Calendar of AMS Meetings

**THIS CALENDAR** lists all meetings which have been approved by the Council prior to the date this issue of the Notices was sent 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 yet been assigned. *Programs* of the meetings will appear in the issues indicated below. First and second announcements of the meetings will have appeared in earlier issues.

**ABSTRACTS OF PAPERS** presented at a meeting of the Society are published in the journal *Abstracts of papers presented to the American Mathematical Society* in the issue corresponding to that of the Notices which contains the program of the meeting. Abstracts should be submitted on special forms which are available in many departments of mathematics and from the office of the Society in Providence. Abstracts of papers to be presented at the meeting must be received at the headquarters of the Society in Providence, Rhode Island, on or before the deadline given below for the meeting. Note that the deadline for abstracts submitted for consideration for presentation at special sessions is usually three weeks earlier than that specified below.

For additional information consult the meeting announcement and the list of organizers of special sessions.

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**DEADLINES:**

- News/Special Meetings: (February Issue) January 17, 1983 (April Issue) February 14, 1983

Other Events Sponsored by the Society


May 1983, Symposium on Some Mathematical Questions in Biology, Detroit, Michigan.

June 5–August 13, 1983, AMS Summer Research Conferences, University of Colorado, Boulder, Colorado. This issue, page 74.

June 27–July 8, 1983, AMS-SIAM Summer Seminar on Large-scale Computations in Fluid Mechanics, Scripps Institution of Oceanography, La Jolla, California. This issue, page 72.


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Mathematical Reviews Online

MATHFILE is the online version of MATHEMATICAL REVIEWS, the authoritative
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Providence, RI 02901, or call toll free 800-556-7774 to charge with Visa or MasterCard.
The Executive Committee of IMU, at its meeting in Paris, November 13, 1982, decided to confirm the organization of the International Congress of Mathematicians in Warsaw in August 1983.

At the General Assembly, held in Warsaw in August 1982, there was a general feeling that the Congress should take place, if possible.

Since then, the Executive Committee has heard from several National Committees. It consulted again with Polish organizers and with many individual mathematicians, Poles and others. Invited speakers were also consulted.

Immediately before the meeting of November 13, the President of IMU visited Poland for consultation. In addition to meeting members of the Organizing Committee and other mathematicians, he was received by the Vice Prime Minister, Mr. Rakowski.

The Executive Committee has been assured that no practical matters will interfere with the organization of the Congress. The Vice Prime Minister confirmed that the plan of the Polish Government to cancel martial law by the end of 1982 still stands.

Information and views received did not point in a single direction and the Committee had considerable difficulty in reaching its decision. In the light of all the information, the Executive Committee did not feel justified in taking the drastic step of cancelling the Congress. On the other hand, the Executive Committee believes that there are indications that a Congress in 1983 could be scientifically successful.

The tradition of regular congresses is an important one which has only been interrupted during the two world wars. It is our conviction that our decision to hold the International Congress of Mathematicians in 1983 best promotes international cooperation in Mathematics.

In reaching this decision, the Executive Committee expresses its sincere wish that all those connected with the Congress will respect its nonpolitical nature.
Mathematics Program Review: Problems and Opportunities

James G. Glimm

Report for the NSF Advisory Subcommittee for the Mathematical Sciences

Strength in science and technology is essential to the welfare of our nation for reasons of both economics and national security. Mathematics is an important component of science and technology. Scientific computing, statistical analysis and a theoretical understanding of nonlinear equations will be vital topics for science for at least the remainder of the twentieth century. Progress at the frontiers of mathematics is part of the forward thrust of science. Most frequently this progress is driven in a direct sense more by the internal goals of mathematics than by the needs of specific applications.

Here we will discuss the relationship of mathematics to science and technology, the strength of recent developments within mathematics and finally, the opportunities and problems which the current situation presents to mathematics.

Mathematics has connections to the rest of science which are both predictable and unpredictable. Predictable connections include computing, statistics and modeling. These are major bread and butter activities of large subfields of mathematics. Fluid dynamics computer codes were originally developed by von Neumann, Richtmyer, Ulam and other mathematicians working in national laboratories and in universities. Over the years the scientific support of mathematicians has resulted in the development of these codes and in their improvement and application.

Modeling is a basic activity of applied mathematics; modeling is necessary in cases where the equations are unknown, inadequate or incompletely understood. Turbulence, multiphase fluid flow and chemical reaction kinetics are areas in need of better modeling. Nonlinear phenomena are poorly understood both in special cases and in general theory.

Statistics is important in a broad range of problems, from safety considerations for nuclear reactors to treatment evaluation for cancer patients.

The unpredictable applications of mathematics are harder to characterize. They spring from the universality and vitality of mathematics. Recent examples include the use of number theory in making and breaking codes, the use of algebra and topology to classify self-dual solutions of the nonlinear Yang-Mills equations and the use of homotopy theory to classify defects in crystals. The unpredictable applications may on occasion be highly important and may even remake a portion of the scientific landscape. Such was the case with Wiener's prediction theory, which in the hands of his MIT collaborators and colleagues became the foundation of modern petroleum seismology.

Looking to the future, we see a challenge in technology which our nation must meet. That new technology will require new mathematics is a lesson which history teaches. That excellence in technology will require excellence in mathematics is a corollary of this lesson.

Every branch of science requires its own goals. None can flourish in a service role. It is said that mathematics is both the handmaiden of science and its queen. Mathematics is for the most part driven by goals of its own choosing. With luck and taste, these choices lead in time to the unpredictable applications, but they also have an immediate relevance: The health and vitality of mathematics as a whole and as a current activity. Here again one can cite recent examples: The classification of four manifolds (the Poincaré conjecture), the classification of nonlinear soliton waves in terms of infinite dimensional Lie algebras and the development of analysis over infinite dimensional spaces to validate in part the foundations of quantum field theory.
In mathematics the essence of innovation and discovery is the formulation of concepts and the elucidation of structure. The classification schemes for solitons, Yang-Mills solutions and crystal defects are based on concepts from topology. Along with the concepts comes a highly developed mathematical structure which yields an analysis and an understanding as well as the classification. The concept of fractional dimension has been linked to turbulence. It is proposed that intermittency of vortices leads to an inertial range theory with singularities in a set of fractional space dimension \( d < 3 \). Below the inertial range (i.e., for the Navier-Stokes equations) it has been shown recently that the singularities have dimension \( d < 1 \). A branch of mathematics which has developed greatly in recent years is numerical analysis. This subject flourished in response to the needs of large scale computing. Numerical analysis offers explanations of stability and estimates of errors resulting from finite grid spacing \( \Delta x \) nonzero, and has produced a number of the computational methods in practice today.

It is essential to mention in this discussion that mathematics has a beauty and a joy uniquely its own. In a final triumph of logic over preconceptions we find infinitely many dimensions beyond the mysterious fourth, one-sided surfaces and number systems for which \( 1 + 1 = 0 \). On a lighter note, the card-counting scheme for winning at blackjack was invented by a mathematician. This was an exercise in probability and computing far removed from the ivory tower.

Mathematics is 'small science.' Though collaboration among two or three researchers is not uncommon, large projects with many researchers devoted to specific goals are relatively rare. Mathematics thrives on the interaction of independent viewpoints and different approaches. The explanation of these facts is that mathematics is to a very large extent theoretical. It is not exclusively theoretical because computers give it an experimental side and data processing problems in statistics have an empirical side. In these respects mathematics is similar to theoretical physics or theoretical chemistry.

What then are our problems and what are our opportunities? Mathematics has narrowed the gap between itself and the rest of science. Half or more of the current research areas of pure mathematics are being used in current research in theoretical physics, a marked contrast to the situation twenty years ago.

The use of mathematics is almost all pervasive within the physical sciences and their engineering applications. The mathematics community should consider whether it has been sufficiently aggressive in responding to interdisciplinary opportunities involving mathematics. We should certainly take more note of our successes as they will instruct not only others but also ourselves as to our capabilities. Included in our successes is the use of numerical solutions of partial differential equations to design airplane wings. The subject of linear programming lies at the heart of modern decision science and is a recent success of mathematics. The modern theory of partial differential equations is fundamental to much of the physical sciences. Modern developments in spline approximation theory are used for efficient representation of curves and surfaces, which is a basic problem in CAD/CAM.

Both internally and in its relation to the rest of science, the vitality of mathematics is high and the position of U.S. mathematics is strong. The morale within the field is low.

Mathematicians receive federal funding at about one-half to two-thirds of the level of the other physical scientists (excluding experimental equipment, for example). Academic salaries provide the bulk of our nation's support for mathematics. The current period of flat academic budgets has thus created a serious problem for mathematics which is unique among the physical sciences. Low levels of pre- and post-doctoral fellowship support as well as the lack of adequate support of research conspire to produce low levels of graduate student enrollment and the demoralized corp of young entrants to the profession. We are raising not so much a point of fairness as a serious question of the future availability of the high calibre mathematics which will be needed by science and technology.

The response to this problem must come partly from within mathematics. In fact the proportion of mathematics doctorates in applied areas and the proportion of the new Ph.D.'s seeking nonacademic employment has risen considerably. This is a healthy development. It should not be the only solution, lest we begin "eating our seed corn." It is in our national interest to increase the support of mathematics in specific ways which will ensure the continued excellence of mathematics.

The thrust of our argument is for a national need to maintain excellence in mathematics and its applications to science and technology. This thrust is translated into budget priorities as follows:

1. Basic repair to the infrastructure of mathematics, including support for students at a preand post-doctoral level, and flexible research support (released time, travel and visitors). The needs in this area were clearly visible in the review of the individual NSF mathematical sciences programs and have been documented by other groups. This category is essential to ensure that the highest levels of talent will enter the field of mathematics. It is the minimum which is essential to reverse the decay which is currently underway in mathematics and to preserve the level of excellence which will be required for solving the problems of technology which our nation will face over the coming decade.
2. Response to new research opportunities.

An excellent example of an opportunity which is currently at our doorstep is computing and the mathematics of computation. Computing is the area where mathematics can have an immediate impact on science and technology. Here we refer both to the use of computation to solve scientific problems (computational modeling and scientific computing) and to the mathematical study of the computational process (numerical analysis and complexity theory). In addition we endorse the recommendations made by other groups in support of increased computing facilities across the physical sciences.

Other opportunities also exist and support for conferences and seminars can bring them to the attention of the mathematical community. Without attempting to predict the future, we give as examples from the recent past: tomography (integral transforms), codes (algebraic geometry and number theory), design of computer components (differential equations), robotics (computational geometry), solitons and other nonlinear waves (geometry, differential equations, topology), complexity theory (combinatorics) and the mathematics of modern physics (analysis, probability theory, geometry, topology, algebra).

In responding to these opportunities it is essential to maintain proper balance between theoretical and applied activities and not to allow currently fashionable and exciting areas to drive out important traditional directions whose future impact could well be very significant. The unexpected quality of new applications of mathematics to science or new interrelations between branches of pure and applied mathematics necessitates excellence in a broad spectrum of quality research along with the enthusiastic following of very promising opportunities.

Finally we feel that the NSF staff is, within its constraints, doing an excellent job of making known the facts and problems concerning the mathematical community. They are not alone in this effort. Many mathematicians interact in sympathetic and useful ways with scientists and engineers who use mathematics. This one-on-one communication is a basic and constructive method of improving the image of mathematics within the scientific community.

EDITORS' NOTE. The article Primes, Codes and the National Security Agency, by Susan Landau, is the third in the series of Special Articles to be published in the Notices. Earlier articles in this series are that by J. C. Lagarias on the van der Waerden conjecture in the February 1982 issue and that by Robert S. Strichartz on para-differential operators in the August 1982 issue.

This series was created to provide a place for articles on mathematical subjects of interest to the general membership of the Society. The Editorial Committee is especially interested in the quality of exposition and intends to maintain the highest standards in order assure that the Special Articles will be accessible to mathematicians in all fields. The articles must be interesting and mathematically sound. They are first refereed for accuracy and (if approved) accepted or rejected on the basis of the breadth of their appeal to the general mathematical public.

Items for this series are solicited and, if accepted will be paid for at the rate of $250 per page to a maximum of $750. Manuscripts to be considered for this series should be sent to Dr. Ronald L. Graham, Associate Editor for Special Articles, Notices of the American Mathematical Society, Post Office Box 6248, Providence, Rhode Island 02940.
Physicists lost their innocence and freedom from government controls with Los Alamos. For biologists that time came in 1976 with National Institutes of Health regulation of recombinant DNA experiments. Mathematicians have been free from restraint—until now. The National Security Agency (NSA) has asked for and received an agreement of prior review on articles concerning cryptography. It recently sought to fund proposals for research in computational mathematics submitted to the National Science Foundation (NSF). Mathematics rarely makes the headlines; but the article on the front page of The New York Times of August 27, 1980 was startling—"Science Agency Blocks Funds to Aid Research on Computer Coding." Even more surprising is that the NSA is funding research on factoring integers. Factoring is so basic a problem that schoolchildren are asked to do it; how could it be a threat to national security?

The interest stems from the crucial role that primes and factoring play in a new mathematical cryptographic scheme. For centuries cryptography was the domain of the military, but an increasing reliance on computer data banks for anything from medical histories to credit records has changed that. There is a growing need for secure transmission of data which has made cryptography an active area of research in the private sector. The critical component of the sending of secret messages is a secure cipher. If many messages using the same code are intercepted, the cipher may be discerned by knowing the frequency distribution of letters in the language. Frequent changes of the cipher removes this problem, only to raise another: how to transmit the encryption scheme securely?

Seeking a way out of this dilemma, Whitfield Diffie and Martin Hellman of Stanford and Ralph Merkle of Berkeley proposed Public-Key cryptography in 1976. In short, Diffie, Hellman and Merkle envisaged an encryption mechanism in which even if the encryption method were known, decryption would be difficult and take years. By the time intercepted messages could be unraveled, the information would be outdated and useless. Encryption would be a "trapdoor"; its strength would lie in the inherent infeasibility of certain computations. At the time of Diffie and Hellman suggested several possibilities for such schemes but saw no workable method. Three computer scientists then at MIT, Ronald Rivest, Adi Shamir and Leonard Adleman did. They had a clever idea to exploit the contrast between the speed of primality testing and the apparent difficulty of factoring. Multiplying together two large primes would be a trapdoor from which factoring would be the exit.

The groundwork for their scheme had been laid in the early seventies. While logicians have wrestled for decades with the question of decidability, the issue in computer science instead has been complexity: on a problem of input size "m", how many steps does it take as a function of m to solve the problem? Answers to this question involve obtaining algorithms which provide an upper bound on the complexity of the problem, and lower bounds which show that any conceivable algorithm will require a certain number of steps. Exhibiting lower bounds is hard; for example, the present best lower bounds on the complexity of multiplying two \( m \times m \) matrices is \( O(m^2) \) (an obvious bound since there are \( m^2 \) entries), while the best algorithm is \( O(m^{2.496}) \).

The critical distinction comes between problems with polynomial time algorithms, and those which require exponential running time. The complexity of factoring integers is unknown, but best present factoring algorithms work in \( m^{1.6} \log m \) steps on an integer of \( m \) digits, which means that factoring a random one hundred digit number is essentially infeasible. Primality testing would appear to be as difficult, but in 1974 Gary Miller of Berkeley devised an algorithm which uses the Extended Riemann Hypothesis (ERH) to test primality of an \( m \) digit integer in \( O(m^4) \) steps. ERH guarantees the existence of a quadratic non-residue less than \( O(\log^2 p) \) in \( \mathbb{Z}/p\mathbb{Z} \), which Miller's algorithm needs to check primality. An approach which avoids the use of ERH was found by Robert Solovay of IBM and Volker Strassen of the University of Zurich; theirs is a probabilistic algorithm which tests primality of an \( m \) digit integer in \( O(m) \) steps. If the integer

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**SUSAN LANDAU** is a doctoral candidate at the Massachusetts Institute of Technology in applied mathematics and computer science. Her thesis, under the supervision of Gary L. Miller, presents a polynomial time algorithm for testing solvability by radicals; her research interests include algebra and theoretical computer science. She has taught for five years at Hampshire College Summer Studies in Mathematics, an NSF program for high ability high school students.
to be checked is prime, the Solovay-Strassen test responds “prime”; if the integer is composite, with probability no greater than one-half, the test declares it to be prime. Suppose \( a \) is an integer less than \( n \), which is relatively prime to \( n \); and let \( (a/n) \) be the Jacobi symbol of \( a \) on \( n \). If \( n \) is prime, then \( (a/n) \equiv a^{(n-1)/2} \mod n \). Solovay and Strassen noted that the set \( \{ (a/n) \equiv a^{(n-1)/2} \mod n \} \) is a proper subgroup of \((\mathbb{Z}/n\mathbb{Z})^*\) for composite \( n \). This means that at least half the \( a \)'s less than \( n \) and relatively prime to \( n \) do not satisfy \( (a/n) \equiv a^{(n-1)/2} \mod n \). The Solovay-Strassen test computes \( (a/n) \) (by quadratic reciprocity) and \( a^{(n-1)/2} \mod n \); if the two are not equal, the test responds “composite,” otherwise it calls the integer “prime.” The algorithm runs \( k \) independent trials; if any respond composite, the integer is composite, and is discarded. If all the trials say the integer is prime, then the probability that it is composite is less than \( 1/2^k \).

Since Miller’s algorithm depends on ERH, and the Solovay-Strassen procedure is probabilistic, the existence of a polynomial time algorithm for testing primality remains an open question. In 1980 however, Adleman, Robert Rumely, then at MIT, and Carl Pomerance of the University of Georgia developed a subexponential algorithm; their test runs in \( O(m^{c\log \log m}) \) steps on an \( m \) digit integer, where \( c \) is a constant. The upshot of these results is that within fifteen seconds a computer can check primality of a fifty-digit number.

The MIT group used the contrasts in complexity to create a simple and elegant Public-Key system. Each participant in the cryptosystem finds two large primes \((\sim 10^{50}) \) \( p \) and \( q \) by one of the fast primality algorithms. Let \( n = pq \), and let \( \varphi(n) \) be the Euler phi-function of \( n \). Each participant also chooses an “\( a \)”, an integer which is less than \( n \) and which is relatively prime to \( \varphi(n) \); such an integer can easily be found since most integers less than \( n \) are relatively prime to \( \varphi(n) = (p-1)(q-1) \). Thus choose \( a \) less than \( n \) and test whether \((a, \varphi(n)) = 1\); if not, repeat until an \( a \) which satisfies the conditions is found. The Public-Key book prints each participant’s \( n \) and \( a \). Suppose the Bank of England wants to communicate with the Federal Reserve. The Bank of England would proceed as follows:

1) Translate the message into numbers, say \( A = 01 \), \( B = 02 \), etc.

2) Break the message into blocks of convenient size.

3) Consult the Public-Key book for the recipient’s \( n \) and \( a \).

4) Send each block as \((block)^a \mod n\).

Decryption is simple for the recipient. Since \((a, \varphi(n)) = 1\), there exist \( x \) and \( y \) such that \( ax + \varphi(n)y = 1 \), and \( x \) and \( y \) can be quickly computed from \( a \) and \( \varphi(n) \). The Fed would decode as follows:

1) Break the message up into blocks.

2) For each block, compute \((block)^b \mod n\). 

3) Glue the blocks back together

4) Decode by \( 01 = A \), \( 02 = B \) etc.

This yields the original message, since

\[
(b^{2^e}(block) \equiv (block)^a \equiv (block)^{1-\varphi(n)y} \equiv (block) \mod n,
\]

by Fermat’s Little Theorem. The Fed decodes the communication easily, since it takes polynomial time to compute \( x \) given \( \varphi(n) \). An interceptor of the communication could do exactly the same calculation, except that he knows \( n \), not \( \varphi(n) \). The standard way to compute \( \varphi(n) \) is to factor \( n \), and in fact, Miller has shown that calculating \( \varphi(n) \) is polynomial time equivalent to factoring \( n \). Since \( n \) is the product of two fifty-digit primes, it is infeasible to factor it using best known algorithms.

Rivest, Shamir and Adleman announced their result in April 1977. The public became aware of it when Martin Gardner described the system in his Mathematical Games column of the August 1977 Scientific American. The discovery also attracted attention from other circles. Shortly before Rivest was scheduled to present the work at an Institute of Electrical and Electronics Engineers (IEEE) conference in Ithaca, New York, the IEEE received a letter from one J. A. Meyer of Bethesda, Maryland, warning that publication of cryptography results might be in conflict with the 1954 Munitions Control Act which regulated the flow of weapons and sensitive equipment to foreign countries. Meyer also said that dissemination of the conference proceedings abroad might be illegal. On the advice of the MIT lawyers, Rivest suspended sending out preprints.

A reporter from Science, Deborah Shapley, soon discovered that Meyer was listed as an employee of the National Security Agency. The NSA denied involvement with the letter, and a spokesman claimed that J. A. Meyer had written it as a private citizen. Rivest, Shamir, and Adleman decided to present their results at the conference and to resume mailing of their paper.

Nothing was heard from the NSA for a year and a half, until a speech by its Director, Admiral Bobby Inman, in 1979. He said that open publication of research in cryptography was harmful to the national security because it interfered with the NSA’s ability to gather and protect intelligence, and urged that a dialogue between the NSA and the academic community begin. The American Council on Education proposed the formation of the Public Cryptography Study Group (PCSG), with eight members from the academic community (the majority of them mathematicians and computer scientists), and one member from the NSA, Daniel Schwartz, a lawyer.

In a series of meetings during 1980-1981, the NSA argued for voluntary agreement regarding
publication of cryptography research. The agency claimed that academic work might inadvertently compromise United States encryption schemes. Research on the weaknesses of cryptosystems might also lead foreign governments to adopt more sophisticated systems, thus denying the U.S. needed intelligence. Although it preferred a voluntary agreement, the NSA made clear that it was also considering seeking statutory authority for prepublication review of sensitive material. (As precedent, the NSA cited two Federal laws: the Arms Export Control Act (22 U.S.C. 2778), which restricts foreign dissemination of certain information relating to cryptology and supercedes the 1954 Munitions Control Act, and Section 181 of Title 35 U.S.C. which permits the imposition of a secrecy order upon a patent application when issuance of a patent would be harmful to national security. Since algorithms and scientific papers are not patentable, neither related to domestic release of nongovernmental research in cryptography.) On January 5, 1981, the PCSG approved a two-year experiment under which the NSA would inform the academic community of its interest in reviewing cryptography papers prior to publication. Compliance would be voluntary, and review prompt. If the NSA wanted to delete portions of a paper, or prevent publication, it would first consult with an advisory panel (whose members would have top security clearance), although the NSA would not be bound by the decisions of the advisory group. Changes would be explained to the greatest degree possible.

One committee member, George Davida, professor of computer science at the University of Wisconsin, issued a dissenting report. He argued that the NSA’s attempt to control publication of cryptography research was of questionable legality, and he called attention to a memorandum the Justice Department had issued stating that, “It is our view that the existing provisions of the ITAR [International Traffic in Arms Regulation of the Arms Export Control Act] are unconstitutional insofar as they establish prior restraint in disclosure of cryptographic ideas and information developed by scientists and mathematicians in the private sector.” Davida contended that the risks to the NSA were far outweighed by the benefits to the public, and that the direction and quality of research in cryptography would be seriously affected by the withholding of results. Rather than limit public research, the NSA should “perform its mission in the old-fashioned way: stay ahead of others,” Davida bluntly suggested.

The situation grew more serious in August 1980 with the renewal of Leonard Adleman’s NSF grant. His budget had already been renegotiated when Adleman was informed that the NSF would be unable to fund part of it due to “national security reasons.” NSF would support Adleman’s work on the complexity of number-theoretic problems and on VLSI (chip design), but declined to support his research in cryptography or related problems. Shortly afterwards Adleman received a call from Admiral Inman, who offered that the NSA fund Adleman’s work. Because NSF funds are limited, the procedure has always been that if a mission agency was interested in funding a proposal, it would do so instead of NSF. The issue here though was disclosure; if the NSA supported Adleman’s research, might it classify it?

On October 9, 1980 representatives from the NSA and the NSF met with White House science advisor Frank Press to clarify the issue. The decision was made that both agencies would fund cryptography research for the present. Although the NSA would require investigators it supports to submit articles to the agency prior to publication, it would not expect to classify the research it supported. Adleman was offered the choice of NSA or NSF funding; he accepted NSF support because, “On a personal level I saw myself as a pure scientist and my natural affinities were to be funded by NSF. As a scientist, it was clear that there would be a national debate on the issues and I didn’t want any action I might take to be misconstrued as suggesting that the NSA had a compelling case that they had a role to play in the scientific process.”

Subsequent to this, a subcommittee of the NSF Mathematics and Computer Sciences Advisory Subcommittee was convened to discuss NSF’s role in supporting cryptology research. On July 13, 1981, it issued its report, which stressed the importance of cryptology to business and private citizens. “Tampering with information related to such things as electronic funds transfers is a new threat which can be posed by criminal, terrorist or enemy agents to personal, corporate or national security … it is clear that increased computerization of our society is leading to the accumulation of vast amounts of personal information … it is imperative that steps be taken to limit access to this information,” the report said. The panel expressed concern that NSF’s budget limitations might soon lead the NSA to dominate the field of cryptography, and recommended that the NSF encourage the Department of Commerce to fund research in this area. The Public Cryptography Study Group guidelines came in for sharp criticism. “The proposed system of prepublication review is unnecessary, unprecedented, and likely to cause damage to the ability and willingness of American research scientists to stay at the forefront of research in public sector uses of cryptology.” Finally, the NSF report observed that cryptography is no more of a threat to national security than many areas of basic research, but that it was distinguished by the fact that a single government agency had controlled the area for nearly thirty years.

Davida and others argue that national security is imperiled more by the lack of secure encryption systems in the commercial environment than
it is by the knowledge garnered by foreign powers from the publication of cryptography research. There can be little doubt of the importance of cryptography to industry, business, banking, and the Department of Commerce, even the Department of Agriculture. In 1972-1973 the Soviets were able to purchase record amounts of grain because of information they had obtained by eavesdropping on calls to and from the Department of Agriculture. Long-distance calls are transmitted by microwave and are not encoded; it is a simple matter to intercept and listen to messages. Information about grain transactions are not the only communications to travel insecurely; everything from banking information to trade secrets is subject to the same type of attack. Dissemination of research on cryptography may make the NSA's job more difficult. In a society where information is a commodity, there is no easy path between Scylla and Charybdis.

In the two years since the PCSG recommendations and the decision that both NSF and NSA would fund cryptography research, the mathematics community has reached a temporary accommodation with the situation. The AMS has chosen to publicize, without endorsement, any request by the NSA for individuals to participate in the review process. The leading professional organization in computer science, the Association for Computing Machinery, encourages authors of papers in cryptography to submit their articles to the NSA for prepublication review, but does not enquire if that has been done. The NSA has received copies of thirty-five papers, and has suggested "minor changes" in two of them. New funding procedures have not had a sufficient time for evaluation. The NSA has funded four grants, while the NSF has experienced a ten percent increase in cryptography proposals submitted, the same growth it has had in other areas of theoretical computer science. But two years is a short time to measure change in a research community, and it is probably too soon to tell if the NSA restraints will have a chilling effect on research in public sector cryptography.

NSA actions relate directly to basic research in mathematics and computer science. For example, the security of the Rivest, Shamir and Adleman system relies on factoring being hard. Does the NSA propose to suppress investigations on factoring integers? The Atomic Energy Act created a precedent for private work being "born classified," but there is a sharp distinction between ideas which apply to the building of bombs, and those which relate to the security of computer systems. If work on cryptography is restricted in the United States, there is nothing to prevent researchers in other countries from pursuing such inquiries. At the time of hearings on the Atomic Energy Act, Enrico Fermi commented, "Unless research is free and outside of control, the United States will lose its superiority in scientific pursuit."

Scientific questions do not arise in a vacuum, nor do ideas develop under the threat of restraint. Restricting the freedom of inquiry in which science thrives is not a decision to be taken lightly.

Bibliography


Broad, W., Evading the Soviet ear at Glen Cove, Science, 3 September 1982, pages 910-911.


Mathematical and Computer Sciences Advisory Subcommittee, The role of the NSF in supporting cryptological research, A Report to the National Science Foundation by its Mathematics and Computer Sciences Advisory Subcommittee, July 13, 1981.


Queries

Edited by Hans Samelson

QUESTIONS WELCOMED from AMS members regarding mathematical matters such as details of, or references to, vaguely remembered theorems, sources of exposition of folk theorems, or the state of current knowledge concerning published or unpublished conjectures.

REPLIES from readers will be edited, when appropriate, into a composite answer and published in a subsequent column. All answers received will ultimately be forwarded to the questioner.

QUERIES and RESPONSES should be typewritten if at all possible and sent to Professor Hans Samelson, American Mathematical Society, P. O. Box 6248, Providence, Rhode Island 02940.

Queries

266. Vladik Ja. Kreininov (P.O. Box 21, Leningrad 22, USSR 197022). (1) Prove that for almost all (in some natural sense) Gaussian measures on the set $F$ of all real continuous functions localized on some compact region in $R^n$ $(n \geq 2)$, the measure of the set of convolutions $f_1 * f_2$, $f_1 \in F_1$, is 0. (2) Is anybody aware of some good algorithm for machine simulation of a Gaussian stochastic process with spectrum $\sim \omega^{-\alpha}$, or of some theorems that will possibly simplify constructing such an algorithm?

267. Niels Jacob (FB Mathematik, Institut für Mathematik, WE 3, Freie Universität Berlin, 1000 Berlin 33, Federal Republic of Germany). For what $n \in \mathbb{N}$, $n > 1$, does there exist an explicit formula for the function $f$ defined by $f(a) = \int_{-\infty}^{\infty} e^{-x^n} \cos ax \, dx$? Such a formula may be used to construct certain Markov processes.

268. A. Wilansky (Department of Mathematics, Lehigh University, Bethlehem, Pennsylvania 18015). Let $X$ be a l.c. Fréchet space. Many texts show that $X'$ is fully complete with $\tau(X',X)$ but none mention $\beta(X',X)$. Is $X'$ fully complete with this topology? ($\tau =$ Mackey, $\beta =$ Strong.)

Responses

The replies below have been received to queries published recently in the Notices. The editor would like to thank all who reply.


260. (vol. 29, p. 406, August 1982, Enzo R. Gentile) Does $Q_p (= p$-adic numbers) contain a subfield $k$ of finite codimension? Reply: No. This is proved in P. Ribenboim, On the completion of a valuation ring, Math. Ann. 155 (1964), 392–394, Proposition 2. For a slightly different proof, one shows a finite Galois extension $K$ of $k$, containing $Q_p$, has a natural discrete valuation and topology that is invariant under the Galois group. Thus $k$ is closed in $K$; since it is also dense in $Q_p$, it equals $Q_p$. (Contributed by D. Leep and J.-P. Serre)
Letters to the Editor

War Mathematics

I found the text of Professor Rosser’s address, *Mathematics and Mathematicians in World War II* (October 1982 *Notices*, pages 509 to 515), to be very interesting, though incomplete. However, I am mystified by two statements made near the beginning:

(a) “Except in cryptanalysis, hardly any of the mathematics done for the War effort was of a higher level than this [junior year level], and much was at lower levels.”

(b) “If we equate being mathematics to being publishable, then indeed very little mathematics was done for the War effort.”

Professor Rosser then proceeds to describe the beginnings during the war of two new branches of mathematics, operations research and computer science. He mentions important developments in statistics, aerodynamics, and aeroballistics, as well as brilliant work in cryptanalysis! He mentions the invention of the analog computer and in effect that of the stored program digital computer, both profoundly mathematical. He mentions the invention of the linear programming matrix method, the theory of spline functions, and the computer assisted solution of the four color problem.

Surely Professor Rosser is a master of understatement or has his tongue in cheek! Even if important new mathematics and technology had not been produced as it was, surely the solution of important problems in other fields is part of the vitality of mathematics and part of its raison d’être.

Of course, one could mention omissions such as the work reported in James, Nichols, and Phillips, *Theory of Servomechanisms*, 1947, and so on. But let us be proud of those wartime accomplishments, as mathematics.

Van McAuley
Huntsville, Alabama

Bulletin

At the risk of sounding the worst sort of prig, I want to express the disquietude I feel at the attitude which some members of the Society have displayed about the Bulletin. I’m sorry for a mathematician whose interest cannot be aroused by anything too “remote” from his or her own research; but my sorrow is replaced by anger and dismay when such a person actually tries to present such a flattened mathematical affect as some sort of positive good, a norm, something to be promoted actively—for instance by eliminating the Bulletin. Are these the people who support MATHFILE for the wrong reason (not that I’m convinced there is a right one), namely, that armed with some “key words” and an ample budget, one need never again run the risk of stumbling across an entertaining or enlightening article on some other topic?

I condemn this paltry instrumentalism. In my ideal, mathematics is one of the humanities, and nothing mathematical should be alien to us. (I do admit that sometimes I have felt I was drowning in survey articles and invited addresses on recursive functions.)

Lee Rudolph
Brandeis University
Institute for Mathematics and Its Applications


The program will deal with optimal rules for economic organization. We give two examples of the kinds of models to be considered.

At time \( t + 1 \) the \( n \) agents send messages \( m^n \) in a message space \( M^n \) according to a rule \( m^n(t+1) = f^n(m^n(t), e^n) \) where the parameter \( e^n \) describes the agent's characteristics and preferences. If this iterative process converges to a fixed point \( \bar{m} \) of \( e \), an outcome function \( h \) is used to determine the allocation \( h(\bar{m}) \) of resources to the agents. The composite function \( h \circ m \) is a mapping from the set \( E \) of possible characteristics of the agents to the set \( A \) of possible allocations. Some interesting questions to be studied are:

1. If a particular performance function \( F: E \rightarrow A \) is deemed desirable, can it be implemented as above, either exactly or approximately, by specifying \( M^n, f^n \), and \( h^n \)? This leads to problems related to differential geometry, network theory, graph theory, and dynamics.

2. If the answer to (1) is affirmative, how can the cost of the messages be minimized? This leads to problems in combinatorics, computational algorithms, and computational complexity as well as the above fields.

Another model of decentralized management establishes a set of possible actions \( D^i \) (which depends on \( e^i \) of the \( i \)th agent) and an outcome function \( h^i \). If \( \mu^i \) is the utility function of the \( i \)th agent, this leads to a game with payoff functions \( \mu^i \circ h^i \). The problem is to determine the \( D^i \) and \( h^i \) so that the solutions \( a^i \) of the game have the property \( a^i \sim F(e) \) where \( F \) is a given performance function, while keeping the rules as simple as possible. Such models also use mathematics from a variety of areas.

The Institute hopes to attract mathematicians, both junior and senior, from diverse backgrounds to interact with the economists. We believe that long-term interactions are most useful, but we plan to have several brief workshops or periods of concentration.

Some postdoctoral and sabbatical support is available for long-term participants through contributions from the NSF, the IMA Participating Institutions (Indiana University, Michigan State University, Northern Illinois University, Northwestern University, Ohio State University, Purdue University, University of Chicago, University of Illinois, Urbana-Champaign, University of Iowa, University of Michigan, University of Minnesota), Cray Research, Honeywell, Magnetic Controls, and 3M.

Further information can be obtained from Hans Weinberger, Director, Institute for Mathematics and its Applications, University of Minnesota, 514 Vincent Hall, 206 Church Street, S.E., Minneapolis, Minnesota 55455.

Kantorovitch Awarded Order of Lenin

Lee Lorch, York University, reports that Academician L. V. Kantorovitch was awarded the Order of Lenin by the Presidium of the Supreme Soviet of the USSR in appreciation of his contributions to Soviet science on the occasion of his seventieth birthday. This was announced
in a decree signed by President Brezhnev dated January 15, 1982. It, together with a photograph of Academician Kantorovitch and a tribute to his scientific achievements, is published in Uspekhi Matematicheskikh Nauk, volume 37 (1982), 201-209. (This journal is translated into English and is published by the London Mathematical Society under the title Russian Mathematical Surveys.)

AWM Noether Lecture Series

The Association for Women in Mathematics invites nominations from the Mathematics community for the 1984 Noether Lecturer. This lecture, which is given every year at the January Mathematics Meetings, is named for the distinguished mathematician Emmy Noether and serves to honor women who have made fundamental and sustained contributions to the mathematical sciences. Past lecturers have included F. Jessie MacWilliams, Olga Taussky-Todd, Julia B. Robinson, and Cathleen S. Morawetz.

Nominations, together with supporting material should be sent to Jill P. Mesirov, American Mathematical Society, Post Office Box 6248, Providence, Rhode Island 02940.

Council for International Exchange of Scholars

The Council for International Exchange of Scholars (CIES) announces that applications are now being accepted for Senior Scholar Fulbright Awards abroad during 1983-1984. Over 200 lecturing and research awards are available in all academic disciplines and most countries.

There is now no specific deadline for receipt of applications. As CIES receives and reviews applications, awards will no longer be available. Individuals should therefore act promptly if they wish to be considered for an award in 1983-1984.

Applications and further information may be obtained from CIES, Eleven Dupont Circle, Washington, D.C. 20036, 202-833-4950; or from the Office of the Graduate Dean at graduate institutions (the Office of International Programs at some institutions) or the Office of the Chief Academic Officer at undergraduate institutions. Prospective applicants should verify with a CIES program officer that a particular award is available before completing an application.

All applicants must be U.S. citizens, hold a doctorate or other higher degree, have significant professional or teaching experience, and, in some cases, be fluent in a foreign language.

The Fulbright program is funded and administered by the United States Information Agency.

--News Release

AMS SHORT COURSE SERIES
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GAME THEORY AND ITS APPLICATIONS
edited by William F. Lucas

This volume contains the lecture notes prepared by the speakers in the short course on Game Theory and its Applications given in Biloxi, Mississippi in 1979.

Game theory has been a topic of broad interest as a purely theoretical subject which has relationships to many other mathematical areas, and also as a subject widely used in applications over a large variety of problem areas. It is concerned with mathematical models for situations involving conflict and/or cooperation. These arise in a fundamental way throughout the behavioral and decision sciences.

Game theory has become a basic modeling technique in much of modern economic theory, political science, sociology, and operations research, and it has frequently been applied to many other fields. It is a subject highly suitable for joint research of an interdisciplinary nature.

This volume is concerned mostly with the $n$-person theory ($n \geq 3$), although chapter 6 also describes several basic two-person models. The first five chapters deal for the most part with the multiperson cooperative games in the characteristic function (coalitional) form. The normal (strategic) form and the extensive (tree) form of a noncooperative game are stressed in chapter 6, although some basic definitions for the normal form do appear in an earlier chapter. Selected applications of the theory which are covered here in some detail include economic market games, measuring power in political systems, equitable allocation of costs, and auctions. Many of the important recent uses of game theory have involved the $n$-person cooperative models.

These lectures were presented to an audience of mature mathematicians. Nevertheless, this volume could also serve as a textbook for a general course in game theory at the upper division or graduate levels.

William F. Lucas, The multiperson cooperative games

William F. Lucas, Applications of cooperative games to equitable allocation

Louis J. Billera, Economic market games

L. S. Shapley, Valuation of games

L. S. Shapley, Measurement of power in political systems

Robert J. Weber, Noncooperative games

1980 Mathematics Subject Classification: 90D

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Commission on Precollege Education in Mathematics, Science and Technology

A new Commission on Precollege Education in Mathematics, Science and Technology has been established by the National Science Board, the policymaking body of NSF. The Commission is expected to develop national agenda to help solve the country's critical need for high school graduates with solid backgrounds in science and mathematics. It will develop an action plan that will include a definition of the appropriate roles of federal, state and local governments, professional and scientific societies, and the private sector in addressing this problem.

The Commission of 18 individuals from a wide variety of fields is co-chaired by William T. Coleman, Jr., former Secretary of Transportation and now a senior partner in a law firm, and by Cecily Cannan Selby, formerly National Executive Director of the Girl Scouts, U.S.A., and chairperson of the Board of Advisors of the North Carolina School of Science and Mathematics. For further information write the Executive Director, Richard Nicholson, Commission on Precollege Education in Mathematics, Science and Technology, National Science Foundation, 1800 G Street, N.W., Washington, D.C. 20550.

National Research Institutes

Start Operations

Two national institutes funded by the National Science Foundation to stimulate research in the mathematical sciences have started full operation on the West Coast and in the Midwest.

Establishment of the Mathematical Sciences Research Institute Inc. in Berkeley and the Institute for Mathematics and its Applications in Minneapolis climaxes many years of planning. The NSF involvement dates formally to 1978 when the National Science Board, the NSF's policymaking body, approved in principle the creation of such institutes.

The Berkeley Institute, occupying temporary quarters on the University of California campus, is directed by S. S. Chern. The Deputy Director is Calvin C. Moore.

A total of 83 mathematical scientists will have appointments during the first year of the Berkeley Institute's operation. Most of the research effort will center around two special programs, one in nonlinear partial differential equations and the other in mathematical statistics. Several workshops and conferences on topics related to the programs will be held during the year.

Plans are underway by the University of California for construction of a building for the Institute overlooking the Berkeley campus and San Francisco Bay. The building is scheduled to be completed in the spring of 1984.

About 55 mathematicians will be working at the Minneapolis Institute which is housed in the Mathematics Building on the university's campus. The Minneapolis Institute is headed by Hans F. Weinberger. The Deputy Director is George R. Sell.

The Minnesota program will focus during the first year on mathematical formulations of statistical and continuum approaches to phase transition phenomena. The fall program will be concerned with statistical mechanics and chaotic behavior of dynamical systems. The winter program will examine mathematical aspects of such problems as interfacial effects in solidification and the behavior of liquid crystal-like polymer solutions used to make high-strength fibers. There will be close collaboration with experts in the Departments of Chemical Engineering, Chemistry, Aerospace Engineering, Mechanical Engineering, and Physics. Scientists from industry and government will be involved in the work at the Minneapolis Institute. The spring and summer effort will concentrate on the continuum thermodynamic approach to phase transitions.

EDITOR'S NOTE: For a more detailed description of the 1983-1984 program in Minneapolis, see page 13.

The United States-Japan Cooperative Science Program

Both Japan and the United States have many international agreements for cooperation in science with other countries. The first such agreement for each country, however, came in 1961 when Prime Minister Hayato Ikeda and President John F. Kennedy issued a joint communique in which they "recognized the importance of broadening educational, cultural and scientific cooperation between the two countries." Scope of the Program. The U.S.-Japan Program currently supports activities of three types: Cooperative Research, Joint Seminars, and 6- to 12-month Long-term Visits to Japan. Fields of science include:

- Education in the Sciences
- Scientific and Technical Communication
- Earth, Planetary and Astronomical Sciences
• Biological, Agricultural and Medical Sciences
• Mathematical, Physical and Chemical Sciences
• Engineering Sciences
• Interdisciplinary Problems, including Problems of Special Current Interest

The Program covers costs of travel, per diem, and logistics to make possible the cooperative activity. Approximately 1,025 awards have been made since 1961, as follows: Cooperative Research, 360; Joint Seminars, 400; Short-term Visits, 65; Long-term Visits, 160; and Planning Meetings, 40.

Eligibility. Proposals may be submitted by individual scientists at universities, research institutions and other organizations, after consultation between the scientists concerned in the two countries.

Administration. In the United States, the Cooperative Program is administered by the National Science Foundation; in Japan, by the Japan Society for the Promotion of Science for research and by the Science and Technology Agency for scientific and technical communication. Scientists interested in collaboration should direct a preliminary inquiry on proposal preparation to the administering agency in their own country:

National Science Foundation, Division of International Programs, 1800 G Street, N.W., Washington, D.C. 20550;
Research Cooperation Division, Japan Society for the Promotion of Science, 5-3-1 Kojimachi, Chiyoda-ku, Tokyo, Japan 102;
Information Policy Section, Institutes Administration Division, Promotion Bureau, Science and Technology Agency, 2-2-1, Kasumigaseki, Chiyoda-ku, Tokyo, Japan 100.

Scandinavia and the Netherlands

Cooperative Science Programs

NSF’s Scandinavia and the Netherlands Cooperative Science programs are considering proposals for these countries, with support offered for three types of activities: cooperative research projects, joint workshops/seminars, and short- and long-term research visits.

There are no deadlines for receipt of these proposals. For information, write to Henryk Uznanski, Division of International Programs, National Science Foundation, 1800 G Street, N.W., Washington, D.C. 20550; 202-357-7554.  

Cooperative Research with Eastern Europe

NSF’s Eastern Europe Cooperative Science programs seek to foster and support scientific and technological cooperation between the U.S. and Bulgaria, Hungary, and Romania. The Division of International Programs administers activities undertaken under this program in the U.S. and maintains liaison with foreign agencies. The following general guidelines have been established:

(1) Both the U.S. and the foreign country must approve each project; (2) Each country will support the cost of research and other scientific activities taking place within its territory; (3) Contributions to the program by the U.S. and the foreign country involved should be on an approximately 50-50 basis.

The program offers financial support for three types of activities: cooperative research projects, seminars and workshops, and scientific visits for planning purposes. Proposals must be submitted to NSF by American institutions, and to the appropriate foreign agency by foreign institutions. Proposals should be prepared according to standard NSF guidelines, but must also contain a section on “International Cooperation,” which describes in detail the cooperative aspects of the work plan and the mutual benefits to be obtained. Proposals for joint research should be submitted at least nine months before the requested starting date; for seminars, 12 months; and for short-term visits, six months. For further information, write to Deborah Wince, Division of International Programs, National Science Foundation, 1800 G Street, N.W., Washington, D.C. 20550; 202-357-9516.

U.S.-Latin America

Cooperative Science Programs

The Division of International Programs offers support for collaborative activities involving U.S. scientists in joint projects with counterpart scientists from countries in the Caribbean, Central and South America.

Support is offered for cooperative research projects, research oriented workshops, symposia and scientific visits. Proposed submission deadlines are May 1 and November 1 each year. For more information, write to Eduardo Feller, Christine French, or Harold Stolberg, U.S.-Latin America Cooperative Science Programs, Division of International Programs, National Science Foundation, 1800 G Street, N.W., Washington, D.C. 20550; 202-357-9563.

New Individual Travel Guidelines in the U.S.-India Program

The individual travel component of the U.S.-India program has been revised to focus on research. U.S. scientists may apply for travel support to India to engage in research or to complete a formal cooperative research proposal with an Indian counterpart scientist.

A preliminary proposal must be submitted along with the travel application.

Individual travel support to India will no longer be considered solely for study tours, lectures, short courses, seminars, or international meetings.
The revised guidelines are available from Jean Johnson, U.S.-India Program, Division of International Programs, National Science Foundation, 1800 G Street, N.W., Washington, D.C. 20550; 202-357-9550. —NSF Bulletin

Research Improvement in Minority Institutions Program

NSF established a new Research Improvement in Minority Institutions (RIMI) program in fiscal year 1982. The program provides for strengthening research capabilities of predominantly minority U.S. colleges and universities with graduate programs in science or programs in engineering.

Predominantly minority institutions are those colleges and universities whose primary mission is to educate students from ethnic minorities which have low participation in science and engineering.

Research improvement projects will be supported up to a maximum of $250,000 each over 36 months. Each eligible institution may submit only one RIMI proposal per year. Proposals, which must be endorsed by the submitting institution’s president or chancellor, must be submitted to NSF on or before December 15 each year, for the following year. For additional information, write to Roosevelt Calbert, Office of Planning and Resources Management, National Science Foundation, 1800 G Street, N.W., Washington, D.C. 20550; 202-357-7350. —NSF Bulletin

Minority Research Initiation Program

NSF will continue the Minority Research Initiation program for fiscal year 1983. The MRI program, established in fiscal year 1981, provides research support for capable science and engineering minority faculty who are nationals of the U.S. and who are members of ethnic groups that have low participation in science and engineering research.

Research proposals are accepted from eligible researchers at any U.S. college or university who have not received previous Federal research support as faculty members. Additional information is available from Roosevelt Calbert, Office of Planning and Resources Management, National Science Foundation, 1800 G Street, N.W., Washington, D.C. 20550; 202-357-7350. —NSF Bulletin

NSF Awards for Purchase of Computing Equipment

The National Science Foundation plans to award approximately $685,000 for the purchase of computing equipment to 15 institutions having graduate programs in mathematics, applied mathematics, or statistics. These awards, the first of their type made by the NSF’s Mathematical Sciences Section, will enhance the quality and productivity of research activities by providing access to appropriate computing equipment.

A panel of distinguished mathematicians and computer scientists assisted the NSF in reviewing and evaluating the proposals. Many of the awardees also received significant contributions from other government agencies, institutional sources and, in some cases, computer manufacturers.

The following departments will receive awards: *Computer graphics equipment or systems: Mathematics, Boston University; Statistics, University of California, Berkeley; Mathematics, University of California, San Diego; Mathematics, New York University; Mathematics, University of North Carolina, Chapel Hill.*

*Minicomputer systems: Applied Mathematics, California Institute of Technology; Mathematics, University of California, Berkeley; Statistics and Mathematics, Carnegie-Mellon University; Institute for Physical Science and Technology, University of Maryland; Mathematical Sciences, Northern Illinois University; Mathematics and Statistics, Biostatistics, University of Rochester; Statistics, Stanford University; Mathematics, State University of New York, Buffalo; Statistics, University of Washington; Statistics, University of Wisconsin.* —NSF News Release

Positions Open in NSF

Applicants for the following positions should submit résumés to NSF, Personnel Administration Branch, Room 212, 1800 G Street, N.W., Washington, D.C. 20550, Attn: E. Paul Broglio; 202-357-7840. NSF is an Equal Opportunity Employer.

**NSF’s Division of Mathematical and Computer Sciences** is seeking qualified applicants for a position which periodically becomes available in computer science. The position will be filled on a one- or two-year rotational basis and is excepted from the competitive civil service. The salary ranges from $39,689 to $57,500 per annum (GS-14/15 equivalent). The opening will be in the field of Intelligent Systems. Applicants should have a Ph.D. or equivalent experience and training in an appropriate field, plus six years of successful scientific research experience. A broad general knowledge of computer research and some administrative experience are also required.

**NSF’s Division of Mathematical and Computer Sciences** is seeking qualified applicants for positions which periodically become available in the mathematical sciences. The positions are filled on a one- or a two-year rotational basis and are excepted from the competitive civil service. Salaries range from $39,689 to $57,500 per annum (GS-14/15 equivalent). Applicants should have a Ph.D. or equivalent experience and training in an appropriate field, plus six years of successful scientific research experience. A broad general knowledge of the field and some administrative experience are also required. —NSF Bulletin
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AMERICAN MATHEMATICAL SOCIETY
P.O. Box 1571, Annex Station, Providence, Rhode Island 02901
The January 1983 Joint Mathematics Meetings, including the 89th Annual Meeting of the AMS, the 66th Annual Meeting of the Mathematical Association of America, and the 1982–1983 Annual Meeting of the Association for Symbolic Logic, will be held January 5–9 (Wednesday–Sunday), 1983, in Denver, Colorado. Sessions of the MAA on Thursday, January 6, and Sunday, January 9, will be held jointly with the National Council of Teachers of Mathematics. The meetings will be preceded by the AMS Short Course on January 3–4 (Monday–Tuesday), 1983. Sessions will take place in the Denver Convention Complex and the Executive Tower Inn.

The members of the Local Arrangements Committee are Paul T. Bateman (ex-officio), Jerrold W. Bebernes, William S. Dorn, Gary W. Grefsrud, Raymond R. Gutzman, Darel W. Hardy, Zenos Hartvigson, Frieda K. Holley, William J. LeVeque (ex-officio), Richard Osborne, Arlan B. Ramsay (chairman), William N. Reinhardt, David P. Roselle (ex-officio) and Nancy M. Thompson (publicity director).

WHERE TO FIND IT

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The American Mathematical Society, in conjunction with its eighty-ninth annual meeting, will present a one and one-half day short course entitled "Computer Communications" on Monday and Tuesday, January 3 and 4, 1983, in the Symphony Ballroom of the Executive Tower Inn in Denver, Colorado.

Computer communication systems are expected to have a profound effect on human communications in the coming decades. Present day computer communications already span an extraordinary range: from the "low level" interaction of circuits on an integrated circuit chip in a typical computer to the "high level" conversations between computers at geographically distant locations.

The course is designed to acquaint the participant with mathematical ideas that pervade almost every level of computer communications. The mathematical methods used in this field include stochastic processes, combinatorics, analysis and logic, as well as various aspects of theoretical computer science.

Included in the course will be discussions of problems in data communication, complexity of VLSI (Very Large Scale Integrated circuits) computations, modelling concurrent processes, probabilistic aspects of networks, and diffusion approximations. Opportunities will be available for participants to obtain first-hand experience working with the speakers in an interactive session on mathematical problems in computer communications.

Synopses of the talks and accompanying reading lists are printed following the announcements of the Denver Mathematics Meetings on pages 580 and 581 in the October issue of the Notices. Participants will be presumed to have background knowledge corresponding to the content of a course in probability theory and introductions to logic and differential equations.

Those who hope to benefit the most from the course may wish to acquire a general background on networks, such as presented in the book Computer networks, by A. S. Tanenbaum, Prentice-Hall, New York, 1981.

The course will consist of five lectures and an "Overview" presented by the organizer; it will conclude with the interactive session mentioned above. The speakers are B. Gopinath (Bell Laboratories, Murray Hill), J. Michael Harrison (Stanford University), Pierre A. Humblet (Massachusetts Institute of Technology), Frank P. Kelly (Statistical Laboratory, University of Cambridge), Robert P. Kurshan (Bell Laboratories, Murray Hill) and Thomas Lengauer (University of Saarland).

The short course is open to all who wish to participate upon payment of the registration fee. There are reduced fees for students and unemployed individuals. Please refer to the section entitled Registration at the Meetings for details.

The program is under the direction of B. Gopinath of the Bell Laboratories, Murray Hill. The short course was recommended by the Society's Committee on Employment and Educational Policy, whose members are Lida K. Barrett (chairman), Irwin Kra, Robert W. McKelvey, Donald C. Rung, Robert J. Thompson, and Barnet M. Weinstock. The short course series is under the direction of the CEEP Short Course Subcommittee, who members are Stefan A. Burr, Ronald L. Graham (chairman), Robert W. McKelvey, Cathleen S. Morawetz, Barbara L. Osofsky, and Philip D. Straffin, Jr.
Invited Addresses

By invitation of the Program Committee, there will be seven invited one-hour addresses. The names of the speakers, their affiliations, the titles of the talks, dates and times of presentation follow.

MICHAEL AIZENMAN, Rutgers University, New Brunswick, Stochastic geometry in quantum field theory and classical statistical mechanics, 2:15 p.m. Friday; BRADLEY EFRON, Stanford University, Mathematics, statistics, and the modern computer, 10:15 a.m. Thursday; MICHAEL H. FREEDMAN, University of California, San Diego, Four-dimensional manifolds, 3:30 p.m. Wednesday; DAVID GIESEKER, University of California, Los Angeles, Geometric invariant theory and moduli problems in algebraic geometry, 8:45 a.m. Thursday; ROGER E. HOWE, Yale University, Aspects of harmonic analysis on the Heisenberg group: dual pairs, theta functions, classical invariant theory, 10:15 a.m. Wednesday; and NEIL J. A. SLOANE, Bell Laboratories, Murray Hill, The Leech lattice, 2:15 p.m. Wednesday.

Special Sessions

By invitation of the same committee, there will be twelve special sessions of selected twenty-minute papers. The topics of these special sessions, the names and affiliations of the mathematicians arranging them, and final lists of speakers are as follows.


Andrew M. Gleason, AMS President 1981, 1982


**September 21** was the deadline for submission of abstracts for consideration for inclusion in these special sessions.

**Contributed Papers**

There will be sessions for contributed papers Wednesday morning and afternoon, Thursday morning and afternoon, Friday morning and afternoon, and Saturday afternoon. The **deadline** for submission of abstracts of contributed papers was **October 12.** Late papers will not be accepted.

**Audio-Visual Equipment**

Rooms where special sessions and contributed paper sessions will be held will be equipped with an overhead projector and screen. Blackboards will not be available.

**Other AMS Sessions**

**Mathematics and Government**

A special address titled *The National Science Foundation: Policies and programs for research in the mathematical sciences* will be given at 2:15 p.m. on Thursday, January 6, by EDWARD A. KNAPP, Director of the National Science Foundation. Prior to his appointment as Director by President Reagan, Dr. Knapp was Assistant Director for Mathematical and Physical Sciences at NSF. Previously, Dr. Knapp headed the Accelerator Technology Division of the Los Alamos Scientific Laboratory, where he was a close associate of the President's Science Advisor, George Keyworth. As someone presently responsible for the funding of basic science and intimately familiar with the policies of the Reagan administration, Dr. Knapp is in a unique position to address members of the mathematical sciences community on the future of research support.

**AMS Committee on Employment and Educational Policy**

The Society's Committee on Employment and Educational Policy (CEEP) and the Mathematical Association of America (MAA) will sponsor a panel discussion at 4:30 p.m. on Friday, January 7, on *Freshman mathematics: Are there alternatives to calculus?* This panel is being organized by IRWIN KRA, SUNY Center at Stony Brook. The speakers are PETER D. LAX, Courant Institute, New York University; ANTHONY RALSTON, SUNY at Buffalo; R. O. WELLS, JR., Rice University; and GAIL S. YOUNG, University of Wyoming.

**Council Meeting**

The Council of the Society will meet at 2:00 p.m. on Tuesday, January 4 in the Zephyr Room of the Executive Tower Inn.

**Business Meeting**

The Business Meeting of the Society will take place immediately following the award of the Birkhoff Prize
**TIMETABLE**  
(Mountain Standard Time)

The final version of the Timetable and Program, including room assignments, will be distributed at the meeting.

### AMERICAN MATHEMATICAL SOCIETY SHORT COURSE SERIES

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Promenade Foyer, Executive Tower Inn |
|              | 2:00 p.m. - 3:15 p.m. | Overview  
B. Gopinath |
|              | 3:30 p.m. - 4:45 p.m. | Introduction to data communication  
Pierre A. Humblet |
| TUESDAY, January 4 | 8:00 a.m. - 2:00 p.m. | REGISTRATION  
Promenade Foyer, Executive Tower Inn |
|              | 9:00 a.m. - 10:15 a.m. | The complexity of VLSI computations  
Thomas Lengauer |
|              | 10:30 a.m. - 11:45 a.m. | Modelling concurrent processes  
Robert P. Kurshan |
|              | 1:30 p.m. - 2:45 p.m. | Probabilistic aspects of networks  
Frank P. Kelly |
|              | 3:00 p.m. - 4:15 p.m. | Diffusion approximations for queuing networks  
J. Michael Harrison |
|              | 4:15 p.m. - 5:00 p.m. | Interactive session |

### JOINT MATHEMATICS MEETINGS

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MAA BOOK SALE |
| WEDNESDAY, January 5 | 8:00 a.m. - 5:00 p.m. | AMS  
MAA |
|              | 8:00 a.m. - 5:00 p.m. | REGISTRATION  
Arena, Denver Convention Complex |
|              | 8:45 a.m. - 9:45 a.m. | AMS BOOK SALE  
MAA BOOK SALE |
|              | 10:00 a.m. - 12:20 p.m. | RETIRING PRESIDENTIAL ADDRESS  
Some remarks on the prime number theorem  
Andrew M. Gleason |
|              | 10:00 a.m. - 12:20 p.m. | SPECIAL SESSIONS  
Proof Theory I |
|              | 10:00 a.m. - 11:55 a.m. | Monotonicity Methods in Differential Equations I  
SESSIONS FOR CONTRIBUTED PAPERS  
Number Theory |
|              | 10:00 a.m. - 11:40 a.m. | Ordinary Differential Equations I  
Operator Theory I |
|              | 10:00 a.m. - 11:10 a.m. | Optimal Control and Calculus of Variations  
General Topology I |
|              | 10:00 a.m. - 11:55 a.m. | Computer Science  
INVITED ADDRESS  
Aspects of harmonic analysis on the Heisenberg group:  
Dual pairs, theta functions, classical invariant theory  
Roger E. Howe  
SESSION FOR CONTRIBUTED PAPERS  
Operations Research and Social and Biological Sciences |
|              | 1:00 p.m. - 2:00 p.m. | COLLOQUIUM LECTURES  
Lecture 1: The uncertainty principle: The SAK principle  
Charles L. Fefferman  
EXHIBITS |
|              | 1:00 p.m. - 5:00 p.m. | }
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The Mathematical Association of America (MAA) will hold its 66th Annual Meeting from Thursday, January 6 through Sunday, January 9. The Business Meeting of the MAA will take place at 9:30 a.m. on Saturday, January 8, at which the 1983 Award for Distinguished Service will be presented.

Sessions of the MAA on Thursday, January 6, and Sunday, January 9, will be held jointly with the National Council of Teachers of Mathematics.

The MAA Board of Governors will meet at 9:00 a.m. on Thursday, January 6.

Minicourses

The MAA will give five Minicourses, as follows:

Minicourse #1: Introduction to microcomputers in mathematics instruction is being organized by KL AUS E. ELD RIDGE and DONALD 0. NORRIS, both of Ohio University, Athens, and will be given from 8:30 a.m. to 12:30 p.m. on Thursday, January 6. This Minicourse is intended for novices, and is a repeat of the very popular course offered in Pittsburgh in August 1981, in Cincinnati in January 1982, and in Toronto in August 1982. It will consist of a brief introduction to BASIC, followed by a discussion of how computers can be used in a variety of courses. The discussion will include traditional examples from calculus and differential equations, as well as simulation models in liberal arts courses or mathematics education courses. It is planned that microcomputers will be available for use by the participants.

Minicourse #2: Placement testing is being organized by RICHARD H. PROSL of the College of William and Mary in Virginia, who is Chairman of the MAA Committee on Placement Examinations. This Minicourse consists of two sessions which will take place from 7:00 p.m. to 10:00 p.m. on Thursday evening, January 6, and Saturday evening, January 8. The talks included in this course are designed to provide an overview of placement testing, test development, and testing-program administration. These talks will complement workshops on test-item writing, the establishment of cut-off scores, and the statistical analysis of test data. Participants will write test items and compose a placement test during the first session of the course. This test will be administered to a group of students in the Denver area by personnel from the Air Force Academy. During the second session, participants will analyze data generated by this administration of their test. James Braswell of the Educational Testing Service staff and Hope Florence of the College of Charleston will join the members of the MAA's Committee on Placement Examinations to conduct the course.

Minicourse #3: Introducing statistical topics in existing mathematics courses is being organized by RICHARD WALKER of Mansfield State College, and will be given from 8:30 a.m. to 12:30 p.m. on Friday, January 7. Probability and statistics are very important areas within the mathematical sciences; however, many students of mathematics, both majors and nonmajors, have little or no exposure to these subjects. The purpose of this Minicourse is to suggest some ways in which topics from probability and statistics, particularly from the latter, can be introduced into existing mathematics courses. In this manner more of our students can be exposed to these important areas. Suggestions will be presented on how one might introduce statistical thinking in both lower division and upper division courses. Resource materials, including some UMAP modules, will be provided.

Minicourse #4: An introduction to the mathematical foundations of computer graphics is being organized by GERALD J. PORTER of the University of Pennsylvania, and will be given from 1:00 to 5:00 p.m. on Friday, January 7. This Minicourse will be a short survey of the mathematics necessary to create pictures on a graphical display device (e.g., Apple computer, Tektronix storage tube, VT100 terminal with retrographics). Knowledge of a structured language such as PASCAL would be helpful. Among the
formations, data structures for pictures, clipping, splines, b-splines, two-dimensional representations of three-dimensional objects, and hidden line removal. The emphasis will be on pictures useful in the teaching of mathematics. Apple computers will be available for demonstrations.

Minicourse #5: Uses of computers in undergraduate mathematics instruction is being organized by DAVID A. SMITH of Duke University who is Series Editor in Mathematics for CONDUIT. This Minicourse will take place from 8:30 a.m. to 12:30 p.m. on Saturday, January 8. A repeat of the course will be scheduled from 1:00 p.m. to 5:00 p.m. on Saturday, if the demand warrants. This Minicourse is a workshop intended for college teachers. Uses of existing microcomputer software to enhance instruction in full courses in the undergraduate mathematics curriculum will be demonstrated, including software for use in single- and multi-variable calculus, differential equations, and topics at the lower division college level. Presentations/demonstrations will be given by mathematicians who have developed the software and have had extensive experience with its use in their courses. It is planned for participants to have the opportunity to work with the software themselves on microcomputers. Speakers will include DAVID A. SMITH, and AUDREY R. BROWN, JR., Colorado School of Mines.

The Minicourses are open only to persons who have registered for the Joint Mathematics Meetings and paid both the Joint Meetings registration fee and the Minicourse registration fee. If the only reason for registering for the Joint Meetings is to gain admission to a Minicourse, this should be indicated by checking the appropriate box on the preregistration form. Then, if the minicourse is full, full refunds can be made of the Minicourse and Joint Mathematics Meetings preregistration fees. Otherwise, the Joint Meetings preregistration will be processed, and then be subject to the 50 percent refund rule.

The Minicourses have separate registration fees of $15 each, and are limited to 30 participants each.

Other MAA Sessions

JOHN L. VAN IWAARDEN of Hope College will run a workshop on High level languages—why PASCAL? at 7:00 p.m. on Friday, January 7. The present mathematical literature abounds with references to the high level language PASCAL. As this language continues to gain prominence in scientific circles, it seems quite necessary that mathematicians acquaint themselves with its unique properties. This workshop will provide an opportunity for anyone with a working knowledge of one other language to see the special structures built into PASCAL by Niklaus Wirth. These features make it a teachable language and the flexibility of its data structures make it very versatile.

The MAA Section Officers will hold an informal meeting at 4:00 p.m. on Friday, January 7.

The MAA Committee on Corporate Members will sponsor an evening session on Mathematics publishing, copyright, and software, at 7:00 p.m. on Friday, January 7. Speakers will include JERRY LYONS (presider), PWS Publishers; RICHARD MOYNihan, The Mitre Corporation; CAROL RISCHER, Association of American Publishers; and ROBERT RUNCK, D. C. Heath and Company.

At 7:00 p.m. on Thursday, January 6, there will be a panel discussion on Please, professor, let’s work together on this! (A dialog between secondary and collegiate mathematics). Speakers are William E. Briggs, University of Colorado (moderator); William Cox, Overland High School; Helen Holmgren, Wason High School; Terry Kret, La Veta High School; B. E. Rhodeas, Indiana University; Ronald Schnackenberg, Steamboat Springs High School; and Donald R. Small, Colby College.

MAA Contributed Papers

The MAA will also schedule sessions for contributed papers on Friday afternoon, January 7, and Saturday morning and afternoon, January 8. Papers are being accepted on two topics in collegiate mathematics for presentation in contributed paper sessions at Denver. The topics and the session leaders are:

(1) The use of computers in undergraduate mathematics instruction, RONALD H. WENGER, University of Delaware.

(2) Discrete mathematics in the lower division curriculum, ANTHONY RALSON, SUNY at Buffalo. The focus of this session will be on the importance of discrete mathematics in the lower division undergraduate mathematics curriculum. Papers are being solicited particularly on:

• Specific curriculum issues related to discrete mathematics;

• more general considerations concerning the importance of discrete mathematics in the undergraduate mathematics curriculum;

• discrete mathematics topics of interest in the lower division curriculum.

Presentations will normally be limited to ten minutes, although selected contributors may be given up to thirty minutes.

The deadline for submission of contributed papers to the MAA has expired.

For a more detailed listing of the activities of the MAA, see the Timetable.

ACTIVITIES OF OTHER ORGANIZATIONS

The Association for Symbolic Logic (ASL) will hold its 1982-1983 Annual Meeting on Saturday and Sunday, January 8-9. In addition to contributed papers, there will be invited talks by TIM CARLSON, ANDRZEJ EHRENFEUCHT, DONALD A. MARTIN, MATATYAHU RUBIN, JONATHAN STAVI and STEVO TODORČEVIĆ. Note the related AMS special sessions on Proof theory and Automatic theorem proving, and the AMS contributed paper session on Logic.
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<thead>
<tr>
<th>Time</th>
<th>American Mathematical Society</th>
<th>Mathematical Association of America and Other Organizations</th>
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<tr>
<td>10:15 a.m.</td>
<td>INVITED ADDRESS Mathmetics, statistics, and the modern computer</td>
<td>Association for Women in Mathematics</td>
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<td>Bradley Efron</td>
<td>PANEL DISCUSSION: Mathematics and Computers</td>
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<td>SESSIONS FOR CONTRIBUTED PAPERS</td>
<td>Lenore Blum</td>
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<td>10:30 a.m.</td>
<td>Linear Algebra</td>
<td>Lucy Garnett</td>
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<td>11:00 a.m.</td>
<td>Special Functions</td>
<td>Louise Hay</td>
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<td>11:15 a.m.</td>
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<td>Nancy Johnson</td>
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<td>Linda P. Rothschild (moderator)</td>
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<td>12:15 p.m.</td>
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<td>AWM - BUSINESS MEETING</td>
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<td>1:00 p.m.</td>
<td>COLLOQUIUM LECTURES</td>
<td>Rocky Mountain Mathematics Consortium</td>
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<td>Lecture II: The uncertainty principle: Schrödinger operators</td>
<td>BOARD OF DIRECTORS MEETING</td>
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<td>Charles L. Fefferman</td>
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<td>2:00 p.m.</td>
<td>SPECIAL INVITED ADDRESS</td>
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<td>The National Science Foundation: Policies and programs for research in the mathematical sciences</td>
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<td>Edward A. Knapp</td>
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<td>SPECIAL SESSIONS</td>
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<td>Diophantine Problems and Analytic Number Theory III</td>
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<td>Representation Theory of Finite Groups of Lie Type I</td>
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<td>Monotonicity Methods in Differential Equations IV</td>
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<td>Pseudo-differential Operators and Applications II</td>
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<td>Automatic Theorem Proving II</td>
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<td>Harmonic Analysis and Measure Theory</td>
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<td>2:15 p.m.</td>
<td>Probability</td>
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<td>3:30 p.m.</td>
<td>How do perturbations of the wave equation behave?</td>
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<td>3:30 p.m.</td>
<td>AWM - EMMY NOETHER LECTURE</td>
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<td>3:30 p.m.</td>
<td>Annual Report from the NSF's Mathematical Sciences Section</td>
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<td>William G. Rosen, NSF</td>
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<td>3:30 p.m.</td>
<td>SESSION FOR CONTRIBUTED PAPERS</td>
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<td>3:30 p.m.</td>
<td>Algebraic Topology and Foliations</td>
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<td>4:45 p.m.</td>
<td>PRIZE SESSION AND BUSINESS MEETING</td>
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<td>6:15 p.m.</td>
<td>SPECIAL SESSIONS</td>
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<td>7:00 p.m.</td>
<td>Number-theoretic Algorithms I</td>
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<td>7:00 p.m.</td>
<td>Applied Category Theory III</td>
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<td>MAA/NCTM - PANEL DISCUSSION</td>
<td>Please, professor, let's work together on this! (A dialog between secondary and collegiate mathematics)</td>
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<td>Ronald Schnickenberg</td>
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The Association for Women in Mathematics (AWM) will sponsor a Panel Discussion on "Mathematics and computers" at 11:15 a.m. on Thursday, January 6, to be immediately followed by the AWM Business Meeting. Speakers on the panel are Lenore Blum, Lucy Garnett, Louise Hay, Nancy Johnson, Marcia A. Perlstadt, and Linda P. Rothschild (moderator). The fourth annual AWM Emmy Noether Lecture will be given at 3:30 p.m. on Thursday, January 6, by CATHELEEN S. MORAWETZ. The title is How do perturbations of the wave equation behave? A party is being planned for Thursday evening, January 6.

The Rocky Mountain Mathematics Consortium (RMMC) will sponsor a symposium on Mathematics and seismc prospecting at 2:15 p.m. on Friday, January 7. The symposium has been organized and will be moderated by A. DUANE PORTER of the University of Wyoming. Speakers are NORMAN BLEISTEIN, University of Denver; ROBERT BURRIDGE, Courant Institute of the Mathematical Sciences, New York University; and KENNETH LARNER, Western Geophysical, Houston. The speakers will give an overview of current mathematical problems arising in seismic prospecting and current methods of attacking them by scientists in academia and in industry. These problems fall into the general category of inverse wave scattering, but solution of the corresponding direct problems may form an ingredient in solving the inverse problem. Bleistein will describe some recent work of his group in applying perturbation techniques to seismic inverse problems. Burridge will give a brief exposition of the underlying continuum mechanics, seismic wave theory (including ray theory), and inverse problems. Larner will describe the collection and interpretation of seismic data. Industrial practice is dominated by consideration of noise and other imperfections of the data, and by the huge scale of the computations necessary to manipulate and analyze it.

The RMMC Board of Directors will meet at 2:00 p.m. on Thursday, January 6.

WILLIAM G. ROSEN, Head of the Mathematical Sciences Section of the National Science Foundation (NSF) will speak at 3:30 p.m. on Thursday, January 6, on the Annual report from the NSF's Mathematical Sciences Section.

The NSF will again be represented at a booth in the exhibit area. NSF staff members will be available to provide counsel and information on NSF programs of interest to mathematicians from 9:00 a.m. to 5:00 p.m., Thursday and Friday, January 6-7.

OTHER EVENTS OF INTEREST

Book Sales

Books published by the AMS and MAA will be sold for cash prices somewhat below the usual prices when these same books are sold by mail. These discounts will be available only to registered participants wearing the official meeting badge. VISA and MASTERCARD credit cards will be accepted for book sale purchases at the meeting. The book sales will be open the same days and hours as the Joint Mathematics Meetings registration desk (except on Saturday, January 8, when they will close at 2:00 p.m.) and are located in the Arena of the Denver Convention Complex.

Exhibits

The book and educational media exhibits are located in the Arena of the Denver Convention Complex and will be open Wednesday, January 5, through Saturday, January 8. The exhibits will be open from 1:00 p.m. to 5:00 p.m. on Wednesday; from 9:00 a.m. to 5:00 p.m. on Thursday and Friday; and from 9:00 a.m. to noon on Saturday. All participants are encouraged to visit the exhibits during the meeting. Participants visiting the exhibits will be asked to display their meeting badge in order to enter the exhibit area.

MATHFILE

An online demonstration of MATHFILE, the computerized version of Mathematical Reviews, can be seen in Booth 113 of the exhibit area in the Denver Convention Complex, during regular exhibit hours. Two printing terminals and a TV monitor will be connected to the computers of two commercial online vendors who offer MATHFILE.

You are invited to come to the booth, submit a literature search and see how quickly and easily the results are obtained with the help of the computer!

MATHFILE is available from vendors BRS (Bibliographic Retrieval Services) in Latham, NY and DIALOG Information Services in Palo Alto, CA. The cost is $36-$55/hour on BRS and $55/hour on DIALOG plus a $6/hour telecommunications charge. Most searches can be completed with a few minutes of connect time.

The MATHFILE User's Guide, containing all the information necessary for searching, will be available at the booth for inspection and can be purchased at the AMS book sale.

INFORMATION FOR PARTICIPANTS

Hotel Accommodations

The rates listed below are subject to a 8.5 percent city hotel tax. The number after the name of the hotel is the number it carries on the map. The estimated walking distance from the hotel to the Denver Convention Complex is given in parentheses following the telephone number.

In all cases "single" refers to one person in one bed; "double" refers to two persons in one bed; "twin" refers to two persons in two single beds; and "twin double" refers to two persons in two double beds. A rollaway cot for an extra person can be added to double or twin rooms only; however, not all hotels are willing to do so.

Please make all changes to or cancellations of hotel reservations with the Housing Bureau in Providence before December 20, 1982. The telephone number in Providence is 401-272-9500 (extension 239). After that date, changes or cancellations should be made
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<th>TIME</th>
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TIMETABLE

THURSDAY, January 6

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COLOQUIUM LECTURES

Lecture III: The uncertainty principle: Finer cutting
Charles L. Fefferman
with the Housing Office of the Denver & Colorado Convention & Visitors Bureau by telephoning 303-892-1112 (extension 73).

**Brown Palace Hotel (4)**
321 17th Street
Denver, Colorado 80202
Telephone: 303-825-3111 (12 minutes)

- **Singles**: $70
- **Twin Doubles**: $80
- **Triples**: $90
- **Quads**: $90

**Executive Tower Inn (2)**
1405 Curtis Street
Denver, Colorado 80202
Telephone: 303-571-0300 (adjacent)

- **Singles**: $49
- **Doubles**: $59
- **Twin Doubles**: $59
- **Triples**: $64
- **Quads**: $69

**Governors Court Hotel (8)**
1776 Grant Street
Denver, Colorado 80203
Telephone: 303-861-2000 (20 minutes)

- **Singles**: $50, $65
- **Doubles**: $60, $75
- **Twin Doubles**: $60, $75
- **Triples**: $70, $85
- **Quads**: $80, $95

**The Denver Hilton (3)**
(Fifteen Fifty Court Place)
Denver, Colorado 80202
Telephone: 303-893-3333 (11 minutes)

- **Singles**: $55
- **Doubles**: $65
- **Twin Doubles**: $65
- **Triples**: $75
- **Quads**: $86

**Holiday Inn Denver Downtown (5)**
15th and Glenarm Place
Denver, Colorado 80202
Telephone: 303-573-1450 (8 minutes)

- **Singles**: $50
- **Doubles**: $62
- **Twin Doubles**: $62
- **Triples**: $74
- **Quads**: $86

**Denver Marriott—City Center (6)**
1701 California Street
Denver, Colorado 80202
Telephone: 303-825-1300 (10 minutes)

- **Singles**: $55
- **Doubles**: $65
- **Twin Doubles**: $65
- **Triples**: $75
- **Quads**: $85

**Quality Inn Central (9)**
2601 Zuni Street, I-25 at Speer Boulevard (Exit 212B)
Denver, Colorado 80211
Telephone: 303-433-6677 (*)

- **Singles**: $37
- **Doubles**: $42
- **Twin Doubles**: $42
- **Triples**: $47
- **Quads**: $52

*Not within walking distance, but shuttle service will be provided by the hotel at no charge.

**Student/Unemployed Housing**

We have been able to reserve a very limited number of rooms in the Standish Hotel, 1530 California Street, for use by students and unemployed participants. The Standish is about a seven-minute walk to the Convention Complex.

Since all rooms contain either two twin beds or one or two double beds, it has been requested that two persons share a room for maximum occupancy, if possible. The rates for these rooms with private bath are as follows:

- **Singles**: $20
- **Doubles**: $24

In addition, a very limited number of rooms, each containing a sink, but with shared baths down the hall, are available at the single rate of $14 per day.

In all cases, a deposit equivalent to one night’s lodging will be required.

N.B.: Only participants who qualify as students or unemployed as defined on the preregistration/housing form will be given these rooms.

**Registration at the Meetings**

Meeting preregistration and registration fees only partially cover expenses of holding meetings. All mathematicians who wish to attend sessions are expected to register, and should be prepared to show their meeting badge, if so requested. The fees for Joint Meetings registration at the meeting (listed below) are 30 percent more than the preregistration fees.

**Joint Mathematics Meetings**

<table>
<thead>
<tr>
<th>Category</th>
<th>Member of AMS, MAA</th>
<th>Emeritus Member of AMS, MAA</th>
<th>Nonmember</th>
<th>Student/Unemployed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>One-day Fee</strong></td>
<td>$49</td>
<td>$12</td>
<td>$75</td>
<td>$12</td>
</tr>
<tr>
<td><strong>AMS Short Course</strong></td>
<td>$49</td>
<td>$12</td>
<td>$75</td>
<td>$12</td>
</tr>
<tr>
<td><strong>All Other Participants</strong></td>
<td>$30</td>
<td>$15</td>
<td>$30</td>
<td>$15</td>
</tr>
<tr>
<td><strong>One-day Fee (Second Day Only)</strong></td>
<td>$15</td>
<td>$15</td>
<td>$30</td>
<td>$15</td>
</tr>
</tbody>
</table>

**MAA Minicourse**

<table>
<thead>
<tr>
<th>Category</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All Participants</strong></td>
<td>$15</td>
</tr>
</tbody>
</table>

Registration fees may be paid at the meetings in cash, by personal or travelers’ checks, or by VISA or MASTERCARD credit cards. Canadian checks must be marked for payment in U.S. funds.

There is no extra charge for members of the families of registered participants, except that all professional mathematicians who wish to attend sessions must register independently.

All full-time students currently working toward a degree or diploma qualify for the student registration fees, regardless of income.
<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
</table>
| 2:15 p.m. - 3:15 p.m. | INVITED ADDRESS  
Stochastic geometry in quantum field theory  
and classical statistical mechanics  
Michael Aizenman |
| 2:15 p.m. - 4:55 p.m. | SESSIONS FOR CONTRIBUTED PAPERS  
Differential Geometry and Global Analysis |
| 2:15 p.m. - 3:55 p.m. | General Topology II  
Numerical Analysis |
| 2:15 p.m. - 5:15 p.m. | RMMC - SYMPOSIUM on Mathematics and seismic prospecting  
Norman Bleistein  
Robert Burridge  
Kenneth Larner  
A. Duane Porter (moderator) |
| 2:30 p.m. - 5:10 p.m. | SPECIAL SESSIONS  
Applied Category Theory V |
| 2:30 p.m. - 5:55 p.m. | INVITED ADDRESS  
Operator Algebras and Operator Theory III |
| 3:30 p.m. - 4:30 p.m. | INVITED ADDRESS  
Geometric invariant theory and moduli problems in algebraic geometry  
David Gieseker |
| 3:30 p.m. - 5:20 p.m. | SPECIAL SESSION  
Pseudo-differential Operators and Applications IV |
| 3:30 p.m. - 4:25 p.m. | SESSION FOR CONTRIBUTED PAPERS  
Topological Groups |
| 4:00 p.m. - 6:00 p.m. | MAA - SECTION OFFICERS  
Informal Meeting |
| 4:30 p.m. - 6:00 p.m. | AMS CEEP/MAA - PANEL DISCUSSION  
Freshman mathematics: Are there alternatives to calculus?  
Irwin Kra (organizer)  
Peter D. Lax  
Anthony R. Ralston  
R. O. Wells, Jr.  
Gail S. Young |
| 4:40 p.m. - 6:00 p.m. | SPECIAL SESSION  
Representation Theory of Finite Groups of Lie Type III |
| 7:00 p.m. - 9:00 p.m. | NO-HOST COCKTAIL PARTY |
| 7:00 p.m. - 9:30 p.m. | MAA - COMMITTEE ON CORPORATE MEMBERS  
SESSION on Mathematics publishing, copyright, and software  
Jerry Lyons (presider)  
Richard Mynihan  
Carol Rascher  
Robert Runck |
| 7:00 p.m. - 9:30 p.m. | MAA - WORKSHOP  
High level languages—why PASCAL?  
John L. Van Wijnden |
| 8:00 p.m. - 11:00 p.m. | MAA and Other Organizations  
Association for Symbolic Logic  
COUNCIL MEETING |
| 8:00 a.m. - 4:00 p.m. | REGISTRATION  
Arena, Denver Convention Complex |
| 8:00 a.m. - 2:00 p.m. | AMS BOOK SALE  
MAA BOOK SALE  
MAA - INVITED ADDRESS  
A systematic method for teaching mathematical proofs  
Daniel Solow |
| 8:30 a.m. - 12:30 p.m. | MAA - MINICOURSE #5  
Uses of computers in undergraduate mathematics instruction  
David A. Smith |
| 9:00 a.m. | EMPLOYMENT REGISTER DISTRIBUTION OF SCHEDULES  
EXHIBITS |
| 9:00 a.m. - noon |  |
The unemployed status refers to any person currently unemployed, actively seeking employment, and who is not a student. It is not intended to include persons who have voluntarily resigned or retired from their latest position.

Persons who qualify for emeritus membership in either the Society or the Association may register at the emeritus member rate. The emeritus status refers to any person who has been a member of the AMS or MAA for twenty years or more, and is retired on account of age from his or her latest position.

Nonmembers who register at the meetings and pay the $75 nonmember registration fee are entitled to a discount of the difference between the member registration fee of $49 and the nonmember registration fee of $75 as a $26 credit against dues in either the AMS or MAA or both, provided they apply for membership before February 9, 1983.

Nonmember students who register at the meetings and pay the $12 registration fee are entitled to a discount of the difference between the student preregistration fee of $9 and the registration fee of $12 as a $3 credit against dues in either the AMS or MAA or both, provided they apply for membership before February 9, 1983.

Nonmembers and nonmember students who thus qualify may apply for membership at the meetings, or by mail afterwards up to the deadline.

Registration Dates and Times
AMS Short Course
Promenade Foyer, Executive Tower Inn
Monday, January 3 9:00 a.m. to 4:00 p.m.
Tuesday, January 4 8:00 a.m. to 2:00 p.m.
Joint Mathematics Meetings
[and MAA Minicourse (until filled)]
Arena, Denver Convention Complex
Tuesday, January 4 4:00 p.m. to 8:00 p.m.
Wednesday, January 5 8:00 a.m. to 5:00 p.m.
Thursday, January 6, through 8:00 a.m. to 4:00 p.m.
Saturday, January 8
Assistance and Information Desk
Outside Theatre, Denver Convention Complex
Sunday, January 9 8:30 a.m. to noon

Please note that the Joint Mathematics Meetings registration desk will not be open on Sunday, January 9, and that the telephone message center will not be in operation. Other services provided during the meeting at the registration desk will also no longer be available (see section below on Registration Desk Services). There will, however, be a small desk set up outside the Theatre in the Denver Convention Complex, where local information will be available and where a staff member will provide limited assistance to participants. No registration or cash transactions will be possible at this desk.

REGISTRATION DESK SERVICES
AMS/MAA Information
Information on the publications and activities of both organizations may be obtained at this section of the registration desk.

Assistance, Comments and Complaints
A log for registering participants' comments or complaints about the meeting is kept at the Transparencies section of the registration desk. All participants are encouraged to use this method of helping to improve future meetings. Comments on all phases of the meeting are welcome. If a written reply is desired, participants should furnish their name and address.

Participants with problems of an immediate nature requiring action at the meeting should see the meeting manager, who will try to assist them.

Audio-Visual Aid
A member of the AMS/MAA staff will be available to advise or consult with speakers on their audio-visual requirements.

Baggage and Coat Check
Checking facilities will be provided at a charge.

Check Cashing
The meeting cashier will cash personal or travelers' checks up to $50, upon presentation of the official meeting registration badge, provided there is enough cash on hand. Canadian checks must be marked for payment in U.S. funds.

Local Information
This section of the desk will be staffed by members of the Local Arrangements Committee and other volunteers from the Denver mathematical community.

Lost and Found
See the meeting cashier, or go to the Main Office of the Denver Convention Complex between 8:00 a.m. and 5:00 p.m., Monday through Friday.

Mail
All mail and telegrams for persons attending the meetings should be addressed to the participant, Joint Mathematics Meetings, c/o Denver & Colorado Convention & Visitors Bureau, 225 West Colfax Avenue, Denver, Colorado 80202. Mail and telegrams so addressed may be picked up at the mailbox in the registration area during the hours the registration desk is open. U.S. mail not picked up will be forwarded after the meeting to the mailing address given on the participant's registration record.

Personal Messages
Participants wishing to exchange messages during the meeting should use the mailbox mentioned above. Message pads and pencils are provided. It is regretted that such messages left in the box cannot be forwarded to participants after the meeting is over.

Telephone Messages
A telephone message center is located in the registration area to receive incoming calls for participants. The center is open from January 5 through 8 only, during the hours that the Joint Mathematics Meetings registration desk is open. Messages will be taken and the name of any individual for whom a message has been received will be posted
<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:30 a.m. - 10:20 a.m.</td>
<td>MAA - BUSINESS MEETING Measures, Souslin cardinals, and the axiom of determinacy Donald A. Martin</td>
</tr>
<tr>
<td>9:30 a.m. - 10:30 a.m.</td>
<td>ASL - INVITED LECTURE Mathematical modeling in petroleum reservoir simulation Richard E. Ewing</td>
</tr>
<tr>
<td>9:30 a.m. - 5:30 p.m.</td>
<td>EMPLOYMENT REGISTER INTERVIEWS</td>
</tr>
<tr>
<td>10:30 a.m. - 11:20 a.m.</td>
<td>MAA - INVITED ADDRESS Homoclinic bifurcation and phase transition in time discrete dynamical systems (with computer pictures) Heinz-Otto Peitgen</td>
</tr>
<tr>
<td>10:30 a.m. - 12:30 p.m.</td>
<td>MAA - CONTRIBUTED PAPER SESSION</td>
</tr>
<tr>
<td>10:45 a.m. - 11:45 a.m.</td>
<td>ASL - INVITED LECTURE A survey of some recent results and problems about partially ordered sets Stevo Todorcevic</td>
</tr>
<tr>
<td>11:30 a.m. - 12:20 p.m.</td>
<td>MAA - INVITED ADDRESS</td>
</tr>
<tr>
<td>1:00 p.m. - 2:00 p.m.</td>
<td>COLLOQUIUM LECTURES</td>
</tr>
<tr>
<td>1:00 p.m. - 3:50 p.m.</td>
<td>SPECIAL SESSIONS</td>
</tr>
<tr>
<td>1:00 p.m. - 5:20 p.m.</td>
<td>Number-theoretic Algorithms III</td>
</tr>
<tr>
<td>1:00 p.m. - 3:20 p.m.</td>
<td>Abstract Adjoints and Boundary Problems III</td>
</tr>
<tr>
<td>1:00 p.m. - 2:40 p.m.</td>
<td>Function-theoretic Methods in Differential Equations II</td>
</tr>
<tr>
<td>1:00 p.m. - 5:00 p.m.</td>
<td>SESSIONS FOR CONTRIBUTED PAPERS</td>
</tr>
<tr>
<td>1:30 p.m.</td>
<td>MAA - MINICOURSE 45</td>
</tr>
<tr>
<td>2:00 p.m. - 3:00 p.m.</td>
<td>Uses of computers in undergraduate mathematics instruction (tentative) David A. Smith</td>
</tr>
<tr>
<td>3:15 p.m. - 5:40 p.m.</td>
<td>ASL - CONTRIBUTED PAPER SESSION</td>
</tr>
<tr>
<td>3:15 p.m. - 5:15 p.m.</td>
<td>Consistency results concerning $K_1$-dense real order types Matatyahu Rubin</td>
</tr>
<tr>
<td>5:30 p.m. - 7:00 p.m.</td>
<td>ASL - CONTRIBUTED PAPER SESSION</td>
</tr>
<tr>
<td>7:00 p.m. - 10:00 p.m.</td>
<td>ASL - RECEPTION</td>
</tr>
<tr>
<td>8:00 p.m. - 11:00 p.m.</td>
<td>MAA - MINICOURSE 62</td>
</tr>
<tr>
<td>SUNDAY, January 9</td>
<td>AMS</td>
</tr>
<tr>
<td>8:30 a.m. - noon</td>
<td>MAA and Other Organizations</td>
</tr>
<tr>
<td>8:30 a.m. - 9:20 a.m.</td>
<td>MAA/NCTM - INVITED ADDRESS VisiCalc and mathematical algorithms: Mathematical applications of an electronic spreadsheet Deane E. Arganbright</td>
</tr>
<tr>
<td>9:30 a.m. - 10:20 a.m.</td>
<td>MAA/NCTM - INVITED ADDRESS Applications in the undergraduate curriculum Solomon A. Garfunkel</td>
</tr>
</tbody>
</table>
The Denver Meetings Travel Hotline — Call 800-556-6882

In Rhode Island and outside the continental U.S. call 401-884-9500 or Telex 952165

CONVENIENCE, SAVINGS, IMMEDIATE CONFIRMATION ON AIRLINE ARRANGEMENTS

Hours of Operation: 9 a.m.-8 p.m. Eastern Time Monday through Thursday, Fridays until 6 p.m.

Another Member Service to Assist You if You’re Attending the Denver Meetings and Use a Major Credit Card

One free call answers all your travel questions and supplies you with all your needs, including reduced-rate airline arrangements.

THE SUPERSERVICE:
- Discount travel arrangements, including special fare check service.
- Whenever possible savings up to 55 percent.
- Guaranteed lowest possible airfare for your itinerary.
- Comparison of individual travel plans to discounted fares.
- Unbiased selection of airlines so the best arrangements can be made.
- Fare check: A special review 30 days prior to your trip and again 15 days prior to insure that you are getting the lowest available airline fare. You will be automatically reticketed if fares drop below your original ticket cost.
- Ground transfers.

THE NECESSITIES:
- You must use VISA, MASTERCARD or AMERICAN EXPRESS to utilize the travel hotline. Please have your card number and expiration date ready when you call.
- Remember, you can use this convenient service to purchase your airline tickets and ground transfers.

THE GUARANTEE: The lowest fares, immediate confirmation and individualized personal service.

If you have any questions regarding this service, call the Denver Meetings Travel Hotline — 800-556-6882

until the message has been picked up at the message center. The telephone number of the message center is 303-534-8319.

Transparencies

Speakers wishing to prepare transparencies in advance of their talk will find the necessary materials and copying machines at this section of the registration desk. A member of the staff will assist and advise speakers on the best procedures and methods for preparation of their material. There is a modest charge for these materials. Please note that this service will not be available on Sunday, January 9.

Visual Index

An alphabetical list of registered participants, including local addresses and arrival and departure dates, is maintained in the registration area.

MISCELLANEOUS INFORMATION

Child Care

Nanny’s Hotel Babysitting, Inc., offers a professional babysitting service in the safety of your hotel room. Many of the babysitters are older parents who have already raised a family of their own. Day or evening service is available. Please notify them as far in advance as possible. For more information, call 303-696-7855. The Brown Palace and the Hilton will arrange for babysitters if given enough prior notice.

Local Information

Taxis presently cost $2.05 for the first mile and 90 cents each additional mile, one passenger. Each additional person is charged 40 cents extra, as long as they go from the same pickup point to the same destination. The Regional Transit District (RTD) operates buses throughout the area. Buses making local stops charge a flat fee of 70 cents during peak hours (6:00 a.m. to 9:00 a.m. and 3:00 p.m. to 6:00 p.m., Monday through Friday), or 35 cents all other hours Monday through Friday, all day Saturday and Sunday. Express buses charge $1-1.50 within town.

A section of 16th Street has been turned into a pedestrian mall, with free transportation up and down its length. Participants staying at the Hilton will find it convenient to utilize this transportation as far as Champa Street, which is only two blocks away from the Convention Complex.

Denver has an Art Museum, a Natural History Museum (including a Planetarium), an Arboretum, the State Capitol building (with a gold dome), the Denver Mint, and historical features such as the Molly Brown House. The nearest ski areas are over an hour away by automobile. Further information will be available at the Local Information section of the registration desk.

Parking

Those coming by car are advised to stay at either the Holiday Inn (which is within walking distance from the Convention Complex and provides free parking for registered guests), the Quality Inn (which has free parking for registered guests and a shuttle service to the Convention Complex), or the Executive Tower Inn (which is adjacent to the Convention Complex and has parking facilities for registered guests costing $3 per day, either onsite or across the street, in and out privileges included). In addition the following hotels provide for parking for registered guests:

Marriott—$10/day, including in/out.
Governors Court—$3.50/day in area.
Hilton—$8.50—$10/day, underground.
SUNDAY, January 9

<table>
<thead>
<tr>
<th>Time</th>
<th>Description</th>
<th>American Mathematical Society</th>
<th>Mathematical Association of America and Other Organizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:30 a.m. - 10:30 a.m.</td>
<td></td>
<td>ASL - INVITED LECTURE</td>
<td>Ramsey type quantifiers and second-order logic</td>
</tr>
<tr>
<td>10:30 a.m. - 11:20 a.m.</td>
<td></td>
<td>MAA/NCTM - INVITED ADDRESS</td>
<td>The role of microcomputers in the mathematics curriculum</td>
</tr>
<tr>
<td>10:45 a.m. - 11:45 a.m.</td>
<td></td>
<td>ASL - INVITED LECTURE</td>
<td>Strong covering lemmas</td>
</tr>
<tr>
<td>11:30 a.m. - 12:20 p.m.</td>
<td></td>
<td>MAA/NCTM - INVITED ADDRESS</td>
<td>Progress report of the National Science Board Commission on Pre-College</td>
</tr>
<tr>
<td>2:00 p.m. - 3:00 p.m.</td>
<td></td>
<td>ASL - CONTRIBUTED PAPER SESSION</td>
<td>Quasi-increasing sequences</td>
</tr>
<tr>
<td>3:15 p.m. - 4:40 p.m.</td>
<td></td>
<td>ASL - CONTRIBUTED PAPER SESSION</td>
<td></td>
</tr>
</tbody>
</table>

Symposium on Algebraic Topology
in Honor of José Adem
Samuel Gitler, Editor

CONTENTS
Samuel Gitler, José Adem's contribution to algebraic topology
J. F. Adams, Graeme Segal's Burnside ring conjecture
Enrique Antoniano, Sections for bundles over projective spaces
Luis Astey, An integrality theorem for K-theory
Chern classes
José L. Arraut and Duane Randall, Index of tangent fields on compact manifolds
M. G. Barratt and W. R. Miller, On the automorphism of the Steenrod algebra
Charles Boyer, On the structure of supermanifolds
Javier Bracho, Strong classification of Haefliger structures
Edgar H. Brown, Smooth n-manifolds immerse in $\mathbb{R}^{2n-\alpha(n)}$
F. R. Cohen and M. E. Mahowald, Unstable properties of $\Omega^nS^{n+k}$
Donald M. Davis, On the cohomology of $MO(8)$
Albrecht Dold, Fixed point theory and homotopy theory
Mauricio Gutierrez, On crossed modules
A. Haefliger and K. Sithanantan, A proof that $Br^*_g$ is 2-connected
J. H. V. Hunt, Branched coverings as uniform completions of unbranched coverings

S. Y. Huseini, Zeros of equivariant $S^3$-maps
James P. Lin, Some theorems about the mod 2 cohomology of a finite $H$-space
Arunas Liulevicius, Finite $G$ sets and Hopf algebras of representation rings
Emilio Lluis-Puebla, On $K_3$ of the dual numbers
W. S. Massey, A generalization of the Alexander duality theorem
J. P. May, Equivariant homotopy and cohomology theory
R. James Milgram, A survey of the compact space form problem
Luis Montejano, $\beta$-homotopy equivalences
Jack Morava, Cohomology of some improper group actions
S. de Neyme de Christ and F. Gonzalez A., A generalization of Fox's spread completion
F. P. Peterson, Self maps of loop spaces of spheres
D. Ravenel, Morava $K$-theories and finite groups
José A. Seade, Invariant framings of quotients of $SL_2(R)$ by discrete subgroups
Victor Snailth and Jorgen Tornehave, On $\Pi^{45}(BO)$ and the Arf invariant of framed manifolds
E. Spanier, Cohomology isomorphisms
Oscar Valdivia G., S-productos vectoriales: Teoría algebraica y topológica
Alberto Verjovsky, Cobordism of three dimensional spheres
Stephen Wilson, Towards $BP_*X$
A. Zabrodsky, Homotopy actions of nilpotent groups

1980 Mathematics Subject Classifications: 55-06, 57Rxx

Prepayment is required for all AMS publications. Order from AMS, P. O. Box 1571, Annex Station, Providence, RI 02901, or call toll free 800-556-7774 to charge with Visa or MasterCard.
Those driving in for the day may park in the garage adjacent to the Convention Complex at a cost of about $5 per day.

All rates quoted above are subject to change.

Parking lots in the city range from 50 cents to $1.75 per hour; 24 hour parking ranges from $3.50 to $16.

**Social Events**

The Local Arrangements Committee has arranged a no-host, cash-bar social at 7:00 p.m. on Friday, January 7, in the Symphony Ballroom at the Executive Tower Inn. More details will be available at the meeting.

**Travel**

In January, Denver is on Mountain Standard Time. There is regular airline service to the Stapleton International Airport by several major airlines. The airport in Denver is approximately five miles from downtown, and the trip takes about fifteen minutes. The airport limousine stopping at the downtown hotels runs every 20 minutes from 6:30 a.m. until 10:30 p.m. daily. Present cost is $4 per person. A taxi from the airport to a downtown hotel costs $8.55 plus 40 cents for each additional passenger one way. There is good bus service provided by the Regional Transit District (RTD) on buses #28, #32, and #38 from the airport to downtown, with the fare varying between 35 cents and 70 cents, depending on the hour of day. Most major car rental agencies maintain desks at the airport.

AMTRAK's San Francisco Zephyr provides train service between Denver and Chicago and between Denver and the major west coast cities. The Denver Rio Grande Western Railroad operates a day train between Salt Lake City and Denver three days per week; in fact this is the only nonAMTRAK intercity train still running in the United States.

Denver can be reached by car via I-70 from the east and west, and via I-25 from the north and south.

**Weather**

Denver is located on the eastern slope of the Rocky Mountains and has a continental climate. The temperature can vary greatly at this time of year, and can easily drop below 0°F; however, the average high temperature in January is 52°F, and the average low is 23°F, with the median temperature in January being 31°F. The temperature drops rapidly at sundown, so the evening temperature is usually close to the overnight low (25°F to 28°F).

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**Important information on the Employment Register immediately follows.**

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**PROCEEDINGS OF SYMPOSIA IN PURE MATHEMATICS**

**THE SANTA CRUZ CONFERENCE ON FINITE GROUPS**

edited by Bruce Cooperstein and Geoffrey Mason

In the last year or so there have been widespread rumors that group theory is finished, that there is nothing more to be done. It is not so.

While it is true that many authors. The major divisions of the book are:
1. Classification theory of finite simple groups,
2. General theory of groups,
3. Properties of the known groups,
4. Representation theory of groups of Lie-type,
5. Character theory of finite groups,
6. Combinatorics,
7. Computer applications,
8. Connections with number theory and other fields.

The table of contents includes so many mathematicians well known and active in the field that it would be unfair to list a sample.

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Prepayment is required for all American Mathematical Society publications.

Send for the book(s) above to: AMS, P.O. Box 1571, Annex Station, Providence, RI 02901
REVIEWS IN RING THEORY

Compiled and Edited by Lance W. Small
Department of Mathematics, University of California, San Diego

These volumes collect 5,396 reviews from Mathematical Reviews of papers in noncommutative ring theory. All reviews of papers in ring theory from Volume 21 (1960) through Volume 58 (1979) appear here. Additionally, the editor has collected those papers from Volume 1 through Volume 20 which are necessary background. Papers on group rings, homological questions, and enveloping algebras with ring theoretic interest are also included.

Each review has an "appearance number" specifying the location of the review by chapter, section and number within the section. By and large, reviews within one section are arranged in "rough" chronological order (i.e., by appearance in Mathematical Reviews). The principal exceptions are papers in a series and very closely related papers. If a cited review occurs in these volumes, then its appearance number is listed after the review in which it is cited.

Cross-references are given at the beginning of some sections and chapters to inform the reader of closely related reviews appearing elsewhere. These cross-references may also be useful to the reader as a guide to finding reviews which do not appear where the reader thinks they should.

These volumes are a research tool. There are no other books containing the information herein except Mathematical Reviews itself.

The editor's previous work includes over 40 papers in ring theory. He has been a reviewer for Mathematical Reviews since 1968.

The work is divided into 31 chapters each subdivided into 3 to 21 sections. Chapter headings are:

1. Primitive, prime and semi-prime rings
2. Theory of radicals
3. Nil, nilpotent and radical rings
4. Simple and semi-simple Artin rings
5. Division rings
6. Matrices over commutative rings and fields and linear algebra (ring theoretic)
7. Classical orders, integral representation theory, arithmetic in algebras
8. Separable algebras, Azumaya algebras and their generalizations
9. Galois theory
10. Hopf algebras—algebraic theory
11. Rings satisfying a polynomial identity
12. Rings with involution
13. Lie and Jordan structures on rings
14. Module theory (general)
15. Projective modules, flat modules and their generalizations
16. Injective modules, self-injective rings and generalizations
17. Von Neumann regular rings and their generalizations
18. Artin rings
19. Quasi-Frobenius (QF) rings and their generalizations
20. Perfect, semi-perfect rings and modules and their generalizations
21. Integral domains
22. Goldie's theorem, rings of quotients
23. Noetherian rings
24. Group rings
25. Homological and categorical methods in ring theory
26. Torsion theories
27. Automorphisms, endomorphisms and derivations on rings
28. Commutativity theorems. Generalizations of commutative rings
29. Topological rings and modules. Ordered rings
30. Other rings and algebras. Miscellaneous topics and results
31. Books, conference proceedings and surveys

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The Mathematical Sciences Employment Register, held annually at the Joint Mathematics Meetings in January, provides opportunities for mathematicians to meet employers who have positions to be filled. Job listings (or descriptions) and résumés prepared by employers and applicants are displayed for the participants so that members of each group may determine which members of the other group they would like to have an opportunity to interview. A computer program assigns the appointments, matching requests to the extent possible, using an algorithm which maximizes the number of interviews which can be scheduled subject to constraints determined by the number of time periods available, the numbers of applicants and employers, and the pattern of requests. The report below outlines the operation of the register, indicating some of the procedures involved for the benefit of those not familiar with its operation.

The Mathematical Sciences Employment Register is apparently unique among employment services offered by professional organizations in the sciences, engineering and the humanities. The computer programs used are constructed around a matching program, devised by Donald R. Morrison and based on an algorithm described in his paper "Matching Algorithms" in Journal of Combinatorial Theory, volume 6 (1969), pages 20 to 32; see also "Matching Algorithms" (abstract) Notices, August 1967, page 630. The number of interviews arranged by the program is significantly greater than the number possible at the employment registers of other organizations, in many cases greater by an order of magnitude.

1983 Employment Register in Denver

The Employment Register at the Denver meeting will take place in the Ballroom Complex on the lobby level of the Denver Hilton Hotel on Thursday, Friday, and Saturday, January 6, 7, and 8, 1983. A short (optional) orientation session will be conducted by the AMS-MAA-SIAM Committee on Employment Opportunities at 9:00 a.m. on Thursday, January 6. The purpose of the orientation session is to familiarize participants with the operation of the Register and with the various forms involved. Interviews between applicants and employers will be scheduled for Friday and Saturday, January 7 and 8.

Fifteen-minute intervals are allowed for interviews, including two or three minutes between successive interviews. The interviews are scheduled in half-day sessions: Friday morning and afternoon, and Saturday morning and afternoon, amounting to four half-day sessions for interviews. There are ten periods in which interviews can be scheduled in the morning sessions and fourteen periods in the afternoon sessions. It is possible that an applicant or employer may be scheduled for the maximum number of interviews in a session, but the interview scheduling program can accommodate only six requests per session for each participant. The scheduling program does not have provision allowing participants to specify particular times for interviews beyond the choice of session (day, and morning or afternoon). No interviews will be scheduled for the first of the three days, Thursday, January 6.

Requests for interviews to take place during the two sessions on Friday must be submitted on Thursday between 9:30 a.m. and 4:00 p.m. Requests for interviews to take place during the Saturday sessions must be submitted on Friday before 4:00 p.m.

On Friday and Saturday mornings at 9 a.m. all schedules for applicants and employers for the day (both the morning and afternoon sessions) will be available for distribution in the Ballroom Complex.

The Saturday afternoon session is the annual "employers' choice" session. For this session interviews will be scheduled on the basis of requests made by employers. Applicants do not submit specific interview requests for this session; but, in order to participate they must indicate their availability for the session by filing the Interview Request Form for Saturday, indicating that they will attend the afternoon session that day. Request Forms for the "employers' choice" session must be submitted by 4:00 p.m. on Friday in order for the interviews to be scheduled for Saturday afternoon.

Applicants should be aware of the fact that interviews arranged by the Employment Register represent only an initial contact with employers, and that hiring decisions are not ordinarily made during or immediately following such interviews. Applicants are advised to bring a number of copies of their vitae or résumés so that they may leave them with prospective employers.

All participants in the Employment Register are required to register for the Joint Mathematics Meetings. For applicants there is no additional fee for participation in the Employment Register.

The preregistration deadline was November 15.

For employers, additional fees for participation in the Employment Register were $50, if paid before the November 15 deadline for Joint Meetings preregistration, or $75 if paid at the meeting.

Employers who wish to participate in the Register and who have neither preregistered nor paid the Employment Register fee must go to the Joint Mathematics Meetings registration desk in the Arena of the Denver Convention Complex in order to complete their registration. (No provision will be made to handle cash transactions at the site of the Employment Register in the Denver Hilton.)

Employers who have completed registration for the Employment Register, and applicants who have preregistered, may pick up their MSER material after
9:30 a.m. on Thursday, January 6, in the Ballroom Complex where the Employment Register will be held. All who wish to have interviews scheduled for Friday or Saturday, must submit their Interview Request Forms on the preceding day by 4:00 p.m. Those who fail to do so cannot be included in the pool of available participants when the matching program which schedules the interviews is run on the computer that night. This applies both to preregistered employers and applicants, and to those registering at the meeting.

The MSER registration fee for employers covers the cost of a copy of the December Issue of Employment Information in the Mathematical Sciences (EIMS). This publication contains printed copies of the résumés of applicants who preregistered prior to the November 15 deadline; it also contains a copy of the summary Winter List of Applicants. The résumés themselves will be posted at the site of the Register. Additional copies of the December Issue of EIMS and both the summary Winter Lists (of Applicants and of Employers) will be available for sale at the AMS Book Sale at the meeting, as long as supplies last. Prices at the meeting are $2 each for the summary lists and $3 for the December issue. Any copies remaining after the meeting will be available from the Providence office of the Society for $3 and $6, respectively. (Attention is called to the fact that the December issue of EIMS will contain the Winter List of Applicants, but will not contain the Winter List of Employers.)

The Winter List of Employers consists of summaries of the position listings submitted by the employers who preregistered for the meeting; it will be distributed without charge to the applicants participating in the Register. Others may purchase the Winter List of Employers at the AMS Book Sale at the meeting or from the Providence office later, as long as the supply lasts. (See previous paragraph for prices.)

The Mathematical Sciences Employment Register is sponsored by the American Mathematical Society, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics; it is operated by members of the AMS staff under the general supervision of the joint AMS-MAA-SIAM Committee on Employment Opportunities.

The Symplectic Cobordism Ring II
Stanley O. Kochman

This Memoir is the second of three which investigate the ring $\Omega_*^{Sp}$ of cobordism classes of closed smooth manifolds with a symplectic structure on their stable normal bundle. The method of computation is the mod two Adams spectral sequence. The third paper will apply the results of the first two papers to study Image[$\Omega_0^{Sp} \rightarrow \pi^*$], Image[$\pi_1^{Sp} \rightarrow \Omega_2^{Sp}$], the images of the Hurewicz homomorphisms, splitting the spectrum $\text{MSP}$, higher torsion in $\Omega_2^{Sp}$ and to compute $\Omega_5^{Sp}$, $0 \leq n \leq 100$.

In this paper the $d_3$-differentials are computed using Landweber-Novikov operations and Massey product methods. Several new theorems are proved which relate differentials, nontrivial extensions and Massey products in a spectral sequence. A theory of families is developed which organizes generators, relations and differentials in the spectral sequence into sequences of elements which are interrelated by Landweber-Novikov operations. Cup-one products are introduced into the theory of bordism chains and are used in the construction of a filtered complex to represent an Adams spectral sequence.

These methods of analyzing a complicated Adams spectral sequence are applicable in a wide variety of either contexts.

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9. A qualitative description of the Adams spectral sequence
10. Cup-one products of manifolds with rigid $B$-structure
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12. Differentials, nontrivial extensions and Massey products
13. $d_3$ differentials in the Adams spectral sequence

Errata to Part I

1980 Mathematics Subject Classifications: 55N22, 55T15, 57N90, 55S10

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Operator Algebras and Applications
Richard V. Kadison, Editor

These volumes present a state-of-the-art account of the theory of operator algebras and its applications. They stem from a conference that represented the subject in over thirteen years. The major part of the first meeting dealing with the major articles in recent years. Many articles have been written to give expository descriptions of these advances. There are major articles by many of the leading contributors to the field.

The Symposium was held at Queen's University, Kingston, Ontario, July 14-August 2, 1980. It was partially supported by a grant from the National Science Foundation.

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R. J. Archbold
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Paul Baum
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Lawrence G. Brown
John W. Bunce
Hisashi Choda
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43A80, 81E05, 82A15.

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Program of the Sessions

All AMS sessions will take place in the Denver Convention Center.
The time limit for each contributed paper in the AMS general sessions is ten minutes. In the special sessions, the time limit varies from session to session and within sessions. To maintain the schedule, time limits will be strictly enforced.

Abstracts of papers presented in AMS sessions at this meeting will be found in the January 1983 issue of Abstracts of papers presented to the American Mathematical Society, ordered according to the numbers in parentheses following the listings below.

For papers with more than one author, an asterisk follows the name of the author who plans to present the paper at the meeting.

Wednesday, 8:45 a.m.

Retiring Presidential Address
8:45–9:45 (1) Some remarks on the prime number theorem. ANDREW M. GLEASON, Harvard University

Wednesday, 10:00 a.m.

Special Session on Proof Theory, 1
10:00–10:20 (2) Decidability of the class (3) by Maslov's inverse method. G. E. MINC, Leningrad, USSR (801-03-205)
10:30–10:50 (3) From choice to comprehension (A brief survey). WILFRIED SIEG, Columbia University (801-03-439)
11:00–11:20 (4) Orthomodular lattices and cut elimination. Preliminary report. ROBERT P. MARBLE, Hofstra University (801-03-62)
12:00–12:20 (6) Keep cut. GEORGE BOOLOS, Massachusetts Institute of Technology (801-03-415)

Wednesday, 10:00 a.m.

Special Session on Monotonicity Methods in Differential Equations, I
10:00–10:20 (7) Monotone operators and nonlinear passive systems. ALEXANDER RAMM, Kansas State University (801-47-34)
10:30–10:50 (8) A class of Sturm-Liouville eigenvalue problems with exponential nonlinearities. PIERRE A. VUILLEMRONT, Emory University (801-34-48)
11:00–11:20 (9) On the solvability of an equation describing the periodic motions of a satellite. Preliminary report. W. V. PETRYSHYN, Rutgers University, New Brunswick (801-34-401)
11:30–11:50 (10) Local expansions and accretive mappings. W. A. KIRK, University of Iowa (801-47-51)
12:00–12:20 (11) Recent results on partial differential equations with delay in the highest order derivative. G. D. BLASIO, Università dell' Aquila, Italy, K. KUNISCH, Technische Universität Graz, Austria, and E. SINESTRARI, Università di Roma, Italy (801-35-476)

Wednesday, 10:00 a.m.

Session on Number Theory
10:00–10:10 (12) Rules for amicable pairs. Preliminary report. DONALD J. BOYCE, Central State University, and DALE WOODS*, Central State University and Northeast Missouri State University (801-10-370)
10:15–10:25 (13) Algebraic approximations to pi. J. MARSHALL ASH, DePaul University (801-10-285)
10:30–10:40 (14) Sums over numbers with restricted prime factors. Preliminary report. DONALD G. HAZLEWOOD, Southwest Texas State University (801-10-228)
10:45–10:55 (15) Frequency of divisibility of $3^n - n$ by the number of divisors of $n$. Preliminary report. CLAUDIA SPIRO, State University of New York, Buffalo (801-10-346)
11:00–11:10 (16) On the distribution of $(k^n)$. Preliminary report. ANDREW D. POLLINGTON, Brigham Young University, Utah (801-10-501)
11:30–11:40 (18) A property of the ternary Golay code. EDWARD Y. MILLER, Polytechnic Institute of New York, and SHERWOOD WASHBURN*, Seton Hall University (801-10-496)
12:00–12:10 (20) Forced differences between terms of subsequences of integer sequences. MICHAEL GILPIN* and ROBERT SHELTON, Michigan Technological University (801-10-92)

12:15–12:25 (21) The Weierstrass family corresponding to Q and Z/pZ. Preliminary report. GORO C. KATO, California Polytechnic State University (801-10-221)

**Wednesday, 10:00 a.m.**

**Session on Groups and Semigroups**

10:00–10:10 (22) Singly generated socles and radicals. T. H. FAY and G. L. WALLS*, University of Southern Mississippi, and E. P. OXFORD, Baylor University (801-20-159)


11:00–11:10 (26) Generalized Rottlander-, Honda-, Yf-groups. CHARLES S. HOLMES, Miami University, Oxford (801-20-445)


11:30–11:40 (28) Loops whose loop rings are alternative. Preliminary report. ORIN CHEIN*, Temple University, and EDGAR G. GOODAIRE, Memorial University of Newfoundland (801-20-177)

11:45–11:55 (29) Right distributive semigroup. Preliminary report. GARY F. BIRKENMEIER, Southeast Missouri State University (801-20-180)

12:00–12:10 (30) Strong inverses for transformations. Preliminary report. BORIS M. SCHEIN, University of Arkansas, Fayetteville (801-20-263)


**Wednesday, 10:00 a.m.**

**Session on Ordinary Differential Equations, I**

10:00–10:10 (32) Some properties of second order linear differential equations and perturbations that preserve them. GEOFFREY BUTLER*, University of Alberta, and V. SREE HARI RAO, Iowa State University (801-34-352)

10:15–10:25 (33) On the nonoscillation of bounded solutions of higher order functional differential equations. JOHN R. GRAEF and PAUL W. SPIKES*, Mississippi State University, and MYRON K. GRAMMATIKOPOULOS, University of Ioannina, Greece (801-34-305)

10:30–10:40 (34) On a peculiar relationship between certain pairs of fourth order differential equations. WILLIE E. TAYLOR, Texas Southern University (801-34-118)


11:00–11:10 (36) Oscillation results for the delay equations with two middle terms. WITOLD A. KOSMALA, University of Tampa (801-34-493) (Introduced by M. Manougian)

11:15–11:25 (37) k-point disconjugacy and disconjugacy for linear differential equations. JOHNNY HENDERSON, University of Missouri, Rolla (801-34-30)

11:30–11:40 (38) The motions of an algebraic differential equation. LEE A. RUBEL, University of Illinois, Urbana-Champaign (801-34-380)


**Wednesday, 10:00 a.m.**

**Session on Operator Theory, I**

10:00–10:10 (40) Toeplitz operators on Bergmann and Hardy spaces. NAZIH S. FAOUR, University of Kuwait (801-47-11)


10:30–10:40 (42) Tridiagonal matrix representations of cyclic self-adjoint operators. JOANNE DOMBROWSKI, Wright State University (801-47-527)

11:00-11:10 (44) Perturbations of normally solvable nonlinear operators. Preliminary report. ANITA M. WALKER, University of Oklahoma (801-47-299)


Wednesday, 10:00 a.m.

Session on Optimal Control and Calculus of Variations
10:00-10:10 (47) Existence theorems for optimal control over infinite horizons. Preliminary report. DEAN CARLSON, University of Delaware (801-49-344)


10:30-10:40 (49) Suboptimal solutions of the infinite horizon optimal control problem. Preliminary report. BARBARA KASKOSZ*, Polish Academy of Sciences and University of Rhode Island, and EMILIO O. ROXIN, University of Rhode Island (801-49-237)

10:45-10:55 (50) Transversality conditions in the infinite horizon problem. Preliminary report. LYNNELL E. STERN, Simmons College (801-49-431)

11:00-11:10 (51) Geometric properties of attainable sets for non-regular one-dimensional differential inclusions. Preliminary report. WANDA SZPUNAR-LOJASIEWICZ, Technical University Cracow, Poland, and University of Rhode Island (801-49-238) (Introduced by Emilio Roxin)

Wednesday, 10:00 a.m.

Session on General Topology, I
10:00-10:10 (52) Strong G-spaces and remote points. THOMAS J. PETERS, University of Hartford (801-54-356)

10:15-10:25 (53) Collectionwise Hausdorff vs. collectionwise normal w.r.t. compact sets. G. M. REED, Ohio University, Athens, and NASA Goddard Space Flight Center (801-54-306)

10:30-10:40 (54) Properties of collectionwise δ-normal spaces. Preliminary report. JAMES C. SMITH, JR., Virginia Polytechnic Institute and State University (801-54-234)

10:45-10:55 (55) Spaces without perfect subsets. SCOTT W. WILLIAMS, State University of New York, Buffalo (801-54-183)

11:00-11:10 (56) Perfect GO-spaces. Preliminary report. H. R. BENNETT and D. J. LUTZER*, Texas Tech University (801-54-116)

11:15-11:25 (57) Nowhere dense subsets of HFDs. Preliminary report. ANDREW J. BERNER, University of Dallas (801-54-66)


11:45-11:55 (59) Mappings onto a P-adic solenoid. Preliminary report. ROBERT D. MAY, Longwood College (801-54-308)

Wednesday, 10:00 a.m.

Session on Computer Science
10:00-10:10 (60) Families of noncommutative bilinear algorithms for 3 X 3 matrix multiplication. RODNEY JOHNSON, Naval Research Laboratory, Washington, D.C., and AILEEN MCLoughlin*, Trinity College (801-68-225)

10:15-10:25 (61) On the relationship between artificial attributes and DDHs. ZBIGNIEW W. RAŚ, University of North Carolina, Charlotte, and University of Warsaw, Poland (801-68-212) (Introduced by Alexandru Solian)

10:30-10:40 (62) On the monoid presented by <a, b; abbaab = 1 >. D. H. POTTS, California State University, Northridge, and University of California, Santa Barbara (801-68-172)

10:45-10:55 (63) Injective sequential operators. Preliminary report. DAN A. SIMOVICI, University of Massachusetts, Boston (801-68-242)

Wednesday, 10:15 a.m.

Invited Address
10:15-11:15 (64) Aspects of harmonic analysis on the Heisenberg group: dual pairs, θ-functions, classical invariant theory. ROGER E. HOWE, Yale University (801-22-06)
Wednesday, 11:15 a.m.

Session on Operations Research and Social and Biological Sciences
11:30–11:40 (66) Proportional weighted veto functions. EDWARD W. PACKEL, Lake Forest College (801-90-371)
11:45–11:55 (67) Noncooperative game models of an exchange economy. DAVID HOUSMAN, Cornell University (801-90-455)
12:00–12:10 (68) Random drift of genotypes and phenotypes. Preliminary report. R. B. CAMPBELL, Purdue University, West Lafayette (801-92-175)

Wednesday, 1:00 p.m.

Colloquium Lectures: Lecture I
1:00–2:00 (69) The uncertainty principle: the SAK principle. CHARLES L. FEFFERMAN, Princeton University (801-35-529)

Wednesday, 2:15 p.m.

Invited Address
2:15–3:15 (70) The Leech lattice. NEIL J. A. SLOANE, Bell Laboratories, Murray Hill (801-52-403)

Wednesday, 2:30 p.m.

Special Session on Applied Category Theory, I
3:30–4:10 (72) Applications of the dual functor in Banach spaces. JOAN WICK PELLETIER, York University (801-18-393)
4:30–5:10 (73) Exponential laws in differential calculus. Preliminary report. LOUIS D. NEI, Carleton University (801-18-50)

Wednesday, 2:30 p.m.

Special Session on Monotonicity Methods in Differential Equations, II
2:30–2:50 (75) Asymptotic behavior of solutions to nonlinear Volterra integral equations in Hilbert space. DOUGLAS S. HULBERT and SIMON REICH*, University of Southern California (801-45-78)
3:00–3:25 (76) Recent developments concerning ground state properties of electron densities. Preliminary report. JEROME A. GOLDBERG, Tulane University (801-35-43)
3:30–3:55 (77) Second order equations with nonlinear damping. SAMUEL M. RANKIN III, West Virginia University (801-34-397)
4:00–4:20 (78) European results for a reaction-diffusion system. P. W. BATES*, Texas A&M University, College Station, and K. J. BROWN, Heriot-Watt University, Scotland (801-35-04)

Wednesday, 2:30 p.m.

Special Session on Operator Algebras and Operator Theory, I
2:30–2:55 (80) Invariant subspaces for the polydisk. Preliminary report. RONALD G. DOUGLAS, State University of New York, Stony Brook (801-47-144)
3:00–3:25 (82) (BCP)-operators, reflexivity, and the invariant subspace problem. H. BERCOWICZ, Massachusetts Institute of Technology, C. FOIA§, Indiana University, Bloomington, and C. PEARCY*, University of Michigan, Ann Arbor (801-47-136)
3:30–3:55 (83) Subnormal operators and representations of bounded analytic functions. THOMAS L. MILLER, ROBERT F. OLN*, and JAMES E. THOMSON, Virginia Polytechnic Institute and State University (801-47-140)

47
4:00– 4:25 (84) (BCP)-operators and dilation theory. H. BERCOVICI, Massachusetts Institute of Technology, C. FOIAŞ*, Indiana University, Bloomington, and C. PEARCY, University of Michigan, Ann Arbor (801-47-143)


5:00– 5:25 (86) Groupoid C*-algebras of operators on Bergman spaces. RAUL CURTO and PAUL S. MUHLY*, University of Iowa (801-47-142)

5:30– 5:55 (87) Completely bounded maps of C*-algebras and similarity theory. Preliminary report. VERN I. PAULSEN, University of Houston, Houston (801-47-139)

**Wednesday, 2:30 p.m.**

**Special Session on Automatic Theorem Proving, I**


3:00– 3:40 (89) Automatic theorem proving and artificial intelligence. HAO WANG, Rockefeller University (801-03-203) (Introduced by Woodrow W. Bledsoe)

4:00– 4:40 (90) Open questions solved with the assistance of AURA. L. WOS* and S. WINKER, Argonne National Laboratory (801-68-202)

5:00– 5:20 (91) Automatic theorem-proving for recursive functions. ROBERT S. BOYER* and J. STROTHER MOORE, University of Texas, Austin (801-03-412) (Introduced by Woodrow W. Bledsoe)


6:00– 6:20 (93) Decidable theories in theorem proving. DEREK OPPEN, Menlo Park, California (801-68-437) (Introduced by Woodrow W. Bledsoe)

**Wednesday, 2:30 p.m.**

**Session on Complex Analysis**

2:30– 2:40 (94) Remainders of power series. II. Preliminary report. JAMES D. MCCALL, Texas A&I University (801-30-54)

2:45– 2:55 (95) A problem of Robinson. KENT PEARCE, Texas Tech University (801-30-85)

3:00– 3:10 (96) Remarks on a problem of Clunie, Sheil-Small, and Hall. ROGER W. BARNARD*, Texas Tech University, and GLENN SCHOOBER, Indiana University, Bloomington (801-30-282)

3:15– 3:25 (97) Some new coefficient inequalities. GLENN SCHOOBER* and JOHN WILLIAMS, Indiana University, Bloomington (801-30-283)

3:30– 3:40 (98) Coefficient estimates for functions with quasiconformal extensions. JOHN WILLIAMS, Indiana University, Bloomington (801-30-284)


4:00– 4:10 (100) Interpolation with meromorphic functions of minimal norm. CARL H. FITZGERALD*, University of California, San Diego, and W. ALAN SCALES, ISSCO Graphics (801-30-334)

4:15– 4:25 (101) The curvature and torsion of stereographically projected analytic curves. STEPHEN M. ZEMYAN, Pennsylvania State University, Mont. Alto Campus (801-30-348)


4:45– 4:55 (103) Dominating sets for harmonic functions in $L^p$. DANIEL H. LUECKING, University of Arkansas, Fayetteville (801-31-213)

5:00– 5:10 (104) Characterization of holomorphic contractions of all biholomorphically invariant metrics on the unit ball of $n \times n$ matrices. EVAN FLETCHER, University of California, San Diego (801-32-198)


5:30– 5:40 (106) On the generalized Seidel class $U$. JUN SHUNG HWANG, Michigan State University (801-30-353) (Introduced by Peter A. Lappan)

**Wednesday, 2:30 p.m.**

**Session on Information Theory, Statistics, and Probability**


3:00– 3:10 (109) Autocorrelation techniques in delineating the physiology of juvenile onset diabetic patients. Preliminary report. Bill Coleman* and John H. Siegel, University of Maryland, Baltimore County, and Nicholas D. Kazarinoff, State University of New York, Buffalo (801-62-467)


4:00– 4:10 (113) Densities for weighted sums of independent random variables. Preliminary report. Jakob I. Reich, Baruch College, City University of New York (801-60-465)

4:15– 4:25 (114) Sequences of Markov chains and sequences of noisy channels of transmission of information. Milli Rosenblatt-Roth, California State University, Fullerton (801-60-335)


Wednesday, 3:30 p.m.

Invited Address

Wednesday, 3:30 p.m.

Special Session on Diophantine Problems and Analytic Number Theory, 1

4:00– 4:20 (118) Additive functions as sums of a random number of random variables. Preliminary report. János Galambos, Temple University (801-10-402)

4:30– 4:50 (119) A new application of the sieve to probabilistic number theory. Krishnaswami Alladi, University of Texas, Austin (801-10-67)

5:00– 5:20 (120) Weighted sieves of Greaves' type. Heini Halberstam*, University of Illinois, Urbana-Champaign, and H.-E. Richert, University of Ulm, Federal Republic of Germany (801-10-163)

5:30– 5:50 (121) The large sieve inequality in an algebraic number field. Preliminary report. Peter Schumer, University of Maryland, College Park (801-10-505)

6:00– 6:20 Discussion Session

Wednesday, 3:30 p.m.

Session on Combinatorics, 1
3:30– 3:40 (122) There are no de Bruijn sequences of span n with complexity 2^{n-1} + n + 1. Richard A. Games, Colorado State University (801-05-182)


4:00– 4:10 (124) A quintessential proof of van der Waerden's theorem on arithmetic progressions. George Mills, Carleton College (801-05-449)

4:15– 4:25 (125) Scheduling optimal tournaments. George Graham and Charles Roberts*, Indiana State University (801-05-53)

4:30– 4:40 (126) Latin cubes and hypercubes of prime order. Charles Laywine, Brock University, and Gary L. Mullen*, Pennsylvania State University, University Park (801-05-262)

4:45– 4:55 (127) Counting in quadrangles; s \leq t^2 revisited. Aaron Meyerowitz, Colorado State University (801-05-480)

5:00– 5:10 (128) Span-symmetric generalized quadrangles: A correction. Preliminary report. Stanley E. Payne, Miami University, Oxford (801-05-186)

5:15– 5:25 (129) Linearity of design automorphism groups. Neal Brand, Loyola University, Chicago (801-05-464)


5:45– 5:55 (131) 3-designs on 78 points. Preliminary report. Gregory M. Constantine, Indiana University, Bloomington (801-05-28)
Wednesday, 8:30 p.m.

Josiah Willard Gibbs Lecture
8:30- 9:30 (132) Mathematical models and controversies of evolutionary theory. SAMUEL KARLIN, Stanford University

Thursday, 8:00 a.m.

Special Session on Proof Theory, II
8:00- 8:20 (133) The set of recursive ordinals is decidable. IRVING H. ANELLIS, McMaster University (801-03-107)
8:30- 8:50 (134) Semantic analysis of propositional constructive logics: some maximality results. P. MIGLIOLI, U. MOSCATO*, M. ORNAGHI, and G. USBERTI, Università di Milano, Italy (801-03-503) (Introduced by Irving H. Anellis)
9:00- 9:20 (135) On totally nonconstructive (t.n.c.) extensions of the countable atomless Boolean algebra. E. W. MADISON, University of Iowa (801-03-526) (Introduced by Irving H. Anellis)
9:30- 9:50 (136) Some theories conservative over intuitionistic arithmetic. MICHAEL BEESON, San José State University (801-03-247)
10:00-10:20 (137) Set existence property for intuitionistic theories with dependent choice. Preliminary report. HARVEY FRIEDMAN, Ohio State University, Columbus, and ANDREJ ŠEDROV*, University of Pennsylvania (801-03-23)
10:30-10:50 (138) Completeness theorem of intuitionistic fuzzy logic and its application. GAISI TAKEUTI*, University of Illinois, Urbana-Champaign, and SATOKO TITANI, University of Washington (801-03-65)
11:00-11:20 (139) Normalization for combinatorially complete systems without implication. JONATHAN P. SELDIN, Concordia University (801-03-42)
11:30-11:50 (140) Smulian trees: their model-theoretic uses. HUGUES LEBLANC, Temple University (801-03-173) (Introduced by Irving H. Anellis)
12:00-12:20 Problem Session

Thursday, 8:00 a.m.

Session on Combinatorics, II
8:00- 8:10 (141) Randomly near-traceable graphs. JOHN FREDERICK FINK, University of Louisville (801-05-329)
8:15- 8:25 (142) On $\lambda$-reducibility of a strong tournament and $\mu$-consistency of a non-transitive tournament. SUBHASH C. SAXENA, University of South Carolina, Conway (801-05-340)
8:30- 8:40 (143) The sound of a hamiltonian cycle. ARTHUR T. WHITE, Western Michigan University (801-05-218)
8:45- 8:55 (144) Automorphism groups of vertex transitive graphs. MARC J. LIPMAN, Indiana University-Purdue University, Fort Wayne (801-05-358)
9:00- 9:10 (145) Automorphisms of rooted trees with height distributions. CHERYL E. PRAEGER and PHILLIP SCHULTZ*, University of Western Australia (801-05-109)
9:45- 9:55 (148) Isomorphic factorizations of complete graphs into regular graphs. BRIAN ALSPACH, Simon Fraser University, and SERGIO RUIZ*, Western Michigan University (801-05-295)
10:00-10:10 (149) On equi-matchable graphs. M. LESK, C.N.E.T., France, M. D. PLUMMER*, Vanderbilt University, and W. R. PULLEYBLANK, University of Waterloo (801-05-349)

Thursday, 8:00 a.m.

Session on Ordered Algebraic Structures
8:00- 8:10 (150) Convexity conditions on $f$-rings. Preliminary report. SUZANNE L. LARSON, Wesleyan University (801-06-171)
8:15- 8:25 (151) Transforms and completions of multiplicative lattices. Preliminary report. JOHN S. RANKIN, Central Michigan University (801-06-195)
8:45-8:55 (153) **Minimal primes of a vector lattice and germs of piecewise linear functions.** Preliminary report. JAMES J. MADDEN, Wesleyan University (801-06-259)

9:00-9:10 (154) **The divisible embedding property for lattice ordered groups.** WAYNE B. POWELL*, Oklahoma State University, Stillwater, and CONSTANTINE TSINAKIS, Vanderbilt University (801-06-229)

9:15-9:25 (155) **Finite varieties of lattice-ordered groups.** Preliminary report. MARLOW ANDERSON, Colorado College, and TODD FEIL*, Denison University (801-06-229)

9:30-9:40 (156) **Retractable groups and unique product groups.** Preliminary report. F. D. PEDERSEN, Southern Illinois University, Carbondale (801-06-312)

9:45-9:55 (157) **Homomorphic extensions of mappings of finite Boolean algebras.** GRANT A. FRASER, California State University, Los Angeles (801-06-359)

10:00-10:10 (158) **Boolean-like ring manuals.** PETER P. HAGLICH, University of Massachusetts, Amherst (801-06-382)

**Thursday, 8:30 a.m.**

**Special Session on Operator Algebras and Operator Theory, II**

8:30-8:55 (159) **Complex Jordan operators.** JOHN W. BUNCE, University of Kansas (801-47-138)

9:00-9:20 (160) **Perfect C*-algebras.** Preliminary report. CHARLES A. AKEMANN*, University of California, Santa Barbara, and FREDERIC W. SHULTZ, Wellesley College (801-46-07)

9:30-9:50 (161) **Encounters with the Hilbert matrix.** MAN-DUEN CHOI, University of Toronto (801-47-141)

10:00-10:20 (162) **Equivariant index of Toeplitz operators.** L. A. COBURN, State University of New York, Buffalo (801-47-137)

10:30-10:50 (163) **Homotopy continuity and shape theory for C*-algebras.** EDWARD G. EFFROS*, University of California, Los Angeles, and JEROME KANINKER, Indiana University-Purdue University, Indianapolis (801-46-417)

11:00-11:20 (164) **Cancellation for projective modules over irrational rotation C*-algebras.** MARC A. RIEFFEL, University of California, Berkeley (801-46-134)

11:30-11:50 (165) **Axiomatic homology for C*-algebras.** CLAUDE SCHOCHE, Wayne State University (801-46-21)

**Thursday, 8:45 a.m.**

**Invited Address**

8:45-9:45 (166) **Constructing rational points of infinite order on elliptic curves.** BENEDET H. GROSS, Brown University (801-12-130)

**Thursday, 9:00 a.m.**

**Special Session on Monotonicity Methods in Differential Equations, III**

9:00-9:20 (167) **Monotonicity methods for odd order differential equations.** Preliminary report. R. KENT NAGLE, University of South Florida, Tampa (801-47-398)

9:30-9:50 (168) **A boundary value problem for a system of difference equations.** PAUL W. ELOE, University of Dayton (801-39-24)

10:00-10:20 (169) **Nonlinear rotative semigroups.** ANDREW T. PLANT* and SIMEON REICH, University of Southern California (801-47-399)

10:30-10:50 (170) **Convergence properties of semigroups on certain memory spaces.** Preliminary report. JOHN R. HADDOCK, Memphis State University (801-34-432)

11:00-11:20 (171) **Nonresonance and existence of time-periodic solutions for semilinear wave equations.** JAMES R. WARD, Jr., University of Alabama, Tuscaloosa (801-35-400)

11:30-11:50 (172) **Poincaré type inequalities and nonlinear boundary value problems.** CHAITAN P. GUPTA*, Northern Illinois University, and JEAN MAWHIN, Catholic University of Louvain, Belgium (801-34-396)

12:00-12:20 Problem Session

**Thursday, 9:00 a.m.**

**Special Session on Abstract Adjoints and Boundary Problems, I**

9:00-9:50 (173) **Adjoint subspaces and boundary value problems.** EARL A. CODDINGTON, University of California, Los Angeles (801-34-407)

10:00-10:20 (174) **Concerning the self-adjointness of the singular Sturm-Liouville problem.** ALLAN M. KRALL, Pennsylvania State University, University Park (801-34-60)
 Thursday, 9:00 a.m.

Special Session on Pseudo-Differential Operators and Applications, 1

9:00–10:00  (178)  Boundary behavior of holomorphic mappings and the $\overline{\partial}$-problem. STEVE BELL, Princeton University (801-32-31)

10:00–10:10  (179)  On boundary regularity of the $\overline{\partial}$-Neumann problem. PRELIMINARY REPORT. DAVID CATLIN, Princeton University (801-35-169) (Introduced by D. H. Phong)


10:20–10:30  (181)  A local parametrix in the $\partial_b$-Neumann problem. PRELIMINARY REPORT. DAVID JERISON, Massachusetts Institute of Technology (801-35-255)

Thursday, 9:00 a.m.

Session on Classical Analysis

9:00–10:00  (183)  On a functional equation involving iterates of a bijection on the unit interval. ARUNAVA MUKHERJEE and J. S. RATTI*, University of South Florida, Tampa (801-26-355) (Introduced by A. G. Kartsatos)


10:00–10:10  (185)  Norlund polynomial methods of type $M(E)$. Preliminary report. J. DEFRANZA*, Youngstown State University, and D. J. FLEMING, St. Lawrence University (801-40-366)


10:20–10:30  (187)  An example of nonconvergence of the Pólya algorithm in $L_0$ approximation. R. B. DARST, Colorado State University, D. A. LEGG, and D. W. TOWNSEND*, Indiana University-Purdue University, Fort Wayne (801-41-196)

10:30–11:00  (188)  Multi-valued Urysohn integral equations. Preliminary report. THOMAS S. ANGELL, University of Delaware (801-45-343)

10:40–11:10  (189)  On the equation $\phi(x) = \int_x^1 f[\phi(\xi)]d\mu(\xi)$. MORTON L. SLATER*, Texas Christian University, and AMY HUANG WANG, Vienna, Virginia (801-45-468)

Thursday, 9:00 a.m.

Session on Geometric Topology

9:00–10:00  (190)  Fixed points for orientation preserving homeomorphisms which have periodic points. Preliminary report. MORTON BROWN, University of Michigan, Ann Arbor (801-58-324)

9:15–10:00  (191)  Applications of topology to the area of computational fluid dynamics. DAVID C. WILSON, University of Florida, Gainesville (801-54-220)

9:30–10:00  (192)  Inequivalent embeddings of Cantor sets and planar continua in $E^3$. Preliminary report. BEVERLY L. BRECHNER, University of Florida, and JOHN C. MAYER*, University of Saskatchewan (801-54-190)

9:45–10:00  (193)  On vertical order of one-dimensional compacta in $E^3$. Preliminary report. FREDERICK C. TINSLEY*, Colorado College, and DAVID G. WRIGHT, Utah State University (801-57-185)

10:00–10:10  (194)  Slidings in handlebodies. DAVID L. WILSON, Kent State University (801-57-199)

10:10–10:20  (195)  A decomposition into homeomorphic handlebodies with naturally equivalent involutions. ROGER B. NELSON, Ball State University (801-57-216)

10:20–10:30  (196)  Maps which induce inner automorphisms on the fundamental group of non-irreducible 3-manifolds. Preliminary report. JOHN E. KALLIONGIS, Southwest Texas State University (801-57-336)

10:40–11:10  (197)  Ambiently universal sets in $E^n$. DAVID G. WRIGHT, Utah State University (801-57-328)

11:00–11:10  (198)  Higher dimensional knot theory. SAMUEL J. LOMONACO, Jr., Institute for Defense Analyses (801-57-463)

11:30-11:40 (200) Set valued maps. Preliminary report. DAVID G. BOURGIN*, University of Houston, Houston, and ROBERT M. NEHS, Texas Southern University (801-55-451)

11:45-11:55 (201) A Nielsen number for deformation-retractible maps. ROBERT F. BROWN, University of California, Los Angeles (801-55-484)

12:00-12:10 (202) End invariants of groups and ends of non-compact 3-manifolds. MATTHEW G. BRIN, State University of New York, Binghamton, and T. L. THICKSTUN*, Southwest Texas State University (801-57-337)

11:45-11:55 (220) Beta functions for $P_n$. THOMAS E. BENGTSON, Miami University, Oxford (801-33-294)

Thursday, 1:00 p.m.

Colloquium Lectures: Lecture II
1:00- 2:00 (221) The uncertainty principle: Schrödinger operators. CHARLES L. FEFFERMAN, Princeton University

Thursday, 2:15 p.m.

Special Invited Address
2:15– 3:15 (222) The National Science Foundation: Policies and programs for research in the mathematical sciences. EDWARD A. KNAPP, National Science Foundation

Thursday, 2:15 p.m.

Special Session on Diophantine Problems and Analytic Number Theory, III
2:15– 2:35 (223) Regulators in totally real cubic fields. Preliminary report. THOMAS W. CUSICK, State University of New York, Buffalo (801-10-256)
2:45– 3:05 (224) On the nonexistence of Siegel zeros for some number fields. Preliminary report. A. M. ODLYZKO, Bell Laboratories, Murray Hill (801-12-404)
3:45– 4:05 (226) The second moment for prime numbers. D. A. GOLDSTON, Institute for Advanced Study (801-10-207)
4:15– 4:35 (227) Intervals containing exceptionally few prime numbers. Preliminary report. HELMUT MAIER, University of Michigan, Ann Arbor (801-10-438)

Thursday, 2:15 p.m.

Special Session on Representation Theory of Finite Groups of Lie Type, I
2:15– 2:35 (228) Weyl modules and principal series modules for Chevalley groups. Preliminary report. JAMES E. HUMPHREYS, University of Massachusetts, Amherst (801-20-129)
2:45– 3:05 (229) Universal observability. JOHN BRENDAN SULLIVAN, University of Washington (801-20-230) (Introduced by Charles Curtis)
3:15– 3:35 (230) Infinitesimal methods in the cohomology of algebraic groups. E. CLINE*, Clark University, and B. PARSHALL and L. SCOTT, University of Virginia (801-20-388)
3:45– 4:05 (231) Cyclotomic polynomials and representations of finite Chevalley groups. Preliminary report. RICHARD BOYCE, Ohio State University, Columbus (801-20-410)
4:15– 4:35 (232) Overgroups of irreducible subgroups of GL(V). GARY M. SEITZ, University of Oregon (801-20-84)

Thursday, 2:15 p.m.

Special Session on Monotonicity Methods in Differential Equations, IV
2:15– 2:35 (233) Critical point theory and second-order periodic systems. S. AHMAD and A. C. LAZER*, University of Miami (801-34-497)
3:45– 4:05 (236) A unifying approach to nonlinear second order equations with applications to partial differential equations. PATRICIO U. AVILAS, Cornell University, and JAMES T. SANDEFUR*, Georgetown University (801-35-58)
4:15– 4:35 Problem Session

Thursday, 2:15 p.m.

Special Session on Pseudo-Differential Operators and Applications, II
2:15– 2:35 (237) Microlocal hypo-analyticity and extension of CR functions. M. S. BAOUENDI, Purdue University, West Lafayette (801-35-208)
2:45– 3:05 (238) Propagation of holomorphic extendability of CR functions. N. HANGES, University of Pittsburgh, Pittsburgh, and F. TREVES*, Rutgers University, New Brunswick (801-35-209)
3:15– 3:25 (239) Effective hyperbolicity. RICHARD MELROSE, Massachusetts Institute of Technology (801-35-97)
4:15– 4:35 Problem Session

Thursday, 2:15 p.m.

Special Session on Automatic Theorem Proving, II
2:15– 2:35 (241) Non-monotonic reasoning and common sense inference. JOHN MCCARTHY, Stanford University (801-68-466)
2:45– 3:05 (242) Automating higher order logic. PETER B. ANDREWS, Carnegie-Mellon University (801-03-201)
3:45– 4:05 (244) Some automatic proofs in analysis. W. W. BLEDSOE, University of Texas, Austin (801-68-69)
4:15– 4:35 Informal Discussion

Thursday, 2:15 p.m.

Session on Combinatorics, III
2:15– 2:25 (245) Uniquely and critically cochromatic graphs. Preliminary report. JOHN GIMBEL, Colby College (801-05-125)
2:45– 2:55 (247) On the Perron eigenvector of a graph. Preliminary report. KENNETH LANE, Colby College (801-05-369)
3:00– 3:10 (248) Which graph-theoretic properties are pointless? TERRY A. MCKEE, Wright State University (801-05-104)
3:15– 3:25 (249) Similar lines and edge unique line graphs. DAVID BANGE and ANTHONY BARKAUSKAS*, University of Wisconsin, La Crosse, and PETER SLATER, University of Alabama, Huntsville (801-05-499)
3:30– 3:40 (250) Toward a characterization of team designs. Preliminary report. NICHOLAS KRIER, Rochester Institute of Technology (801-05-440)
4:00– 4:10 (252) The Kuratowski covering of graphs in the projective plane. Preliminary report. SANDRA L. JOHNSON, University of Kansas (801-05-286)
4:15– 4:25 (253) The maximal number of edges in the covering graph of a poset of rank k. JAMES A. WISEMAN, Rochester Institute of Technology (801-05-441)

Thursday, 2:15 p.m.

Session on Harmonic Analysis and Measure Theory
2:15– 2:25 (254) Hilbert transforms for odd convex curves. Preliminary report. ALEXANDER NAGEL and STEPHEN WAINGER, University of Wisconsin, Madison, Jim VANCE, Wright State University, and DAVID WEINBERG*, Texas Tech University (801-42-150)
2:30– 2:40 (255) Hilbert transforms for convex curves. ALEXANDER NAGEL and STEPHEN WAINGER, University of Wisconsin, Madison, James VANCE*, Wright State University, and DAVID WEINBERG, Texas Tech University (801-42-239)
2:45– 2:55 (256) Tauberian $L^1$-convergence classes of Fourier series. WILLIAM O. BRAY*, University of Maine, Orono, and ČASLAV V. STANOJEVIĆ, University of Missouri, Rolla (801-42-318)
3:00– 3:10 (257) Hypercontractivity for the heat semigroup for ultraspherical polynomials and on the n-sphere. CARL E. MUELLER and FRED B. WEISSLER*, University of Texas, Austin (801-43-155)
3:30– 3:40 (259) Spectral synthesis for sets E of the form $E = \text{int}(E)$. Preliminary report. DAVID COLELLA, Youngstown State University (801-43-293)
4:00– 4:10 (261) Transformations in a measure space. Preliminary report. H. DIEKHANS, Indiana State University (801-28-338)
Thursday, 2:15 p.m.

Session on Functional Analysis, I
2:15- 2:25 (262) Compact operators in F-lattices. PRZEMYSŁAW KRANZ, University of Arkansas, Fayetteville (801-46-500)
2:30- 2:40 (263) Lattice homomorphisms on certain function spaces. WILLIAM A. FELDMAN* and JAMES F. PORTER, University of Arkansas, Fayetteville (801-46-274)
2:45- 2:55 (264) Equivalence classes of lattice homomorphisms. JAMES F. PORTER* and WILLIAM A. FELDMAN, University of Arkansas, Fayetteville (801-46-275)
3:00- 3:10 (265) Mappings from a separable Banach space to $C(\Delta)$. Preliminary report. ELIZABETH BATOR, Pennsylvania State University, University Park (801-46-447)
3:15- 3:25 (266) Somewhat quasi-reflexive Banach spaces. STEVEN F. BELLENOT, Florida State University (801-46-373)
3:30- 3:40 (267) Differential analysis and geometry of Banach spaces. Preliminary report. KONDA GUNTA SUNDARESAN, Cleveland State University (801-46-315)
4:15- 4:25 (270) k-reflectivity and the canonical $\gamma$-completion. Preliminary report. MANJUL GUPTA*, University of Iowa, and N. R. DAS, Arya Vidyapeeth College, India (801-46-289) (Introduced by S. S. Khurana)

Thursday, 2:15 p.m.

Session on Operator Theory, II
2:30- 2:40 (273) Solution to a conjecture of F. A. Valentine. Preliminary report. THAKYIN HU, Tamkang University, Taiwan (801-47-266) (Introduced by Paul T. Bateman)
3:00- 3:10 (275) Invariant subspaces of shifts on Krein space. Preliminary report. BRIAN W. MCENNIS, Ohio State University, Marion (801-47-310)
3:30- 3:40 (277) Forward and inverse Riccati scattering of acoustic waves in a half-space. Preliminary report. RODERIC C. DEYÓ, University of Utah (801-47-528)
3:45- 3:55 (278) Modified Feynman integral for a negative singular potential. MICHEL L. LAPIDUS, University of Southern California (801-47-492)

Thursday, 2:15 p.m.

Session on Geometry
2:15- 2:25 (279) Polymorphic polyominoes. ANNE FONTAINE, College of St. Rose, and GEORGE E. MARTIN*, State University of New York, Albany (801-50-17)
2:30- 2:40 (280) Relative isoperimetric problems and the topology of linkage spaces. THOMAS F. BANCHOFF, Brown University (801-51-223)
2:45- 2:55 (281) Pseudo planes and pseudo fields. GEORGE GRAHAM, Indiana State University (801-51-345)
3:00- 3:10 (282) A note on curves and their profiles. Preliminary report. MANGHO AHUJA, Southeast Missouri State University (801-52-112)

Thursday, 2:15 p.m.

Session on Probability
2:15- 2:25 (283) The Lévy-Lindeberg central limit theorem for $L_q$ valued random elements. ANNA T. LAWNICZAK, Louisiana State University, Baton Rouge (801-60-27)
2:30- 2:40 (284) Uniqueness and extremality for a class of multiply-stochastic measures. Preliminary report. R. M. SHORTT, Michigan Technological University (801-60-74)

3:00– 3:10 (286) Applications of Reuven and Palm type measures for additive functionals in weak duality. BRUCE W. ATKINSON*, University of Southern California, and JOANNA B. MITRO, University of Cincinnati, Cincinnati (801-60-191)


4:00– 4:10 (290) On duality between estimation and control for a linear stochastic functional differential equation in Banach spaces. Preliminary report. MOU-HSIUNG CHANG, University of Alabama, Huntsville (801-93-153)


Thursday, 3:30 p.m.

Report from the National Science Foundation

3:30– 4:30 (292) Annual report from the NSF’s Mathematical Sciences Section. WILLIAM G. ROSEN, Head, Mathematical Sciences Section, National Science Foundation

Thursday, 3:30 p.m.

Session on Algebraic Topology and Foliations

3:30– 3:40 (293) Transfer in generalized sheaf cohomology. ROBERT J. PIACENZA, University of Alaska, Fairbanks (801-55-35)

3:45– 3:55 (294) Integral formulas for characteristic classes of foliations. Preliminary report. DAVID B. ELLIS* and ROBERT H. SZCZARBA, Yale University (801-55-184)

4:00– 4:10 (295) Stability theorems for conformal foliations. ROBERT A. BLUMENTHAL, St. Louis University (801-57-83)

4:15– 4:25 (296) Transversality of surfaces and foliations in dimension 3. KENNETH MILLETT, University of California, Santa Barbara (801-57-160)

4:30– 4:40 (297) Ereshmann connections for foliations. Preliminary report. JAMES J. HEBDA* and ROBERT A. BLUMENTHAL, St. Louis University (801-57-316)

Thursday, 4:45 p.m.

AMS Prize Session and Business Meeting

Thursday, 7:00 p.m.

Special Session on Number-Theoretic Algorithms, I

7:00– 7:20 (298) A p-adic algorithm for univariate partial fraction decompositions. Preliminary report. OLAF P. STACKELBERG* and PAUL S. WANG, Kent State University (801-10-40)

7:30– 7:50 (299) Treating coefficients in polynomial factorization algorithms. Preliminary report. PAUL S. WANG, Kent State University (801-10-41)

8:00– 8:20 (300) A redundant number system that speeds up modular arithmetic. GUSTAVUS J. SIMMONS, Sandia National Laboratories (801-10-427) (Introduced by Carl Pomerance)


9:00– 9:20 (302) The updating of Reuven in Number Theory. RICHARD K. GUY, University of Calgary (801-10-430)

Thursday, 7:00 p.m.

Special Session on Applied Category Theory, III

7:00–10:00 Informal Discussion
Friday, 8:30 a.m.

Special Session on Applied Category Theory, IV
8:30 – 9:10 (303) Higher order categorical logic. Preliminary report. J. LAMBEK*, McGill University, and P. J. SCOTT, University of Ottawa (801-03-115)
10:30 – 11:10 (305) The interaction of category theory and set theory. ANDREAS BLASS, University of Michigan, Ann Arbor (801-03-520)

Friday, 8:45 a.m.

Session on Set Theory and Logic
8:45 – 8:55 (307) A weak form of Martin's axiom provable in ZFC. Preliminary report. DAN VELLEMAN, University of Texas, Austin (801-04-33)
9:00 – 9:10 (308) Aronszajn trees and Specker types on $\omega_1$. Preliminary report. ROBERT E. BEAUDOIN, Dartmouth College (801-04-327)
9:30 – 9:40 (310) The returning ultrafilter over $P_{\omega_1}$. Preliminary report. ROBERT J. MIGNONE, College of Charleston (801-04-317)
9:45 – 9:55 (311) On complementedly normal lattices. II. Preliminary report. KLAUS KAISER, University of Houston, Houston (801-03-188)
10:00 – 10:10 (312) Game determinateness: Finite and local approximations. Preliminary report. BARRY BURD, Drew University (801-03-189) (Introduced by Alan Candiotti)
10:15 – 10:25 (313) Subsystems of second order arithmetic. STEPHEN G. SIMPSON, Pennsylvania State University, University Park (801-03-416)

Friday, 9:00 a.m.

Special Session on Number-Theoretic Algorithms, II
9:00 – 9:20 (314) A new idea for factorization as yet undeveloped. DANIEL SHANKS, University of Maryland, College Park (801-10-504)
9:30 – 9:50 (315) A random factorization method. Preliminary report. HANS J. ZASSENHAUS, Ohio State University, Columbus (801-04-327)
10:00 – 10:20 (316) How to factor a 100 digit number. JOSEPH L. GERVER, Rutgers University, Camden (801-10-102)
10:30 – 10:50 (317) Optimizing the design of parallel computers for continued fraction factoring. MARVIN C. WUNDERLICH, Northern Illinois University (801-04-327)
11:00 – 11:20 (318) Factoring large integers. Preliminary report. SAMUEL S. WAGSTAFF, JR., University of Georgia (801-10-121)
11:30 – 11:50 (319) Accelerators for large integer computations. Preliminary report. JEFFREY W. SMITH, University of Georgia (801-10-122) (Introduced by Samuel S. Wagstaff, Jr.)

Friday, 9:00 a.m.

Special Session on Pseudo-Differential Operators and Applications, III
9:00 – 9:20 (320) Necessary and sufficient conditions for the absolute continuity of elliptic-harmonic measure. Preliminary report. E. B. FABLES and C. E. KENIG*, University of Minnesota, Minneapolis, and D. S. JERISON, Massachusetts Institute of Technology (801-35-16)
10:00 – 10:20 (322) A special class of complex potentials. VICTOR GUILLÉMIN, Massachusetts Institute of Technology (801-58-100)
11:00 – 11:20 (324) Maximal estimates for the boundary Laplacian on some weakly pseudoconvex domains. LINDA PREISS ROTHSCHILD*, University of Wisconsin, Madison, and ALAIN GRIGIS, École Polytechnique, France (801-58-419)
Friday, 9:00 a.m.

Session on Ordinary Differential Equations, II

9:00–9:10 (325) The topological dynamics of perturbed ordinary differential equations. STEPHEN H. SAPERSTONE, George Mason University (801-34-320)


9:30–9:40 (327) A numerical study of the known limit cycle configurations for quadratic systems in the plane. L. M. PERKO, Northern Arizona University (801-34-120) (Introduced by Richard D. Meyer)


10:00–10:10 (329) Existence and monotone method for periodic solutions of first order nonlinear functional differential equations. S. G. DEO* and G. S. LADDE, University of Texas, Arlington (801-34-482)

10:15–10:25 (330) Existence and uniqueness for two-point boundary value problems with a linear gradient term. JAMES A. PENNLINE, NASA Lewis Research Center, Cleveland (801-34-278)


10:45–10:55 (332) On the sign of Green’s functions for difference equations. Preliminary report. ALLAN C. PETERSON, University of Nebraska (801-34-300)

Friday, 9:00 a.m.

Session on Partial Differential Equations

9:00–9:10 (333) Comparison results for parabolic differential equations at resonance. G. R. SHENGDE*, University of Iowa, and A. S. VATSALA, Bishop College (801-35-301) (Introduced by V. Lakshmikantham)


10:00–10:10 (337) Decay rates for diffusion dependence in the FitzHugh-Nagumo system. Preliminary report. CLYDE E. COLLINS, Louisiana State University, Baton Rouge (801-35-235)


11:00–11:10 (341) Gradient estimates for the capillary problem via the maximin principle. Preliminary report. GARY M. LIEBERMAN, Iowa State University (801-35-326)


11:30–11:40 (343) On quasianiqueness. VLADIMIR SCHUCHMAN, Texas Tech University (801-35-362)


Friday, 10:00 a.m.

Session on Algebraic Number Theory, Field Theory, and Polynomials

10:00–10:10 (345) A remark on the quadratic analogue of the Quillen-Suslin theorem. LARRY J. GERSTEIN, University of California, Santa Barbara (801-12-36)

10:15–10:25 (346) Continuity, rationality, and minimality for sums of squares of real linear forms. Preliminary report. CHARLES N. DELZELL, Louisiana State University, Baton Rouge (801-12-354)

10:30–10:40 (347) Some elementary results in field theory. DAVID SACHS, Wright State University (801-12-94)

10:45–10:55 (348) Equal distribution of Galois module structure for tame, elementary abelian extensions. KURT C. FOSTER, University of Illinois, Urbana-Champaign (801-12-374)
11:00–11:10 (349) A class number formula for group rings of abelian \( \ell \)-groups of homogeneous type. Preliminary report. LEON R. MCCULLOH, University of Illinois, Urbana-Champaign (801-12-379)

11:15–11:25 (350) Class group rank relations in \( \mathbb{Z}_p \)-extensions. Preliminary report. JOSEPH G. D'MELLO* and MANOHAR L. MADAN, Ohio State University, Columbus (801-12-507)

11:30–11:40 (351) Minimal polynomials for circular numbers. S. GURAK, University of San Diego (801-12-515) (Introduced by Lynne Small)

11:45–11:55 (352) A result about exponential polynomials in characteristic \( p \). Preliminary report. DAVID R. RICHMAN, University of South Carolina and Massachusetts Institute of Technology (801-12-297)

12:00–12:10 (353) Quasi-rationality, rationality and linearizability of cyclotomic automorphisms. MOWAFFAQ HAJJIA, Yarmouk University, Jordan (801-12-99)

12:15–12:25 (354) Bi-unitary perfect polynomials over \( GF(q) \). Preliminary report. J. T. B. BEARD, JR., Tennessee Technological University (801-12-192)

**Friday, 1:00 p.m.**

**Colloquium Lectures:** Lecture III

1:00–2:00 (355) The uncertainty principle: Finer cutting. CHARLES L. FEFFERMAN, Princeton University

**Friday, 1:00 p.m.**

**Special Session on History of Mathematics, I**

1:00–1:20 (356) Riemann's geometry: revolution in mathematics. ESTHER PORTNOY, University of Illinois, Urbana-Champaign (801-01-386)

1:30–1:50 (357) Recent developments of a theory of singular perturbations and its applications. ROBERT E. O'MALLEY, JR., Renselaer Polytechnic Institute (801-01-387)


2:30–2:50 (359) Mathematics and the weather biz. JOHN A. DUTTON, Pennsylvania State University, University Park (801-01-461) (Introduced by Arthur Schliess)


4:00–4:20 (362) A critical study of Poincaré's influence upon the mathematical development of the three body problem and related dynamical systems. Preliminary report. ARTHUR SCHLISSEL* and SAMUEL GRAFF, John Jay College of Criminal Justice, City University of New York (801-01-372)

**Friday, 1:00 p.m.**

**Special Session on Proof Theory, III**

1:00–1:20 (363) Gödel's and some other examples of problem transmutation. HAO WANG, Rockefeller University (801-03-204) (Introduced by Irving H. Anellis)

1:30–1:50 (364) Formalized proofs of Matijasevic's theorem in subsystems of Peano arithmetic. Preliminary report. J. P. JONES* and G. MINC, University of Calgary (801-03-68)

2:00–2:20 (365) On one of the undesirable consequences of dropping similarity type. Preliminary report. T. G. MCLAUGHLIN, Texas Tech University (801-03-15)


3:00–3:20 (367) The provability logics of recursively enumerable extensions of Peano arithmetic in arbitrary extensions of Peano arithmetic. Preliminary report. ALBERT VISSER, Stanford University (801-03-113) (Introduced by Irving H. Anellis)

3:30–3:50 (368) Logical syntax and complexity. HARRY R. LEWIS* and LARRY DENENBERG, Harvard University (801-03-414) (Introduced by Irving H. Anellis)

4:00–4:20 (369) Logic tailored for computational complexity. YURI GUREVICH, University of Michigan, Ann Arbor (801-68-413)

4:30–4:50 (370) On a version of the compactness theorem for evolving theories. RAYMOND D. GUMB, California State University, Northridge (801-03-91) (Introduced by Irving H. Anellis)

5:00–5:20 (371) Proofs in first-order logics with only finitely many variables. Preliminary report. LEON HENKIN, University of California, Berkeley (801-03-258)

5:30–5:50 (372) Complete formalization of theories of interacting stocks. Preliminary report. HELENA RASIOWA, University of Warsaw, Poland (801-03-522) (Introduced by Irving H. Anellis)
Friday, 1:00 p.m.

Special Session on Diophantine Problems and Analytic Number Theory, IV
1:00– 1:20 (373) On norm form equations. PETER WARKENTIN, Mathematisches Institut der Universität, Freiburg, Federal Republic of Germany (801-10-406) (Introduced by W. M. Schmidt)
1:30– 1:50 (374) Distribution of values of a binary recurrence. D. J. LEWIS*, University of Michigan, Ann Arbor, and JAN TURK, Erasmus University, Rotterdam (801-10-489)
2:00– 2:20 (375) Qualitative measures of algebraic independence. Preliminary report. ROB TUBBS, Pitzer College (801-10-506)
2:30– 2:50 (376) On certain transcendental numbers and their approximation by algebraic numbers. Preliminary report. PETER BUNDSCHEU, Universität Köln, Federal Republic of Germany (801-10-486)
3:00– 3:20 (377) Effective approximations to a class of algebraic numbers. JULIA MUELLER*, Fordham University, and ENRICO BOMBERI, Institute for Advanced Study (801-10-511)
3:30– 3:50 (378) Non-homogeneous indefinite quadratic forms. RAM P. BAMBAH, Ohio State University, Columbus (801-10-498)
4:00– 4:20 (379) Simultaneous Diophantine approximation of rationals by rationals. Preliminary report. JEFFREY C. LAGRARIAS, Bell Laboratories, Murray Hill (801-10-471)
5:00– 5:20 (381) Approximation of functions. Preliminary report. CHARLES F. OSGOOD, U.S. Naval Research Laboratory (801-10-52)
5:30– 5:50 (382) Zero estimates for functions satisfying differential equations. W. DALE BROWNWELL, Pennsylvania State University, University Park (801-10-433)
6:00– 6:20 Problem Session

Friday, 1:00 p.m.

Special Session on Representation Theory of Finite Groups of Lie Type, II
1:00– 1:20 (383) Rational cohomology and the nilpotent variety. BRIAN PARSHALL, University of Virginia (801-20-436)
1:30– 1:50 (384) Brauer trees in classical groups. Preliminary report. BHAMA SRINIVASAN, University of Illinois, Chicago (801-20-435)
2:00– 2:20 (385) Homology representations for classical and sporadic groups. STEPHEN D. SMITH, University of Illinois, Chicago (801-20-08)
2:30– 2:50 (386) Rationality of certain zeta functions associated with modular representations. LEONARD CHASTKOFSKY, University of Georgia (801-20-89)

Friday, 1:00 p.m.

Special Session on Abstract Adjoints and Boundary Problems, II
1:00– 1:20 (387) Functions of bounded variation as solutions to boundary problems. Preliminary report. FRANK W. STALLARD, Georgia Institute of Technology (801-34-252) (Introduced by M. Zuhair Nashed)
1:30– 1:50 (388) An algebraic theory of boundary value problems. ISMAEL HERRERA-REVILLA, IIMAS-UNAM, Mexico (801-35-12) (Introduced by M. Zuhair Nashed)
2:00– 2:20 (389) Adjoints of convex processes. JONATHAN M. BORWEIN, Dalhousie University (801-46-98)
2:30– 2:50 (390) A definiteness result for determinantal operators. PAUL BINDING and PATRICK J. BROWNE*, University of Calgary (801-47-510)
3:00– 3:20 (391) On the use of generalized inverses in bifurcation problems. W. S. LOUD, University of Minnesota, Minneapolis (801-34-210)
4:30– 4:50 (394) On the numerical solution of the first kind by the finite element method. Preliminary report. MANSUK SONG, Yonsei University, Korea (801-65-128)
5:00– 5:20 (395) Functional evolution equations involving maximal monotone operators in Banach spaces. ATHANASSIOS G. KARTSATOS* and MARY E. PARROTT, University of South Florida, Tampa (801-35-61)
5:30– 5:50 Discussion and Problem Session

61
Special Session on Function-Theoretic Methods in Differential Equations, I

Friday, 1:00 p.m.

1:00—1:20 (396) 
Approximate methods for elliptic systems. ROBERT P. GILBERT, University of Delaware (801-35-513)

1:30—1:50 (397) 
Inversion and representation for the reduced dual Poisson-LaGuerre transform. Preliminary report. DEBORAH TEPPER HAIMO, University of Missouri, St. Louis (801-44-63)

2:00—2:20 (398) 
The kernel function in scattering problems. RALPH E. KLEINMAN, University of Delaware (801-35-248)

2:30—2:50 (399) 
Variational derivatives and function-theoretic gradients. E. P. HAMILTON, Washington College, and M. Z. NASHED*, University of Delaware (801-49-424)

3:00—3:20 (400) 
Steepest descent for systems of nonlinear partial differential equations. JOHN W. NEUBERGER, North Texas State University (801-35-117)

3:30—3:50 (401) 
Homogeneous linear perturbations of the differential equation $y^{(n)} = 0$. Preliminary report. ATTILA MÁTÉ*, Brooklyn College, and PAUL G. NEVAI, Ohio State University, Columbus (801-34-250)

4:00—4:20 (402) 
A complex cure for an ill-posed problem. GILBERT G. WALTER, University of Wisconsin, Milwaukee (801-45-146)

Session on Commutative Algebra

Friday 1:00 p.m.

1:00—1:10 (403) 
Gauge functions and the divisor chain condition. MELVIN HENRIKSEN, Harvey Mudd College and Wesleyan University (801-13-244)

1:15—1:25 (404) 
Torsion theories over commutative rings. WILLY BRANDAL* and EROL BARBUT, University of Idaho (801-13-264)

1:30—1:40 (405) 

1:45—1:55 (406) 
Noetherian nonintegrally closed domains. Preliminary report. NICK VAUGHAN, North Texas State University (801-13-442)

2:00—2:10 (407) 
Extensions of Nash functions. Preliminary report. GUSTAVE A. EFROYMSON, University of New Mexico (801-14-147)

2:15—2:25 (408) 
Hilbert sets. Preliminary report. CHARLES C. HANNA, United States Naval Academy (801-13-347)

2:30—2:40 (409) 
Some theorems and conjectures about polynomial rings. Preliminary report. BUDH NASHIER, Pennsylvania State University, Mont Alto Campus (801-13-351)

2:45—2:55 (410) 
A note on isomorphisms of power series rings. J. H. KIM, East Carolina University (801-13-105)

Invited Address

2:15—3:15 (411) 
Stochastic geometry in quantum field theory and classical statistical mechanics. MICHAEL AIZENMAN, Rutgers University, New Brunswick (801-60-516)

Friday, 2:15 p.m.

Session on Differential Geometry and Global Analysis

2:15—2:25 (412) 
A criterion for a curve in Euclidean n-space to be closed. NEILL H. ACKERMAN, Pennsylvania State University, Berks Campus (801-53-448)

2:30—2:40 (413) 
A theorem of Lie-Cartan revisited. Preliminary report. ROBERT B. GARDNER, University of North Carolina, Chapel Hill (801-53-56)

2:45—2:55 (414) 
Isospectral compact solvmanifolds which are not isometric. C. GORDON*, Lehigh University, and E. N. WILSON, Washington University (801-53-245)

3:00—3:10 (415) 
Whitney stability of solvability. JOHN K. BEEM*, University of Missouri, Columbia, and PHILLIP E. PARKER, University of Iowa (801-53-273)

3:15—3:25 (416) 
Surfaces with prescribed mean curvature. S. WALTER WEI, Michigan State University (801-53-483)

3:30—3:40 (417) 
The classification and harmonic analysis of sectional curvature. Preliminary report. JOHN K. BEEM, University of Missouri, Columbia, and PHILLIP E. PARKER*, University of Iowa (801-53-307)

3:45—3:55 (418) 
The nonspacelike conjugate locus of a Lorentzian warped product. THOMAS G. POWELL, University of Missouri, Rolla (801-53-309)

62
4:00–4:10 (419) **Necessary codimensions for local isometric embeddings.** STANLEY M. ZOLTEK, George Mason University (801-53-319)

4:15–4:25 (420) **A higher order invariant of differential manifolds.** Preliminary report. GREGORY A. FREDRICKS, Texas Tech University (801-53-363)

4:30–4:40 (421) **Topological sufficiency and stratification of the jet-space.** Preliminary report. JOHN D. RANDALL, Rutgers University, New Brunswick (801-58-450)

4:45–4:55 (422) **Closed and complete spacelike hypersurfaces in Minkowski space.** STEVEN G. HARRIS, Brown University (801-53-460)

**Friday, 2:15 p.m.**

**Session on General Topology, II**

2:15–2:25 (423) **A compactification with ϑ-continuous lifting property.** Preliminary report. DARRELL C. KENT, Washington State University, and GARY D. RICHARDSON*, East Carolina University (801-00-106) (Introduced by J. H. Kim)

2:30–2:40 (424) **The C-completions and C-compactifications of any topological space.** HUEYTZEN J. WU, Texas A.&I University (801-54-10)

2:45–2:55 (425) **The Heine-Borel theorem revisited.** Preliminary report. R. B. KILLGROVE, University of South Carolina, Aiken (801-54-156)

3:00–3:10 (426) **Weak continuity and almost continuity.** DAVID ALON ROSE, Francis Marion College (801-54-459)

3:15–3:25 (427) **κ-total spaces.** Preliminary report. R. M. STEPHENSON, JR., University of South Carolina, Columbia (801-54-64)

3:30–3:40 (428) **On the quasicategory of quasi-spaces.** Preliminary report. H. HERRLICH, University of Bremen, Federal Republic of Germany, and M. RAJAGOPALAN*, University of Toledo (801-54-76)

3:45–3:55 (429) **On the exponential law for function spaces.** PANOS TH. LAMBRINOS, Democritos University of Thrace, Greece (801-54-292)

**Friday, 2:15 p.m.**

**Session on Numerical Analysis**

2:15–2:25 (430) **Approximation of eigenvalues of linear random integral equations.** MELVIN D. LAX, California State University, Long Beach (801-65-231)

2:30–2:40 (431) **Numerical solution for a Volterra integral equation with a delay dependent on the solution.** Preliminary report. BARUCH CAHLON, Oakland University (801-65-523) (Introduced by S.-S. Wang)

2:45–2:55 (432) **Averaging interpolating polynomials.** Preliminary report. JUDITH A. PALAGALLO, University of Akron (801-65-332)

3:00–3:10 (433) **On Walsh equiconvergence.** Preliminary report. THOMAS E. PRICE, JR., University of Akron (801-65-333)

3:15–3:25 (434) **On the condition number of Lagrangian numerical differentiation.** Preliminary report. GEORGE MIEL* and ROSE MOONEY*, University of Nevada, Las Vegas (801-65-330)

3:30–3:40 (435) **A finite element method for the initial value problem for second-order systems of differential equations.** JOHN GREGORY* and MARVIN ZEMAN, Southern Illinois University, Carbondale (801-65-261) (Introduced by Ronald Kirk)

3:45–3:55 (436) **Source solutions for the finite difference heat, Laplace, and wave equations.** DALE H. MUGLER*, University of Santa Clara, and STEVEN F. ASHBY, University of Illinois, Urbana-Champaign (801-65-14)

4:00–4:10 (437) **A nonlinear SOR scheme for the steady-state Euler equations.** Preliminary report. CHARLES W. SCHELIN, University of Wisconsin, La Crosse (801-65-341)

4:15–4:25 (438) **Convergence of Gauss-Seidel iteration for some nonsymmetric matrices.** Preliminary report. JANE M. DAY*, San José State University, and MELVIN HENRIKSEN, Harvey Mudd College and Wesleyan University (801-65-453)

4:30–4:40 (439) **On the rate of convergence of Schauder decompositions.** HIDEAKI KANEKO, Mississippi State University (801-65-475)

4:45–4:55 (440) **Perpendicular least squares.** Preliminary report. EVANGELOS A. YFANTIS, University of Nevada, Las Vegas (801-65-383) (Introduced by George Miel)

**Friday, 2:30 p.m.**

**Special Session on Applied Category Theory, V**

2:30–3:10 (441) **Abstract Galois theory.** MICHAEL BARR, McGill University (801-18-391) (Introduced by John W. Gray)
3:30– 4:10 (442) Synthetic differential geometry; application to affine connections. ANDERS KOCK, Aarhus Universitet, Denmark (801-53-485)

4:30– 5:10 (443) Smooth mappings in synthetic differential geometry. MARTA BUNGE, McGill University (801-18-390)

Friday, 2:30 p.m.

Special Session on Operator Algebras and Operator Theory, III

2:30– 2:55 (444) Topics in non self-adjoint operator algebras. WILLIAM ARVESON, University of California, Berkeley (801-47-251)

3:00– 3:25 (445) Two extensions of quasirigidity. Preliminary report. DOMINGO A. HERRERO, Arizona State University (801-47-133)

3:30– 3:55 (446) Nest algebras and similarity transformations. DAVID R. LARSON, University of Nebraska, Lincoln (801-47-524)

4:00– 4:25 (447) Similarity and compact perturbations of nest algebras. KENNETH R. DAVIDSON, University of Waterloo (801-47-157)

4:30– 4:55 (448) Derivations on certain CSL algebras. FRANK GILFEATHER, University of Nebraska, Lincoln (801-46-96)

5:00– 5:25 (449) A note on rank one operators in reflexive algebras. CECELIA LAURIE*, University of Alabama, Tuscaloosa, and W. E. LONGSTAFF, University of Western Australia (801-47-133) (Introduced by Norberto Salinas)

5:30– 5:55 (450) Tensor products of reflexive algebras. JON KRAUS, State University of New York, Buffalo (801-46-135)

Friday, 3:30 p.m.

Invited Address

3:30– 4:30 (451) Geometric invariant theory and moduli problems in algebraic geometry. DAVID GIESEKER, University of California, Los Angeles (801-14-469)

Friday, 3:30 p.m.

Special Session on Pseudo-Differential Operators and Applications, IV


4:00– 4:20 (453) Dispersive electromagnetic pulse effects. Preliminary report. DAVID K. COHOON* and JOHN W. PENN, U.S.A.F. School of Aerospace Medicine, San Antonio (801-92-59)


Friday, 3:30 p.m.

Session on Topological Groups

3:30– 3:40 (456) Monoids on a Möbius band. B. MICHAEL CASTELLANO, University of Alabama, Huntsville (801-22-57)

3:45– 3:55 (457) Global solvability on two step compact nilmanifolds. JACEK M. CYGAN* and LEONARD F. RICHARDSON, Louisiana State University, Baton Rouge (801-22-93)

4:00– 4:10 (458) Characters of p-adic symplectic groups. CHARLES A. ASMUTH, Texas A&M University, College Station (801-22-502)


Friday, 4:40 p.m.

Special Session on Representation Theory of Finite Groups of Lie Type, III

4:40– 5:00 (460) Lifting theory of finite groups of Lie type. Preliminary report. K. MCGOVERN, Ohio State University, Columbus (801-20-389)

5:10– 5:30 (461) Homology realizations of principal series unipotent representations of finite Chevalley groups. Preliminary report. DAVID B. SUROWSKI, Kansas State University (801-20-90)

5:40– 6:00 (462) Murnaghan's rule revisited. Preliminary report. DEAN ALVIS, University of Notre Dame (801-20-206)

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Colloquium Lectures: Lecture IV
1:00–2:00 (463) The uncertainty principle: Approximate diagonalization. CHARLES L. FEFFERMAN, Princeton University

Saturday, 1:00 p.m.

Special Session on Number-Theoretic Algorithms, III
1:00–1:20 (464) A new factoring method. Preliminary report. DUNCAN A. BUELL, Louisiana State University, Baton Rouge (801-10-426)
1:30–1:50 (465) Necessary conditions for the integral equivalence of binary quadratic forms. Preliminary report. RANDY TULER, State University of New York, Binghamton (801-10-79)
2:00–2:20 (466) A primer on wheels. PAUL PRITCHARD, Cornell University (801-10-425) (Introduced by Carl Pomerance)
2:30–2:50 (467) Some machine results concerning periodic continued fractions. H. C. WILLIAMS* and C. PATTERSON, University of Manitoba (801-10-246)
3:00–3:20 (468) Knapsack public key cryptosystems and Diophantine approximation. Preliminary report. JEFFREY C. LAGARIAS, Bell Laboratories, Murray Hill (801-10-470)
3:30–3:50 (469) Large highly powerful numbers are cubeful. J. L. SELFRIDGE*, Mathematical Reviews and Northern Illinois University, and C. B. LACAMPAGNE, University of Michigan, Flint (801-10-429)

Saturday, 1:00 p.m.

Special Session on Abstract Adjoints and Boundary Problems, III
1:00–1:20 (470) On applications of conformal mapping and summability theory to iterative methods. Preliminary report. RICHARD S. VARGA, Kent State University, Kent (801-41-508)
1:30–1:50 (471) Dual operators and degenerate evolutions. J. W. JEROME, Bell Laboratories, Murray Hill (801-46-408)
2:00–2:20 (472) Free boundary problems and set-valued operator equations. KARL-HEINZ HOFFMANN, University of Augsburg, Federal Republic of Germany (801-49-509) (Introduced by M. Zuhair Nashed)
3:00–3:20 (474) A class of hyperbolic boundary value problems. Preliminary report. KURT KREITH, University of California, Davis (801-35-01)
3:30–3:50 (475) Periodic boundary value problems for first-order differential equations. Preliminary report. V. LAKSHMIKANTHAM, University of Texas, Arlington (801-34-166)
4:00–4:20 (476) Solution space structure of certain linear differential equations. Preliminary report. G. J. ETGEN*, University of Houston, Houston, G. D. JONES, Murray State University, and W. E. TAYLOR, Texas Southern University (801-34-409)
4:30–4:50 (477) On the classification of differential equations having orthogonal polynomial solutions. LANCE L. LITTLEJOHN, University of Texas, San Antonio (801-33-77)
5:00–5:20 Discussion and Problem Session

Saturday, 1:00 p.m.

Special Session on Function-Theoretic Methods in Differential Equations, II
1:00–1:20 (478) A similarity principle for Pascal systems. JAMES L. BUCHANAN, United States Naval Academy (801-35-422)
1:30–1:50 (479) Convergence to boundary values for higher order partial differential equations. MARK A. KON, Boston University (801-35-421)
2:00–2:20 (480) Quasiconformal mappings and elliptic partial differential equations. Preliminary report. C. WAYNE MASTIN, Mississippi State University (801-35-45) (Introduced by John R. Graef)
2:30–2:50 (481) Boundary behavior of hypercomplex functions with values in a Clifford algebra. AHMED I. ZAYED, California Polytechnic State University (801-35-423)
3:00–3:20 (482) Hyperbolic boundary value problems that arise in conjunction with Poisson processes. Preliminary report. PETER A. MCCOY, United States Naval Academy (801-35-20)
Saturday, 1:00 p.m.

Session on Rings and Algebras

1:00–1:10 (483) On the isomorphism of group rings. BYOUNG-SONG CHWE, University of Alabama, Tuscaloosa (801-16-381)

1:15–1:25 (484) Does Loc $M = \{0\}$ imply $M = \{0\}$ for Lie coalgebras? WALTER J. MICHAELIS, North Carolina State University (801-16-311)


1:45–1:55 (486) An isomorphism problem for normal subgroups of division rings. Preliminary report. GARY R. GREENFIELD, University of Richmond (801-16-233)

2:00–2:10 (487) The group of automorphisms of a distributively generated near ring. J. J. MALONE, Worcester Polytechnic Institute (801-16-281)

2:15–2:25 (488) An application of Morita duality. LILLIAN E. PETERS HUPERT, Loyola University, Chicago (801-16-443)

2:30–2:40 (489) Semihereditary semigroup rings. JAMES KUZMANOVICH, Wake Forest University, and MARK L. TEPLY*, University of Florida (801-16-313)

2:45–2:55 (490) Commutativity and structure of rings with commuting nilpotents. HAZAR ABU-KHUZAM, University of Petroleum and Minerals, Saudi Arabia, and ADIL YAQUB*, University of California, Santa Barbara (801-16-103)

3:00–3:10 (491) Reduction lemmas for a modular Weyl formula. II. Preliminary report. ROBERT DECKHART, Miami University, Oxford (801-17-47)

3:15–3:25 (492) Separable polynomials over nonassociative algebras. Preliminary report. DAVID R. FINSTON, University of California, San Diego (801-17-170)


Saturday, 1:00 p.m.

Session on Group Theory

1:00–1:10 (494) Amalgams of torsion-free nilpotent groups of class three. BERTHOLD MAIER, Michigan State University (801-20-88) (Introduced by Paul T. Bateman)

1:15–1:25 (495) Polygroups derived from cogroups. STEPHEN D. COMER, The Citadel (801-20-29)

1:30–1:40 (496) Finite groups which are automorphism groups of infinite groups only. Preliminary report. JAY ZIMMERMAN, University of Illinois, Urbana-Champaign (801-20-181)

1:45–1:55 (497) Finite valued groups. Preliminary report. ROBERT O. STANTON, St. John's University, New York (801-20-265)

2:00–2:10 (498) Characters on $p$-groups of Frobenius type. IAN D. MACDONALD, University of Kentucky (801-20-268)


2:30–2:40 (500) The Schur multiplicator of $SL(2, Z/mZ)$ and the congruence subgroup problem. F. RUDOLF BELYI, University of Heidelberg, Federal Republic of Germany (801-20-127)

2:45–2:55 (501) On the automorphism group of a linear algebraic monoid. MOHAN S. PUTCHA, North Carolina State University (801-20-71)

3:00–3:10 (502) Nilpotent groups and unipotent algebraic groups. Preliminary report. FRITZ GRUNEWALD, University of Bonn, Federal Republic of Germany, and JOYCE O’HALLORAN*, University of Wisconsin, Milwaukee (796-20-222) (Abstracts, August 1982, page 330)

Saturday, 1:00 p.m.

Session on Functional Analysis, II

1:00–1:10 (503) A matrix method in analysis. Preliminary report. PIOTR ANTONIK, University of Texas, El Paso (801-46-479) (Introduced by Paul T. Bateman)

1:15–1:25 (504) Factorization of positive multilinear operators. ANTON R. SCHEP, University of South Carolina, Columbia (801-46-325)

1:30–1:40 (505) $2$-majorants of operator-valued measures. Preliminary report. MILTON ROSENBERG, St. John’s University, New York (801-46-269)


2:00–2:10 (507) On functions that are universally Pettis integrable. Preliminary report. LAWRENCE H. RIDDLE*, Emory University, and ELIAS SAAB, University of Missouri, Columbia (801-46-114)
Session on Mechanics and Physics

1:00 - 1:10 (516) Discrete modeling of minimal surfaces. CHARLES COPPIN*, University of Dallas, and DONALD GREENSPAN, University of Texas, Arlington (801-70-321)

1:15 - 1:25 (517) Gradient flows and regular equilibria for elastostatic rod boundary value problems. Preliminary report. JOHN F. PIERCE, Johns Hopkins University (801-70-472)

1:30 - 1:40 (518) On the torsion problem. Preliminary report. EVELYN E. OBAID and SAMIH A. OBAID*, University of Texas, San Antonio (801-73-73)

1:45 - 1:55 (519) Magneto-elastic plane waves in infinite rotating media. S. K. ROY CHOWDHURI, Burdwan University, India, and LOKENATH DEBNATH*, East Carolina University (801-73-260)

2:00 - 2:10 (520) Generalized function treatment of the Alphen-gravity wave problem. L. DEBNATH and K. VAJRAVELU*, East Carolina University (801-76-269)

2:15 - 2:25 (521) A distributional derivation of the macroscopic Maxwell equations. DAVID BETOUNES, University of Southern Mississippi (801-78-87)


2:45 - 2:55 (523) On the quantization of classical systems. REESE T. PROSSER, Dartmouth College (801-81-420)

3:00 - 3:10 (524) On the spin-states of electrons when modeled by relativistic strings in 4 spatial dimensions. BERNARD MARCUS, San Diego State University (801-81-454)

3:15 - 3:25 (525) Critical behavior of the doubling algorithm. DAVID ISAACSON*, Rensselaer Polytechnic Institute, ELI L. ISAACSON, University of Wyoming, DAN MARCHESIN and PAULO JORGE PAEL-LEME, Pontificia Universidade Catolica do Rio de Janeiro, Brazil (801-82-498)


Session on Mathematical Education

1:00 - 1:10 (527) A faculty exchange program for colleges with limited resources. Preliminary report. H. B. COONCE*, Mankato State University, and M. F. RUCHTE, Humboldt State University (801-98-302)

1:15 - 1:25 (528) Computer science in the mathematics curriculum. GERALD WILDENBERG, St. John Fisher College (801-98-495) (Introduced by John Blanton)

1:30 - 1:40 (529) Computer science literacy for elementary education majors. Preliminary report. DAVID J. LUTZER and MONTY J. STRAUSS*, Texas Tech University (801-98-25)


2:00 - 2:10 (531) Interfacing calculator and calculus instruction. Preliminary report. BEVERLY J. GIMMESTAD, Michigan Technological University (801-98-174)

2:15 - 2:25 (532) On derivatives of \( \sin \theta \) and \( \cos \theta \) without using \( \lim_{\theta \to 0} \frac{\sin \theta}{\theta} = 1 \). Preliminary report. SADANAND VERMA, University of Nevada, Las Vegas (801-00-376) (Introduced by L. J. Simonoff)

2:30 - 2:40 (533) An algorithm for partial fractions. PREM N. BAJAJ, Wichita State University (801-99-317)

Paul T. Bateman
Associate Secretary

Urbana, Illinois
The eight hundred second meeting of the American Mathematical Society will be held at the University of Oklahoma, Norman, on Friday and Saturday, March 18–19, 1983. Sessions will be held in the Oklahoma Center for Continuing Education, located at the southern edge of the campus.

Invited Addresses

By invitation of the 1982 Committee to Select Hour Speakers for Central Sectional Meetings, there will be four invited one-hour addresses. The speakers, their affiliations, titles of their talks, and scheduled times of presentation, are as follows:

BORIS MITYAGIN, Ohio State University, Nonlinear singular equations, 11:00 a.m. Friday.

PAUL E. SCHUPP, University of Illinois, Urbana-Champaign, Behavior at infinity: Ends, automata, and second-order logic, 1:45 p.m. Friday.

MICHAEL STARBIRD, University of Texas, Austin, Decompositions of $S^3$, 11:00 a.m. Saturday.

JEFFREY D. VAALER, University of Texas, Austin, Some recent applications of Fourier analysis in number theory, 1:45 p.m. Saturday.

Special Sessions

By invitation of the same committee, there will be eleven sessions of selected twenty-minute papers. The topics of these special sessions, the names of the organizers, and partial lists of speakers are as follows:


Linear algebra and matrix theory, GEORGE PHILLIP BARKER, University of Missouri, Kansas City, and North Carolina State University. The tentative list of speakers includes George Phillip Barker, David H. Carlson, Thomas L. Markham, George D. Poole, and Donald W. Robinson.


Analytic number theory, HAROLD G. DIAMOND, University of Illinois, Urbana-Champaign. The tentative list of speakers includes Paul Erdős, Robert Freud, Amit Ghosh, Dorian Goldfeld, Sidney W. Graham, Douglas S. Hensley, Grigori Kolesnik, Helmut Maier, Kevin S. McCurley, Eugene Kwan Sang Ng, Georg J. Rieger, and Michael D. Vose.


Rings and modules, JOEL K. HAACK, Oklahoma State University. The tentative list of speakers includes Victor P. Camillo, John Dauns, Carl Faith, Kent R. Fuller, Edward L. Green, Lawrence S. Levy, Bruno Muller, Robert B. Warfield, and Birge Zimmerman-Huisgen.

The algebra of algorithms, automata, and languages, ROGER C. LYNDON, University of Michigan, Ann Arbor. The tentative list of speakers includes Andrzej Ehrenfeucht, Yuri Gurevich, Robert H. Haring-Smith, Robert McNaughton, David E. Muller, John Myhill, Howard Straubing, and Gabriel Thierrin.


Theory of semigroups, BORIS M. SCHEIN, University of Arkansas, Fayetteville. This session will be divided into three subsessions; the titles of these subsessions, names of the suborganizers who are all at the University of Arkansas, and tentative lists of speakers, are as follows:


Most of the papers to be presented at these special sessions will be by invitation. However, anyone submitting an abstract for the meeting who feels that his or her paper would be particularly appropriate for one of these special sessions should indicate this clearly on the abstract form and submit it by December 30, 1982, three weeks before the deadline for contributed papers.

Contributed Papers

There will also be sessions for contributed ten-minute papers. Abstracts should be sent to the American Mathematical Society, P.O. Box 6248, Providence, Rhode Island 02940, so as to arrive prior to the deadline of January 20, 1983. Abstracts should be prepared on the standard AMS form available from the AMS office in Providence, or in departments of mathematics.

Registration

The meeting registration desk will be located in the Forum Building of the Oklahoma Center for Continuing Education. The hours during which the desk will be open will be announced in the February issue of the Notices. The registration fees are $10 for members, $16 for nonmembers, and $5 for students or unemployed mathematicians.

Accommodations

As indicated below, various types of accommodations will be available at the Oklahoma Center for Continuing Education. These rooms may be occupied the nights of March 17, 18, and 19, unless otherwise shown; the rates are not taxed. Participants should make their own reservations by writing to the Oklahoma Center for Continuing Education, 1700 Asp Avenue, Norman, OK 73037. The telephone numbers to call for reservations are 405-329-2270 or 405-325-1011. Confirmation will be sent to participants whose room reservations are received by March 4, 1983. Participants are advised to check in and obtain room keys at the desk in Sooner House for all accommodations except Walker Tower Dormitory, which has its own check-in desk.

Sooner House (Hotel)
(Twin bedroom, tub and shower)
Single $22 Double $30

Cottage Suites (Two twin bedrooms in each suite)
1 person $31
2 persons $19 per person
3 persons $15 per person
4 persons $14 per person

Hall of Advanced Study Suites
(Four single bedrooms in each suite)
Not available March 17.
1 person $25
2 persons $16 per person
3 persons $15 per person
4 persons $14 per person

Walker Tower Dormitory (Twin bedrooms)
Limited number of rooms available on March 17.
Single $16 Double $12 per person

In addition to the above, the following area motels are included for information purposes. The rates shown do not include the additional 9 percent sales tax.

Holiday Inn (3 miles)
Interstate 35 and West Main, Norman 73069
Telephone: 405-329-1624
Single $37 up Double $45 up

Howard Johnson's (3 miles)
Interstate 35 and West Main, Norman 73069
Telephone: 405-329-8000
Single $38 up Double $44 up

Food Service

During the meeting breakfast and lunch will be available at the Commons Restaurant in the Center for Continuing Education. There will be a banquet on Friday evening March 18, for the Oklahoma-Arkansas Section of the MAA. Tickets and other details will be available at the meeting registration desk. Many restaurants are within a short walk or within a mile of the Center, and a restaurant list, with prices, will be available at the desk.

Travel

Norman is located approximately 20 miles south of Oklahoma City on U.S. Interstate 35. The Will Rogers World Airport is located south of Oklahoma City and is served by American, Continental, Delta, Eastern, Pan American, and TWA, as well as Frontier, Southwest, and Trans Central Airlines. There is limousine service from the airport to locations in Norman and to the University. Norman is also served by Trailways Bus Line.

Parking

Participants residing on campus in the Center for Continuing Education housing will be provided with free parking permits for use in any parking area at the center. Other participants may also park free, but should use only the parking lot by the Forum Building where the sessions will take place.
First Announcement of the 803rd Meeting

The eight hundred third meeting of the American Mathematical Society will be held at the New York Statler Hotel, Seventh Avenue and 33rd Street, New York City, on Thursday and Friday, April 14 and 15, 1983. The New York Statler is located directly across from Madison Square Garden, and Pennsylvania Station.

Invited Addresses

By invitation of the Committee to Select Hour Speakers for Eastern Sectional Meetings, there will be four invited one-hour addresses. The speakers, their affiliations, and titles of their talks are as follows:

- W. Dale Brownawell, Pennsylvania State University, University Park, Recent trends in transcendence theory.
- Richard S. Hamilton, Cornell University, Three-manifolds with positive Ricci curvature.
- Oliver McBryan, Courant Institute of Mathematical Sciences, New York University, Computational methods for discontinuous solutions.
- Wolfgang Ziller, University of Pennsylvania, On the existence of closed geodesics on Riemannian manifolds.

Special Sessions

By invitation of the same committee, there will be nine special sessions of selected twenty-minute papers. The topics of these special sessions and the names of the mathematicians arranging them are:

- Abelian groups, K. Benaboullla, University of Montreal.
- Transcendence theory and Diophantine problems, W. Dale Brownawell.
- Combinatorial group theory, Anthony Gaglione, United States Naval Academy.
- Sensitivity of functionals, Vadim Komkov, West Virginia University.
- Singularities of algebraic and analytic varieties, Henry Laure, SUNY, Center at Stony Brook.
- Computational methods and fluid mechanics, Oliver McBryan.
- Value distribution and its applications, C. C. Yang, United States Naval Research Laboratories.
- Variational problems in Riemannian geometry, Wolfgang Ziller.

Most of the papers to be presented at these special sessions will be by invitation. However, anyone submitting an abstract for the meeting who feels that his or her paper would be particularly appropriate for one of these special sessions should indicate this clearly on the abstract form and submit it by January 25, 1983, three weeks before the deadline for contributed papers.

Contributed Papers

There will also be sessions for contributed ten-minute papers. Abstracts should be sent to the American Mathematical Society, P. O. Box 6248, Providence, Rhode Island 02940, so as to arrive prior to the deadline of February 15, 1983. Abstracts should be prepared on the standard AMS form available from the AMS office in Providence, or in departments of mathematics.

Council Meeting

The Council of the Society will meet at 5:00 p.m. on Thursday, April 14, in the Petite Terrace on the lobby level at the New York Statler.

Symposium on Inverse Problems

With the anticipated support of the National Science Foundation, a symposium on Inverse Problems will be held on Tuesday and Wednesday, April 12-13, 1983. The topic was selected by the AMS-SIAM Committee on Applied Mathematics, whose members are Roger Brockett, John Dennis, Norman Lebowitz, Alan Newell (chairman), George C. Papanicolaou, and Robert S. Warming.

Inverse methods are fundamental to most measurement and detection problems in science, engineering, and technology. Such problems arise in diverse areas including tomography in medicine, image reconstruction and enhancement in astronomy, discovering oil deposits and general earth structure in seismology, interpretation of satellite observations, detection of ocean currents, climatology, and many more. A variety of mathematical techniques, with various degrees of sophistication, are used to attack these diverse physical problems which are generally categorized by the necessity of dealing with insufficient and/or inaccurate data of one sort or another.

The symposium will be organized in four sections, each concentrating upon one of these topics. The sections are Geophysical Inverse Problems, Computer Tomography and Inverse Problems in Medicine, Methods of Maximum Information Entropy, and Developments in Mathematical Inverse Theory. Each section will be designed to provide a generally accessible overview of current progress and to describe outstanding current problems in one typical area. The speakers
will be announced in the February issue of the Notices.

The members of the Organizing Committee are Robert Burridge, Courant Institute of Mathematical Sciences, New York University; Joseph B. Keller, Stanford University; R. B. Marr, Brookhaven National Laboratory; D. W. McLaughlin (chairman), University of Arizona; and C. R. Smith, University of Wyoming. Further information about the symposium can be obtained from D. W. McLaughlin, Program in Applied Mathematics, University of Arizona, Tucson, Arizona 85721.

Registration

The registration desk will be located in the Cornell/Dartmouth Rooms of the Ivy Suite on the ballroom floor of the New York Statler Hotel, and will be open from 8:30 a.m. to 4:00 p.m. Tuesday through Thursday, and from 8:30 a.m. to 2:00 p.m. on Friday. Registration fees for the symposium and meeting are:

<table>
<thead>
<tr>
<th>Registration Type</th>
<th>Nonmember</th>
<th>Member AMS/SIAM</th>
<th>Student/Unemployed</th>
</tr>
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<tbody>
<tr>
<td>Symposium Only</td>
<td>$30</td>
<td>$20</td>
<td>$10</td>
</tr>
<tr>
<td>Meeting Only</td>
<td>$16</td>
<td>$10</td>
<td>$5</td>
</tr>
<tr>
<td>Symposium and Meeting</td>
<td>$46</td>
<td>$30</td>
<td>$15</td>
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</table>

Book Exhibits and Sale

An exhibit of assorted mathematics books offered by various publishers, and a sale at substantial discounts of recent books published by the American Mathematical Society, will be located in the Cornell/Dartmouth Rooms during the above registration hours Tuesday through Friday.

Accommodations

A block of rooms is being held at the New York Statler Hotel for use by participants attending the symposium and meeting. Participants should make their reservations prior to the cut-off date of March 14, after which requests for rooms will be honored on a space available basis. The rates shown below are subject to 8.25 percent sales and $2 per night occupancy taxes. A rollaway cot for an extra person can be added to double or twin sleeping rooms only. Note that there is no charge for a maximum of two children under the age of 17 years when occupying a room with parents, provided a rollaway cot is not required. If the reservation is to be guaranteed and the room held for arrival after 6:00 p.m., an American Express charge card number (or check to cover the first night's accommodations) must accompany the reservation. No other charge cards are accepted for guaranteed reservations, although they will be accepted for payment of the bill for rooms occupied. The address to which reservations must be sent is shown below. For your convenience, a reservation form will be found at the back of this issue of the Notices.

New York Statler Hotel
Room Reservations Office
7th Avenue and 33rd Street
New York, New York 10001
Telephone: 212-736-5000

<table>
<thead>
<tr>
<th>Room Type</th>
<th>Single</th>
<th>Double/Twin</th>
<th>Rollaway</th>
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<tbody>
<tr>
<td>Member AMS/SIAM</td>
<td>$64, 70, 78, 88, 98</td>
<td>$81, 87, 95, 105, 115</td>
<td>$16 extra per person</td>
</tr>
<tr>
<td>Student/Unemployed</td>
<td>$5</td>
<td>$10</td>
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The Statler offers a variety of restaurants, including the Deli-Express off the lower lobby where moderately priced food and beverages are served cafeteria-style to either eat in or take out.

Travel

The New York Statler is conveniently located across Seventh Avenue from Pennsylvania Station, where Amtrak trains arrive from Washington, D.C., Philadelphia, Boston, and Montreal, in addition to Long Island Railroad commuter trains. Seventh Avenue is reached from the main concourse by stairs and escalator. Amtrak trains from upper New York State, Toronto, and Chicago, as well as Conrail commuter trains, come into Grand Central Terminal which is located at 42nd Street between Park and Vanderbilt Avenues.

All of the major airlines and many commuter airlines serve the New York metropolitan airports. From LaGuardia Airport, located 8 miles northeast of New York City, Carey Bus provides ground transportation every 20 to 25 minutes between 6:50 a.m. and 12:30 a.m. to 42nd Street and Park Avenue at a cost of $4 per person. From John F. Kennedy International Airport, located 15 miles southeast of New York City, Carey Bus operates every 20 to 30 minutes between 5:20 a.m. and midnight, dropping passengers off at the East Side Airlines Terminal at 38th Street and First Avenue; the current fare is $5 per person. Passengers arriving at Newark International Airport, 16 miles southwest of New York City, can take the New Jersey Transit Express bus, which operates every 15 to 30 minutes from 5:00 a.m. to midnight; it presently costs $4 per person and drops passengers off at the Port Authority Bus Terminal. Mini-Bus Service also operates from Newark Airport to some of the midtown Manhattan hotels every one-half hour Monday through Friday. The fare ranges up to $10, and further information can be obtained by calling 212-586-8280.

The Port Authority Bus Terminal is located at 41st Street and Eighth Avenue; it serves all...
buses coming into New York City, including the New Jersey Transit Express buses from Newark Airport.

Parking

The Statler Hotel offers in-once valet parking for guests, the current rate for which is $15 per day. There are several parking garages in the vicinity of the hotel, the closest one being on 31st Street (across from Madison Square Garden).

Raymond G. Ayoub  
Associate Secretary  
University Park, Pennsylvania

1983 Summer Research Institute

Nonlinear Functional Analysis and Applications  
July 11–29, 1983  
University of California, Berkeley

The thirty-first Summer Research Institute sponsored by the American Mathematical Society will be devoted to nonlinear functional analysis and will take place at the University of California, Berkeley, from July 11–29, 1983. Members of the Organizing Committee include Haim Brezis, Felix Browder (chairman), Tosio Kato, J. L. Lions, Louis Nirenberg, and Paul Rabinowitz. It is anticipated that the institute will be supported by a grant from the National Science Foundation.

The topic was selected by the 1982 Committee on Summer Institutes, whose members were Morris W. Hirsch, Robert Osserman (chairman), George C. Papanicolaou, Wilfried Schmid, Harold Stark, and Stephen Wainger.

During the past two decades there has been a strong upsurge of activity in the study of nonlinear problems in analysis, involving both the development of general methods for the study of relatively broad classes of problems and the attack on many significant classes of special problems. The primary objective of the institute is to bring together the specialists in the various branches of this development to foster a unified view of what has been achieved and the principal directions of future development, as well as the current state of the art in the applications of general methods to problems of importance in applied mathematics and mathematical physics. There has been no broad-scale meeting surveying these developments either in the United States or on an international level during the past decade. The institute will have two levels of organization, the first centering on the general levels of methodology in the field, and the second a more extensive development of the application of these methods to various broad classes of important problems, centering primarily upon nonlinear partial differential equations.

Housing accommodations will be available in the campus residence halls for participants and their families, and daily meals will be served in the adjacent dining hall. Facilities are fully accessible to the handicapped. In the spring a brochure will be mailed to all who are invited to attend. It will include information about the scientific program, the residence and dining facilities, firm room and board rates, as well as travel and local information and a reservation form to be used for obtaining accommodations at Berkeley. Each participant will pay a social fee to cover the cost of refreshments served at breaks and for social events, in addition to a meeting registration fee of $45 (reduced to $15 for students). Funds for support will be limited and, therefore, it will be necessary for many participants to obtain their own funds. Anyone who wishes to receive an invitation to participate in the institute and/or be considered for financial assistance should write to Mrs. Dorothy Smith, American Mathematical Society, P. O. Box 6248, Providence, R.I. 02940 prior to April 15, 1983. The Organizing Committee will then consider all requests and successful applicants will be informed sometime thereafter if funds are available to provide support.

1983 Summer Seminar in Applied Mathematics

Large-scale Computations in Fluid Mechanics  
June 27–July 8, 1983  
(Please note change in dates.)  
Scripps Institution of Oceanography  
University of California, San Diego  
La Jolla, California

The fifteenth AMS-SIAM Summer Seminar in Applied Mathematics will be held June 27–July 8, 1983, and will take place at the Scripps Institution of Oceanography, University of California, San Diego, La Jolla, California. The seminar will be sponsored jointly by the American Mathematical Society and the Society for Industrial and Applied Mathematics, and it is anticipated that it will be supported by a grant from a federal agency. The topic Large-scale computations in fluid mechanics was selected by the AMS-SIAM Committee on Applied Mathematics whose members at the time were John Dennis, Norman Lebowitz, Alan Newell, (chairman), and George C. Papanicolaou. The members of the organizing committee are Alexandre J. Chorin (University...
of California, Berkeley), Bjorn E. Engquist (University of California, Los Angeles), Stanley J. Osher (University of California, Los Angeles), and Richard C. J. Somerville, chairman (University of California, San Diego).

In the early spring a brochure will be available (from the AMS office) which will include a description of the scientific program, as well as information on the residence and dining hall facilities, with firm room and board rates, local information, and a reservation form to be used to obtain accommodations on campus. Each participant will pay a social fee to cover the cost of refreshments served at breaks and for social events. There will also be a meeting registration fee of $30 ($10 for students and unemployed individuals).

Individuals may apply for admission to the seminar. Application blanks for admission and/or financial assistance can be obtained from the Meetings Department, American Mathematical Society, P. O. Box 6248, Providence, Rhode Island 02940. The deadline for return of applications is March 4, 1983. An applicant should have completed at least one year of graduate school and will be asked to indicate his or her scientific background and interest. A graduate student’s application must be accompanied by a letter from his or her faculty advisor concerning the applicant’s ability and promise. Those who wish to apply for a grant-in-aid should so indicate on the application form; however, funds available for the seminar are limited and individuals who can obtain support from other sources should do so.

Current Trends in Algebraic Topology
Richard M. Kane, Stanley O. Kochman, Paul S. Selick, and Victor P. Snaith, Editors

Current trends in algebraic topology is the proceedings of a conference by the same name held at the University of Western Ontario, London, Ontario from June 29 to July 10, 1981. It contains papers which were presented at the conference and some related papers.

The book contains research papers in topology and so potential readers should be at least at the level of graduate students in topology. Since the book is a collection of research papers from different areas, papers of interest to any individual will vary according to his or her research interests. Anyone doing research in topology is likely to find some papers of interest.

Contents of Part 1

ALGEBRAIC K-THEORY, with papers by R. Charney, M. Karoubi, E. Lluis-Puebla and V. Snaith, V. Snaith (two papers), C. Soulé, J. Stienstra, R. Thomason, and F. Waldhausen

GENERALIZED HOMOLOGY AND COHOMOLOGY, with papers by J. Boardman, P. Landweber and Z. Yosimura, H. Miller and V. Snaith, D. Ravenel, and R. Seymour

HOMOTOPY THEORY, with papers by R. Bruner, F. Cohen, D. Davis and M. Mahowald, J. Nielsen-dorfer and P. Selick, and P. Selick

H-SPACES, with papers by J. Harper and R. Kane

ORDINARY HOMOLOGY AND COHOMOLOGY, with papers by A. Bahri, A. Baker, S. Kochman, D. Kraines and T. Lada, J. McCleary, S. Papastavridis, and D. Pengelley

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The 1983 conferences in the AMS Summer Research Conference Series will be held at the University of Colorado, Boulder, between June 5 and August 13, 1983. It is anticipated that the series of week-long conferences will be supported by a grant from the National Science Foundation. There will be ten one-week conferences in ten different areas of mathematics. Each week participants will arrive on Sunday and leave the following Saturday. The topics and organizers for the ten conferences were selected by the AMS Committee on Summer Research Conferences. The selections were based on suggestions made by the members of the committee, by members of the Council of the AMS and others. 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 will be similar in structure to 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 much 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 about thirty participants in each conference. Others, in addition to those funded, will be welcome, within the limitations of the facilities of the campus. Up to about seventy participants can be accommodated at each conference. Housing accommodations will be available on campus for those attending the conference, and daily meals will be served in a dining hall near the dormitories. A brochure describing the facilities available at the University of Colorado will be available from the AMS office in March 1983. The brochure will include information on firm room rates and the residence facilities, as well as local information and a reservation form to be used for accommodations on campus. Each participant will pay a social fee to cover the cost of refreshments served at breaks and for social events.

Those interested in attending one of the conferences should request an application form from Carole Kohanski, AMS Summer Research Conference Coordinator, American Mathematical Society, Post Office Box 6248, Providence, RI 02940 (401-272-9500, extension 286), specifying which conference they wish to attend. Selection of the participants and approval of participant support will be made by the Organizing Committee for each conference. Women and members of minority groups are encouraged to apply and participate in these conferences. The deadline for receipt of applications is February 1, 1983. Those who wish to apply for a grant-in-aid should so indicate on the application form; however, funds available for these conferences are limited and so individuals who can obtain support from other sources should do so.

The AMS Summer Research Conference Series is under the direction of the AMS Committee on Summer Research Conferences which includes: James G. Glimm, Benedict Gross, Kenneth Kunen, Katsumi Nomizu, Donald S. Ornstein, Julius Shaneson, R. O. Wells, Jr. (chairman), and Shmuel Winograd. Descriptions of the subject matter of each of the 1983 conferences appeared in the October Notices, pages 582 to 584; they were accompanied by lists of members of the respective organizing committees.

**June 5 to June 11**  
*Combinatorics and algebra*  
**RICHARD P. STANLEY** (Massachusetts Institute of Technology), Chairman

**June 12 to June 18**  
*Applications of algebraic K-theory to algebraic geometry and number theory*  
**KEITH DENNIS** (Cornell University), Chairman

**June 19 to June 25**  
*Axiomatic set theory*  
**JAMES E. BAUMBARTNER** (Dartmouth College), Chairman

**June 26 to July 2**  
*Group actions on manifolds*  
**REINHARD SCHULTZ** (Purdue University), Chairman

**July 3 to July 9**  
*Ordered fields and real algebraic geometry*  
**D. W. DUBOIS** (University of New Mexico), Chairman  
Jointly supported by NATO as NATO Advanced Research Workshop 58/83.

**July 10 to July 16**  
*Microlocal analysis*  
**LINDA PREISS ROTHSCHILD** (University of Wisconsin, Madison), Chairman

**July 17 to July 23**  
*Fluids and plasmas: geometry and dynamics*  
**JERROL E. MARSDEN** (University of California, Berkeley), Chairman

**July 24 to July 30**  
*Probability theory, partial differential equations and applications*  
**DANIEL STROOCK** (University of Colorado, Boulder), Chairman

**July 31 to August 6**  
*Geometrical analysis of singularities*  
**JEFF CHERGER** (SUNY, Center at Stony Brook), Chairman

**August 7 to August 13**  
*Kleinian groups*  
**HOWARD MASUR** (University of Illinois, Chicago), Chairman

AMS Summer Research Conference Series

University of Colorado, Boulder, June 5 to August 13, 1983
Invited Speakers
and Special Sessions

Invited Speakers 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.

**Norman, March 1983**
- Boris Mityagin
- Michael Starbird
- Paul E. Schupp
- Jeffrey D. Vaaler

**New York, April 1983**
- W. Dale Brownawell
- Oliver McBryan
- Richard S. Hamilton
- Wolfgang Ziller

**Albany, August 1983**
- Selman Akbulut
- Ira Herbst
- James Eells
- Hervé Jacquet
- Robert C. Gunning
- J. H. B. Kemperman

Organizers and Topics of Special Sessions

The list below contains all the information about Special Sessions at meetings of the Society available at the time this issue of the Notices went to the printer.

The section below entitled Information for Organizers describes the timetable for announcing the existence of Special Sessions.

**March 1983 Meeting in Norman**

Central Section
- Deadline for organizers: Expired
- Deadline for consideration: December 30

- Roger C. Alperin, Homological and combinatorial methods in group theory
- Dale E. Alspach, Theory of Banach spaces
- George Phillip Barker, Linear algebra and matrix theory
- Donald S. Coram and Benny D. Evans, Geometric topology
- Harold G. Diamond, Analytic number theory
- Kevin A. Grasse and Luther W. White, Control theory and applications
- Joel K. Hasck, Rings and modules
- Robert C. Lyndon, The algebra of algorithms, automata, and languages
- Andy R. Magid and Richard D. Rosco, Universal enveloping algebras and group algebras of infinite groups
- William O. Ray, Nonlinear functional analysis
- Boris M. Schein, Theory of semigroups

**April 1983 Meeting in New York**

Eastern Section
- Deadline for organizers: Expired
- Deadline for consideration: January 25

- K. Benabdulla, Abelian groups

- W. Dale Brownawell, Transcendence theory and Diophantine problems
- Anthony Gaglione, Combinatorial group theory
- Vadim Komkov, Sensitivity of functionals
- Henry Laufer, Singularities of algebraic and analytic varieties
- Joseph L. Lehner and Marvin Knopp, The mathematical legacy of Hans Rademacher
- Oliver McBryan, Computational methods and fluid mechanics
- C. C. Yang, Value distribution theory and its applications
- Wolfgang Ziller, Variational problems in Riemannian geometry

**April 1983 Meeting in Salt Lake City**

Far Western Section
- Deadline for consideration: January 31

- Lawrence W. Baggett, Theory and application of cocycles of an irrational rotation
- Robert Barnhill, Computer-aided geometric design
- K. R. Goodearl and T. H. Lenagan, Noncommutative ring theory
- Klaus Schmitt, Nonlinear elliptic and parabolic differential equations
- Ronald J. Stern, Four-dimensional topology

**August 1983 Meeting in Albany**

- Associate Secretary: Hugo Rossi
- Deadline for organizers: January 11, 1983
- Deadline for consideration: April 26

- Bertram Schreiber and Colin C. Graham, Tensor products and p-summing operators in harmonic analysis

**January 1984 Meeting in Louisville**

- Associate Secretary Designate: W. Wistar Comfort
- Deadline for organizers: April 15, 1983
- Deadline for consideration: To be announced

Information for Organizers

Special Sessions at Annual and Summer meetings are held under the general supervision of the Program Committee. They are administered by the Associate Secretary in charge of the meeting with staff assistance from the Society office in Providence.

Some Special Sessions arise from an invitation to a proposed organizer issued through the Associate Secretary. Others are spontaneously proposed by interested organizers or participants. Such proposals are welcomed by the Associate Secretaries.

The number of Special Sessions at a Summer or Annual Meeting is limited to twelve. Proposals, invited or offered, which are received at least nine months prior to the meeting are screened for suitability of the topic and of the proposed list of speakers, and for possible overlap or conflict with other proposals (specific deadlines for requesting approval for Special Sessions at national meetings are given above). If necessary, the numerical limitation is enforced.
Proposals for Special Sessions should be submitted directly to the Associate Secretary in charge of the meeting (at the address given in the accompanying box). If such proposals are sent to the Providence office, addressed to the Notices, or directed to anyone other than the Associate Secretary, they will have to be forwarded and may not be received before the quota is filled.

In accordance with an action of the Executive Committee of the Council, no Special Session may be arranged so late that it may not be announced in the Notices early enough to allow any member of the Society, who wishes to do so, to submit an abstract for consideration for presentation in the Special Session before the deadline for such consideration.

Special Sessions are effective at sectional meetings and can usually be accommodated. They are arranged by the Associate Secretary under the supervision of the Committee to Select Hour Speakers for the section. The limitation on the number of sessions depends on the space and time available. The same restriction as for national meetings applies to the deadline for announcing Special Sessions at sectional meetings: no Special Session may be approved too late for its announcement to appear in time to allow a reasonable interval for members to prepare and submit their abstracts prior to the special early deadline set for consideration of papers for Special Sessions.

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.

Abstracts of papers submitted for consideration for presentation at a Special Session must be received by the Providence office (Editorial Department, American Mathematical Society, Post Office Box 6248, Providence, RI 02940) by the special deadline for Special Sessions, which is usually three weeks earlier than the deadline for contributed papers for the same meeting. The Council has decreed that no paper, whether invited or contributed, may be listed in the program of a meeting of the Society unless an abstract of the paper has been received in Providence prior to the deadline.

Send Proposals for Special Sessions to the Associate Secretaries

The Associate Secretary in charge of the AMS program at the Summer Meeting in Albany, August 1983, is Hugo Rossi (address below); Special Sessions for this meeting must be approved before January 11, 1983. The programs of sectional meetings are arranged by the Associate Secretary for the section in question:

Far Western Section (Pacific and Mountain)
Hugo Rossi, Associate Secretary
Department of Mathematics
University of Utah
Salt Lake City, UT 84112
(Telephone 801-581-8159)

Central Section
Paul T. Bateman, Associate Secretary
Department of Mathematics
University of Illinois
Urbana, IL 61801
(Telephone 217-333-4996)

Eastern Section
W. Wistar Comfort
Associate Secretary Designate
Department of Mathematics
Wesleyan University
Middletown, CT 06457
(Telephone 203-347-9411)

Southeastern Section
Frank T. Birtel, Associate Secretary
Department of Mathematics
Tulane University
New Orleans, LA 70118
(Telephone 504-865-5646)

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.
Special Meetings

THIS SECTION contains announcements of meetings 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 the 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.

IN GENERAL, announcements of meetings held in North America carry only date, title of meeting, place of meeting, names of speakers (or sometimes a general statement on the program), deadline dates for abstracts or contributed papers, and source of further information. Meetings held outside the North American area may carry more detailed information. All communications on special meetings should be sent to the Editor of the Notices, care of the American Mathematical Society in Providence.

DEADLINES are listed on the inside front cover of each issue. In order to allow participants to arrange their travel plans, organizers of meetings are urged to submit information for these listings early enough to allow them to appear in more than one issue of the Notices prior to the meeting in question. To achieve this, listings should be received in Providence SIX MONTHS prior to the scheduled date of the meeting.

1982–1983. Special Year in Lie Group Representations, University of Maryland, College Park, Maryland. (June 1982, p. 373)


JANUARY 1983


10–14. Fourth International Symposium on Approximation Theory, Texas A&M University, College Station, Texas. (October 1982, p. 589)


Topics: Abstract calculi, denotational semantics, constructive models in computing and programming, non-determinism and concurrency, abstract algebras, logics and combinators in computing theory, general computability and decidability, computational and arithmetic complexity, theory of algorithms and feasible computations.

Lecturers: E. Börger (West Germany), R. Daley (United States), M. Hennessey (Great Britain), M. Karpinski (Poznań, Poland), P. Martin-Löf (Sweden), R. Milner (Great Britain), R. Parikh (United States), C. P. Schnorr (West Germany), D. S. Scott (United States), J. Tiuryn (Poland), and R. Verbeek (West Germany).

Course Directors: Marek Karpinski (Polish Academy of Sciences), Vladimir Kirin (University of Zagreb), and Helena Rasiowa (University of Warsaw).

Information: Secretariat, Inter-University Centre of Postgraduate Studies, Franja Bulita 4, YU-50000 Dubrovnik, Yugoslavia.

FEBRUARY 1983


13–18. Conference on Geometry, University of Haifa, Israel.

Topics: Algebraic and combinatorial foundations of geometry, computational geometry; geometry and school.

Information: R. Arzy, Department of Mathematics, University of Haifa, 31990 Haifa, Israel.


21–25. Conference on Computational Complexity Theory, Santa Barbara, California.

Program: There will be a series of invited lectures as well as contributed papers.

Organizing Committee: Juris Hartmanis, S. Rao Kosaraju, Ronald V. Book.

Support: National Science Foundation.

Information: R. V. Book, Department of Mathematics, University of California, Santa Barbara, California 93106.


Program: Principal lecturer, Werner C. Rheinboldt, University of Pittsburgh. Related contributed papers are sought.


Information: D. W. Brewer, Department of Mathematics, University of Arkansas, Fayetteville, Arkansas 72701, (501) 375-3351.


Program: This two-day conference will feature one- or two-hour lectures of a predominantly expository nature and 20-minute talks on current or proposed research. Informal discussions are also fostered.

Call for Papers: Send title and one- or two-sentence abstract of 20-minute talks to the address below by March 25, 1983.

Information: L. C. Eggan, Department of Mathematics, Illinois State University, Normal, Illinois 61761.


Sponsor: Journal of Undergraduate Mathematics.

Invited Speakers: George Piranian (University of Michigan); C. H. Edwards, Jr. (University of Georgia); Lynn O. Wilson (Bell Laboratories); Reuben Herah (University of New Mexico).

Information: James Choike, Department of Mathematics, Oklahoma State University, Stillwater, Oklahoma 74078, or J. R. Boyd, Editor, Journal of Undergraduate Mathematics, Guilford College, Greensboro, North Carolina 27410.


30–May 1. Conference on Differential Geometry, Purdue University, West Lafayette, Indiana.

Program: The conference is devoted to recent developments in differential geometry and related areas. There will be seven one-hour lectures by invited speakers.

Speakers: Jeff Cheeger (SUNY at Stony Brook), Samuel I. Goldberg (University of Illinois, Urbana), Blaine Lawson (SUNY at Stony Brook), Peter Li (Purdue University), Richard Schoen (University of California, Berkeley), and S. T. Yau (Institute for Advanced Study).

Information: Harold Donnelly, Richard Penney, Y. L. Tong, or S. P. Wang, Department of Mathematics, Purdue University, West Lafayette, Indiana 47907.

MAY 1983


Call for Papers: Papers are sought in the areas of 1) sensitivity and stability analysis results and their applications; 2) solution methods for problems involving implicitly defined problem functions; 3) solution methods for problems involving deterministic or stochastic parameter changes; 4) solution approximation techniques and error analysis.

Deadline for Abstracts: March 1, 1983.


24–June 12. First Southeast Asian Colloquium on Graph Theory, National University of Singapore. (November 1982, p. 700)


JUNE 1983

6–8. 1983 National Educational Computing Conference (NECC 83), Towson State University, Baltimore, Maryland.

Information: Doris K. Lidtke, General Chairman, NECC 83, Department of Mathematics and Computer Science, Towson State University, Baltimore, Maryland 21204.


Program: The program will include three symposia emphasizing new developments in applied mathematics: system identification and parameter estimation; signal processing; and numerical solutions of partial differential equations.

Principal Speakers: A. V. Balakrishnan (University of California, Los Angeles); H. T. Banks (Brown University); K. W. Iliif (NASA Dryden Flight Research Center); E. Polak (University of California, Berkeley); A. Papoulis (Polytechnic Institute of New York); R. A. Roberts (University of Colorado); R. W. Schaefer (Georgia Institute of Technology); A. Wyner (Bell Laboratories); Gerald Browning (National Center for Atmospheric Research).

The Multiple Stochastic Integral

David Douglas Engel

Norbert Wiener laid down the foundation of the theory of stochastic integration in his classic papers on homogeneous chaos and discrete chaos (which are now called Brownian motion and the Poisson process, respectively). Modern researchers find these papers difficult to read and even more difficult to relate to today's viewpoint of stochastic integration. The Multiple Stochastic Integral is an attempt to show the beauty and simplicity of the original theories and how they provide a geometric interpretation of many of the well-known formulas involving stochastic integrals. This is accomplished by employing certain Banach space valued measures on R^n which yield the desired stochastic integrals when evaluated on appropriate subsets.

1980 Mathematics Subject Classifications: 60H05; 28A35, 28B05, 28C20

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Atmospheric Research); Richard E. Ewing (Mobil Research and Development Corporation); Anita Mayo (IBM Corporation); and John C. Strikwerda (University of Wisconsin, Madison).


16–18. Short Course on Factoring and Primality Testing, Kent State University, Kent, Ohio.

Principal Lecturers: Carl Pomerance and Samuel S. Wagstaff, Jr.

Sponsor: Ohio Section, Mathematical Association of America.

Description: The 1983 Short Course will be an introduction to modern factoring and primality testing algorithms, culminating with the new Adleman-Rundy-Cohen-Lenstra tests. Mornings will be devoted to lectures, and afternoons to workshops in applications. The lectures will assume a general understanding of undergraduate modern algebra, and the workshops will assume the basic fundamentals of Fortran or WATFIV programming. The registration fee for the course is $30.

Information: Jacqueline Parsons, Conference Bureau, 211A Kent Student Center, Kent State University, Kent, Ohio 44242, (216) 672-3161.


Program: There will be presentations of research results in the areas of: digital representation and modeling of remotely sensed scenes; extraction of information from digital remotely sensed and ancillary data related to earth resources; and utilization of digitally processed data related to earth resources. A pre-symposium short course in Numerical Analysis of Remote Sensing will be held during the week of June 13-17.

Information: D. B. Morrison, Purdue University/LARS, 1220 Potter Drive, West Lafayette, Indiana 47906, (317) 494-6305.


Information: R. A. Rankin, Department of Mathematics, University of Glasgow, Glasgow G12 8QW, Scotland.

JULY 1983


4–22. Séminaire de Mathématiques Supérieures–NATO Advanced Study Institute on Topological Methods in Nonlinear Analysis, Université de Montréal, Montréal, Canada.

Sponsors: NATO Advanced Study Institutes Program; Ministry of Education of Québec; Natural Sciences and Engineering Research Council of Canada; Université de Montréal.

Program: Topological methods in bifurcation theory, convex analysis and ordinary and partial differential equations; variational and fixed point index methods in differential equations; introductory courses on above subjects followed by seminars on recent developments.

Principal Speakers: H. Brezis, Paris; K.-C. Chang, Beijing; J. Dugundji, University of Southern California; K. Geba, Gdansk; A. Granas, Montréal; R. B. Guenther, Oregon State; M. König, München; Ky Fan, Santa Barbara; J. Mawhin, Louvain-la-Neuve; L. Nirenberg, Courant Institute; R. D. Nussbaum, Rutgers; P. H. Rabinowitz, Wisconsin.

Information: SMS-NATO ASI, Département de mathématiques et de statistique, Université de Montréal, C.P. 6128, Montréal H3C 3J7, Canada.


Program: The program will include three lectures in Continuum Mechanics by M. Curtis. A workshop is scheduled for each day to discuss open problems and directions for further study. Contributed talks are welcomed.

Support: Financial support is being sought from several federal agencies. Anticipated is partial travel support for 30 participants.

Information: J. Lightbourne or S. Rankin, Mathematics Department, West Virginia University, Morgantown, West Virginia 26506, (304) 293-2014/2011.


Information: Z. Nahorski, ul. Nowelska 6, PL01-447 Warsaw, Poland.


11–16. Seventh International Congress of Logic, Methodology and Philosophy of Science, Salzburg, Austria. (October 1982, p. 590)

11–22. Quadratic Forms and Hermitian K-theory, McMaster University, Hamilton, Canada.

Sponsors: Canadian Mathematical Society and McMaster University.

Topics: Algebraic theory of quadratic forms, isomorphism theory of classical groups, arithmetic theory of quadratic and hermitian forms, hermitian K-theory and L-theory.

Program: There will be lectures on the historical development and current state of each of the four topics as well as talks on recent results.

Information: C. Riehm, Department of Mathematical Sciences, McMaster University, Hamilton, Ontario, Canada L8S 4K1.


18–22. International Conference on Mathematics in Biology and Medicine, Bari, Italy. (October 1982, p. 590)


AUGUST 1983

1–14. Workshop and Conference in Algebraic Topology, Memorial University, Saint John’s, Newfoundland. (November 1982, p. 701)


SEPTEMBER 1983


AUGUST 1984

August 1984. Fifth International Congress on Mathematics Education, University of Adelaide, Australia. (June 1982, pp. 331, 376)

BOUNDARY VALUE PROBLEMS FOR ELLIPTIC PSEUDODIFFERENTIAL EQUATIONS

by G. I. Eskin, translated by S. F. Smith

The English edition differs from the Russian in that an Introduction and three new sections (§§ 25-27) have been added. Moreover, various corrections, improvements and remarks have been made by the author throughout the book, especially in Chapter 6.

CONTENTS

1. Generalized functions and the Fourier transform
2. Boundary value problems for an elliptic pseudo-differential operator in a halfspace
3. Smoothness of solutions of pseudodifferential equations
4. Systems of elliptic pseudodifferential equations in a halfspace
5. Pseudodifferential operators with variable symbols
6. Boundary value problems for elliptic pseudo-differential operators in a bounded domain with smooth boundary
7. Applications

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The Mathematics of Networks
Stefan A. Burr, Editor

This volume represents a considerable expansion of the lecture notes prepared for the Short Course on the Mathematics of Networks at the Summer Meeting in Pittsburgh in August 1981.

The theory of networks is a lively one, both in terms of developments in the theory itself and in terms of the variety of its applications. The editor’s intention was to introduce most of the basic ideas of network theory and develop some of these ideas to a considerable extent. In addition, his plan was to introduce a number of more specialized topics, including a number of areas of active research and a wide variety of applications, in order to indicate the breadth and depth of the field.

The first chapter, Introduction to Basic Network Problems, sets the stage. Frank Boesch gives the basic definitions in the mathematics of networks, and in the closely-related topic of graph theory. He discusses two fundamental network problems, the shortest path problem and the minimum spanning tree problem, and some of their variants. He also discusses network reliability. In the second chapter, Maximum Flows in Networks, Frances Yao considers the problem many consider the most fundamental of all in the field. The history of this topic is one of steady improvement in the performance of the algorithms to solve it, and this chapter gives an account of several of the steps in this history.

One of the most significant recent developments in discrete mathematics is the recognition that many natural problems in areas such as network theory appear to be inherently intractable. In the third chapter, The Computational Complexity of Network Problems, Richard Karp gives an account of this theory, with an emphasis on network problems. In the fourth chapter, Effective Use of Heuristic Algorithms in Network Design, Shen Lin demonstrates by means of a case study some of the ways it is possible to get plausible solutions to problems for which exact solutions are out of the question.

In the fifth chapter, Some Practical Network Problems, Daniel Kleitman discusses four applications of the mathematics of networks. These consist of the design of irrigation systems, the theory of electrical networks (the first area of network theory to be developed systematically, the scheduling of delivery trucks, and the physics of ice. In the sixth chapter, Telephone Switching Networks, Nicholas Pippenger presents an area of network theory that leads to difficult mathematics drawn from such an apparently unrelated field as harmonic analysis. In the final chapter, Concluding Remarks, the editor makes some general comments, presents a chronology of events relating to the theory of networks and gives a short bibliography.

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Computed Tomography
Lawrence A. Shepp, Editor

This book is composed of the lecture notes from an AMS Short Course on Computed Tomography given in Cincinnati, January 1982. It reviews (for both pure and applied mathematicians) the algorithms and mathematics of computed tomography (CT). It presents one particularly important (medically, financially, scientifically) example of applied mathematics, illustrating the general applied mathematical approach of problem solving and problem posing through modelling—an approach not often taught in pure mathematics programs. New problems in emission CT and nuclear magnetic resonance CT are posed and new research frontiers defined, e.g., estimation of errors in limited angle CT; correction for attenuation in emission CT; Radon transform range spaces in homogeneous space CT.

An individual who reads this book can expect to gain a feel for experimental or nondeductive methods through the use of computers in applied problems, i.e., simulation, large scale computation, numerical techniques, and imaging methods.

CONTENTS
Lawrence A. Shepp, Scope of pure and applied tomography
Kennan T. Smith, Reconstruction formulas in computed tomography
CONTEMPORARY MATHEMATICS

Algebraists' Homage: Papers in Ring Theory and Related Topics
S. A. Amitsur, D. J. Saltman, and G. B. Seligman, Editors

These Proceedings contain papers presented in person or by title at the Conference in Algebra held at Yale University, June 2-5, 1981, on the occasion of the retirement of Professor Nathan Jacobson. Support was generously provided by the National Science Foundation. About seventy mathematicians were visitors in residence at Yale for all or part of the conference. In addition, numbers of people within commuting distance participated on a daily or occasional basis.

The theme of the conference was to discuss the current status and to suggest directions for the future in those areas that have been decisively influenced by Nathan Jacobson.

The book contains surveys of recent work in division algebras, rings with polynomial identity, representations of associative algebras, Lie algebras and finite groups of Lie type; by experts in these fields: S. Amitsur, E. Formanek, M. Auslander, J. Humphreys, T. Springer. These topics and other themes in related fields are developed in some thirty-five papers presented in addition reports by leading algebraists.

Here is the picture of the "state-of-the-art." At the risk of offending many participants by omission, the editors cite the report of Sweedler on Weak cohomology, of P. M. Cohn on Determinants, of Schacher on Applications of the classification of finite simple groups to Brauer groups, of Block and Wilson summarizing their recent work on classifying simple Lie algebras of prime characteristic, and of Mac Lane on Proof theory as articles of high research value. Some Yale authors might also be mentioned: Saltman on Generic structures and field theory, Feit-Zuckerman on Spin and orthogonal groups, Seligman on Generalized Clifford algebras, Tamagawa on Regularly closed fields.

The sections of the book contain papers by the authors listed below.

Surveys: S. A. Amitsur, M. Auslander, E. Formanek, J. E. Humphreys and T. A. Springer.

Addresses: P. M. Cohn and M. E. Sweedler.


Lectures on Nielsen Fixed Point Theory
Boju Jiang

This book is expository in nature. Starting with simplest examples, it gives an easy introduction to the subject, then explains several very recent developments. It makes available in the English language the covering space approach to Nielsen fixed point theory. As far as research value is concerned, the Nielsen theory of periodic points is published here for the first time, and an exposition and improvement of the latest progress in the Nielsen theory of fiber maps (a paper by You to appear in the Pacific Journal of Mathematics) is provided. There is only one other book in the field: R. Brown, Lefschetz fixed point theorem, Scott, Foresman and Company, Glenview, Illinois, 1971. The present work introduces the subject via a more satisfactory approach—the covering space approach, and includes the most important results of the 1970s.

General Summary: The Nielsen fixed point theory is becoming increasingly important in geometric topology and, potentially, has applications in analysis. These notes introduce the subject via a covering space approach, which is very fruitful. It starts from the beginning, and goes all the way to the frontier of our knowledge, including very recent work (some

These notes are based on courses given at the University of California, Berkeley in 1980 and at the University of California, Los Angeles in 1981.

The Introduction explains what Nielsen theory is about. Chapter I gives the basic notions of the theory, while Chapter II is devoted to computational methods. In Chapter III the author broadens the scope and introduces the Nielsen-type theory for periodic points. Chapter IV provides an exposition of the latest progress in the Nielsen theory for fiber maps. Another chapter in the original courses is now sketched as §1.6 because the material is easily available in the literature. The Historical Notes and Bibliography attached are not intended to be complete.

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Contemporary Mathematics
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LECTURES ON MATHEMATICS
IN THE LIFE SCIENCES
(ISSN 0075-8523)

Some Mathematical Questions in Biology—Neurobiology
Robert M. Miura, Editor

The six papers presented in this book deal with three different aspects of neurobiology—the morphology of nerve cells, the analysis and study of action potential phenomena, and ion movements inside and outside nerve cells. The papers are addressed to biologists, especially physiologists and neuroscientists, and mathematicians who are interested in the applications of mathematics to neurobiology. They should also appeal to others who have general interests in seeing the interactions between mathematics and experimental neurobiology.

The collection of papers contains experiments and theory working together and leads to a better understanding of neurobiology. Most of the earlier books in this series have concentrated mainly on mathematics—a few on biology. Here there is a healthy mix of the two. Four of the papers were written by experimentalists who also do mathematics. Readers should gain an appreciation of the synergy between experiment and mathematics and a view of the current state of basic research in mathematical neurobiology.

These lectures were presented at the Sixteenth Annual Symposium on Some Mathematical Questions in Biology at the AAAS meeting in Washington, D. C. in January 1982. It was jointly organized and sponsored by AMS, SIAM, and Section A, Mathematics of the AAAS.

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Speakers and session chairmen
Robert M. Miura, Preface
Charles F. Stevens, Quantitative specification of neuron form
John Rinzel, Neuronal plasticity (learning)
Richard E. Plant, The analysis of models for excitable membranes: An introduction
Alwyn C. Scott, Nerve pulse interactions
John A. Connor and Georgia Nikolakopoulou, Calcium diffusion and buffering in nerve cytoplasm
Charles Nicholson and Joseph M. Phillips, Diffusion in the brain cell microenvironment

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MEMOIRS OF THE AMS
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Generic Bifurcations for Involuntary Area Preserving Maps
Russell J. Rimmer

This Memoir describes the generic bifurcations from symmetric fixed points of families of involuntary area preserving maps defined in the plane. Interest in this problem arose from the study of bifurcations from symmetric periodic solutions of Hamiltonian systems which possess a symmetry property. An intriguing feature of the results reported here is that two types of bifurcation persist generically for one class of symmetric fixed points. This occurs when the multipliers of the initial fixed point are 1, and in this case, one of the generic results involves bifurcations which do not possess the symmetry property of the initial fixed point. Unsymmetric periodic solutions corresponding to this particular generic behaviour were observed in numerical studies of the three body problem about 15 years ago, but have received little attention since.

Throughout this Memoir elementary methods have been used wherever possible. The exception to this has been the need to use some transversality theory. In any case the proofs of most results are given in complete detail
The Fundamental Principle for Systems of Convolution Equations
Daniele Carlo Struppa

In 1961 Ehrenpreis proved, in what he called "The fundamental principle for P.D.E.," that the solutions of homogeneous P.D.E. with constant coefficients could be represented as finite sums of absolutely convergent integrals over certain varieties related to the specific equations. In 1980 a similar result was obtained by Berenstein and Taylor for the case of convolution equations. This paper is devoted to the extensions of the previous results to the case of systems of convolution equations. So if a homogeneous $N \times m$ system of convolution equations on analytically uniform spaces is given, conditions are sought which will permit Fourier representation theorems for the solutions of the given system. The author first considers the case in which the unknown functions belong to spaces $X$ such that $X^1 = A_p(C^n)$ is the space of entire functions satisfying, for some $A, B > 0$, $|f(z)| \leq A \exp(Bp(z))$; and proves that, under natural conditions, the solutions of such a system admit a Fourier representation convergent in $X$. This result is then extended to more general classes of spaces, specifically it is shown that one can take, for the space $X^1$, a countable inductive limit of spaces as above; finally the existence of a representation theorem is linked to the concept, developed separately by Ehrenpreis and Palamodov, of LAU space; it is shown that most of the concrete spaces of analysis are LAU spaces, and, for them, a version of the representation theorem is provided.

β-homotopy Equivalences
have α-cross Sections
Luis Montejano

Let $M^p, N^p$ be manifolds, $A$ an ANR, $p : M^p \to A$ a surjective map, $h : N^p \to A$ an embedding and $\alpha$ an open cover of $A$. The author's purpose is to study the following problem: When is there a locally flat embedding $g : N^p \to M^p$ such that $pg$ is $\alpha$-close to $h$? His answers are phrased in terms of homotopy restrictions on $p$. This problem is intimately related to the problem of approximating topological embeddings with locally flat embeddings.

The Stability of Multi-dimensional Shock Fronts
Andrew Majda

Abstract

A systematic study of the linearized stability of multi-dimensional shock-front solutions of a system of hyperbolic conservation laws is developed. The novel feature of these linearized problems is that they involve the coupling of an evolution equation for the perturbed shock surface satisfied on the unperturbed shock front with the boundary values of solutions of linear hyperbolic equations satisfied on each side of this shock front. Several interesting new phenomena occur and these are analyzed. An appropriate notion of well-posedness is defined and applied to establish the existence, uniqueness, and differentiability of solutions of this new mixed problem. A special emphasis is placed on applying the theory to shock fronts for the physical equations of gas dynamics. In particular, in several space variables, shock front solutions of the ideal gas Euler equations have stronger stability properties than those of a scalar conservation law in several space variables.

AMS TRANSLATIONS, SERIES 2
(ISBN 0065-9290)
Sixteen Papers on Differential Equations
Lev Leifman, Editor

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P. R. Popivanov, On the local solvability of a class of pseudodifferential equations with double characteristics
A. N. Šokitašvili, On bifurcation of topological type of singular points of vector fields depending on parameters

D. A. Silaev, Construction of the solutions of a system of boundary-layer equations by the method of lines with respect to time

A. I. Suslov, On Prandtl’s system of equations for the boundary layer with a surface of discontinuity

M. I. Vičik and A. I. Komeč, On the solvability of the Cauchy problem for the Hopf equation corresponding to a nonlinear hyperbolic equation

Ju. V. Egorov and C. V. Rangelov, On a class of pseudodifferential equations with multiple characteristics

Ju. S. Il’jašenko, The multiplicity of limit cycles arising from perturbations of the form \( w' = P_{2}/Q_{3} \) of a Hamiltonian equation in the real and complex domain

T. F. Kalugina, A priori estimates for equations of parabolic type

V. Ju. Kiselev, Almost periodic Fourier integral operators and some of their applications

A. A. Lokšin, Fundamental solutions of quasihyperbolic equations and polynomials of several variables

O. A. Oleinik and N. O. Maksimova, On the behavior of solutions of inhomogeneous elliptic systems in unbounded domains

A. V. Fursikov, First integrals and integrability of systems of quasilinear equations

M. A. Subin, The density of states of selfadjoint elliptic operators with almost periodic coefficients

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**Plane Ellipticity and Related Problems**

**Robert P. Gilbert, Editor**

In this collection of papers concepts associated with plane-ellipticity are extended in several ways. For example, the investigations of Begehr and Gilbert, Begehr and Hsiao, Hile and Snyder treat systems of elliptic partial differential equations in the plane which resemble in some sense the Cauchy-Riemann equations. Their point of view is to seek general representation formulas and to use these in some cases to solve boundary value problems. Continuing with the theme of generalizing the Cauchy-Riemann equations, Buchanan treats the Bers-Vekua type systems in two complex variables, while Delanghe and Sommen, Brackx and Pincket, and Lounesto investigate hypercomplex function theory in \( \mathbb{R}^n \), that is, the class of homogenic functions having values in a Clifford algebra.

The remaining talks comprising this special meeting cannot be categorized as falling into a general group, but rather explore isolated, albeit important, topics associated with ellipticity.

**Homology and Dynamical Systems**

**John M. Franks**

This book is an exposition of a number of results dealing with the connections between algebraic topology and dynamical systems. For the most part proofs are included; where they are omitted a reference is given. The topics covered include: Morse gradients, symbolic dynamics and subshifts of finite type, Smale and Morse-Smale diffeomorphisms and flows, and the zeta function and homology zeta function of a diffeomorphism.

The book is intended for graduate students or researchers interested in the relationship between topology and dynamical systems. It is especially appropriate for persons with a background in topology who want to learn about dynamical systems.

This book would be appropriate for a graduate level course. Except for an assumed background in algebraic topology the material is largely self-contained. There are numerous books on algebraic topology and many on dynamical systems. This is the only book devoted to the inter-relationships of these two fields.

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Personal Items

Stephen E. Anaeker of Missoula, Montana, has been appointed to an assistant professorship at Central Michigan University.

Jacob Hammer of the University of Florida has been appointed to an assistant professorship at Case Western Reserve University.

John Hannah of University College of Dublin, Ireland, has taken a junior lectureship at University College Galway.

Bruce Ikenaga of Cornell University has been appointed to an assistant professorship at Case Western Reserve University.

Les A. Karlovitz of the Georgia Institute of Technology has been appointed Dean of the College of Sciences and Liberal Studies of that university.

Joseph A. Langsam of the University of Michigan, Ann Arbor, has been appointed to an assistant professorship at Case Western Reserve University.

H. Turner Laquer of Harvard University has been appointed to an assistant professorship at Case Western Reserve University.

Haim Reingold, Professor Emeritus of Illinois Institute of Technology, has been appointed to a visiting professorship at Purdue University, Calumet.

John Wilson of Carnegie-Mellon University has been appointed to an assistant professorship at Case Western Reserve University.

Julius Zelmanowitz of the University of California, Santa Barbara, currently a visiting professor at McGill University, Montreal, Canada, has been awarded a Fulbright grant to conduct mathematics research in Munich, Germany.

Deaths

Edwin F. Beckenbach of the University of California, Los Angeles, died on September 5, 1982 at the age of 76. He was a member of the Society for 51 years.

Ludwig Bieberbach of Oberaltdorf, Germany died on September 1, 1982 at the age of 96. He was a member of the Society for 23 years.

Emilio E. Cosculluela, President of Beta Construction Company, Coral Gables, Florida died on October 8, 1982 at the age of 54. He was a member of the Society for 5 years.

Evelyn Frank of the University of Illinois, Chicago, died on September 28, 1982. She was a member of the Society for 38 years.

Hitoshi Kumano-Go of Osaka University died on August 24, 1982 at the age of 46. He was a member of the Society for 14 years.

Edwin W. Titt of Albuquerque, New Mexico died on June 29, 1982 at the age of 75. He was a member of the Society for 50 years.

Visiting Mathematicians

(Supplementary List)

Mathematicians visiting other institutions during the 1982-1983 academic year have been listed in recent issues of the Notices: June 1982, pages 382-384; August 1982, pages 474-476; October 1982, pages 592-593; and November 1982, page 707. The list below gives the name and home country, the host institution, period of visit, and field of special interest of additional visiting mathematicians.

Krishnaswami Alladi (India), University of Texas, Austin, September 1982 to May 1983, analytic number theory.

Dan Amir (Israel), University of Texas, Austin, September 1982 to May 1983, approximation theory, functional analysis.

Garrett Birkhoff (U.S.A.), Institute of Applied Mathematics of the Chinese Academy of Sciences, Beijing, People's Republic of China (under the 1982-1983 CSCPRC Distinguished Scholar Exchange Program), computational physics, computer science, and numerical mathematics.

Carlo Franchetti (Italy), University of Texas, Austin, January 1983 to May 1983, approximation theory.

P. C. N. Groenewald (South Africa), University of Texas, Austin, January 1983 to May 1983, statistics.

Qichang Huang (People's Republic of China), Southern Illinois University, Carbondale, August 1982 to August 1983, differential equations. (Professor Huang was previously listed on page 707 of the November 1982 Notices without his field of special interest.)

Barbara Kaskoss (Poland), University of Rhode Island, September 1982 to August 1983, optimal control theory.

Richard Litherland (England), University of Texas, Austin, January 1983 to May 1983, topology.

Patrick J. Rabier (France), University of Texas, Austin, January 1983 to May 1983, nonlinear functional analysis.

Stanislaw J. Szarek (Poland), University of Texas, Austin, September 1982 to May 1983, Banach space theory.

Wanda Szpunar-Lojasiewicz (Poland), University of Rhode Island, October 1982 to August 1983, optimization.


Zvi Ziegler (Israel), University of Texas, Austin, September 1982 to May 1983, approximation theory.
Recent Appointments

Committee members’ terms of office on standing committees expire on December 31 of the year given in parentheses following their names, unless otherwise specified.

William A. Massey (1985) has been appointed by President-Elect Julia B. Robinson to the Proceedings of Symposia in Applied Mathematics Editorial Committee. Continuing members of the committee are Stephen Childress (1983) and Lloyd R. Welch, chairman (1984).

President-Elect Julia B. Robinson has appointed Israel N. Herstein (1984) and William B. Johnson (1984) to the Committee to Select Hour Speakers for Central Sectional Meetings. Continuing members of the committee are Richard A. Askey (1983), Paul T. Bateman (ex officio), and J. Ian Richards (1983) who has been appointed chairman.

Yum Tong Siu (1984) and Richard P. Stanley (1984) have been appointed to the Committee to Select Hour Speakers for Eastern Sectional Meetings by President-Elect Julia B. Robinson; Hyman Bass (1983) has been appointed chairman. Other members of the committee are W. Wistar Comfort (ex officio) and Bernard Maskit (1983).

Tsit-Yuen Lam (1984) has been appointed by President-Elect Julia B. Robinson to the Committee to Select Hour Speakers for Far Western Sectional Meetings and Paul J. Cohen (1984) has been reappointed to the committee and as chairman. Continuing members of the committee are William J. Helton (1983), Alistair H. Lachlan (1983), and Hugo Rossi (ex officio).

A. T. Bharucha-Reid (1984) and Carl Pomerance (1984) have been appointed to the Committee to Select Hour Speakers for Southeastern Sectional Meetings by President-Elect Julia B. Robinson. Continuing members of the committee are Frank T. Birtel (ex officio), and Michael C. Reed (1983), and Bjarni Jonsson (1983) who has been appointed chairman.

Halsey L. Royden (1985) has been appointed by President-Elect Julia B. Robinson to the Committee on Academic Freedom, Tenure, and Employment Security and Arlan B. Ramsay (1983) has been reappointed chairman. Continuing members of the committee are Fred G. Bauer (1983), Martin D. Davis (1984), James E. Joseph (1984), and Calvin C. Moore (1983).

Lida K. Barrett (1984) has been reappointed to the Committee on Employment and Educational Policy and Donald C. Rung (1984) has been appointed chairman by President-Elect Julia B. Robinson.

Continuing members of the committee are Irwin Kra (1984), Robert W. Mckelvey (1983), and Barnet M. Weinstock (1983).

Leon A. Henkin (1985) has been appointed and John A. Nohel (1985) has been reappointed to the Committee on Human Rights of Mathematicians by President-Elect Julia B. Robinson. Continuing members of the committee are Chandler Davis (1983), Ed Dubinsky (1983), Peter J. Hilton (1984), Gail S. Young, Jr. (1983), Eduardo D. Sontag (1984) has been reappointed chairman.

Gloria F. Gilmer (1985) and Manuel P. Berriozabal (1985) have been reappointed by President-Elect Julia B. Robinson to the Committee on Opportunities in Mathematics for Disadvantaged Groups. Continuing members of the committee are James A. Donaldson (1984), chairman, Roland F. Esquerra (1984), Harold J. Stolberg (1984), and Scott Williams (1983).


President-Elect Julia B. Robinson has appointed Sun-Yung Alice Chang to the Committee on Translations from Chinese. Continuing members of the committee are Tsit-Yuen Lam, chairman, Chia-Chiao Lin, Tai-Ping Liu, and Franklin P. Peterson. This committee, established as a committee of the Trustees, has, by agreement of the President and the Chairman of the Board, become instead a standing committee of the Council. This change has no effect on the work of the committee, being only a change of the body to which the committee is accountable.

Paul R. Halmos, John C. Oxtoby and E. G. Straus have been appointed by President-Elect Julia B. Robinson to the new ad hoc Committee on Professional Ethics. Professor Halmos will serve as chairman.
Reports of Past Meetings

The Summer Meeting in Toronto

The 86th Summer Meeting of the American Mathematical Society was held from August 23 to August 26, 1982, at the University of Toronto, Ontario, Canada. It was held jointly with the 62nd summer meeting of the Mathematical Association of America, and the 1982 annual meeting of Pi Mu Epsilon. The meeting was preceded by the AMS Short Course, Statistical Data Analysis. There were 1,299 registrants, including 859 members of the Society.

Colloquium Lectures. Morris W. Hirsch of the University of California, Berkeley, presented a series of four Colloquium Lectures entitled Convergence in ordinary and partial differential equations. Professor Gleason was the presiding officer at these lectures.

Steele Prizes. Four 1982 Leroy P. Steele Prizes were awarded in a prize session held on Wednesday, August 25. The 1982 recipients were Lars V. Ahlfors of Harvard University; Tsit-Yuen Lam of the University of California, Berkeley; John W. Milnor of the Institute for Advanced Study; and Fritz John of the Courant Institute of Mathematical Sciences, New York University (see pages 504 to 508 of the October 1982 Notices).

Invited Addresses. By invitation of the Program Committee, there were eight invited one-hour addresses as follows:

David W. Boyd, University of British Columbia, Vancouver, Constructive aspects of the theory of the Pisot and Salem numbers. The presiding officer was George E. Andrews.

Sun-Yung Alice Chang, University of California, Los Angeles, $H^p$ spaces in one and several variables. The presiding officer was Robert Fefferman.

Harish-Chandra's address, On the theory of the Whittaker integral, was delivered by V. S. Varadarajan. The presiding officer was Peter A. Fillmore.

Joel L. Lebowitz, Rutgers University, New Brunswick, Recent developments in statistical mechanics. The presiding officer was Andrew M. Gleason.

John W. Milnor, Institute for Advanced Study, Knots and contact structures in 3-space. The presiding officer was Julia B. Robinson.

Brent Pendleton Smith, California Institute of Technology, Winding numbers and Fourier transforms. The presiding officer was John B. Friedlander.

W. T. Tutté, University of Waterloo, Map colorings and differential equations. The presiding officer was Richard K. Guy.

Shmuel Winograd, IBM Watson Research Center, Algebras, their representations and the discrete Fourier transform. The presiding officer was Louis Auslander.

Special Sessions. By invitation of the same committee, there were fourteen special sessions of selected twenty-minute papers as follows:


Complexity and digital signal processing, Louis Auslander, Graduate Center, CUNY. The speakers were C. Sidney Burrus, Allen L. Gorin, F. Alberto Grünbaum, H. Lev-Ari, James H. McClellan, L. Robert Morris, R. Tolimieri, and Michael Vulis.


Applications of logic to mathematics and computer science, Harvey M. Friedman, Ohio State University. The speakers were Paul Bankston, Tim Carlson, Thomas John, Kenneth McAlon, Anil Nerode, Marion B. Pour-El, Karel L. Priy, Rick L. Smith, Richard Statman, Charles Steinhorn, Franklin D. Tall, and Michael von Rimsa.


Computing theory, Saul Gorn, University of Pennsylvania. This session was in two parts. The first part was on Computability and complexity theory and was coordinated by Ronald Book, University of
California, Santa Barbara. Speakers in this session included Jean H. Gallier, Timothy J. Long, Michael J. O’Donnell, Charles Rackoff, Arto Salomaa, Alan L. Selman, and Paul Young. The second part on Algorithms was coordinated by S. R. Kosaraju, Johns Hopkins University, and Allan Borodin, University of Toronto. Speakers in this session included Stephen A. Cook, Michael L. Fredman, Frank Thomson Leighton, Martin Tompa, and L. G. Valiant.

History of mathematics, CHARLES V. JONES, University of Toronto. The speakers were Victor J. Katz, George Miel, Gregory H. Moore, J. J. Tattersall, Marshall Walker, and Ross D. Willard.


Ergodic theory, NATHANIEL F. G. MARTIN, University of Virginia, Charlottesville. The speakers were Michael Brin, Robert Brooks, J. R. Choksi, Andrés del Junco, Albert Edrei, Walter Gautschi, Jacek Gilewicz, John Gill, William B. Jones, L. J. Lange, Arne Magnus, Burnett Meyer, Walter M. Reid, W. J. Thron, H. van Rossum, and Haakon Waadeland.


Bijective proofs in generalized partition theory and enumerative combinatorics, HERBERT S. WILF, University of Pennsylvania. This session was in two parts. The speakers for the section on Bijective proofs in partition theory were Daniel I. A. Cohen, Adriano M. Garsia, Basil Gordon, Jeffrey B. Remmel, and Herbert S. Wilf. The speakers for the section on Enumerative combinatorics were Janet Simpson Beissinger, Judith E. Dayhoff-Goldberg, Curtis Greene, L. H. Harper, A. M. Odlyzko, and Richard P. Stanley.

Contributed Papers. There were twelve sessions for contributed ten-minute papers. The presiding officers for these sessions were: M. Aissen, B.-A. Case, B. Faires, K. Eldridge, J. W. Grossman, D. A. Hensley, J. W. Lorimer, K. Magill, J. R. Quine, J. Rosenthal, N. Roy and N. Williams.

Other AMS Sessions. At the invitation of the AMS Program Committee ETTORE F. INFANTE, Division Director of the Mathematical and Computer Sciences Division of the National Science Foundation, spoke on Federal support for the mathematical sciences: some simple facts on some difficult questions.

Joint AMS–MAA Sessions. The AMS and MAA jointly sponsored a series of one-hour addresses on topics in the history of mathematics. The speakers and the titles of their talks were:

J. BARKLEY ROSSER, Mathematics Research Center, University of Wisconsin, Madison, Mathematics and mathematicians in World War II.

GEORGE W. WHITEHEAD, Massachusetts Institute of Technology, Homotopy theory: the first twenty-five years.

CLIFFORD A. TRUESDELL III, Johns Hopkins University, and STUART S. ANTMAN, University of Maryland, College Park, The influence of elasticity on analysis. Professor Truesdell spoke on The classical heritage, and Professor Antman on Modern developments.

JEAN A. DIEUDONNÉ, Nice, France. The work of Bourbaki during the past thirty years.

Other Events. A talk about MATHFILE was given by John L. Selfridge of Mathematical Reviews.

Council and Business Meetings. The reports of the Council and Business Meetings held during the summer meeting were given on pages 595 and 596 of the October 1982 issue of the Notices.

Raymond G. Ayoub
University Park, Pennsylvania Associate Secretary
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POSITIONS AVAILABLE

THE AUSTRALIAN NATIONAL UNIVERSITY

The Australian National University invites applications from suitably qualified persons for appointment to POSTDOCTORAL FELLOWSHIPS or RESEARCH FELLOWSHIPS in the DEPARTMENT OF MATHEMATICS (Head: Professor D. W. Robinson, FAA) in the Research School of Physical Sciences.

 Preference will be given to applicants in the following fields: functional analysis, mathematical physics, partial differential equations, differential geometry and Lie groups.

 Appointment as Postdoctoral Fellow will be for two years and as Research Fellow for up to three years in the first instance with the possibility of extension to five years.

 Salary ranges: Postdoctoral Fellow $19,133–22,148 per annum; Research Fellow $22,430–29,467 per annum.

 Reasonable travel expenses, superannuation, assistance with housing are also available. The University reserves the right not to make an appointment or to make an appointment by invitation at any time. Applicants may obtain further particulars from:

 The Registrar
 The Australian National University
 P.O. Box 4
 CANBERRA A.C.T. 2600
 AUSTRALIA
 with whom applications close on 28 February 1983.

YONSEI UNIVERSITY, SEOUL, KOREA

Applications are invited in any area of Mathematics. Ph.D. required. Working knowledge of Korean desirable. Apply: Professor Inwhan Chung, Mathematics Department, Yonsei University, Seoul, Korea. Or contact Visiting Professor Kunsoo Chang, Department of Mathematics, University of Nebraska, Lincoln, Nebraska 68588.

UNIVERSITY OF BRITISH COLUMBIA

Two tenure-track positions starting July 1, 1983, are available. One assistant professorship and one assistant or associate professorship. Appointment to these positions may be subject to budgetary restrictions. Requirements are Ph.D. and excellence in research and teaching. Duties include graduate and undergraduate teaching and research. C.V. and three letters of reference to be sent to Professor F. W. Boyd, Department of Mathematics, The University of British Columbia, No. 121, 1984 Mathematics Road, Vancouver, B.C., Canada V6T 1Y4. The closing date is February 15, 1983, or whenever the positions are filled. The University is an Equal Opportunity Employer. In accordance with Canadian immigration requirements, this advertisement is directed to Canadian citizens and permanent residents of Canada.

EAST CAROLINA UNIVERSITY

CHAIRPERSON DEPARTMENT OF MATHEMATICS

The search has been reopened for the position of Chairperson of the Department of Mathematics. The Search Committee will continue to review applications until the position is filled. Candidates should submit c.v. with three letters of reference. Candidates must have Ph.D. in mathematics/mathematical sciences and should furnish evidence of effectiveness in teaching, of ability to lead and administer a multifaceted department, and of scholarly achievement involving research, creative activity, publications, etc. Rank and salary commensurate with qualifications. The Mathematics Department has 34 full-time members in mathematics, mathematics education, computer science, and statistics, and offers B.A. in mathematics, B.A. in computer science, and B.S. in mathematics for preparation of teachers, and the master's degree, as well as service courses for all university students. Send application to Professor Eugene E. Ryan, Chair, Search Committee, Department of Mathematics, East Carolina University, Greenville, NC 27834; 919-757-6121. An AA/EO Employer.

East Carolina University
Mathematics Department, Greenville NC 27834

Applications are invited for two tenure-track positions (rank and salary commensurate with credentials) beginning Fall, 1983. One position is in the area of Computer Science and the other in the area of either Mathematics or Statistics. Candidates for each position must have a Ph.D. Degree in a Mathematical Science; in addition, candidates for the Computer Science position should have the equivalent of a Master's Degree in Computer Science. Applicants must have a strong commitment to both research and teaching. Send resume and three recent letters of reference to Gary Richardson, EO/AAE.

DEPARTMENT OF STATISTICS, PRINCETON UNIVERSITY

We have openings for an Assistant Professor and for Visiting Faculty, beginning September 1983. Candidates should have teaching experience and evidence of research ability. Junior faculty at Princeton are encouraged to work on sponsored research projects or on their own research in lieu of some teaching. Among candidates of equal quality, preference will be given to those with experience or interest in two or more of theoretical questions; applications of statistics and data analysis; innovative statistical use of computers, The Department has its own Digital Equipment Corporation VAX-11/750.

The Department encourages applications from women and members of minority groups. Apply to: G. S. Watson, Acting Chairman, Department of Statistics, Princeton University, Fine Hall, P.O. Box 37, Princeton, NJ 08544.
APPLICATIONS FROM OUTSTANDING MATHEMATICIANS (OF ANY AGE) WHO ARE RECENT RECIPIENTS OF A DOCTORATE—PEOPLE WHO WILL INTERACT WELL WITH MEMBERS OF OUR DEPARTMENT, WHO CARE ABOUT TEACHING, AND WHO CAN CONTRIBUTE TO OUR RESEARCH AND INSTRUCTIONAL PROGRAMS. TEACHING LOAD IS 2 COURSES PER SEMESTER. HIGH PROBABILITY OF ADDITIONAL INCOME THROUGH RESEARCH OR TEACHING DURING SUMMERS BETWEEN CONSECUTIVE YEARS OF INSTRUCTION. DEADLINE FOR APPLICATIONS IS DECEMBER 31, 1982. WRITE J. MARSHALL OSBORN, CHAIRMAN, DEPARTMENT OF MATHEMATICS, 213 VAN VLECK HALL, UNIVERSITY OF WISCONSIN, MADISON, WISCONSIN 53706. THE UNIVERSITY OF WISCONSIN-MADISON IS AN EQUAL OPPORTUNITY EMPLOYER.

UNIVERSITY OF RHODE ISLAND

The University of Rhode Island, Department of Mathematics, Kingston, RI 02881 anticipates the possibility of a tenure-track position at the Assistant or Associate Professor level, and one-year position(s) at the Assistant Professor level commencing in Fall 1983. Applications should be sent no later than February 1, 1983 to Professor P. T. Liu, Department of Mathematics, University of Rhode Island. Candidates should have Ph.D. in Mathematics and must have demonstrated evidence of excellence in research in one of the following areas: numerical analysis, partial differential equations, stochastic processes, optimal control and related subjects. Evidence of excellence in teaching is preferred. URI is an equal opportunity/affirmative action employer.

California State University, Sacramento

Mathematics and Statistics Department, CSU Sacramento, Sacramento, CA 95819. (3) TENURE-TRACK POSITIONS, assistant professor level (salary $20,968 to $22,896), beginning August 1983; Require Mathematics or Statistics Ph.D.; 12 unit/ semester teaching load; Applicants must be committed to excellence in teaching. The department will give special consideration to applicants who desire to teach courses in applied statistics or computer-oriented mathematics, or who have research potential in any area of mathematics. Respond by 2/1/83.

(2) ONE-YEAR POSITIONS, assistant professor level (salary $19,044 to $22,896), beginning August 1983; Require Mathematics or Statistics Ph.D.; 12 unit/ semester teaching load; Applicants must be committed to excellence in teaching. Respond by 3/1/83. Résumé, transcripts and 3 letters of recommendation (at least one attesting to teaching ability) should be sent to: Mathematics & Statistics Hiring Committee.

CSUS is an EO/Affirm. Action/Handicapped/Titl IX/Vietnam Era Vet Employer.

CENTRAL MICHIGAN UNIVERSITY

The Department of Mathematics anticipates two tenure-track positions at the Assistant Professor level beginning in August, 1983. One position is for a statistician with preference given to an individual with related nonacademic experience. The other position is for a mathematician with research interests in approximation theory, combinatorial designs and algebras, or functional analysis. Candidates for either position should have a Ph.D. and demonstrated ability in both research and teaching. Salary is competitive and benefits include University paid TIAA, Medical, Dental, Group Life. Résumés and 3 letters of recommendation should be sent by March 1, 1983 to Richard J. Flagg, Department of Mathematics, Central Michigan University, Mt. Pleasant, MI 48859. CMU IS AN AFFIRMATIVE ACTION/EQUAL OPPORTUNITY EMPLOYER.

THE CHINESE UNIVERSITY OF HONG KONG

CHAIR PROFESSOR OF MATHEMATICS

The CHINESE UNIVERSITY is a young British Commonwealth University situated on a campus of 113.8 hectares in a scenic area on the outskirts of Hong Kong. It is a Ph.D.-granting institution with over 500 teaching staff, 4,500 undergraduate and 700 postgraduate students. There are 45 teaching departments belonging to five Faculties: Arts, Business Administration, Science, Social Science and Medicine. Teaching load being relatively light, original research is supported and actively encouraged, and evidence of scholarly achievement is required for substantiation (tenure) and promotion. The principal medium of instruction is Chinese, but the majority of the teaching staff are bilingual (Chinese/English) and have studied and/or taught in major universities all over the world.

APPLICATIONS are invited for the captioned Chair position tenable from August 1, 1983. Applicants should possess outstanding academic qualifications, considerable university teaching and research experience and have published scholarly works of originality and merit in the discipline. ANNUAL SALARY: HK$288,480 or above (Exchange rate US$1 = HK$6.4 approximately). An applicant who does not possess the required qualifications as Professor may be considered for appointment as Reader with annual salary ranging from HK$210,840 to 280,200.

ADDITIONAL BENEFITS include long leave with full pay at one-sixth of resident service, contributory superannuation (University 15%, appointee 5%), medical benefits, education allowance for children, furnished housing accommodation on campus (rental at 7.5% of salary) and, for Professors or appointees on overseas terms, passage benefits for the appointee and his dependents as well.

FURTHER INFORMATION and APPLICATION FORMS are obtainable from Personnel Section, The Chinese University of Hong Kong, Shatin, New Territories, Hong Kong. Application, together with one set of major publications and copies of testimonials, marked "Professorship/Readership Application" on cover, should reach the University before February 15, 1982.

QUEENS COLLEGE OF THE CITY UNIVERSITY OF NEW YORK

The Mathematics Department invites applications for a tenure-track position. Preference will be given to mathematical statisticians. Please send vita and three letters of recommendation to Professor Gerald Roskes, Acting Chairman, Department of Mathematics, Queens College of the City University of New York, Flushing, New York 11367. Queens College is an affirmative action/equal opportunity employer.

SUSQUEHANNA UNIVERSITY

The Department of Mathematical Sciences at Susquehanna University anticipates a possible opening commencing September 1983 in a faculty position teaching undergraduate courses in Computer Science and Mathematics. Doctorate preferred, but others may apply. Strength in Computer Science is mandatory. Academic rank will be Assistant Professor, unless credentials are unusually strong. Salary will be commensurate with qualifications. To apply, a résumé, graduate transcripts, and three letters of reference should be sent to Professor John M. Reade, Chairman, Department of Mathematical Sciences, Susquehanna University, Selinsgrove, PA 17870.

Susquehanna has a Hewlett-Packard 3000 computer and a strong and growing academic program in computer science with 104 majors in addition to the 24 students majoring in mathematics. Ability to contribute to the continued development of a strong computer science major will be an important consideration in this search.

Susquehanna University is an Equal Employment Opportunity, Affirmative Action, and Title IX institution.
POSITIONS AVAILABLE

BOSTON UNIVERSITY
DEPARTMENT OF MATHEMATICS

The Department of Mathematics at Boston University anticipates several openings at the Assistant and Associate Professor levels beginning September, 1983. Fields unrestricted. Women and minorities especially encouraged to apply. Three letters of reference to Dennis Berkley, Chairman, Department of Mathematics, Boston University, 264 Bay State Road, Boston, MA 02215. Boston University is an Equal Opportunity/Affirmative Action Employer.

Department of Mathematics
University of Alabama in Birmingham

A tenure-track position for Fall 1983. Candidates must have an established record of quality research and be able to enhance the current research efforts of the department. Department members are currently active in algebra, applied mathematics, ordinary and partial differential equations and point set topology. Appointments will be made at the rank of assistant professor, associate professor or professor, depending on qualifications and experience. Salary negotiable. Applicants should send letter of application, vita and three letters of reference to Professor Louis Dale, Mathematics Department, University of Alabama in Birmingham, Birmingham, AL 35294. UAB is an Affirmative Action/Equal Opportunity Employer.

UNIVERSITY OF ALABAMA IN HUNTSVILLE
Department of Mathematics

One or more tenure-track positions beginning September 1, 1983. Rank and salary commensurate with experience and credentials. Strong evidence of excellent research ability and a specialty area of numerical analysis, differential equations (ordinary or partial), mathematical modeling, or optimization is required. Funded research experience is highly desirable. The University of Alabama in Huntsville has over 6,000 students and offers graduate degrees in all mathematical sciences, natural science, and engineering disciplines. Send letter of application, vita, and three letters of reference to F. L. Cook, Chairman, Department of Mathematics, The University of Alabama in Huntsville, Huntsville, Alabama 35899. Screening of applicants will begin February 1, 1983. The University of Alabama in Huntsville is an Equal Opportunity/Affirmative Action Institution.

The Department of Mathematics and Statistics, University of Alabama in Birmingham, is accepting applications for at least two tenure-track positions at the rank of Assistant Professor. A successful applicant must possess a Ph.D. in Mathematics. Preferred specialties include differential equations, functional analysis, geometric topology, number theory, and numerical analysis. The duties of these positions include teaching undergraduate and graduate mathematics courses, carrying out research or other creative activity, and contributing to a scholarly atmosphere. The appointment will begin September 1983. Applicants should send a detailed résumé, transcripts, and three letters of recommendation to Dr. S. Gene Crosley, Chairman, Department of Mathematics and Statistics, University of Alabama, Mobile, Alabama 36688. The closing date is March 1, 1983. USA is an equal opportunity/affirmative action employer.

Assistant/Associate Professor, Biomathematics Program, North Carolina State University. Teaching, research, consulting in field of stochastic modeling/model validation. Résumé, research interests, transcripts (recent graduates), three reference letters to: Dr. H. R. van der Vaart, Statistics Department, NCSU, Raleigh, NC 27650-5457. January 31, 1983 or until position is filled. AA/EOE.

Mathematical Sciences
VIRGINIA COMMONWEALTH UNIVERSITY


Send vita and names of three references to William E. Haver, Chairman, Department of Mathematical Sciences, Virginia Commonwealth University, Richmond, VA 23284. Attention: James A. Wood (for position 1); I. A. Koutrouvelis (for position 2). AA/EOE.

MATHMATICS: The Virginia Military Institute, a state supported undergraduate college, anticipates an opening at the instructor or assistant professor level in the Department of Mathematics in August 1983. The applicant should have a strong interest in teaching undergraduates in a military college environment; computer experience desirable. Send your résumé by March 31, 1983 to Department of Mathematics, The Virginia Military Institute, Lexington, VA 24450.

AA/EOE

Assistant Professor
Southern Methodist University

The Department of Mathematics at Southern Methodist University seeks an assistant professor, tenure-track, beginning August, 1983. The department offers a Ph.D. in applied mathematics, and candidates are sought with a research specialty in applied mathematics, broadly defined, or who are in an area that can support an applied group. Effective teaching and strong potential in research are expected. Applicants should send a vita and the names of three references to George Reddien, Chairman, Department of Mathematics, Southern Methodist University, Dallas, TX 75275.

Equal Opportunity/Affirmative Action Employer

INSTITUTE FOR MATHEMATICS and its APPLICATIONS
UNIVERSITY OF MINNESOTA

POST-DOCTORAL MEMBERSHIPS

Stipend $24,800 for 12-month period beginning 9-1-83

SABBATICAL SUPPORT MEMBERSHIPS

Partial support for periods from 3 to 12 months.

1983–1984 Program

MATHEMATICAL MODELS FOR THE ECONOMICS OF DECENTRALIZED RESOURCE ALLOCATION

Ideas from most fields of mathematics may be useful. Applicants must show evidence of mathematical excellence, but need not be specialists in any particular field or be "applied mathematicians." Applicants should arrange to have the following materials submitted by January 15, 1983:

1) A curriculum vitae including a list of publications.
2) Three letters of recommendation.
3) A personal statement of scientific interests, plans, and reasons for wishing to participate in the Institute program. (This statement is an important part of the application.)

All correspondence should be sent to:

Hans Weinberger, Director
Institute for Mathematics and its Applications
University of Minnesota
514 Vincent Hall/206 Church Street, S.E.
Minneapolis, Minnesota 55455, U.S.A.

The University of Minnesota is an equal opportunity educator and employer and specifically invites and encourages applications from women and minorities.
POSITIONS AVAILABLE

ALLEGHENY COLLEGE, Department of Mathematics
Meadville, PA 16335

One year position with rank open is available September 1983. Preference will be given to those candidates having a Ph.D. in mathematics. Candidates should also have a strong interest in teaching and doing research at an undergraduate liberal arts college. Teaching load is 7 courses per year, approximately 5 of which are at the freshman level, distributed over 3 terms. Applicants should send résumé and 3 letters of reference so that they arrive by January 5, 1983. Allegheny College is an Equal Opportunity Employer.

UNIVERSITY OF LOUISVILLE

Entry level, tenure-track position to begin in Fall, 1983. Requirements include a Ph.D. in Mathematics or related area, active research program, evidence of good teaching ability, and a strong interest in teaching advanced undergraduate probability and statistics courses. Interested candidates should send a letter of application, graduate transcripts and at least (3) letters of recommendation to Dr. John A. Roberts, Chairman, Search Committee, Department of Mathematics, University of Louisville, Louisville, Kentucky 40292. Consideration will begin on January 2, 1983, and continue until filled. Equal Opportunity/Affirmative Action Employer.

UNIVERSITY OF LOUISVILLE

Entry level, tenure-track position to begin in Fall, 1983. Requirements include a Ph.D. in Mathematics or related field, active research program, evidence of good teaching ability, and a strong interest in teaching advanced undergraduate analysis courses. Interested candidates should send a letter of application, graduate transcripts and at least (3) letters of recommendation to Dr. John A. Roberts, Chairman, Search Committee, Department of Mathematics, University of Louisville, Louisville, Kentucky 40292. Consideration will begin on January 2, 1983, and continue until filled. Equal Opportunity/Affirmative Action Employer.

KENT STATE UNIVERSITY

Department of Mathematical Sciences

Applications are invited for two tenure-track faculty positions in analysis at the Assistant or the Associate Professor level. Appointment effective Fall Semester, 1983. Applicants should have a Ph.D. in Mathematics. Duties include teaching, research, and dissertation direction. Of particular interest are the areas of numerical analysis, approximation theory, harmonic analysis, functional analysis, pde's and related areas. Salary is competitive and open. Departmental computing equipment includes a VAX-11/780 with the extensive algebraic symbolic manipulation package called MACSYMA, ONYX 28000 micro time sharing system, and other micro and graphics equipment. Application deadline: February 15, 1983. Send résumé and three letters of recommendation to Dr. Ola F. Stackelberg, Chairman, Department of Mathematical Sciences, Kent State University, Kent, Ohio 44242.

SYRACUSE UNIVERSITY

Tenure-track renewable faculty position is available at the assistant professor level. Research potential is of prime importance; Ph.D is required, with specialization in numerical analysis or in a closely related field, together with sufficient graduate study in numerical analysis to teach graduate courses in the area. Applications must include a detailed vita. Each candidate should arrange for three letters of reference and a transcript to be sent. Complete applications are due February 15, 1983. Applications should be sent to Professor L. J. Lardy, Chairman, Department of Mathematics, Syracuse University, Syracuse, NY 13210.

An AA/EO employer.

UNIVERSITY OF KANSAS

Applicants are invited for several postdoctoral instructorships in mathematics. These appointments are for a single academic year, but are normally renewable for a second and third year. Applicants must have Ph.D., or dissertation accepted with only formalities to be completed. Preference will be given to applicants whose research interests mesh well with those of current staff. Send detailed résumé and dissertation abstract, and have three letters of reference sent, to C. J. Himmelberg, Chairman, Department of Mathematics, University of Kansas, Lawrence, KS 66045. Closing date is March 1, 1983.

University of Kansas is an Affirmative Action/Equal Opportunity Employer.

MATHMATICS

TENURE TRACK POSITION

UNIVERSITY OF MARYLAND BALTIMORE COUNTY

The UMBC Mathematics and Computer Science Department invites applications for a tenure-track assistant professor position beginning September 1983. Candidates should have Ph.D., strong teaching ability, and demonstrable research potential with interests in discrete mathematics and/or in fields currently represented on the faculty (applied and complex analysis, computer science, control systems, numerical analysis, operations research, statistics and probability). Experience or ability to teach undergraduate computer science courses is desirable. The Department offers a B.A. program in mathematics, a B.S. program in computer science, M.S. and Ph.D. programs in applied mathematics. Send a curriculum vitae, reprints and/or preprints, names of at least three references to: Richard C. Roberts, Chairman, Department of Mathematics and Computer Science, University of Maryland Baltimore County, Catonsville, Maryland 21228, telephone 301-455-2405. EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER.

COMPUTER SCIENCE

UNIVERSITY OF MARYLAND BALTIMORE COUNTY

The UMBC Mathematics and Computer Science Department anticipates having several tenure-track and tenured faculty positions at the assistant, associate, or full professor level beginning September 1983. Candidates should have Ph.D. in computer science or in a closely related field, demonstrable research potential, and strong ability to teach a broad range of basic computer science courses and graduate courses in one's field of specialization. The Department offers a B.A. program in mathematics, a B.S. program in computer science, M.S. and Ph.D. programs in applied mathematics. Current graduate course offerings are grouped in the following areas: applied analysis, computer science, control systems, numerical analysis, operations research, statistics and probability. Send a curriculum vitae, reprints and/or preprints, names of at least three references to: Richard C. Roberts, Chairman, Department of Mathematics and Computer Science, University of Maryland Baltimore County, Catonsville, Maryland 21228. EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER.

WESLEYAN UNIVERSITY

Wesleyan University invites applications for a junior tenure-track position in Computer Science, within the Mathematics Department, beginning Fall, 1983; the closing date for applications is February 15, 1983. The area of specialization is completely open, and the teaching responsibilities are two courses per semester. Wesleyan's central computing facility operates a DECSYSTEM-2060. Please send vita and three letters of recommendation to: Anthony W. Hager, Mathematics Department, Wesleyan University, Middletown, Connecticut 06457. An Equal Opportunity/Affirmative Action Employer.
POSITIONS AVAILABLE

POSITION IN OPERATIONS RESEARCH

The Mathematical Sciences Department of Rice University expects to have a position in Operations Research available beginning Fall, 1983. Although the position is expected to be at a senior level, applications at all levels are invited. Primary duties include providing leadership in teaching, research, and direction of graduate students in the department's Operations Research program. The department currently has responsibilities in the areas of computer science, numerical analysis, operations research, probability, statistics, and physical mathematics and biomathematics. The department has an active undergraduate and graduate program in these areas. If interested, please send resume and names of four references to Professor Richard Tapia, Chairman, Mathematical Sciences Dept., Rice University, P.O. Box 1892, Houston, Texas 77251.

Southwest Texas State University, San Marcos, Texas 78666
Applications are invited for positions beginning Fall 1983: Assistant or Associate Professorships in Computer Science, tenure and non-tenure track. Applicants should have a Ph.D. in computer science (or closely related area) or extensive experience in computer science. Preference will be given to candidates in Computer Science Education. Responsibilities include undergraduate and graduate teaching and curriculum development.

Assistant or Associate Professorships in Mathematics, tenure and non-tenure track. Applicants should have a Ph.D. in mathematics (or closely related area) and demonstrate potential for excellence in research and teaching. Preference will be given to candidates with research interests in number theory, quadratic forms, or mathematics education. Applicants in differential equations, operations research, and geometric topology are also invited to apply.

Instructorships, non-tenure track. Applicants should have an M.A. or equivalent in mathematics or computer science (or closely related area), and demonstrate excellence in teaching or teaching potential, and be willing to participate in faculty seminars and committee projects. Substantial experience is desired for Computer Science applicants.

Salary and rank commensurate with qualifications and experience. Applications should be completed by February 15, 1983 (late applications will be considered if openings exist). Information concerning specific positions is available from Dr. John Spellman, Chairman, Dept. Math/C.S. SWTSU is an Equal Opportunity/Affirmative Action Employer.

COLUMBIA UNIVERSITY

Department of Computer Science

Lectureships

Positions as lecturer or senior lecturer will be offered to excellent teachers with superior academic backgrounds. Faculty of all ranks in other disciplines, as well as computer science, are encouraged to apply for these non-tenured term appointments, whose duration will typically be 3 to 6 years. Pay is comparable to professorial levels.

These lectureships provide an opportunity for teacher/scholars with some substantial prior computing experience to make a transition to computer science. Columbia University has an outstanding young research faculty and facilities. A five-million dollar office and research-laboratory building is now nearly completed. Lecturers will be encouraged to participate fully in departmental activities.

Lecturers will teach two undergraduate courses each semester. They must be able to make highly effective presentations to large classes. The University has several DEC 2060 computer systems dedicated to instructional use. Many terminals for students are in dormitories and other convenient locations. Knowledge of innovative uses of technology for teaching is desirable.

Send resume and names of three references to Professor Jonathan L. Gross, Vice-Chairman, Department of Computer Science, Columbia University, New York, NY 10027. Columbia University is an equal opportunity/affirmative action employer.

UNIVERSITY OF BRIDGEPORT

CHAIRPERSON, DEPARTMENT OF MATHEMATICS

Tenure-track appointment beginning Fall 1983. Candidates must have Ph.D. in Mathematics/Mathematical Sciences. Applicants should have evidence of leadership ability and excellence in teaching. Research interests in Applied Mathematics/Statistics preferred. The Mathematics and Electrical and Computer Engineering Departments jointly offer a Computer Science program. Some expertise in Computer Science is desirable. Send resume and names of four references to Dr. Grace Ho, Mathematics Department, University of Bridgeport, Bridgeport, CT 06601. An Equal Opportunity/Affirmative Action Employer.

RUTGERS, THE STATE UNIVERSITY OF NEW JERSEY

Department of Mathematics at New Brunswick anticipates the following open positions beginning September 1983:

(1) VISITING POSITIONS. Candidates must have Ph.D., proven record of outstanding research accomplishments in pure or applied mathematics, and concern for teaching. These are non-renewable one- or two-year positions.

(2) HILL ASSISTANT PROFESSORSHIPS. Candidates must have received Ph.D., show outstanding promise in research ability in pure or applied mathematics, and concern for teaching. These are three-year non-renewable positions.

(3) TENURE-TRACK ASSISTANT PROFESSORSHIPS. Candidates must have Ph.D., with outstanding research ability in pure or applied mathematics and concern for teaching.

(4) SENIOR MATHEMATICAL PHYSICIST at the full professor level. Candidates should have a national and international record of outstanding research achievements and a concern for teaching.

(5) INSTRUCTORSHIPS AND LECTURESHIPS, with primary responsibility and concern for teaching, but with some interest in research. Applicants should have their Ph.D. degree or be working towards its completion. These are one- or two-year non-tenure-track non-renewable positions.

Resumes and 3 letters of recommendation should be sent to: Professor Charles Sims, Chairman, Department of Mathematics, Rutgers University, New Brunswick, NJ 08803.

RUTGERS UNIVERSITY IS AN EQUAL OPPORTUNITY/ AFFIRMATIVE ACTION EMPLOYER.
POSITIONS AVAILABLE

MICHIGAN TECHNOLOGICAL UNIVERSITY

Several tenure-track positions in applicable mathematics (e.g., probability, fluid mechanics, ODE, PDE, etc.) statistics, differential geometry, numerical analysis and computer science, as well as visiting positions are available. Assistant or associate professors preferred. Excellent research and teaching are required. MTU is a strong engineering school with good students and consulting possibilities. Houghton has temperatures moderated by Lake Superior with a great deal of snow and recreational activities. To apply, write Dr. Richard Millman, Head, Department of Mathematical and Computer Sciences, Michigan Technological University, Houghton, Michigan 49931. MTU is an equal opportunity educational institution/equal opportunity employer.

DEPARTMENT HEAD

WORCESTER POLYTECHNIC INSTITUTE

A candidate must have demonstrated achievement in scholarship and a commitment to quality undergraduate teaching. The position is two courses per quarter, two courses per semester for visiting positions. Duties include teaching 7-9 hours per semester of undergraduate courses, committee service, and scholarly publication. Qualifications include a Ph.D. with established record and/or strong potential in diverse areas of applicable mathematics. Send credentials and three letters of reference to the Search Committee, Department of Mathematical Sciences, W.P.I., Worcester, MA 01609. Deadline for receipt of materials is February 15, 1983. EO/AAE

MIAMI UNIVERSITY

The department of mathematics and statistics, Miami University, Oxford, Ohio, has two tenure-track positions available beginning in August 1983. The first is an assistant professorship in statistics on the Oxford campus. Normally, duties include teaching 7-9 hours per semester of undergraduate and graduate statistics courses, continuing research, and serving on departmental committees. Qualifications include a Ph.D. in statistics and a demonstrated aptitude in teaching and research. An interest in statistical applications would be desirable. The second is an assistant professorship in mathematics, statistics, or mathematics education on the Hamilton campus. Duties include teaching an average of 12 hours per semester of undergraduate courses, committee service, and scholarly publication. Qualifications include a doctoral degree in mathematics, statistics, or mathematics education, demonstrated ability in teaching, and interest in scholarly publication. ABD candidates may be considered for an instructorship.

To apply for one of these positions, send vita, graduate transcript, and three letters of recommendation to D. J. Lutzer, Department of Mathematics and Statistics, Miami University, Oxford, Ohio 45056, by February 15, 1983 (late applications may be considered). Miami is an AA/EEO employer.

CLEVELAND STATE UNIVERSITY

Mathematics Department.

Visiting Assistant or Associate Professor for 1983-1984. Ph.D. with established record and/or strong potential in research area. Field open, but preference given to people working in areas compatible with research interests of faculty. Commitment to excellence in teaching and broad undergraduate teaching interests are necessary. Department offers courses through masters level. Normal teaching load is two courses per quarter. Competitive salary and excellent fringe benefits. Selection process begins February 15, 1983, but late applications will be accepted until the position is filled. Send vita and at least three letters of recommendation to Search Committee, Department of Mathematics, Cleveland State University, 1983 East 24th Street, Cleveland, Ohio 44115. At Denver meeting, see B. Scott. An equal opportunity employer M/F/H.

Department of Mathematics

Chairperson

Murray State University is accepting applications for the position of Chairperson, for employment beginning July 1, 1983. Screening will begin on January 15, 1983, and will continue until the position is filled. Applicants must have a Ph.D. in an appropriate discipline and have an appreciation for teaching, research, and public service. The Department of Mathematics has a faculty of seventeen and offers courses in Mathematics and Statistics which lead to bachelor and masters degrees in Mathematics. Murray State University, located in the heart of Western Kentucky's lake country, has an enrollment of 8,000 students, and is located in a city of 17,000. Send applications including complete transcripts, vita, and names of three references to:

Chairman, Search Committee
Department of Mathematics
Murray State University
Murray, KY 42071

Murray State University is an Equal Opportunity Affirmative Action Employer.

Cumberland College, a four year, church-related liberal arts college of approximately 1,800 students in the mountains of Eastern Kentucky invites applications for two tenure-track positions at the assistant/associate professor level in mathematics and computer science.

Mathematics: Ph.D. required. Duties include teaching upper level college mathematics. Experience in Computer Science and college level teaching desired.

Computer Science: Assistant Director of Computer Services. Experience with BASIC, COBOL, FORTRAN is required. Duties include development and installation of college related software.

Salaries and fringe benefits are competitive. Send application, letters of recommendation, and current vita to:

Joseph E. Early
Academic Dean
Cumberland College
Williamsburg, Kentucky 40769

UNIVERSITY OF NEW BRUNSWICK

DEPARTMENT OF MATHEMATICS & STATISTICS

The Department of Mathematics and Statistics will have a tenure-track position for a statistician commencing July 1, 1983. The appointment will be made at the rank of Assistant Professor. The July 1, 1982 salary range is $24,359–$34,613. The minimum qualification requirement is the Ph.D. Placement within the salary range will depend upon academic qualifications and experience. Duties include undergraduate teaching and research. Send an up-to-date vita and the names of 3 referees to Dr. Gordon R. Mason, Chairman, Department of Mathematics and Statistics, University of New Brunswick, P.O. Box 4400, Fredericton, New Brunswick, Canada E3B S3S. In accordance with Canadian immigration requirements, this advertisement is directed to Canadian citizens and legal residents of Canada. The University of New Brunswick does not discriminate in employment on the basis of color, age, sex, race, religion or national origin.

UNIVERSITY OF SOUTH CAROLINA, COLUMBIA

Applications are invited for faculty positions in mathematics and applied mathematics, starting Fall 1983. Ph.D. degree with strong research potential and dedication to teaching at undergraduate and graduate level required. Candidates should send vita and arrange for four letters of recommendation to be sent to Dr. William T. Trotter, Jr., Chairman, Department of Mathematics and Statistics, University of South Carolina, Columbia, SC 29208. AA/EOE
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NEW YORK SYMPOSIUM & MEETING
April 12–15, 1983

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