and the disabled are especially encouraged to apply.

VIRGINIA POLYTECHNIC INSTITUTE
AND STATE UNIVERSITY
Department of Mathematics

The department invites applications in the area of partial differential equations. Applicants should have a strong theoretical background in partial differential equations and a demonstrated interest in applications. We are particularly interested in applicants at the assistant professor level. Applicants should submit a curriculum vitae and list of publications and arrange three letters of recommendation to be sent to Michael Renardy, Chair, Applied PDE Search Committee, Department of Mathematics, Virginia Tech, Blacksburg, VA 24061-0123. Applications will be accepted until March 15, 1992 or until position is filled. 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.

WEST VIRGINIA

WEST VIRGINIA UNIVERSITY
Department of Mathematics

The Department of Mathematics intends to make two faculty appointments at the Assistant Professor rank that will commence August 1992. Candidates are expected to have a Ph.D. in mathematics or equivalent with a strong record or demonstrated potential in both research and teaching. Preference will be given to applicants whose research interests complement those
classified Advertisements

WYOMING

THE UNIVERSITY OF WYOMING
Department of Mathematics
Position in Mathematics

Applications are invited for a tenure-track position in Applied Mathematics or Analysis at the rank of assistant professor. Strong consideration will be given to, but not limited to, the following areas: partial differential equations, numerical linear algebra, applied functional analysis, and numerical analysis. Salary is competitive and commensurate with experience and qualifications. Candidates should demonstrate accomplishment and potential in research and teaching.

Applicants should send vita, three letters of recommendation, and brief description of his/her research plans to: Dr. John George, Chairman, Department of Mathematics, University of Wyoming, Laramie, Wyoming 82071. Email inquiries should be sent to gauss@CORRAL.UWYO.EDU. Applications completed by January 15, 1992 will receive first consideration. The University of Wyoming is an AA/EQE.

AUSTRALIA

UNIVERSITY OF NEWCASTLE
Senior Lecturer
Department of Mathematics

The appointee would be expected to be able to make a significant contribution to teaching, play a major role in scholarship, research and or professional activities, and have significant relevant experience and a demonstrated record of scholarship and professional achievement.

This position has been created to support the recently appointed Chair of Mathematics. ESSENTIAL:

• Ph.D. in Mathematics
• Strong research record in modern mathematics with research interests in operator algebras, representation theory and related subjects
• Ability to establish constructive working relations with students and colleagues

DESIRABLE:

• Background of efficient and effective teaching at University level
• Compatibility with and willingness to join a research team led by Professor Ian Raeburn.

SALARY: Salary will be in the range $47,500-$55,000 depending on qualifications and experience.

GENERAL: For further information please contact Professor I. Raeburn by telephoning (049) 215535 or via overseas fax number 0011-61-49-216900.


GENERAL INFORMATION: Further information concerning conditions of employment may be obtained by contacting the Recruitment Unit, telephone (049) 215444.

Applications quoting the appropriate position number and including the full details of qualifications and experience, and the names, addresses and telephone numbers of three referees should be addressed to reach the undermentioned by the date specified above.

The Staff Office, The University of Newcastle, NSW, 2308

The University is an Equal Opportunity Employer and has a policy of no smoking in the workplace.

CANADA

CONCORDIA UNIVERSITY
Department of Computer Science

We are looking for new faculty members with either strong research records or excellent research potential to fill two tenure track positions in the Assistant or Associate Professor rank. Applicants must have an interest and ability to teach effectively at both the undergraduate and graduate levels. Selected candidates will be expected to carry out independent research and other academic duties associated with our bachelor's, master's and Ph.D. programs. To fit our needs, priorities will be given to the following areas: software engineering, programming languages, expert systems and combinatorial 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 30 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-six 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 des Ordinateurs de Haute Performance et VLSI). In particular, CICMA promotes research in algebraic computing, combinatorics and computational group theory. The department also intends to strengthen its activities in software systems. 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 is committed to Employment Equity and encourages applications from women, aboriginal peoples, visible minorities and disabled persons. All things being equal, women candidates shall be given priority. Interested applicants should send a resume and the names of at least three references to Chair, Department Personnel Committee

Department of Computer Science Concordia University 1455 de Maisonneuve West Montreal, Quebec H3G 1M8 Canada Fax (514)484-2830

In accordance with Canadian Immigration requirements, priority shall be given to Canadian citizens and permanent residents of Canada.

McMASTER UNIVERSITY

Department of Mathematics & Statistics

Applications are invited for the Britton Post-Doctoral Fellowship in Mathematics. Named after Dr. Ronald Britton, the Britton Fellowship is intended for talented, young research mathematicians who have recently completed the Ph.D. degree. The Britton Fellowship is open to candidates of any nationality and selection will be based upon the candidate's research potential. Preference will be given to candidates working in partial differential equations or harmonic analysis. The Britton Fellowship is tenable for a period of two years with effect from July 1, 1992 at a salary of $34,000 per year plus a research grant of $5,000. Applications, including three letters of reference, should be completed by January 31, 1992 and sent to: Dr. I. Hambleton, Chairman or V. P. Snalsh, S.C.D., F.R.S.C., Britton Professor of Mathematics, Dr. P. Guan, Dr. E. Sawyer, Department of Mathematics & Statistics, McMaster University, Hamilton, Ontario, Canada, L5K 1E1.

McMASTER UNIVERSITY

Department of Mathematics & Statistics

The Department of Mathematics and Statistics will sponsor applicants for the new NSERC International Fellowships. These fellowships provide an opportunity to spend up to two years engaged in research, and are particularly

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NOVEMBER 1991, VOLUME 38, NUMBER 9
suitable for talented, young mathematicians who have recently completed the Ph.D. degree.

The fellowships are open to non-Canadian candidates of any nationality and selection will be based upon the candidate's research potential.

Starting July 1, 1992, the stipend will be $29,000 plus a $3,000 grant for research expenses.

Applications and three letters of reference should be sent by November 30, 1991 to: I. Hambleton, Chairman, Department of Mathematics & Statistics, McMaster University, Hamilton, Ontario, Canada, L8S 4K1.

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**THE UNIVERSITY OF BRITISH COLUMBIA**
Department of Mathematics

Assistant Professorship

The Mathematics Department is seeking an outstanding candidate for a tenure-track Assistant Professorship to begin July 1, 1992. Our highest priority is for a candidate in one of the following fields: Real or Complex Analysis, Operator Algebras, Functional Analysis, Partial Differential Equations. Applicants should have a proven research record of high quality and have demonstrated interest and ability in teaching. Preference will be given to candidates who have one or more years of postdoctoral experience. This position is subject to final budgetary approval. In very exceptional circumstances, this position may be upgraded. The salary will be commensurate with experience and research record. In accordance with Canadian Immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada. UBC encourages qualified women and minority applicants. Applicants should send a C.V. including a list of publications, statement of research and teaching interests and arrange for three letters of recommendation to arrive before January 1, 1992 to the attention of: Head, Department of Mathematics, The University of British Columbia, Room 121 - 1984 Mathematics Road, Vancouver, B.C., Canada V6T 1Z2.

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**UNIVERSITY OF TORONTO**
Department of Mathematics

The Department solicits applications for a tenure-stream position in Analysis at the downtown (St. George) campus at the level of Assistant Professor, to begin July 1, 1992. Candidates are expected to have at least three years experience in teaching and research after the Ph.D., and to be able to demonstrate excellence in each. In particular, a candidate's research should clearly show the ability to make significant original and independent contributions to Mathematics.

Applicants should send their complete C.V. including a list of publications and any appropriate material about their teaching, and arrange to have at least four letters of reference sent directly to Professor J. Repka, Associate Chair, Department of Mathematics, University of Toronto, Toronto, Canada, M5S 1A1. At least one letter should deal with the candidate's teaching. To insure full consideration, this information should be received by January 31, 1992.

The University of Toronto encourages both women and men to apply. In accordance with Canadian Immigration requirements, priority will be given to Canadian citizens and permanent residents.

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**UNIVERSITY OF TORONTO**
Department of Mathematics

The Department solicits applications for two limited term Assistant professorships at the downtown (St. George) campus, each for the three-year period from July 1, 1992 to June 30, 1995. Duties consist of teaching and research, and candidates must demonstrate clear strength in both.

Applicants should send their complete C.V. including a list of publications and any appropriate material about their teaching, and arrange to have at least four letters of reference sent directly to Professor J. Repka, Associate Chair, Department of Mathematics, University of Toronto, Toronto, Canada, M5S 1A1. At least one letter should deal with the candidate's teaching. To insure full consideration, this information should be received by January 31, 1992.

The University of Toronto encourages both women and men to apply. In accordance with Canadian Immigration requirements, priority will be given to Canadian citizens and permanent residents.

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**HONG KONG**

**THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY**
Department of Mathematics

The Hong Kong University of Science and Technology is a new publicly funded research University. The first intake of students will be in October 1991 at both undergraduate and graduate levels including the doctorate. Enrollment is expected to grow to 7,000 students by 1996-1997. The medium of instruction is English. Applications are invited for the following positions:

- **Professor:** Minimum US$79,600 p.a.  

The Department will place major emphasis on applications with an appropriate component of pure mathematics to preserve the integrity of the discipline. Research areas will be highly interdisciplinary and will include scientific computation, statistics, fluid and solid mechanics, mathematical physics, analysis, algebra, geometry, etc.

Applicants should have a Ph.D. degree in the relevant fields. Appointees at the senior level are expected to have a distinguished record in research and have demonstrated an ability to develop research programs; appointees at Lecturer level are expected to have outstanding potential to develop research in his/her own fields. Responsibilities include undergraduate and postgraduate teaching of not exceeding two courses per semester. Applications for earlier positions will be reviewed and such candidates need not reapply.

Generous fringe benefits including medical and dental benefits, annual leave, and children's education allowances are provided. Air passage, housing or private tenancy allowance are also provided where applicable. Initial ap-
pointments will generally be on a three-year contract which is renewable subject to mutual agreement. A gratuity of an amount equal to 25% of the total basic salary drawn will be payable upon successful completion of contract. It is the intention of the University to introduce a superannuation scheme and arrangements will be made for eligible staff to join the scheme as appropriate. Approved sabbatical leave will be at full salary.

Applications/nominations should be sent with a complete CV together with the names and addresses of at least three referees to:

Director of Personnel
The Hong Kong University of Science and Technology
12/F, World Shipping Centre
7 Canton Road
Tsim Sha Tsui
Kowloon, Hong Kong
Fax No.: (852) 735-7806

The search will continue until suitable appointments are made.

POSITIONS WANTED

MATHEMATICS PROFESSOR, TEACHING AND RESEARCH


MISCELLANEOUS

Prepare $\LaTeX$ Documents FAST with 100s of Shortcuts:

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  + manual: $30 \LaTeX$, $25 \LaTeX$, $40$ both.
  La$\TeX$, PO Box 1151, Lisle, IL 60532.

PUBLICATIONS FOR SALE

MATHEMATICAL REVIEWS. Complete set from volume 1 to present, including indices. Excellent condition. Contact J. Neuberger, Math.

COMPUTER-AIDED VERIFICATION '90

E. M. Clarke and R. P. Kurshan, Editors

Proceedings of a DIMACS Workshop, Volume 3

This volume, published jointly with the Association for Computing Machinery, contains the proceedings of the second workshop on Computer-Aided Verification, held at DIMACS at Rutgers University in June 1990. The motivation for the workshop was to bring together researchers working on effective algorithms or methodologies for formal verification (as distinguished from, for example, attributes of logs or formal languages). The theoretical results leading to new or more powerful verification methods include advances in the use of binary decision diagrams, dense time, reductions based on partial order representations, and proof-checking in controller verification.

The general focus of this volume is on the problem of making formal verification feasible for various models of computation. Specific emphasis is on models associated with distributed programs, protocols, and digital circuits. The general test of algorithm feasibility is to embed it into a verification tool and to exercise that tool on realistic examples. This volume provides a look at the latest theoretical advances in this exciting and important area of research.

All prices subject to change. Free shipment by surface; for air delivery, please add $6.60 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 (584-4867) in the continental U.S. and Canada to charge with Visa or MasterCard. Please add 7% GST to all orders being shipped to Canada.


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PUBLICATIONS WANTED


NOVEMBER 1991, VOLUME 38, NUMBER 9
Applications and nominations are invited for a full-time position as an Associate Editor of *Mathematical Reviews* (*MR*), to commence January 1, 1992 and continue for a term of two years. An individual with considerable breadth in pure or applied mathematics is sought and preference will be given to those applicants with expertise in number theory, Lie algebras and Lie groups, complex analysis and global analysis.

The *Mathematical Reviews* 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 fifteen 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. 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.)

The twelve-month salary is negotiable and will be commensurate with the experience the applicant brings to the position. Persons interested in this position are encouraged to write (or telephone) for further information. Persons interested in taking leave from an academic appointment to accept the position as Associate Editor are encouraged to apply.

Applications (including curriculum vitae, bibliography and name, address, and phone number of at least three references) and nominations should be sent to:

Dr. G. J. Janusz, Executive Editor  
*Mathematical Reviews*  
P. O. Box 8604  
Ann Arbor, MI 48107-8604  
Telephone: 313-996-5255  
FAX: 313-996-2916  
INTERNET: GJJ@MATH.AMS.COM

Interested applicants are urged to inquire without delay.

The American Mathematical Society is an equal opportunity employer.
INSTITUTE FOR MATHEMATICS AND ITS APPLICATIONS

announces a program on

CONTROL THEORY AND ITS APPLICATIONS


COORDINATORS: H. J. Sussmann (Chairman), W. H. Fleming, P. P. Khargonekar, P. R. Kumar, D. L. Russell, S. E. Shreve


POSTDOCTORAL MEMBERSHIPS*

All requirements for a doctorate should be completed by September 1, 1992. 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, 1992):

(1) Personal statement of scientific interests, research plans, and reasons for wishing to participate in the Control Theory program. (This is an essential part of the application.)
(2) Curriculum vitae and a list of publications.
(3) Three letters of recommendation, to be sent directly to the IMA.

SENIOR MEMBERSHIPS

Preference will be given to supplementary support for persons with sabbatical leaves, fellowships, or other stipends.

POSTDOCTORATES IN INDUSTRIAL MATHEMATICS

IMA announces at least 4 one-to-two-year positions in Industrial Mathematics, effective September 1, 1992. These appointments are in addition to the regular IMA postdoctoral 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, 1992. 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: viscous free-surface flows; (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, both traditional and electrophotography; (9) Air quality modeling; (10) Control theory; 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".

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

IMA PARTICIPATING INSTITUTIONS: 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 (Champaign), 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

IMA PARTICIPATING CORPORATIONS: Bellcore, Cray Research, Eastman Kodak, Ford, Hitachi, General Motors, Honeywell, IBM, Kao, Motorola, Siemens, 3M, UNISYS
Announcing a new journal - 1992
Journal of Algebraic Geometry

Editors: V.I. Arnold (Moscow), A. Beauville (Orsay), S. J. Bloch (Chicago), E. Brieskorn (Bonn), F.M.E. Catanese (Pisa), D. Eisenbud (Waltham), H. Hironaka (Cambridge), J. Kollár (Salt Lake City), Lê D.T. (Paris), S. Mori (Kyoto), K. Saito (Kyoto), S. S.-T. Yau (Managing editor, Univ. of Illinois at Chicago, Box 4348, Chicago, IL 60680 USA)

Associate Editors: G. Faltings (Princeton), W. Fulton (Chicago), J. Harris (Cambridge)

The Journal of Algebraic Geometry will be published four times per year; volume 1 is the 1992 volume, with the first issue appearing in October of 1991. Please make your subscription now to AMS.

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800-321-4AMS (321-4267)

Algebraic geometry and singularity theory have made remarkable progress in the last several decades. In the early 1940s, van der Waerden, Weil, Zariski, and others established solid foundations for algebraic geometry. Weil's methods opened new applications to number theory, culminating in his proof of the Riemann hypothesis for curves over a finite field. Hodge and de Rham developed the transcendental method of studying algebraic varieties of arbitrary dimension, initiating the theory of harmonic integrals. These results were further developed by Kodaira, Weil, and others and were applied to various classical problems in the field.

The theory of sheaves invented by Leray was developed by H. Cartan, who employed coherent analytic sheaves and their cohomology groups. Serre transplanted these methods to lay new foundations for algebraic geometry and also applied these methods to obtain such results as the comparison theorem of algebraic and analytic geometry. The theory of coherent analytic sheaves, combined with the potential theoretic methods, produced many important results on compact complex manifolds.

In the mid-1950s, Hirzebruch first proved the Riemann-Roch theorem for a nonsingular projective variety by using Thom's cobordism theory. Later, Atiyah and Singer also produced a proof, this time in the case of an arbitrary complex compact manifold, by using their index theorem for elliptic operators on a compact manifold.

In the late 1950s, Grothendieck introduced schemes, which generalized the concept of an algebraic variety as a ringed space, and clarified the relationship of algebra and geometry in full generality. The new methods had a strong influence on algebraic geometry and offered new techniques for classical problems. Hironaka's results in the resolution of singularities, Mumford's work on moduli schemes, Artin and Grothendieck's introduction of étale cohomology, and Deligne's proof of Weil's conjecture on zeta functions are some of the highlights of this era.

The study of singularities of differentiable maps goes back to ideas of Whitney, Thom, Mather and Arnold. Singularities of differentiable maps are closely related to singularities of analytic maps and therefore to algebraic geometry. Moreover, in this field of studies, important work of the last two decades has produced a surprising interplay between algebraic geometry, in particular Mixed Hodge theory, Picard-Lefschetz theory, and deformation theory, Lie algebras, Lie groups and locally symmetric spaces, arithmetic of quadratic forms, braid groups, and other important fields of mathematics as well as science and engineering.

This diverse and highly interconnected melange of activity has produced an explosion of work of unprecedented depth and excellence. The Journal of Algebraic Geometry will provide a forum for the best work in algebraic geometry, the study of singularities, and related fields, such as number theory, commutative algebra, projective geometry, complex geometry, Kahler geometry, and geometric topology.

The Journal will focus on research that clearly exhibits the symbiotic relationship among techniques of algebra, geometry, analysis, and topology. Committed to serving as the journal of record for important new results that stimulate interactions among these fields, the Journal of Algebraic Geometry will establish and maintain the highest standards of innovation and quality.
New in 1991 from Birkhäuser

New!
S. Lojasiewicz, Jagiellonian University, Cracow, Poland
Introduction to Complex Analytic Geometry

The subject of this book is analytic geometry, understood as the geometry of analytic sets (or, more generally, analytic spaces), i.e., sets described locally by systems of analytic equations. Though many of the results are relatively modern, they are already part of the classical tool-kit of workers in analytic and algebraic geometry and in analysis. The book is an introduction that aims to familiarize the reader with the basic range of problems, using means as elementary as possible. At the same time, the author's intention is to give the reader access to complete proofs without the need to rely on so-called "well-known" facts.


New!
H. Triebel, Freiburg-Schiller-Universitat Jena, Germany
Theory of Function Spaces II

This book deals with the theory of function spaces of type $B^p_q$ and $F^p_q$ as it stands at the end of the 1980's. These two scales of spaces cover many well-known function spaces such as Hölder-Zygmund spaces, (fractional) Sobolev spaces, Besov spaces, inhomogeneous Hardy spaces, spaces of $BMO$-type and local approximation spaces which are closely connected with Morrey-Campanato spaces. This monograph is self-contained, although it may be considered an update of the author's earlier book of the same title.

Monographs in Mathematics, Volume 84

K.L. Alexander and J.C. Watkins, University of Southern California
Spatial Stochastic Processes
A Festschrift in Honor of Ted Harris on His Seventieth Birthday

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R. Durrett, Cornell University, Ithaca, NY; and H. Kesten, Cornell University, Ithaca, NY (Eds.)
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Progress in Probability, Volume 28

G.-Q. Zhang, University of Georgia, Athens
Logic of Domains

A thorough study of some important logical aspects of domains as used in the denotational semantics of programming languages. Against a background of a well developed and sophisticated domain theory, the author builds logical frameworks from domains and uses them for the derivation of program logics. The reader will gain from this work a broad and deep understanding of the state of knowledge in this vital area of theoretical computer science.

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January 8-11, 1992

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:

Linda Heineman
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 18, 1991 (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, 1991

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 Linda Heineman at the above address:

I would like to attend 1 Minicourse 2 Minicourses

Please enroll me in MAA Minicourse(s): #__ and #__

In order of preference, my alternatives are: #__ and #__

PAYMENT

Check enclosed: $ __ Credit card type: □ MasterCard □ Visa

Credit card # __________________________ Expiration date: _____________________

Your Employing Institution

Organised by

Minicourse Number and Name Fee

1. Alternatives to the lecture method in collegiate mathematics $36

Julian Weissglass

2. The Harvard calculus reform project: Hands-on experience with the project materials $36

Deborah Hughes Hallett, Sheldon P. Gordon, William McCallum & Thomas Tucker

3. Using history in teaching calculus $36

V. Frederick Rickey

4. Environmental Modeling $36

Robert McKelvey

5. Using group projects in calculus $36

Stephen Hilbert, John Maceli, Eric Robinson, Diane Schwartz & Stanley Seltzer

6. Introduction to research in the teaching and learning of undergraduate mathematics: Examples in calculus $36

Joan Ferrini-Mundy & Kathleen Heid

7. Using NETPAD software to teach and learn about graphs $60

Nathaniel Dean & Joseph G. Rosenstein

8. CAS laboratory projects for first year calculus using DERIVE $60

Carl L. Leinbach & Marvin L. Brubaker

9. Learning abstract algebra by programming in ISETL $60

Ed Dubinsky & Uri Leron

10. How to make effective use of inexpensive pocket computers to develop the concepts and techniques of calculus $36

Franklin Demana & Bert K. Waits

11. Instituting a mathematics placement program: Creating order out of chaos in freshman mathematics $36

Philip C. Curtis, Jr.

12. Mathematical modeling with a spreadsheet $36

Stephen D. Comer & Hughes B. Hoyle III

13. Integrating calculus and physics for freshmen $36

Joan R. Hundhausen & F. Richard Yeatts

14. The Fibonacci and Catalan numbers $36

Ralph P. Grimaldi

15. Why, when and how to use CAS calculators in calculus and linear algebra instruction $36

John Kenelly & Donald R. LaTorre

16. Challenging students with research projects in calculus $36

Douglas Kurtz & David Pengelley

17. Advanced workshop on DERIVE $30

David R. Stoutemyer

$ I plan on preregistering for the Baltimore, Maryland meetings ONLY in order to attend the MAA Minicourse(s) indicated above. It is my understanding that, should the course(s) of my choice be filled, full refund of the Baltimore meetings preregistration fee will be made.

☐ I would like to preregister for the free Student Workshop organized by the MAA Committee on Student Chapters and the Ad hoc Committee on Mathematics and the Environment.
In a contemporary course in mathematical analysis, the concept of series arises as a natural generalization of the concept of a sum over finitely many elements, and the simplest properties of finite sums carry over to infinite series. Standing as an exception among these properties is the commutative law, for the sum of a series can change as a result of a rearrangement of its terms. This raises two central questions: for which series is the commutative law valid, and just how can a series change upon rearrangement of its terms? Both questions have been answered for all finite-dimensional spaces, but the study of rearrangements of a series in an infinite-dimensional space continues to this day.

In recent years, a close connection has been discovered between the theory of series and the so-called finite properties of Banach spaces, making it possible to create a unified theory from the numerous separate results. This book is the first attempt at such a unified exposition.

This book would be an ideal textbook for advanced courses, for it requires background only at the level of standard courses in mathematical analysis and linear algebra and some familiarity with elementary concepts and results in the theory of Banach spaces. The authors present the more advanced results with full proofs, and they have included a large number of exercises of varying difficulty. A separate section in the last chapter is devoted to a detailed survey of open questions.

The book should prove useful and interesting both to beginning mathematicians and to specialists in functional analysis.

1980 Mathematics Subject Classifications: 46
ISBN 0-8218-4546-2; LC 91-6322; ISSN 0065-9282
122 pages (hardcover), April 1991
Individual member $43,
List price $72, Institutional member $58
To order please specify MMONO/86NA

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 continental U.S. and Canada to charge with Visa or MasterCard.

Please add 7% GST to all orders being shipped to Canada.

Instructions for Applicant's Form on facing page

The form. Applicants' forms submitted for the Employment Register by the November 18 deadline will be photographically reproduced in the December 1991 issue of Employment Information in the Mathematical Sciences (EIMS). Resumes of only those attending will be posted at the meeting.

The forms must be carefully typed using a fresh black ribbon. The best results are obtained with a carbon-coated polyethylene film ribbon, but satisfactory results may be obtained using a ribbon made of nylon or other woven fabric if suitable care is exercised. It is important that the keys be clean and make a sharp, clear impression. Do not erase—it causes smudges which reproduce when photographed. Use a correcting typewriter or correction tape or fluid if necessary. Submit the original typed version only. Copies will not reproduce properly and are not acceptable.

Hand lettered forms will be returned. Do not type outside the box.

Applicants' forms must be received by the Society by November 18, 1991 in order to appear in the special issue of EIMS and must be accompanied by the Preregistration/Housing Form printed in this issue, if attending the meeting.
1. Form must be typed. (Please see instructions on facing page. No other format will be accepted.)
2. This form CANNOT be submitted by electronic mail.
3. Hand lettered forms will be returned. Do not type beyond the box
4. Please check if Pre-registration/Housing Form previously sent 
5. Return form with payment with your Pre-registration/Housing
   Form by November 18 to AMS, P.O. Box 6887, Providence, RI 02940, to be included in the December issue of EIMS.

**APPLICANT:** Name__________________________

**CODE:** Mailing address (include zip code) ____________________________

- Specialties______________________________________________________________
- Career objectives and accomplishments
  - ACADEMIC: □ Research, □ Teaching
  - NON-ACADEMIC: □ Research and Development, □ Consulting, □ Supervision

Near-term career goals ______________________________________________________

Significant achievements or projects, including role____________________________________

Honors and offices________________________________________________________________

Other (e.g., paper to be presented at THIS meeting)______________________________

Selected titles of papers, reports, books, patents____________________________

- Degree Year Institution __________________________
  __________________________
  __________________________

**EMPLOYMENT HISTORY:**

<table>
<thead>
<tr>
<th>Present</th>
<th>Previous</th>
<th>Previous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employer.__________________________</td>
<td>Position __________________________</td>
<td></td>
</tr>
<tr>
<td>Duties __________________________</td>
<td>Days __________________________</td>
<td></td>
</tr>
<tr>
<td>Years ________ to ____ ________ to ____</td>
<td></td>
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</tr>
</tbody>
</table>

**DESIRABLE POSITION:**

- Duties ______________________________________________________________
- Available mo./yr. ________ Location __________________________
- References (Name and Institution)________________

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

**AVAILABLE FOR INTERVIEWS:**

(Interviews for Session 4 scheduled on the basis of employer's request only.)

<table>
<thead>
<tr>
<th>Session 1 □</th>
<th>Session 2 □</th>
<th>Session 3 □</th>
<th>Session 4 □</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thurs. AM 9:00-11:15</td>
<td>Thurs. PM 12:45-4:30</td>
<td>Fri. AM 9:00-11:15</td>
<td>Fri. PM 12:45-4:30</td>
</tr>
</tbody>
</table>

I do not plan to attend the Baltimore meetings □
EMPLOYER FORM  MATHEMATICAL SCIENCES EMPLOYMENT REGISTER  BALTIMORE, MARYLAND  JANUARY 8-10, 1992

This form CANNOT be submitted by electronic mail.

INSTRUCTIONS: Please read carefully before completing form below. Circled letters identify corresponding items in the FORM and the SUMMARY STRIP; abbreviations to be used are provided in the notes below. Please print or type in black ink. Block capitals are suggested. The FORM itself will be placed on display at the Register exactly as submitted. The SUMMARY STRIP (be sure to complete) will be used to prepare a computer printed list of summaries for distribution at the Register. Employers are encouraged to provide more than one interviewer when they are able to do so, in order to increase the number of interviews which may be scheduled. Please take care to indicate on the Form the number of interviewers for whom simultaneous interviews may be scheduled. (If all interviewers will be interviewing for the same position, or for the same set of positions, only one form should be submitted and only one employer code number will be assigned; therefore, each interviewer would then receive a separate computer schedule and separate table number.) More than one employer code will be required if some interviewers will not interview for all positions. Thus, if there are two disjoint sets of positions, two forms are required and two employer codes will be assigned. (Please refer to the section on the Employment Register following the Baltimore meeting announcement.) Return form with payment with your preregistration/Housing form by November 18.

<table>
<thead>
<tr>
<th>EMPLOYER CODE</th>
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<tr>
<th>Name of Interviewer(s)</th>
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<td>2.</td>
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<td>3.</td>
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<td>4.</td>
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<tr>
<th>City, State, Zip</th>
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<table>
<thead>
<tr>
<th>A</th>
<th>Title(s) of Position(s)</th>
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<table>
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<tr>
<th>B</th>
<th>Number of Positions</th>
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<tr>
<th>C</th>
<th>Starting Date</th>
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<tr>
<th>D</th>
<th>Term of Appointment</th>
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<thead>
<tr>
<th>E</th>
<th>Renewal ( ) Possible Tenure Track Position</th>
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<tr>
<th>F</th>
<th>Specialties Sought</th>
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<th>G</th>
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<th>H</th>
<th>Degree Accepted</th>
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<th>I</th>
<th>Duties</th>
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<th>Citizenship Restriction</th>
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<table>
<thead>
<tr>
<th>L</th>
<th>Available for Interviews</th>
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<table>
<thead>
<tr>
<th>M</th>
<th>Number of Interviewers</th>
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</table>

NOTES: A Inst, Lect, Asst Prof, Assoc Prof, Prof, Dean, Open, MTS (Member Technical Staff), OPAN (Operations Analyst), PREN (Project Engineer), RESC (Research Scientist); C Date e.g. 01/92; E Possible = P, Impossible = I; F Algebra = AL, Analysis = AN, Biomathematics = BI, Biostatistics = BS, Combinatorics = CB, Communication = CM, Control = CN, Computer Science = CS, Circuits = CT, Differential Equations = DE, Economics = EC, Mathematical Education = ED, Functional Analysis = FA, Financial Mathematics = FM, Fluid Mechanics = FL, Geometry = GE, History of Mathematics = HM, Logic = LO, Mathematics = MB, Mechanics = ME, Modeling = MO, Mathematical Physics = MP, Management Science = MS, Numerical Analysis = NA, Number Theory = NT, Operations Research = OR, Probability = PR, Systems Analysis = SA, Statistics = ST, Topology = TO; G / H Bachelor = B, Master = M, Doctor = D; I Teaching = T, Undergraduates = U, Graduates = G, Research = R, Consulting = C, Administration = A, Supervision = S, Industry = IND, Governments = GOV, Data Processing = DP; No experience required = N; K U.S. Citizen = C, U.S. Citizen or permanent resident = CP, No restriction = NR; L Periods available for interviews: Check 1, 2, 3, and/or 4, see the FORM above.

* Interviews are scheduled in this session on the basis of employers request only.
Preregistration/Housing Form, Baltimore, Maryland
January 8–11, 1992

Please complete this form and return it with your payment to
Mathematics Meetings Service Bureau
P.O. Box 6887, Providence, Rhode Island 02940 – Telephone: (401) 455-4143-Telex: 797192

DEADLINES:
Room Lottery Qualification: October 29, 1991
Joint Meetings & AMS Short Course Preregistration/Employment Register/Hotel Reservations/Tickets: November 18, 1991
Final Preregistration ONLY (No housing, Employment Register, and/or tickets): December 10, 1991
Housing Changes/Cancellations: January 3, 1992
50% Refund Preregistration/Employment Register/AMS Short Course: December 30, 1991
Other Changes to Preregistration: December 30, 1991
50% Refund on Tickets: December 30, 1991

REGISTRATION FEES
Preregistration by December 10, 1991
JOINT MATHEMATICS MEETINGS
Member of AMS, CMS, MAA: $105
Nonmember: $163
* Student, Unemployed, or Emeritus: $25

AMS SHORT COURSE
Member/Nonmember: $60
* Student, Unemployed, or Emeritus: $25

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

(Note: A separate form appears in this issue for preregistration for MAA Minicourses)

* See section on "How to Preregister" in the Notices or Focus for definition of "student", "unemployed", or "emeritus" status.

PREREGISTRATION SECTION: Please check the function(s) for which you are preregistering:
Joint Meetings [ ] AMS Short Course (January 6–7, 1992) [ ] Employer [ ] Co-Interviewer [ ] Applicant [ ] Posting [ ]

1) [ ] (Please print) Surname [ ] First [ ] Middle
2) [ ] (Mailing address) [ ] (E-mail address)
   I do not wish my badge, program, and/or Employment Register material to be mailed; however, the mailing address for my acknowledgement is given above.
3) [ ] Badge information: Affiliation
4) [ ] I am a student at
   1) [ ] Member of AMS [ ] CMS [ ] MAA [ ] Nonmember [ ]
   5) [ ] Emeritus member [ ] Unemployed [ ] MR Classification # [ ] MR Reviewer [ ]
5) [ ] Member of other organizations: AWM [ ] NAM [ ]
6) [ ] Joint Meetings fee $ [ ] AMS Short Course fee $ [ ]
7) [ ] Employer fee(s) $ [ ]
8) [ ] Co-Interviewer fee(s) $ [ ]
9) [ ] Applicant fee $ [ ]
10) [ ] Posting fee for job descriptions for noninterviewing employers $ [ ]
11) [ ] AMS 25-Year Banquet ticket(s) @ $25 each = $ [ ]
12) [ ] NAM Luncheon ticket(s) @ $20 each = $ [ ]
13) [ ] MER Banquet ticket(s) @ $26 each = $ [ ]
14) [ ] AWM Lunch ticket(s) @ $25 each = $ [ ]
15) [ ] Veg. meal [ ]
16) [ ] TOTAL AMOUNT ENCLOSED FOR 7 through 17 $ [ ]

NOTE: May be paid by check payable to AMS (Canadian checks must be marked "U.S. Funds") or VISA or MasterCard credit cards.

[ ] original institutional purchase order attached

Credit card type:

Card number:
Expiration date:

If this is your credit card, please print your name as it appears on the credit card on the line below as well as sign your name.
If this is not your credit card, please print card holder's name as it appears on the credit card on the line below, and have the card holder sign:

(Printed name) (Signature)

Please complete the appropriate sections on the reverse.

For office use only:

Codes: Options: Hotel: Room type:

Dates: Hotel Deposit Total Amt. Paid:

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 12% sales/occupancy tax.

GUARANTEE REQUIREMENTS: $50 by check or a credit card guarantee with VISA, MasterCard, or American Express (for housing only). No other credit cards will be accepted for room guarantees. 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>Single</th>
<th>Double 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* (starting rates)</th>
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<tbody>
<tr>
<td>Hyatt (Headquarters Hotel)</td>
<td>(See Hyatt categories below.)</td>
<td></td>
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<tr>
<td>Regular</td>
<td>85</td>
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<td>95</td>
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<td>N/A**</td>
<td>135</td>
<td>N/A**</td>
<td>225 +</td>
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<tr>
<td>Student***</td>
<td>76</td>
<td>76</td>
<td>76</td>
<td>96</td>
<td>N/A**</td>
<td>116</td>
<td>N/A**</td>
<td>225 +</td>
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<tr>
<td>Stouffer Harborplace</td>
<td>(See Stouffer categories below.)</td>
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<tr>
<td>Standard-Regular</td>
<td>85</td>
<td>95</td>
<td>95</td>
<td>105</td>
<td>N/A</td>
<td>115</td>
<td>N/A</td>
<td>185 +</td>
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<tr>
<td>Standard-Student***</td>
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<td>75</td>
<td>N/A</td>
<td>75</td>
<td>N/A</td>
<td>185 +</td>
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<tr>
<td>Harborview</td>
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<td>115</td>
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<td>125</td>
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<td>275+</td>
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<td>130</td>
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<td>140</td>
<td>N/A</td>
<td>275+</td>
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<td>Sheraton Inner Harbor</td>
<td>(See Sheraton Categories below.)</td>
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<td>Regular</td>
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<td>108</td>
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<td>123</td>
<td>123</td>
<td>325+</td>
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<td>88</td>
<td>88</td>
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<td>88</td>
<td>103</td>
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<td>133</td>
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<td>205+</td>
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<tr>
<td>Hospital Inn</td>
<td>69</td>
<td>79</td>
<td>79</td>
<td>89</td>
<td>89</td>
<td>99</td>
<td>109</td>
<td>200+</td>
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<tr>
<td>Days Inn</td>
<td>55</td>
<td>65</td>
<td>65</td>
<td>75</td>
<td>N/A</td>
<td>85</td>
<td>N/A</td>
<td>125+</td>
</tr>
</tbody>
</table>

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

** The Hyatt offers a flat fee of $20 per hotel stay for the use of a rollaway cot.

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

Special housing requests, handicapped needs, etc.: ________________________________________________________________

I will arrive on (date) ___________________________ at ___________________________ a.m./p.m., and depart on (date) ___________________________ at ___________________________ a.m./p.m.

Please list other room occupants, indicating ages of children. Please check here if one of the occupants is your spouse □

FULL NAME

ARIVAL DATE

DEPARTURE DATE
JOURNALS

ANNALS OF PURE AND APPLIED LOGIC

APPLIED NUMERICAL MATHEMATICS
An IMACS Journal
Editors-in-Chief: R. Vichnevetsky, J.E. Flaherty

ASYMPTOTIC ANALYSIS
Editor-in-Chief: L.S. Frank

COMPUTATIONAL GEOMETRY
Theory and Applications
Editors-in-Chief: J.-R. Sack, J. Urrutia
Honorary Editors: F.P. Preparata and P. Erdős

DIFFERENTIAL GEOMETRY AND ITS APPLICATIONS
Editor-in-Chief: D. Krupka

DISCRETE APPLIED MATHEMATICS
Combinatorial Operations Research and Computer Science
Editor-in-Chief: P.L. Hammer

DISCRETE MATHEMATICS
Editor-in-Chief: P.L. Hammer

JOURNAL OF COMPUTATIONAL AND APPLIED MATHEMATICS
Principal Editors: M.J. Goovaerts, J. Wimp and L. Wuytack

JOURNAL OF PURE AND APPLIED ALGEBRA
Managing Editors: P.J. Freyd, A. Heller, C.A. Weibel

MATHEMATICS AND COMPUTERS IN SIMULATION
Transactions of IMACS
Editor-in-Chief: R. Vichnevetsky

THEORETICAL COMPUTER SCIENCE
The Journal of the European Association for Theoretical Computer Science
Editor-in-Chief: M. Nivat

TOPOLOGY AND ITS APPLICATIONS
A Journal Devoted to General, Geometric, Set-Theoretic and Algebraic Topology
Managing Editors: R.B. Sher and J.E. Vaughan

BOOK SERIES

NORTH-HOLLAND MATHEMATICAL LIBRARY

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