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of the American Mathematical Society

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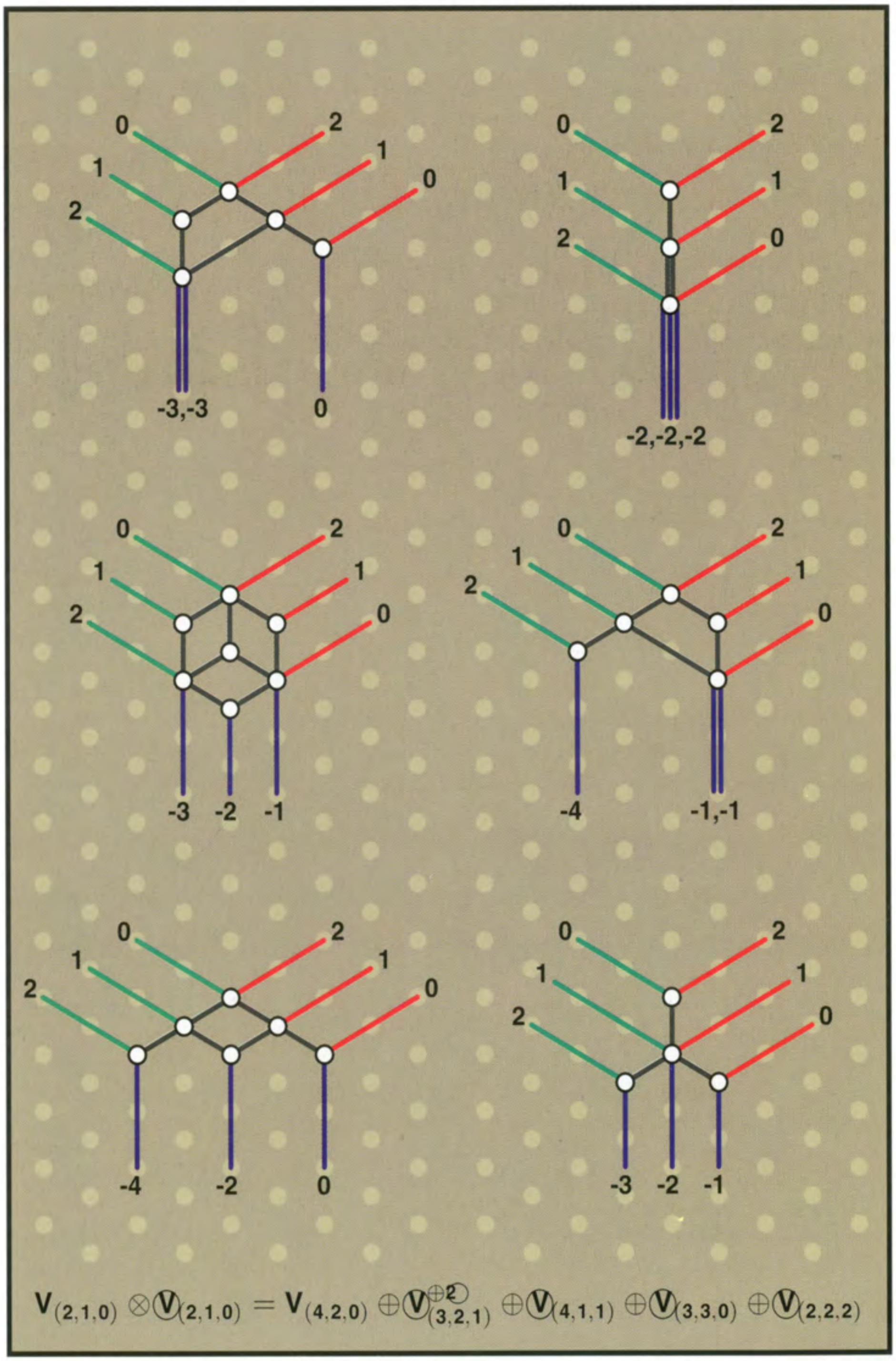


Honeycombs and Tensor Products *(see page 186)*

American Mathematical Society

New Titles from the AMS

Supplementary Reading

Partial Differential Equations in Several Complex Variables

So-Chin Chen, *National Tsing-Hua University, Hsinchu, Taiwan*, and **Mei-Chi Shaw**, *University of Notre Dame, IN*

This book is intended as both an introductory text and a reference book for those interested in studying several complex variables in the context of partial differential equations. In the last few decades, significant progress was made in the study of Cauchy-Riemann and tangential Cauchy-Riemann operators; this progress greatly influenced the development of PDEs and several complex variables. After the background material in complex analysis is developed in Chapters 1 through 3, the next three chapters are devoted to the solvability and regularity of the Cauchy-Riemann equations using Hilbert space techniques. The second part of the book gives a comprehensive study of the tangential Cauchy-Riemann equations, another important class of equations in several complex variables first studied by Lewy. Embeddability of abstract CR structures is discussed in detail here for the first time.

This fairly self-contained book provides a much-needed introductory text. It also provides a rich source of information to experts.

Titles in this series are copublished with International Press, Cambridge, MA.

AMS/IP Studies in Advanced Mathematics, Volume 19; 2001; 380 pages; Hardcover; ISBN 0-8218-1062-6; List $49; All AMS members $39; Order code AMSIP/19NT102

Topics in Functional Differential and Difference Equations

Teresa Faria, *Universidade de Lisboa, Portugal*, and **Pedro Freitas**, *Instituto Superior Técnico, Lisboa, Portugal*, Editors

This volume contains papers written by participants at the Conference on Functional Differential and Difference Equations held at the Instituto Superior Técnico in Lisbon, Portugal. The conference brought together mathematicians working in a wide range of topics, including qualitative properties of solutions, bifurcation and stability theory, oscillatory behavior, control theory and feedback systems, biological models, state-dependent delay equations, Lyapunov methods, etc. Articles are written by leading experts in the field. A comprehensive overview is given of these active areas of research.

Fields Institute Communications, Volume 29; 2001; 378 pages; Hardcover; ISBN 0-8218-2701-4; List $110; Individual member $66; Order code FIC/29NT102

Operator Theoretical Methods

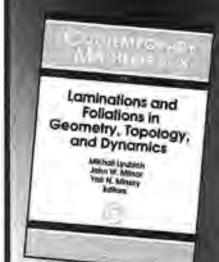
A. Gheondea, **R. N. Gologan**, and **D. Timotin**, *Romanian Academy, Bucharest*, Editors

A publication of the Theta Foundation.

This volume contains carefully selected contributions by participants at the Seventeenth International Conference on Operator Theory held at the University of Timişoara (Romania). A large variety of topics are covered, including single operator theory, C^*-algebras, spectral theory, special classes of concrete operators, and holomorphic operator functions. The book also includes applications in other areas of mathematics and science.

Distributed worldwide, except in Romania, by the AMS.

International Book Series of Mathematical Texts; 2000; 415 pages; Hardcover; ISBN 973-99097-2-8; List $38; All AMS members $30; Order code THETA/1NT102

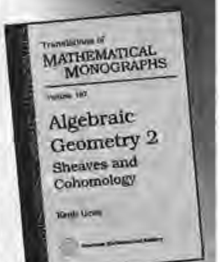


Laminations and Foliations in Geometry, Topology, and Dynamics

Mikhail Lyubich, **John W. Milnor**, and **Yair N. Minsky**, *SUNY at Stony Brook, NY*, Editors

This volume is based on a conference held at SUNY, Stony Brook (NY). The concepts of laminations and foliations appear in a diverse number of fields, such as topology, geometry, analytic differential equations, holomorphic dynamics, and renormalization theory. Although these areas have developed deep relations, each has developed distinct research fields with little interaction among practitioners. The conference brought together the diverse points of view of researchers from different areas. This book includes surveys and research papers reflecting the broad spectrum of themes presented at the event.

Contemporary Mathematics, Volume 269; 2001; approximately 232 pages; Softcover; ISBN 0-8218-1985-2; List $59; Individual member $35; Order code CONM/269NT102



Recommended Text

Algebraic Geometry 2

Sheaves and Cohomology

Kenji Ueno, *Kyoto University, Japan*

Modern algebraic geometry is built upon two fundamental notions: schemes and sheaves. The theory of schemes was explained in *Algebraic Geometry 1: From Algebraic Varieties to Schemes* (see Volume 185 in the same series, Translations of Mathematical Monographs). In the present book, Ueno turns to the theory of sheaves and their cohomology. Loosely speaking, a sheaf is a way of keeping track of local information defined on a topological space, such as the local holomorphic functions on a complex manifold or the local sections of a vector bundle. To study schemes, it is useful to study the sheaves defined on them, especially the coherent and quasicoherent sheaves. The primary tool in understanding sheaves is cohomology. For example, in studying ampleness, it is frequently useful to translate a property of sheaves into a statement about its cohomology.

The text covers the important topics of sheaf theory, including types of sheaves and the fundamental operations on them, such as …

- coherent and quasicoherent sheaves.
- proper and projective morphisms.
- direct and inverse images.
- Čech cohomology.

For the mathematician unfamiliar with the language of schemes and sheaves, algebraic geometry can seem distant. However, Ueno makes the topic seem natural through his concise style and his insightful explanations. He explains why things are done this way and supplements his explanations with illuminating examples. As a result, he is able to make algebraic geometry very accessible to a wide audience of non-specialists.

The book contains numerous problems and exercises with solutions. It would be an excellent text for the second part of a course in algebraic geometry.

Translations of Mathematical Monographs (*Iwanami Series in Modern Mathematics*), Volume 197; 2001; approximately 200 pages; Softcover; ISBN 0-8218-1357-9; List $29; All AMS members $23; Order code MMONO/197NT102

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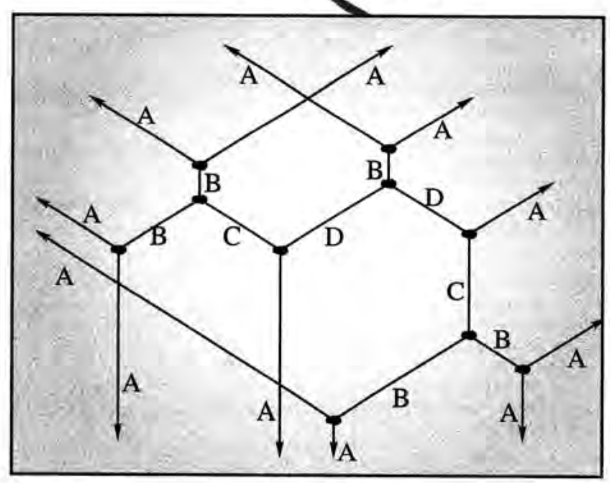
of the American Mathematical Society

February 2001

Feature Articles



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Commentary

Notices
of the American Mathematical Society

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Departments

From the AMS Secretary

Geek Chic

It's a thing that nonmathematicians don't realize. Mathematics is actually an aesthetic subject almost entirely.
—John H. Conway

We mathematicians know well the aesthetic pleasures of our subject. G. H. Hardy wrote in *A Mathematician's Apology* that a "mathematician's patterns, like the painter's or the poet's, must be *beautiful*; the ideas, like the colors or the words, must fit together in a harmonious way." How frustrating it is that these pleasures cannot be transmitted to the general public. How frustrating that our intelligent and otherwise highly literate friends have so little appreciation for our labors.

I have some *good news* to report. There is right now in the popular culture a *wave* of interest in mathematics. Even better, the image that has captured the public imagination is that of a mathematician working intensely and usually alone on the most difficult and abstract problems. What was once considered hopelessly geeky is suddenly au courant.

A recent manifestation of this phenomenon is the play *Proof*, in which three of the four characters are mathematicians. The plot centers on a notebook of uncertain authorship that may or may not contain a great proof. Ben Shenkman is excellent as Hal, a graduate student that many will recognize. Yes, he is geeky and callow (the repartee about his rock band is hilarious) but simultaneously very human and humane. The star, Mary Louise Parker playing Catherine, is amazing. I've often been disappointed by theatrical attempts to portray genius. Parker's Catherine has an authentic genius. She struggles with family and with mental illness. She has enormous intensity and vivid sexuality. The disparate pieces come together (this is magic to me) in an utterly believable and compelling portrayal. Reviews of the play, including one that appeared in the *Notices* (October 2000, pages 1082–1084), have been excellent. Buoyed by this success, *Proof* moved to Broadway in October 2000.

How can we mathematicians ride this wave? "Proof: A Symposium", held last October at New York University, provides an outstanding model. The symposium was a forum for discussion by mathematicians and nonmathematicians of some of the mathematical themes and ideas raised in *Proof*. The symposium's first panel discussion, on the nature of proof, was the most mathematical. The star was Thomas Nagel, a distinguished philosopher whose incisive views on objective truth were of interest to mathematician and nonmathematician alike. The second panel, "Women and Proof", had an all-star cast. The stories these women told were at turns funny and moving. Skillful organization kept the strong-minded panelists on common themes. The final panel, "Images of Proof", consisted of writers and actors. Hearing these panelists discuss my world was an eye-opener. They are always searching for the best image for their works. Andrew Wiles at lunch discussing French history is not a powerful image. Andrew Wiles in the attic for seven years is, for them, ideal. Most disconcerting to us are images that join mathematics and madness, a theme in almost all the popular works.

The key to the success of "Proof: A Symposium" and similar ventures is to bring together people from inside and outside the mathematical community. "Proof: A Symposium" was cosponsored by the Sloan Foundation, which is taking a leading role in the popularization of science and mathematics; the Manhattan Theatre Club, which produced *Proof*; and the Courant Institute. (Full disclosure: While Courant is my institutional home, I had no part in the organization of the symposium.) The Mathematical Sciences Research Institute in Berkeley has had a series of successful public events of this kind, beginning with the "Fermat Fest" in 1993. More recent events have included a conversation between mathematician Robert Osserman of Stanford University and playwright Tom Stoppard concerning Stoppard's work *Arcadia*, and a mix of conversations and theatre about the life of Galileo.

On the screen *Good Will Hunting* and π will soon be joined by a film based on *A Beautiful Mind*, Sylvia Nasar's biography of John Nash. *Proof* joins *Copenhagen* on Broadway. Bookstores are stocked with biographies of Paul Erdős; the latest book by the renowned mathematics expositor Keith Devlin; and novels with mathematical themes, such as *Uncle Petros and Goldbach's Conjecture* and *The Wild Numbers*. All this attention is most enjoyable. Let's take it as an opportunity to communicate to the public the beauty and centrality of our subject.

—Joel Spencer
Courant Institute, New York University

Proof: A Symposium
October 16, 2000
New York University

Panel I: *What's a Proof and What's It Worth?*: Peter Sarnak (moderator), Princeton University; Kit Fine, NYU; Arthur Jaffe, Harvard University and Clay Mathematics Institute; Dusa McDuff, SUNY Stony Brook; Thomas Nagel, NYU; Michael Rabin, Harvard University; Jack Schwartz, Courant Institute, NYU.

Panel II: *Women and Proof:* Margaret H. Wright (moderator), Lucent Technologies; Dusa McDuff, SUNY Stony Brook; Cathleen Morawetz, Courant Institute, NYU; Mary Pugh, University of Pennsylvania; Jean E. Taylor, Rutgers University; Karen Uhlenbeck, University of Texas at Austin.

Panel III: *Proof in Performance and Prose:* Michael Janeway (moderator), Columbia University; David Auburn, author of *Proof*; Rebecca Goldstein, novelist; Sylvia Nasar, Columbia University; Ben Shenkman, actor who plays Hal in *Proof*.

Letters to the Editor

Standards in School Mathematics

The *Notices* for September and October 2000 featured some discussion of the *Principles and Standards for School Mathematics* ("PSSM") of the National Council of Teachers of Mathematics (NCTM), this manifesto being for the most part a revision of NCTM's 1989 *Standards*. The earlier document, mainly unnoticed by the mathematical profession at the time, offered as its principal vision that school mathematics need not be difficult or dull and that the cure was to remove the mathematical content from it, leaving behind the mathematical concepts as a sort of Cheshire Cat grin. There is no place here for detail, for which see the "Mathematically Correct" Web page (`http://mathematicallycorrect.com/`) or find a copy in a library and see for yourself.

Needless to say, not everyone agrees with the above assessment of the import of the 1989 *Standards*, but by the end of the 1990s enough mathematicians—notable among them Richard Askey, the late Han Sah, and Hung-Hsi Wu—had developed a loathing for NCTM doctrine that managed to attract the attention of NCTM itself. Other opposition has also emerged, mainly from parents' groups enraged at the NCTM-blessed mathematics programs beginning to spread in their schools. ("Mathematically Correct", which speaks for some scientists and mathematicians as well, was a pioneer among these.) Clearly NCTM would have to take account of mathematicians in writing its scheduled new edition (i.e., PSSM), and it did.

As Joan Ferrini-Mundy, its principal editor, explained in her September *Notices* article, NCTM this time commissioned the commentary of many mathematicians, including committees of AMS, MAA, and SIAM, upon an earlier draft prepared for us. I myself served on the AMS committee and (by commission) as an individual too. NCTM solicited public advice at large, and I know several who also attempted to link the mathematical world with the new document, but the effort was to little avail; the message—the "vision" of PSSM—remains, in my vision, much the same as that of the original 1989 *Standards*.

PSSM continues to abhor direct instruction in, among other things, standard algorithms, Euclidean geometry, and the uses of memory. Though like its predecessor it has the word "standards" in its title, it is not a set of standards in the usual meaning of the term, for it refuses to say what exactly a child should learn in thirteen years of schooling. Long division? Quadratic formula? How to compute the quotient of two fractions? (See p. 218 of PSSM for an enlightening discussion.) Proof of a theorem on inscribed angles? Trigonometric identities? PSSM will neither affirm or deny, lest it seem to dictate content.

Joan Ferrini-Mundy has publicly averred that both PSSM and its predecessor have been misunderstood and that NCTM does indeed advocate learning the multiplication tables. This is almost true for the multiplication table, though only as a last resort (PSSM, p. 152). Other such concessions are harder to find. Almost anything in the way of content to be remembered can be omitted from a school mathematics program without running afoul of PSSM, providing the pedagogy is right and the process suitably "exploratory". "Explore", "develop", and "understand", and their variants, are much more prominent in the text than "know", "prove", and "remember".

Under the color of NCTM's vision of mathematics as expressed in the 1989 *Standards* have been written a number of school mathematics programs recently officially recognized as "exemplary" or at least "promising" by the U.S. Department of Education, but to a chorus of public protests, some of it from mathematicians. Because many of us with children—or grandchildren—in today's schools have now seen these programs in action, the public protests are still mounting. PSSM may prove a marginally better theoretical guide to further such projects than the 1989 version, but we deserve better than this. If the world of mathematics, sadly divorced from the world of school mathematics education, pays no more effective attention to the schools in the next ten years than it has in the past thirty, the country is in for a meager intellectual future.

True, it is not the primary business of mathematicians to study the problems of school mathematics programs, let alone engage in the political struggle needed to make a difference in the public schools themselves, but I appeal to all who read this letter to obtain a copy of PSSM (`http://www.nctm.org/`) and reflect on what such a document means to the future of the children in today's schools. I warn you that these "principles and standards" cannot be appreciated by reading only a few pages. In the small the document sometimes sounds good. But if PSSM in the large informs our vision, then self-esteem is better than knowledge, dictionaries can replace a ready (memorized?) vocabulary, and higher-order thinking skills will boil stones into soup.

—*Ralph A. Raimi*
University of Rochester

(Received October 20, 2000)

Hellmuth Kneser's Forgotten CR Extension Theorem

F. Treves' interesting and informative article in the November 2000 issue discusses several major themes in multidimensional complex analysis in the concrete context of the hyperquadric.

In particular, the author recalls the local extension theorem for Cauchy-Riemann functions (Theorem 1, page 1248), with reference to Hans Lewy's well-known 1956 paper. Treves, as well as virtually all other researchers in the field, had not been aware that this celebrated CR extension theorem was proved twenty years before H. Lewy's paper in a remarkable 1936 paper by Hellmuth Kneser, come back to light only recently (Die Randwerte einer analytischen Funktion zweier Veränderlichen, *Monatsh. Math. Phys.* **43** (1936), 364–380).

This important paper, together with earlier contributions by W. Wirtinger (1926) and F. Severi (1931), documents that CR functions have a history much older than commonly recognized.

Related to this matter is the widespread confusion regarding the global CR extension theorem, first proved by G. Fichera in 1957 and often attributed mistakenly to S. Bochner. For the record, there is no evidence whatsoever in Bochner's 1943 paper to suggest that Bochner had even remotely been thinking about CR functions and the corresponding version of Hartogs's famous extension theorem. More details may be found in my forthcoming historical article in *The Mathematical Intelligencer.*

—R. Michael Range
State University of New York at Albany

(Received October 31, 2000)

Correction to the History of Hilbert's Problems

In the August issue of the *Notices* appeared Grattan-Guinness's intriguing article "A Sideways Look at Hilbert's Twenty-three Problems of 1900". One claim made in that article calls for correction. Grattan-Guinness, discussing the comments after Hilbert's 1900 lecture at the International Congress of Mathematicians, stated that "Peano...remarked that [Hilbert's] Second Problem on [proving] the consistency of arithmetic was already essentially solved by colleagues working on his project of mathematical logic and that the forthcoming Congress lecture by Alessandro Padoa...was pertinent to it" (p. 756). Actually, Peano made a much more direct and unqualified assertion: "Monsieur Padoa's later communication will answer Hilbert's Second Problem" (p. 21 of the Congress proceedings). Despite Peano's claim, Padoa's article did not solve Hilbert's Second Problem by proving the consistency of arithmetic, but only stated that "to prove the consistency of a postulate system, one must find an interpretation of the undefined symbols which satisfies all the postulates simultaneously" (p. 249 of the Congress proceedings). What Hilbert wanted to do was, in fact, to find an absolute consistency proof, not a relative consistency proof using models. At that time only such relative consistency proofs were known, and this may account for Padoa's and Peano's confusion.

Next, Grattan-Guinness added: "Unfortunately Hilbert did not make amends in the *Archiv* version (presumably lack of Italian again), but in *L'Enseignement Mathématique* Padoa explicitly discussed this problem...". The fact that Hilbert did not modify his article when it was later reprinted in the *Archiv der Mathematik und Physik* to reflect Padoa's Congress article was not due to Hilbert's not knowing Italian, since Padoa's article was in French. Rather, it was because Padoa's Congress article contributed nothing to the solution of Hilbert's Second Problem, despite Padoa's claim in *L'Enseignement Mathématique* to have solved it.

Grattan-Guinness leaves the reader with the impression that Peano and Padoa were right in claiming that the Second Problem was solved and Hilbert wrong. But, in fact, the opposite is true. As is well known, the Second Problem was not solved until 1931 by Kurt Gödel in the profound result now known as his Second Incompleteness Theorem.

—Gregory H. Moore
McMaster University

(Received November 7, 2000)

Response to Moore's Letter

On consistency, it is clear that Hilbert required an absolute version for arithmetic, and I should have distinguished it from relative ones. It is a pity, though, that Padoa's foundational work has been overshadowed by that of others. His Paris lecture did not appear till 1901, after the *Archiv* version of Hilbert's paper anyway.

Two pieces of information from readers of my article are worth passing on.

The first has some kinship with the above point. Professor Rüdiger Thiele (Halle University) has found in a notebook in file 600 of Hilbert's mountainous *Nachlass* at Göttingen University Library an apparently undated passage in which Hilbert recalled including a 24th problem for his Paris address. It was concerned with finding criteria for finding simplest proofs of theorems in mathematics in general—once again, more a programme than a problem in the normal sense. He left it out of his final version, I suspect after realising that, ironically, simplicity is an extremely *complicated* notion to capture in a *general* way, so that nothing useful could be said here.

Concerning the complaints about the presentation of the lectures at the Paris Congress which I reported, Professor Wilfrid Hodges (University of London) tells me that recently he himself lectured in the same room that Hilbert had used. Apparently the acoustics there are terrible!

—Ivor Grattan-Guinness
Middlesex University

(Received November 20, 2000)

Mathematics for Teaching

Al Cuoco

Reflecting a growing interest in mathematics education at all levels, many in the mathematics community have turned their attention to the mathematical preparation of prospective precollege teachers. Education researchers ([1], [2], for example) have documented striking differences in mathematical sophistication between teachers in the U.S. and teachers from other countries. A decade of thought and effort has produced several sets of specific recommendations for the improvement of the mathematical preparation of teachers [3], [4], [5]. And the NCTM document *Principles and Standards for School Mathematics* outlines some broad goals:

> Teachers need several different kinds of mathematical knowledge—knowledge about the whole domain; deep flexible knowledge about curriculum goals and about the important ideas that are central to their grade level; knowledge about how the ideas can be represented to teach them effectively; and knowledge about how students' understanding can be assessed. ...This kind of knowledge is beyond what most teachers experience in standard preservice mathematics courses in the United States. ([6], p. 17)

Exactly what, if anything, needs to be changed in the mathematics courses teachers study in college? In this article I'll focus on the preparation of secondary (mainly high school) teachers, because most mathematics courses for future secondary teachers are taught in mathematics departments and because this is the grade span I know best. For the past three decades I've spent most of my time thinking about high school mathematics—teaching it, working with people who teach it or plan to teach it, and writing materials for it.

What Needs to Be Changed

Recommendations arise in an effort to improve things, so before I make mine I'd like to take a look, from the inside out, at what needs improving. In fact, most of what needs improving in high schools has nothing to do with the mathematical preparation teachers receive. Oppressive working conditions (five or more classes a day), the culture of schools, lack of resources, low pay and lack of respect in the community, top-heavy administrations, separation from the rest of the mathematics community, and government officials who propose political solutions to educational problems are at least as responsible as the current undergraduate curriculum is for the underperformance of mathematics programs. And it is, of course, a gross generalization to describe something as "a problem" when classrooms are as different as the people who teach in

Al Cuoco directs the Center for Mathematics Education at Education Development Center. His e-mail address is alcuoco@edc.org.

My sincere thanks are extended to the many people who helped with this article. Early drafts were improved greatly by the comments of Paul Goldenberg, Wayne Harvey, Michelle Manes, Dick Askey, and a colleague of Dick whose identity remains mysterious. The people mentioned in the article were generous with details about their work. The reviewers and the editor provided invaluable advice and help in polishing the penultimate version.

them. Still, there are some common features of almost every high school program I've seen that are very troublesome and that probably can be traced back to the kind of mathematics one learns as an undergraduate. Let me start by describing these; see if you recognize any of the following as habits undergraduates might pick up in your classes.

- *What it's all about.* In many schools, mathematics is perceived as an established body of knowledge that is passed on from one generation to the next. Instead of seeing the theorems of geometry, the formulas of trigonometry, and the methods of algebra as the *products* of doing mathematics, these artifacts are seen *as* the mathematics (see [7], [8], [9] for more on this). The questions people worried about and the struggles they went though trying to answer them almost never appear; instead, we see the results of the struggles, neatly packaged into pieces of boxed text. The mastery of any subject requires a thorough knowledge of basic facts, but when you see students studying for tests by learning the difference between the "$y = mx + b$ form" and the "two-point form", you know there's something wrong.
- *The "flatness" syndrome.* What really stands out in many of the classes I observe is that *everything* is on the same level. Vocabulary, notation, and convention are treated with as much importance as solving problems or proving theorems. So learning the definition of cosine is presented as the same kind of mathematics as proving the addition formulas. And the addition formulas are given the same emphasis as many other much more esoteric trigonometric identities. I've heard countless teacher-room discussions about whether or not a parallelogram is a trapezoid or whether the correct symbol for the whole numbers is $\mathbb{Z}^+$ or $\mathbb{N}$.
- *Worksheet-centered classes.* In many classes I've seen, the object of the game is to get through the work as quickly and as effortlessly as possible. The class routine consists of a continuous stream of delivering, completing, and collecting worksheets. The worksheets are usually of two types: forty identical calculations or a puzzle. In some cases the exercises or the puzzles are designed to make a point, but that point is hardly ever made in practice.
- *Watch-and-do pedagogy.* This style of teaching starts with the teacher working out a problem in detail. Next the students try it on an almost identical problem, mimicking what the teacher just did. This is followed by lots of practice on more nearly identical problems. The cycle then repeats until the end of class, where homework is assigned that consists of even more practice, just to cement things. And the problems often involve substituting numbers in formulas or applying some procedure, over and over.
- *Lemma-less curricula.* There's a deeply rooted notion in the precollege community that students need to have all the prerequisites for solving a problem before they can work on it. I was once part of a heated discussion about whether kids should be allowed to explore the theorem that the midpoints of a quadrilateral form the vertices of a parallelogram *before* they saw the theorem that a segment joining the midpoints of two sides of a triangle is half as long as the third side and parallel to it. I expected the need for that "midline" theorem would emerge in the course of the quadrilateral investigation, and it could be then posited as a lemma and treated later. This notion of assuming something for the time being to see where it gets you is completely foreign to most precollege curricula.
- *Learn it all in college.* Many teachers apply the above "know all you need before you start" philosophy to themselves. Instead of seeing their undergraduate studies as equipping them with the tools they need to become lifelong mathematics learners, they perceive that college is where you learn all the mathematics you'll ever need to teach the subject. The implications of this belief are quite profound. For example, most in-service programs for practicing teachers emphasize pedagogy, curriculum implementation, or other skills connected with the craft of teaching[1] much more than they focus on mathematical content—teachers learned "the math" when they were in college. Combined with the notion that mathematics is an established body of facts, this places many teachers in the frightening situation where their mathematical expertise is defined, not by what they can figure out, but by the facts they learned as undergraduates. With such a mindset, questions from students can be very intimidating.
- *The vertical disconnect.* Most teachers see very little connection between the mathematics they study as undergraduates and the mathematics they teach. This is especially true in algebra, where abstract algebra is seen as a completely different subject from school algebra. As a result, high school algebra has evolved into a subject that is almost indistinguishable from the precalculus study of functions. Another consequence is that, because individual topics are not recognized as things that fit into a larger landscape, the emphasis on a topic may end up being on some low-level application instead of on the mathematically important connections it makes. For example, look at what most curricula do

[1] *These skills are, of course, quite important. My point is that they receive vastly more attention than content in professional development programs.*

with DeMoivre's theorem. If it shows up at all, it is applied to finding small roots and powers of specific complex numbers. There are no connections to cyclotomy, constructibility of polygons, or algebraic and trigonometric identities.

These are generalities, and there are notable exceptions to every one of them. For example, most teachers of my vintage learned virtually nothing about technology in college but have, on their own, gained immense expertise in this area. And I know many teachers who are genuine mathematicians, who continue to study mathematics throughout their careers, and who have a real knack for helping students develop their own mathematical thinking. On the other hand, the problems just described are not the sole province of underprepared teachers or teachers working out of their areas of certification. I'm talking about teachers with undergraduate degrees in mathematics from good schools—teachers who may have studied with you. My only reason for making a list like this is that these are the kinds of serious problems that can, I think, be traced to the mathematics courses teachers take in college and that can be ameliorated by changing some things in the mathematical preparation of teachers.

I'm leaning on the "you teach the way you were taught" maxim knowing full well that it is an oversimplification. There are other influences on the mathematics that happens in high school classrooms. An important one is the materials (texts, tests, software, and so on) that teachers use. For a complex set of reasons having to do more with economics than education, large publishing houses have produced some truly abysmal curriculum materials that have, in turn, driven many of the problems on my list.

What Can Be Done?

Most of the problems described in the previous section are quite subtle. *Solutions will not come from rearranging the topics in a syllabus or by adding more topics to an already bloated undergraduate curriculum.* Making lists of topics that teachers should know when they graduate from college won't do it either. Yes, teachers need "the facts". But, in addition to learning something about its results, how can we help prospective teachers experience the *doing* of mathematics? How can we help them develop mathematical taste? How can we give them a sense for the really important questions that have led to breakthroughs? How can we help them develop the skill of seeing what to emphasize with their high school classes? How can we help teachers develop a passion for the discipline that lives on beyond college graduation? Here are some general principles that address these questions and that might be used to redesign part of the undergraduate experience for prospective teachers.

Make Connections to School Mathematics

One way to help practicing teachers develop the habit of "mining" the topics they teach for substantial mathematics is to make this habit explicit in undergraduate courses. For example, one could start with several seemingly different activities from high school texts, using them as springboards to the advanced mathematics that ties them together. I recently did just this with a group of middle and high school teachers as part of a field test for a professional development curriculum [10]. We started with activities they could use with their students: counting paths in "taxicab geometry" and counting ordered partitions of positive integers. Pascal's triangle came up in both investigations, so we looked for the underlying structural similarities between the two problems that would account for this. This led to a discussion of recursion, mathematical induction, the binomial theorem, computer algebra systems, partitions, and, finally, generating functions. By the end of the (ten-hour) course, every teacher had seen some new mathematics and had made new mathematical connections. I'm convinced that the distance we were able to travel depended crucially on the fact that the mathematics we discussed continually wove itself around the mathematics of middle and high school. And there are hundreds of units like this just waiting to be developed, sequences that start and end with school mathematics but that take students well into the realm of undergraduate mathematics along the way.

There are other ways of making connections to what teachers will teach. One promising idea is sometimes called a "shadow seminar". Prospective teachers in, say, a classical linear algebra class would attend a weekly seminar, designed perhaps by a mathematician, a practicing teacher, and a faculty member from a school of education. The seminar would shadow the course, showing how ideas in the course could be made tractable for precollege students or how they shed light on topics from precollege algebra and geometry. Variations on this idea abound. For example, Carole Greenes and colleagues from education and mathematics at Boston University are designing a "companion course" for prospective teachers that will help them tie together mathematics from abstract algebra, linear algebra, number theory, and the precollege curriculum.

Another way to connect with school mathematics is to show applications of mathematics to the craft of teaching. For example, at the University of Michigan Hyman Bass teaches a course on task design that looks at the design of student activities from both mathematical and psychological perspectives. Bass's course is an in-depth treatment of every aspect of designing student activities. But a more modest effort could be incorporated into mathematics courses for prospective teachers. For example, a great deal of classical undergraduate mathematics can be motivated by or applied to "meta problems" that teachers wonder about all the time as they invent problems for their students (see [11] for more on this theme). This mathematics could include questions like these:

- (How) can you generate Pythagorean triples?
- (How) can you generate integer-sided triangles with a 60° angle?
- If two polygons have the same area, (how) can you cut one up to get the other?
- (How) can you find three lattice points in the plane that determine a triangle with integer side-lengths?
- (How) can you generate cubic polynomials in $\mathbb{Z}[x]$ with distinct rational extrema and roots?
- (How) can you generate the graph of $y = \sin x$ with dynamic geometry software?

Applications of mathematics to science, finance, and sports have become staples of many undergraduate courses. Why not include applications of mathematics to the teaching of mathematics?

Look at Different Models of Classroom Organization

This is a tough one for me. I love going to talks, and a well-executed lecture is as enjoyable for me as a well-performed concert. But the fact is, most of my students don't see it that way. They need to work on problems *in class*. They need to bounce ideas off their classmates. Many of them have a very hard time learning something by listening to me present it. On the other hand, they learn a great deal by having me work on problems with them, and they love to make presentations of their own, especially if they have come up with something clever. This is not the way I was taught in college, and it took me several years as a teacher to figure out effective ways of getting my students to do mathematics. If we want prospective teachers to be effective *and* to teach the way they are taught, we should construct our undergraduate classrooms around what mathematicians *do* rather than around what they *say*.

I want teachers to see how mathematical results are obtained rather than how they are presented. We all know that these things are different. When we close the study door to begin work on a problem, what takes place is nothing like what's in the paper that appears a year and a half later. What we do behind closed doors is full of false starts, extensive calculations, experiments, and special cases. We reduce things to lemmas for which we have no proofs; suspend work on these lemmas and on other details until we see if they'll help at all; calculate and play with logical connections for hours; and hope that some order, some missing link, some new connection to old ideas will emerge out of all this immersion. We don't worry about truth or beauty or conviction or the purity of the deductive method. We just look for clues.

Some students can learn to do what we do behind the study door by studying what we say in public. *Many more can't.* That doesn't mean that they can't become teachers who have a real sense for mathematics. It just means that we have to be honest with them. We have to show them what mathematics is really about; we have to focus and organize our classes around the style of work used by mathematicians rather than around the results of that work. Students need to see and experience what goes into a solution as well as what comes out of it. They need to experience all the mucking around that happens *before* the polishing of the proof begins.

Put Mathematical Ideas into Larger Contexts

Undergraduate mathematics experiences for prospective teachers could do a great deal to make sure that topics from school mathematics are put in more general contexts so that prospective teachers get a chance to think about questions like "What is this an example of?" For instance, imagine undergraduate courses that explicitly discuss questions like these:

- Are there other functions that act like absolute value on the rational numbers? What does it mean to "act like absolute value"?
- Are there other reasonable ways to measure distance between points on the plane? What does that do to plane geometry?
- There's a Cauchy-Schwarz inequality in linear algebra and a Cauchy-Schwarz inequality in statistics. Is this just a coincidence?
- Geometric probability[2] suggests there's a connection between probability and area. Is there more than a superficial similarity?
- The books all say that Galois theory is about solving equations. What exactly do they mean by that?
- The formula for standard deviation looks a lot like the distance formula. Is that a coincidence?
- If you square a Gaussian integer, the real and imaginary parts are legs of a Pythagorean triple. Is *that* a coincidence?
- There's a characteristic equation in linear algebra and a characteristic equation used to solve difference equations. Are they connected?

I conjecture that if questions like these were taken up regularly, we'd see much more similarity between secondary and postsecondary subjects with the same name.

Build a Research Experience into Teacher Preparation

There are very few absolutes in education, but there's one thing of which I am absolutely certain: *The best high school teachers are those who have a research-like experience in mathematics.* I don't

[2] *Geometric probability in precollege mathematics centers around calculating the probability that a random point lands in a region by computing ratios of areas.*

mean research in the sense of producing new knowledge. Frontline problems take immense backgrounds. But the *methods* used by research mathematicians are widely accessible (my colleagues and I believe they are accessible to high school students). And working for an extended period of time on a hard problem that has no apparent approach or solution has profound effects on how one perceives the nature of the enterprise. Teachers who have done this type of research are much less likely to think of mathematics as an established body of facts than are teachers who have simply taken a set of courses. They are more likely to stay engaged in mathematics after they start teaching. They are used to looking for connections that don't live on the surface. And they are much more likely to organize their classes around large investigations rather than low-level exercises. There are many rich areas of investigation on which undergraduates can embark without a huge amount of machinery—"no threshold, no ceiling" problems that allow them to work as mathematicians for a piece of their undergraduate experience. An ideal teacher preparation program combines the kind of orchestrated assimilation of the main results in mathematics that you get in courses with the much messier unstructured explorations that come from working with a mentor and grappling with a research project.

Some Examples

Over the years many people have implemented subsets of these and other suggestions for improving teacher preparation. Here are just a few that I know about. I'm sure there are many others. Perhaps the *Notices* is one place where discussions of innovative approaches in this area can appear.

My first example is almost thirty years old. In 1972 I took a summer course from the late Ken Ireland (of Ireland-Rosen fame [12]) at Bowdoin College. The course had a tremendous influence on my life. Ireland's premise was that there are dozens of famous mathematical results that are part of the "folklore" of elementary mathematics. Some of these results go back to the Greeks, some come from arithmetic and number theory, and some involve classical algebra or analysis (examples include the impossibility of certain constructions with straightedge and compass and the transcendence of π). They are folklore in the sense that most teachers know the *statements* of the results, but few know about their proofs or even their history. The course was constructed to fix that; in six very intense weeks Ireland helped us develop the mathematical backgrounds to understand the proofs of these famous facts, how they are connected to each other, and where they sit in the history of mathematics. The course was based on about 200 problems, handed out in waves and supplemented by daily lectures that were anything but didactic and that changed forever my own thoughts about effective teaching. It's amazing how ahead of its time this course was. We were encouraged to work together on the problems (and even to pass in joint solutions), an idea unheard of at the time but that has become a centerpiece of the current reform movement in mathematics education. The lectures were designed to give us the connections we'd need to make progress on the problems, not to provide us with templates we could use to solve them. This emphasis on "teacher as coach" is another basic ingredient to today's reform movement, but I remember how disquieting it was to many of us in 1972. That summer introduced me to the notion that one could design a substantial mathematics course organized around topics that underlie school mathematics, using a teaching style that lets struggling with problems lead the way.

My next example is old too. It traces its pedigree back forty years to the Ross program at Ohio State. Glenn Stevens and David Fried, together with Marjory Baruch and Steve Rosenberg, have transported an enhanced version of the program to Boston University, where it has been running as PROMYS (Program in Mathematics for Young Scientists) for over a decade. For almost that long, teachers (prospective and practicing) have been attending the program, spending six weeks for each of two summers immersed in number theory and other mathematics. The program for teachers is a perfect example of how immersion in mathematics is effective teacher preparation and professional development. It centers around three activities:

1. *The courses.* Teachers take an intense six-week number theory course along with the high school students in the program. Like Ireland's course, it centers around problems: carefully orchestrated sets are passed out, graded, and passed back in cycles of one day. Stevens gives a morning lecture, but, as he says, "I see to it that I never discuss a topic unless people have struggled with it for three days."
2. *The research experience.* The number theory experience is carefully planned, and the problem sets lead to specific results. To complement this, each teacher works with three students on a research project. Participants are given suggestions ("circles of ideas", as they are known at PROMYS) from which they design and investigate a project for the entire summer. The projects allow easy entry but can (and often do) lead teachers and students into very new and advanced territory.[3]

[3] *For examples of the kinds of projects used in the program, see Michelle Manes's project for high school students and their teachers at* `http://www2.edc.org/makingmath/`.

3. *The academic-year seminars.* Between the two summers teachers attend five all-day seminars at Education Development Center in which they work on translating the PROMYS experience into classroom practice. We look for connections between the PROMYS topics and school mathematics. We also look for ways to implement the teaching style of allowing students to explore a topic before teachers present it.

Teachers find the PROMYS experience overwhelming. They see what it's like to do real mathematics—always being at the edge of what you understand, having much more to do than you can possibly finish, and seeing hints of mysterious connections emerge almost out of nowhere. Extensive support structures are provided to deal with the frustration. There are undergraduate and graduate students on hand to act as counselors and to lead problem sections, and the faculty is always around for help. By the end of three weeks most participants turn a corner, and they start working as real mathematicians. They develop a view of what mathematics is about that will help teachers avoid the problems I described earlier.

The preceding two examples have the luxury of not being confined to the academic-year schedule of semesters and courses. But even within these constraints, some very creative approaches are being tried out:

- Hung-Hsi Wu has developed a set of principles for designing courses for mathematics majors who do not intend to go to graduate school. These principles include many devices designed to address the problems I described earlier (for a complete list see [13]):
  - Make explicit connections between the topics in the course and topics in elementary mathematics.
  - Place topics in their historical contexts.
  - With surveys and exposition, place topics in their broader mathematical contexts.
  - Give motivation at every opportunity.

  Wu has implemented his complete set of principles with some success in several upper-division courses for mathematics majors at Berkeley. His algebra course, for example, goes a long way to help prospective teachers make connections between school algebra and algebra as a mathematical discipline.
- Bill McCallum describes (personal communication) a program at the University of Arizona, developed, with accompanying texts [14], [15], by David Gay and Fred Stevenson. Undergraduates who decide to teach high school replace abstract algebra and analysis with two innovative courses:
  - *Introduction to Number Theory and Modern Algebra* starts with the natural numbers (and elementary number theory) and builds to a construction of the real numbers. Along the way students look at the theory of decimal expansions, find rational points on algebraic curves, and study various ways to represent real numbers. The course then gives students an extensive selection of projects that deal with topics ranging from Fibonacci numbers to continued fractions.
  - *Topics in Geometry* reads to me like a catalogue of what every high school teacher needs in his or her back pocket. Measure and measurement, polyhedra, shortest path problems, kaleidoscopes, symmetry, and isoperimetric problems are all treated.
- Joe Rotman has developed a course (and an accompanying text [16]) that he uses at the University of Illinois to give students a broad sense of what doing mathematics is about. The course helps students develop self-confidence in writing proofs by starting with results about binomial coefficients that can be proved by mathematical induction. Rotman believes that what students need is not experience with truth tables but time to develop the skill of producing convincing proofs, and he spends a great deal of time in his course having students read, critique, develop, and present proofs. The core course also treats convergence of sequences and the algebra of complex numbers. Additional topics include Pythagorean triples, parametrizing the circle and conic sections, a discussion of π leading to a proof of its irrationality, and the cubic and quartic formulas.

These ideas, courses, and examples are all very different, but they share several features that are essential to preparing quality high school teachers:

- They have a coherent design and a focussed goal.
- They show mathematics as something you do rather than something you memorize.
- They emphasize (and are explicit about) the thinking and habits of mind employed by working mathematicians.
- They bring students into the culture of mathematics—a culture with its own history, aesthetics, elegance, and even humor.
- They focus on the interactions among the students and the instructor.
- Problems precede abstractions, experience precedes axiom systems, and student thinking is at the center of the work.

Every time I make a list like this, I wonder why this shouldn't be the kind of undergraduate mathematics experience *everyone* gets.

It's customary, when designing mathematics curricula in the U.S., to concentrate on lists of topics to be covered. We've become quite good at that, and very reasonable lists can be found elsewhere. But my contention here is that such lists are bound to be ineffective if we don't find ways to communicate the spirit of doing mathematics to the people who plan to teach it.

References

[1] L. Ma, *Knowing and Teaching Elementary Mathematics: Teachers' Understanding of Fundamental Mathematics in China and the United States*, Erlbaum, Mahwah, NJ, 1999.

[2] J. W. Stigler and J. Hiebert, *The Teaching Gap: Best Ideas from the World's Teachers for Improving Education in the Classroom*, Free Press, New York, 1999.

[3] J. R. C. Leitzel (ed.), *A Call for Change: Recommendations for the Mathematical Preparation of Teachers of Mathematics*, Mathematical Association of America, Washington, DC, 1991.

[4] Mathematical Sciences Education Board, *The Preparation of Teachers of Mathematics: Considerations and Challenges, A Letter Report*, National Research Council, Center for Science, Mathematics, and Engineering Education, Washington, DC, 1996.

[5] CBMS Mathematics Education of Teachers Project Draft Report, 2000, `http://www.maa.org/cbms/metdraft/index.htm`.

[6] National Council of Teachers of Mathematics, *Principles and Standards for School Mathematics*, NCTM, Reston, VA, 2000.

[7] A. Cuoco, E. P. Goldenberg, and J. Mark, Habits of mind: An organizing principle for a mathematics curriculum, *J. Math. Behavior* **15** (4) (1996), 375–402.

[8] A. Cuoco, What I wish I knew about mathematics when I started teaching, *Math. Teacher* **91** (5) (1998).

[9] ——, Some worries about mathematics education, *Math. Teacher* **88** (3) (1995).

[10] *Connecting with Mathematics*, an NSF-funded materials development project for practicing teachers. For more details contact Helen Lebowitz (`hlebowitz@edc.org`).

[11] A. Cuoco, Meta-problems in mathematics, *College Math. J.*, **31** (5) (2000), 373-378.

[12] K. Ireland and M. Rosen, *A Classical Introduction to Modern Number Theory*, Springer-Verlag, New York, 1982.

[13] H. H. Wu, On the education of mathematics majors, *Contemp. Issues Math. Ed.*, vol. 36, MSRI, 1999.

[14] D. Gay, *Geometry by Discovery*, Wiley, New York, 1998.

[15] F. W. Stevenson, *Exploring the Real Numbers*, Prentice-Hall, Upper Saddle River, NJ, 2000.

[16] J. Rotman, *Journey into Mathematics: An Introduction to Proofs*, Prentice-Hall, Upper Saddle River, NJ, 1998.

Honeycombs and Sums of Hermitian Matrices

Allen Knutson and Terence Tao

In 1912 Hermann Weyl [W] posed the following problem: given the eigenvalues of two $n \times n$ Hermitian matrices A and B, how does one determine all the possible sets of eigenvalues of the sum $A + B$? When $n = 1$, the eigenvalue of $A + B$ is of course just the sum of the eigenvalue of A and the eigenvalue of B, but the answer is more complicated in higher dimensions. Weyl's partial answers to this problem have since had many direct applications to perturbation theory, quantum measurement theory, and the spectral theory of self-adjoint operators. The purpose of this article is to describe the complete resolution to this problem, based on recent breakthroughs [Kl], [HR], [KT], [KTW].

To standardize the notation, we shall always write the eigenvalues of an $n \times n$ Hermitian matrix as a weakly decreasing n-tuple $\lambda = (\lambda_1 \geq \ldots \geq \lambda_n)$ of real numbers. Thus, for instance, the eigenvalues of diag(3, 2, 5, 3) are (5, 3, 3, 2).

To illustrate Weyl's problem, suppose that $n = 2$ and that A, B have eigenvalues (3, 0) and (5, 0) respectively. Then one can easily verify that $A + B$ can have eigenvalues (8, 0) or (5, 3) or, more generally, $(8 - a, a)$ for any $0 \leq a \leq 3$. This turns out to be the complete set of possibilities; $A + B$ cannot have eigenvalues $(9, -1)$ or $(7, 0)$ or $(4, 4)$, etc.

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Let us denote the eigenvalues of A, B, and $A + B$ as λ, μ, and ν respectively; thus λ_2 is the second largest eigenvalue of A, etc. It is fairly easy to obtain necessary conditions on the triple λ, μ, ν. For instance, from the simple observation that the trace of $A + B$ must equal the sum of the traces of A and B, we obtain the condition

$$\nu_1 + \ldots + \nu_n = \lambda_1 + \ldots + \lambda_n + \mu_1 + \ldots + \mu_n. \tag{1}$$

Another immediate constraint is that

$$\nu_1 \leq \lambda_1 + \mu_1, \tag{2}$$

since the largest eigenvalue of $A + B$ is at most the sum of A's and B's individual largest eigenvalues. (Exercise for the reader: Show equality occurs exactly when the same vector is a principal eigenvector for both matrices.) Weyl found a number of similar necessary conditions, such as the statement $\nu_{i+j+1} \leq \lambda_{i+1} + \mu_{j+1}$ whenever $0 \leq i, j, i + j < n$. When $n = 1, 2$ these conditions are both necessary and sufficient; for higher dimensions many other necessary conditions were found by later authors. All of these conditions took the form of homogeneous linear inequalities (e.g., $\nu_1 + \nu_2 \leq \lambda_1 + \lambda_2 + \mu_1 + \mu_2$). These inequalities were generally proven by "minimax" methods, but there did not appear to be a general scheme that would produce a systematic and complete list of these inequalities.

This problem was studied extensively by Alfred Horn [Ho]. Among other things, he showed that a complete set of necessary conditions could be given by (1), together with a list of linear inequalities of the form

$$\nu_{k_1} + \ldots + \nu_{k_r} \leq \lambda_{i_1} + \ldots + \lambda_{i_r} + \mu_{j_1} + \ldots + \mu_{j_r} \tag{3}$$

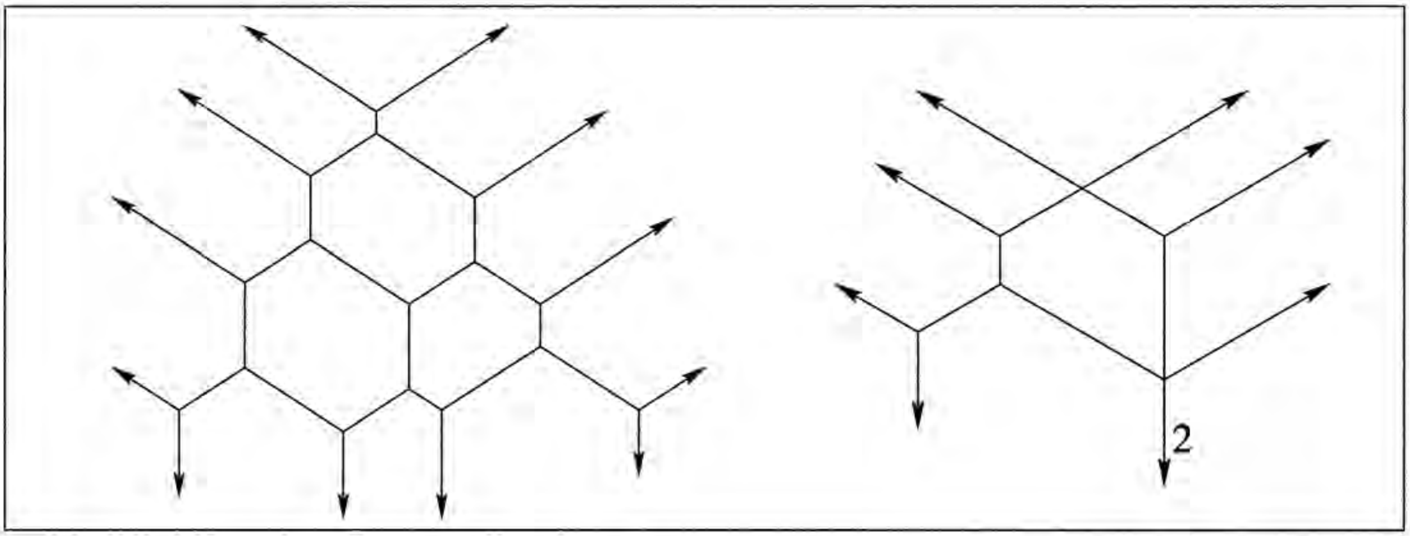


Figure 1. Two honeycombs. The left one is more typical in having only Y vertices, as will be explained in Theorem 3. All edges are multiplicity 1, except for the edge labeled 2 in the right-hand honeycomb.

for all $1 \le r < n$ and all triplets of indices $1 \le i_1 < \ldots < i_r \le n$, $1 \le j_1 < \ldots < j_r \le n$, and $1 \le k_1 < \ldots < k_r \le n$ in a certain finite set $T_{r,n}$. The problem was then reduced to describing the sets $T_{r,n}$ of triplets.

Horn computed this set for $n \le 8$ and for general dimensions was able to demonstrate that the indices $i_1, \ldots, k_r$ in $T_{r,n}$ satisfied the trace condition

(4) $i_1+\ldots+i_r+j_1+\ldots+j_r = k_1+\ldots+k_r+r(r+1)/2$

as well as linear inequalities such as

$$i_1 + j_1 \le k_1 + 1.$$

These relations were obviously similar to the relations (1), (2) in the original problem. This led to the remarkable

Conjecture 1 (Horn conjecture). *The set $T_{r,n}$ is equal to the set of all triplets of indices $1 \le i_1 < \ldots < i_r \le n, 1 \le j_1 < \ldots < j_r \le n, 1 \le k_1 < \ldots < k_r \le n$ which obey* (4) *and*

$$i_{a_1} + \ldots + i_{a_s} + j_{b_1} + \ldots + j_{b_s} \ge k_{c_1} + \ldots + k_{c_s} + s(s+1)/2$$

for all $1 \le s < r$ and all triplets of indices $1 \le a_1 < \ldots < a_s \le r, 1 \le b_1 < \ldots < b_s \le r, 1 \le c_1 < \ldots < c_s \le r$ in $T_{s,r}$.

This conjecture would give a highly recursive (but impractical) algorithm to generate the sets $T_{r,n}$ in terms of the earlier generations $T_{s,r}$ and thus to give a complete solution to Weyl's problem at each dimension n. The conjecture turns out to be correct, though it waited thirty-six years for resolution.

We approached this problem by first observing that Weyl's problem could be rephrased using *honeycombs,* which we introduced (for this purpose) in [KT]. These are a family of planar arrangements of edges labeled with multiplicities (some examples are in Figure 1). We give the precise definition in the next section.

The relevance of honeycombs to sums of Hermitian matrices is the following theorem, which we explain in more detail later.

Theorem 1. *Let λ, μ, ν be weakly decreasing n-tuples of real numbers. Then there exist matrices A, B, and $A+B$ with respective eigenvalues λ, μ, and ν if and only if there exists a honeycomb with boundary values $(\lambda, \mu, -\nu)$.*

Although the problem about sums of Hermitian matrices is classical, a quantum analogue concerning $U(n)$ representations turns out to be crucial to the resolution of Horn's conjecture. As we shall see, there is also a quantum version of Theorem 1 linking this representation theory problem to (integer) honeycombs. One of the key steps in the proof of Horn's conjecture is the proof of the *saturation conjecture,* which asserts that the classical and quantum problems are in a certain sense equivalent.

We shall give a rather ahistorical (and pro-honeycomb) survey of this circle of ideas, starting with honeycombs (which were actually the last piece of the puzzle to be discovered), then discuss the connections between the classical and quantum problems, followed by a sketch of the honeycomb-based proof of the saturation conjecture. Then we restate Horn's conjecture and sketch the honeycomb-based proof of this from saturation.

There are many other closely related and interesting mathematical questions that we will not address, and we refer the reader to the excellent survey article [F2].

Honeycombs

We now set up some notation needed to define honeycombs and their relation to Weyl's problem.

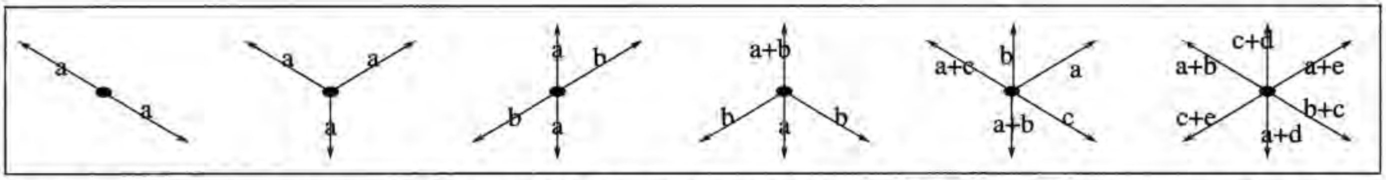


Figure 2. Zero-tension points, with the rays labeled by their multiplicities, which are positive integers. All but the first type are called "vertices".

In the one-dimensional case $n = 1$, a necessary and sufficient set of conditions on λ, μ, ν is given of course by $\lambda + \mu = \nu$. Using the one-dimensional case as an analogy, we then define the relation

$$\lambda \boxplus \mu \sim_c \nu \tag{5}$$

if there exist Hermitian matrices A, B, C with eigenvalues λ, μ, ν respectively such that $A + B = C$. The "c" in $\sim_c$ stands for "classical"; we will define a quantum analogue

$$\lambda \boxplus \mu \sim_q \nu \tag{6}$$

later on. Weyl's problem is thus to determine the solution set to (5).

It is convenient to rephrase Weyl's problem in a more symmetric form. We say that the relation

$$\lambda \boxplus \mu \boxplus \nu \sim_c 0 \tag{7}$$

holds if there exist Hermitian matrices A, B, C with eigenvalues λ, μ, ν respectively such that $A + B + C = 0$. Clearly we have

$$\lambda \boxplus \mu \sim_c \nu \iff \lambda \boxplus \mu \boxplus (-\nu) \sim_c 0$$

where $-\nu := (-\nu_n, \dots, -\nu_1)$ is the negation of ν. Thus to solve Weyl's problem, it suffices to determine the set of triples λ, μ, ν which obey (7). This formulation has the advantage of S_3 symmetry in (λ, μ, ν), as opposed to mere S_2 symmetry in (λ, μ).

In one dimension $n = 1$, we of course have

$$\lambda \boxplus \mu \boxplus \nu \sim_c 0 \iff \lambda + \mu + \nu = 0.$$

In more general dimensions we have the necessary condition

$$\lambda_1 + \ldots + \lambda_n + \mu_1 + \ldots + \mu_n + \nu_1 + \ldots + \nu_n = 0, \tag{8}$$

which is the analogue of (1). Similarly, (2) becomes

$$\lambda_1 + \mu_1 + \nu_n \geq 0. \tag{9}$$

Based on these relations, it is natural to introduce the plane

$$\mathbb{R}^3_{\Sigma=0} := \{(x, y, z) \in \mathbb{R}^3 : x + y + z = 0\}.$$

We shall always depict this plane with the six "cardinal directions" $(0, 1, -1), (-1, 1, 0), (-1, 0, 1),$ $(0, -1, 1)$, $(1, -1, 0)$, and $(1, 0, -1)$, drawn northwest, north, northeast, southeast, south, and southwest respectively. (Of course, "northwest" makes a 60° angle with north rather than a 45° angle, and similarly for the other diagonal cardinal directions.)

Define a *diagram* to be a configuration of (possibly half-infinite) line segments in $\mathbb{R}^3_{\Sigma=0}$, with each edge parallel to one of the cardinal directions (north-south, northeast-southwest, northwest-southeast) and labeled with a positive integer which we refer to as the "multiplicity" or "tension". To every diagram we can associate a measure on $\mathbb{R}^3_{\Sigma=0}$, defined as the sum of Lebesgue measure on each line segment, weighted by the multiplicity. We say that two diagrams d, d' are *equivalent* if their associated measures are equal.

If h is a diagram and v is a point in $\mathbb{R}^3_{\Sigma=0}$, we say that v is a **zero-tension point** of h if, in a sufficiently small neighborhood of v, h is equivalent to a union of rays emanating from v and the sum of the coordinate vectors of these rays, multiplied by their tensions, equals zero.

The two possibilities that will interest us most are a point on a line segment, in which case the zero-tension condition says that the two rays must have the same multiplicity, and a point at the center of a Y with again three equal-multiplicity rays. There are several more complicated possibilities, as shown in Figure 2.

Define a **honeycomb** h as a diagram (or, more precisely, an equivalence class of diagrams) such that

1. every point in $\mathbb{R}^3_{\Sigma=0}$ is a zero-tension point
2. there are only finitely many "vertices", i.e., points with more than two rays emanating
3. the semi-infinite lines go only in the northeast, northwest, and south directions (i.e., no southeast, southwest, or north rays)

The lines mentioned in number 3 are called the **boundary edges** of the honeycomb. Two examples of honeycombs appear in Figure 1.

It is a pleasant exercise to show that the number of boundary edges (with multiplicity) pointing in one cardinal direction is the same as the number in each of the other two directions. (This is basically because the net tension of the honeycomb must be zero.) We will call a honeycomb with n boundary edges in each direction an n-**honeycomb** and denote the space of such by HONEY_n.

Since every edge in a honeycomb is parallel to one of the cardinal directions, each of which has one of its three coordinates equal to zero, every honeycomb edge has a **constant coordinate** (common

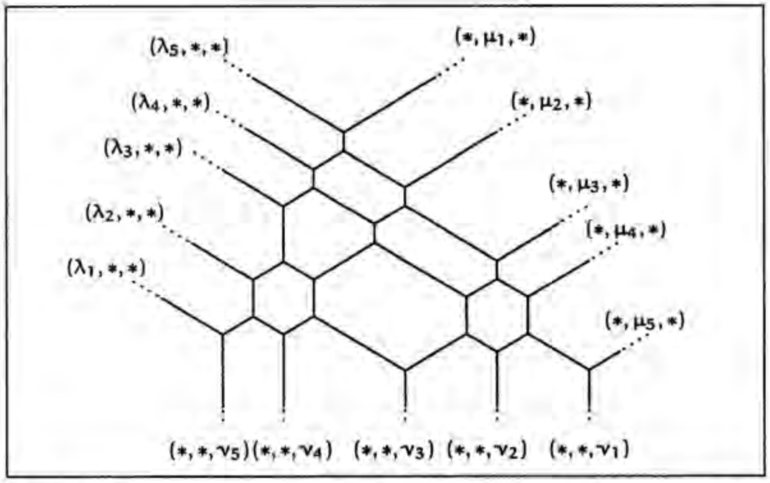


Figure 3. The constant coordinates on the boundary edges of a 5-honeycomb. (The stars are the nonconstant coordinates.)

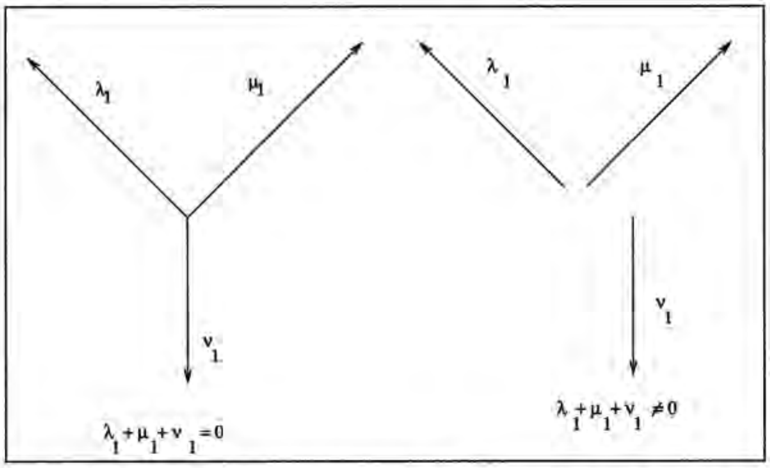


Figure 4. A 1-honeycomb can be formed if and only if the boundary values sum to zero. The edges are labeled by their constant coordinates.

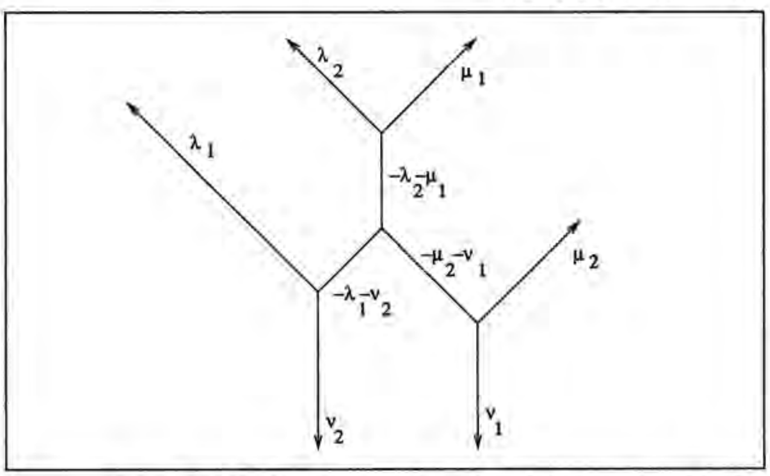


Figure 5. A 2-honeycomb is uniquely determined by its boundary values. The boundary values must satisfy (8), and the edge lengths must be nonnegative. The edges are labeled by their constant coordinates. The edge lengths can be computed (up to an irrelevant factor of $\sqrt{2}$) by subtracting the constant coordinates of two parallel adjacent edges; for instance, the lower left edge has length $\lambda_1 - (-\mu_2 - \nu_1)$.

to every point along that edge). In particular, we can read off the constant coordinates of boundary edges and call them

$$(\lambda_1, \dots, \lambda_n, \mu_1, \dots, \mu_n, \nu_1, \dots, \nu_n) = (\lambda, \mu, \nu)$$

as in Figure 3. (In our pictures of honeycombs we use roman letters to denote multiplicities (which are positive integers), and Greek letters to denote constant coordinates (which are real numbers, but are often integers as well).)

We can now phrase Theorem 1 in this symmetrized setting:

Theorem 2. *The relationship $\lambda \boxplus \mu \boxplus \nu \sim_c 0$ holds if and only if there exists a honeycomb with boundary values (λ, μ, ν).*

Interestingly, almost all the proofs we know of this theorem proceed by first proving a quantized version, which we define in a later section. We shall therefore not discuss the proof of this theorem here, and content ourselves instead with producing evidence which strongly suggests that the theorem is plausible.

We first consider the $n = 1$ case. In this case $\lambda = (\lambda_1)$, $\mu = (\mu_1)$, $\nu = (\nu_1)$, and it is clear that (7) holds if and only if $\lambda_1 + \mu_1 + \nu_1 = 0$. (In other words, the trace condition is already necessary and sufficient.) On the honeycomb side this claim can be easily seen if one accepts the fact (which is actually a little tricky to prove) that 1-honeycombs must have the shape of a "Y". See Figure 4.

More generally, it is a pleasant exercise to show that the boundary values of any n-honeycomb must satisfy (8), basically because the three coordinates around every vertex sum to zero (by virtue of lying in $\mathbb{R}^3_{\Sigma=0}$).

Now consider the $n = 2$ case, so that $\lambda = (\lambda_1, \lambda_2)$, $\mu = (\mu_1, \mu_2)$, $\nu = (\nu_1, \nu_2)$. In this case there can be at most one 2-honeycomb with the specified boundary values (Figure 5). The lengths of the three line segments in the honeycomb can be computed as $\lambda_2 + \mu_1 + \nu_1, \lambda_1 + \mu_2 + \nu_1, \lambda_1 + \mu_1 + \nu_2$. Since these line segments need to have nonnegative length, we obtain the necessary conditions

$$\lambda_2 + \mu_1 + \nu_1, \lambda_1 + \mu_2 + \nu_1, \lambda_1 + \mu_1 + \nu_2 \geq 0.$$

These inequalities can be rephrased using (8) as the statement that the quantities $\lambda_1 - \lambda_2$, $\mu_1 - \mu_2$, $\nu_1 - \nu_2$ form the side-lengths of a triangle. The reader may verify from some linear algebra that these conditions are indeed necessary and sufficient for (7).

In the $n > 2$ case things become more complicated, because the boundary values no longer uniquely determine the honeycomb. In fact, every hexagon present in a honeycomb provides a degree of freedom; the hexagon can be "breathed" inwards or outwards (see Figure 6).

However, it is still possible to demonstrate that inequalities such as (9) must hold for n-honeycombs. Indeed, one can simply extend the μ_1 ray southward until it intersects the λ_1

ray. This intersection point must be northwest of the intersection of ν_n and λ_1, which gives (9). More generally, the Weyl inequalities $\lambda_i + \mu_j + \nu_k \geq 0$ for $i + j + k = n + 2$ can be demonstrated by constructing a Y-shaped object embedded inside the n-honeycomb which is quite similar to a 1-honeycomb (see Figure 7). Similarly, inequalities involving pairs of eigenvalues can be demonstrated by constructing an object similar to a 2-honeycomb; the reader may be amused by locating the object needed to prove $\lambda_1 + \lambda_4 + \mu_1 + \mu_4 + \nu_{n-4} + \nu_{n-1} \geq 0$. A more careful pursuit of this idea can be used to obtain half of Horn's conjecture (that lower-order honeycombs generate inequalities for higher-order honeycombs). The other half, that all inequalities for honeycombs are generated in this way, is proven by the machinery of transverse clockwise overlays, which we discuss later.

Having given some examples of how necessary conditions for (7) translate to the honeycomb setting, we now look at sufficient conditions. It is easy to see (by restricting A, B, C to diagonal matrices) that (7) will hold if there exist permutations $\alpha, \beta \in S_n$ such that $\lambda_{\alpha(i)} + \mu_{\beta(i)} + \nu_i = 0$ for all $1 \leq i \leq n$. The honeycomb analogue of this is depicted in Figure 8; one can obtain a (rather degenerate) n-honeycomb by overlaying n separate 1-honeycombs on top of one another.

More generally, there is a notion of *overlaying* an n-honeycomb h and an m-honeycomb h' to form an $(n+m)$-honeycomb $h \oplus h'$. To be precise, $h \oplus h'$ is the honeycomb whose associated measure is the sum of the measures associated to h and h'. This operation corresponds to the direct sum operation on Hermitian matrices (which takes an $n \times n$ matrix and an $m \times m$ matrix and forms an $(n+m) \times (n+m)$ block-diagonal matrix) or the concatenation operation on spectra (which takes a set of n eigenvalues and a set of m eigenvalues and forms the (sorted) set of $n+m$ eigenvalues). Intuitively, an overlay can be demonstrated by drawing two honeycombs on transparencies and stacking both transparencies on the same projector; see Figure 9. We shall have more to say about overlays later in this article.

The statement that (λ, μ, ν) admits a honeycomb with these boundary values is clearly symmetric under cyclic permutations. However, the relation (7) is symmetric under the larger group S_3, thanks to the commutativity of addition. The corresponding S_3 symmetry result for honeycombs is not trivial; an elegant proof of this based on scattering arguments is given in [Wo]. The same argument also gives the associativity property

$$(10)\quad (\exists \nu : \lambda \boxplus \mu \sim_c \nu; \nu \boxplus \rho \sim_c \sigma) \iff (\exists \nu' : \mu \boxplus \rho \sim_c \nu'; \lambda \boxplus \nu' \sim_c \sigma);$$

this property, combined with a "Pieri rule" to handle the generating cases when λ or μ is equal to

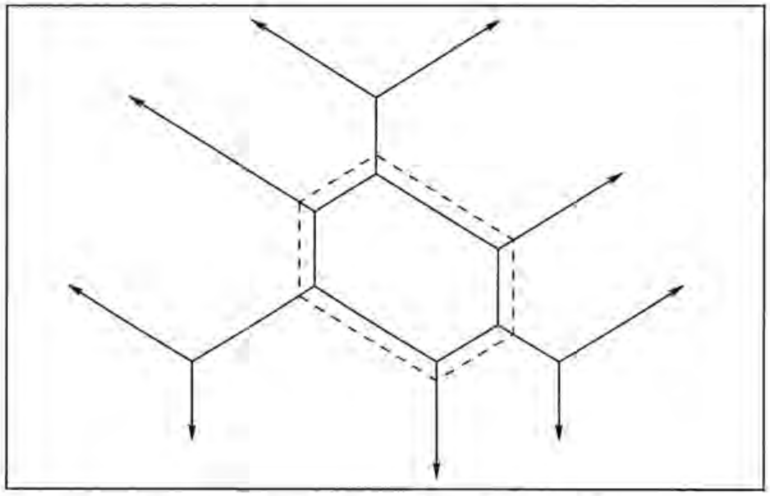


Figure 6. A hexagon in a honeycomb, with a dotted line indicating a place to which one might dilate it.

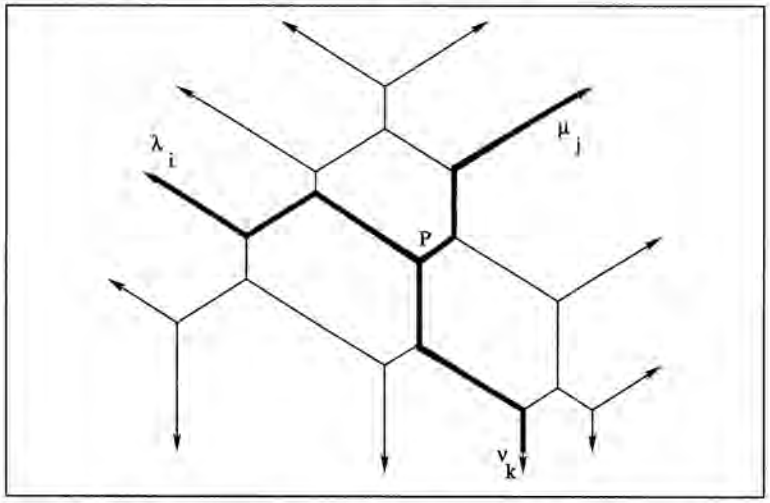


Figure 7. A honeycomb proof of an inequality $\lambda_i + \mu_j + \nu_k \geq 0$. The three coordinates of point P must sum to zero; however, the first coordinate cannot exceed λ_i, the second cannot exceed μ_j, and the third cannot exceed ν_k, hence the claim. Note the resemblance between the shape drawn in bold and a 1-honeycomb.

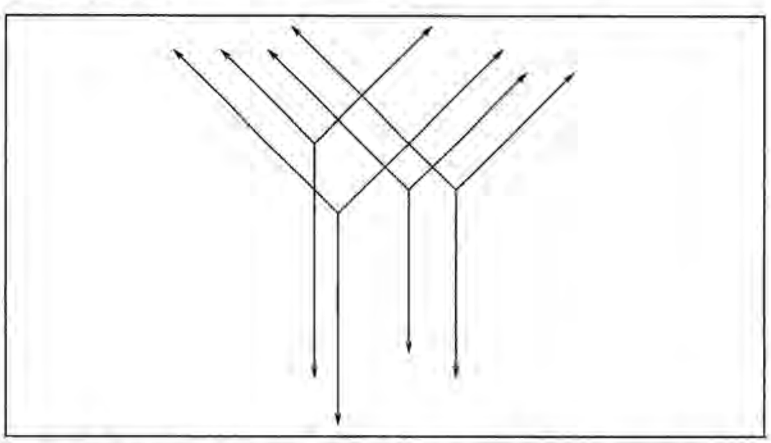


Figure 8. An n-honeycomb can be obtained by overlaying n 1-honeycombs on top of one another. Here α and β map 1, 2, 3, 4 to 4, 3, 1, 2 and 4, 3, 2, 1 respectively.

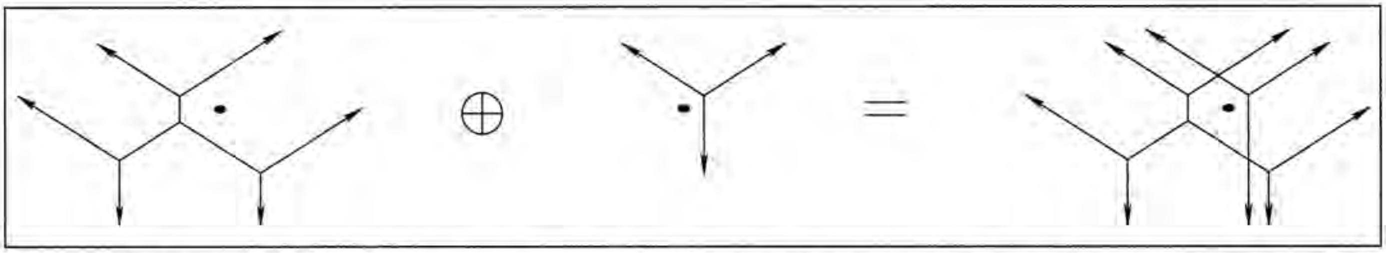


Figure 9. Two honeycombs overlaid to produce a third. The origin $(0,0,0)$ is marked in each picture with a black dot.

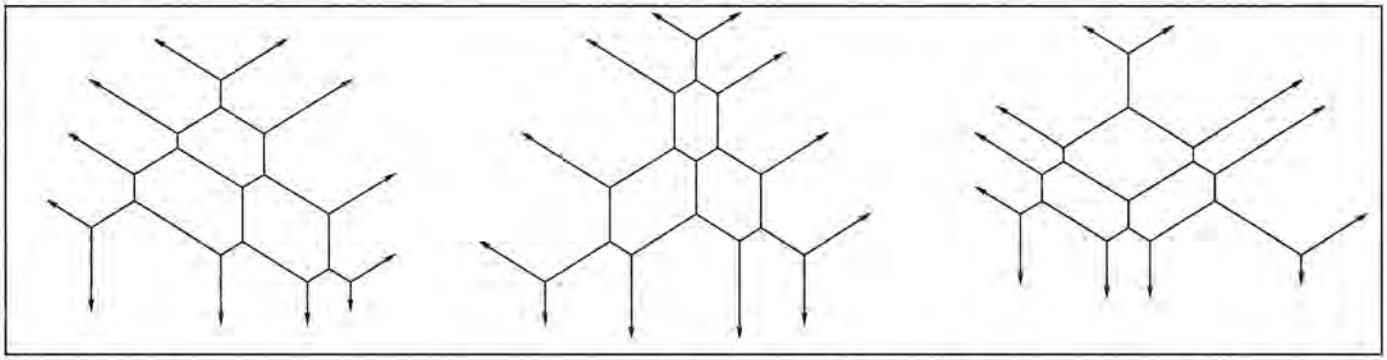


Figure 10. Three nondegenerate 4-honeycombs. Note that there is a natural way to correspond the edges in one with the edges in any other.

$(\varepsilon, 0, \dots, 0)$ for some small ε, can be used to give an inductive proof of Theorem 1.

An interesting degenerate case occurs when ν is kept fixed, while the spacings between eigenvalues of λ and μ are allowed to become very large. In this case the honeycomb degenerates into a pattern known as a Gelfand-Cetlin pyramid, while Weyl's problem degenerates to Schur's problem of determining which n-tuples can be the diagonal entries of a Hermitian matrix with specified eigenvalues. (In fact, we discovered honeycombs by extrapolating from this degenerate case.)

We encourage the reader to try out the honeycomb Java applet at `http://www.math.ucla.edu/~tao/java/Honeycomb.html`.

Organizing Honeycombs into a Polyhedral Cone

The space $\texttt{HONEY}_n$ of all n-honeycombs has been defined as an abstract set, but one can, in fact, give this space the structure of a polyhedral cone inside some finite-dimensional vector space.

Call a honeycomb **nondegenerate** if

1. all its edges are multiplicity 1, and
2. all its vertices are either right-side-up or upside-down Ys.

It is straightforward to prove that all nondegenerate n-honeycombs have the same topological shape, namely that of Figure 10. In particular, there is a natural one-to-one correspondence between the edges in one nondegenerate n-honeycomb with those in any other.

This gives us a way of making the space of nondegenerate n-honeycombs into an open polyhedral cone in a real vector space. The coordinates are given by the constant coordinates of the edges, and linear constraints are imposed by saying that the constant coordinates of three edges meeting at a vertex add to zero and that every edge has strictly positive length.

Theorem 3. [KT] *The identification in the above paragraph between nondegenerate n-honeycombs and points in a certain polyhedral open cone extends to an identification of all* $\texttt{HONEY}_n$ *with the closure of this cone. In particular, nondegenerate n-honeycombs form a dense open set in* $\texttt{HONEY}_n$.

This theorem is surprisingly annoying to prove and takes pp. 1067–1074 of [KT]. Its virtue is in enabling us to use the theory of such cones to define certain special honeycombs (the "largest lift" honeycombs). The proof of the saturation conjecture hinges on the fact that every honeycomb can be deformed to a largest lift honeycomb.

For a honeycomb h, let $\partial h \in (\mathbb{R}^n)^3$ denote the list $(\lambda_1, \dots, \lambda_n, \mu_1, \dots, \mu_n, \nu_1, \dots, \nu_n)$ of constant coordinates on the boundary edges of h, and let $\texttt{BDRY}_n \subset (\mathbb{R}^n)^3$ be the image of this map $\partial : \texttt{HONEY}_n \to (\mathbb{R}^n)^3$. Then we can think of the main question as being to list the inequalities determining $\texttt{BDRY}_n$.

It is not hard to show directly that this map is proper, so each fiber is a compact, convex polyhedron.

As one application of this formalism we can easily show that for any λ, μ, ν the truth or falsity of (7) or (5) can be determined in polynomial time with respect to the dimension n; this fact appears to be previously unknown. Indeed, the problem is equivalent to determining whether the polytope $\partial^{-1}(\lambda, \mu, \nu)$ is nonempty. Since the cone $\mathtt{HONEY}_n$ has about $O(n^2)$ faces, which can all be described explicitly, this problem can be decided in polynomial time by standard algorithms (e.g., the simplex method). [The authors thank Peter Shor for pointing out this fact.] On the other hand, we do not know how to enumerate all the determining inequalities for the relationship (7) in an efficient manner; the recipe given by Horn's conjecture requires worse-than-exponential time and memory in n and in fact produces many redundant inequalities for (7).

One can also use this formalism to create a more quantitative version of Theorems 1 and 2. Let $\mathcal{O}_\lambda$ denote the manifold of Hermitian matrices with eigenvalues λ, and let A be the random variable with the uniform distribution on $\mathcal{O}_\lambda$ (where "uniform" can be defined using induced Lebesgue measure, or the $U(n)$ action). In other words, A is a random matrix with spectrum λ. Similarly, define B as a random matrix with spectrum μ. One can then define $P(\lambda \boxplus \mu \sim_c \nu)$ to be the probability density of the spectrum of the sum $A+B$ of two independent random matrices evaluated at ν. Similarly, define $P(\lambda \boxplus \mu \boxplus \nu \sim_c 0)$.

Theorem 4. *Up to inessential factors (constants and Vandermonde determinants), $P(\lambda \boxplus \mu \sim_c -\nu)$ and $P(\lambda \boxplus \mu \boxplus \nu \sim_c 0)$ are equal to the volume of $\partial^{-1}(\lambda, \mu, \nu)$.*

Readers familiar with symplectic geometry will recognize this type of theorem from the theory of moment maps of compact Lie groups such as $U(n)$. Indeed, $P(\lambda \boxplus \mu \sim_c -\nu)$ is essentially the volume of the symplectic reduction of the manifold $\mathcal{O}_\lambda \times \mathcal{O}_\mu$ (with the diagonal $U(n)$ action) at the point $-\nu$ and similarly for $P(\lambda \boxplus \mu \boxplus \nu \sim_c 0)$. We shall have more to say about this later on.

Quantum Analogues

We now describe the quantum analogue (6) of the classical relation (5). Roughly speaking, (6) is to the representation theory of $U(n)$ as (5) is to the symplectic geometry of $U(n)$ (or, more precisely, of the coadjoint orbits $\mathcal{O}_\lambda$ of $U(n)$).

Recall that the irreducible unitary representations of $U(1)$ are all one-dimensional. In fact, for each integer λ we can define the irreducible representation V_λ as a one-dimensional vector space, with the action of $e^{i\theta}$ given by multiplication by $e^{i\lambda\theta}$ on V_λ.

More generally, for any weakly decreasing sequence $\lambda = (\lambda_1 \geq \ldots \geq \lambda_n)$ of integers we can define an irreducible unitary representation V_λ of $U(n)$ by standard constructions (see, e.g., [F]). The n-tuple λ is referred to as the *weight* of V_λ. For instance, if λ consists of k ones and $n-k$ zeroes, then V_λ is the space of k-forms $\bigwedge^k \mathbb{C}^n$ with the standard $U(n)$ action. More generally, if $\lambda_n \geq 0$, we define V_λ to be the highest-weight irreducible representation in

$$\bigotimes_{i=1}^{n} Sym^{\lambda_i - \lambda_{i+1}} \bigwedge^i \mathbb{C}^n$$

with the convention $\lambda_{n+1} = 0$, and the $\lambda_n < 0$ representations can be defined via a dualization.

Given two irreducible representations V_λ, V_μ of $U(n)$, the tensor product $V_\lambda \otimes V_\mu$ is another representation of $U(n)$. In the $n = 1$ case the tensor product is again an irreducible representation: $V_\lambda \otimes V_\mu \equiv V_{\lambda+\mu}$. However, in general the tensor product is not irreducible and splits up as a direct sum of many smaller irreducible representations V_ν. We can now define the relation (6) as the statement that a copy of V_ν appears at least once in the tensor product $V_\lambda \otimes V_\mu$. Note that the quantum relation is only defined for *integral* λ, μ, ν, whereas the classical relation (5) is defined for *real* λ, μ, ν.

There is a close parallel between (5) and (6). For instance, one can obtain the trace identity (1) as a necessary condition for (6) by considering the action of the center $U(1)$ of $U(n)$. One can similarly obtain the necessary condition (2) by considering the highest weights of the action of a maximal torus $U(1) \times \ldots \times U(1)$ in $U(n)$. From a more physical viewpoint, one can view the classical problem as a problem of describing how the moments of inertia of bodies in $\mathbb{C}^n$ behave under superposition, while the quantum problem is the problem of describing how the spin states of particles in $\mathbb{C}^n$ behave under superposition. (The $n = 2$ case is especially interesting to physicists, since $U(2)$ is closely related to $O(3)$. In this case every representation V_ν appears at most once in $V_\lambda \otimes V_\mu$ (this corresponds to the fact that 2-honeycombs are determined by their boundary values), and one can parameterize the decomposition explicitly using the Clebsch-Gordan coefficients.)

This connection between the classical and quantum problems seems to have been noted first in [L] (and in a more general context in [He], both in 1982) and appears in detail in [Kl]; the most natural framework for such results is exposed in [Kn]. Explicitly, the connection is given by

Theorem 5. *Let λ, μ, ν be weakly decreasing sequences of n integers.*

1. *(Quantum implies classical.) If (6) holds, then (5) holds.*
2. *(Classical implies asymptotic quantum.) Conversely, if (5) holds, then there exists an integer $N > 0$ such that $N\lambda + N\mu \sim_q N\nu$. (Here $N\lambda$ is the sequence $(N\lambda_1, \ldots, N\lambda_n)$.)*

From this theorem it is natural to phrase

Conjecture 2 (saturation conjecture). *One can take $N = 1$ in the above theorem. In other words, (5) and (6) are equivalent for integer λ, μ, ν.*

This conjecture seems to be special to $U(n)$; the naïve analogue of this conjecture for other Lie groups can be easily shown to be false. The saturation conjecture is so named because it is equivalent to the set of triples (λ, μ, ν) obeying (6) being a saturated submonoid of $\mathbb{Z}^{3n}$.

Using some formidable algebraic and geometric machinery, Klyachko [Kl] was able to demonstrate a further nontrivial recursive relationship between the classical and quantum problems and noted that this, combined with the saturation conjecture, would imply Horn's conjecture; we shall have more to say about this later. In [KT] we used Theorem 1 (and the quantum analogue of this theorem) to convert the saturation conjecture into a statement about honeycombs and then proved this statement by combinatorial methods, thus proving the saturation and Horn conjectures. (Recently it has been shown [KTW] that one can derive Horn's conjecture directly from the saturation conjecture by purely combinatorial techniques, bypassing the machinery of [Kl]. Also, a very different proof of saturation, based on the representation theory of quivers, has since been given in [DW]. Finally, a short rendition of [KT] can be found in [Bu].)

To attack the saturation conjecture using honeycombs, we need a quantum analogue of Theorems 1 and 2. We first phrase a symmetric form of (6). We say that

$$\lambda \boxplus \mu \boxplus \nu \sim_q 0 \tag{11}$$

holds if $V_\lambda \otimes V_\mu \otimes V_\nu$ contains a nontrivial $U(n)$-invariant vector. It is easy to show that (11) is equivalent to $\lambda \boxplus \mu \sim_q -\nu$.

A honeycomb is said to be *integral* if its vertices lie on $Z^3_{\sum=0} := \mathbb{R}^3_{\sum=0} \cap \mathbb{Z}^3$. Note that the boundary values of an integral honeycomb are necessarily integers.

Theorem 6. *The relationship (11) holds if and only if there exists an integral honeycomb with boundary values (λ, μ, ν). As a corollary the relationship (6) holds if and only if there exists an integer honeycomb with boundary values $(\lambda, \mu, -\nu)$.*

Note that Theorems 6 and 5 imply Theorems 1 and 2.

The problem of determining the solutions to (6) has had a long history, and a solution is given by the famous Littlewood-Richardson rule. This rule has been formulated in many different ways, most of which involve Young tableaux; a variant due to Berenstein and Zelevinsky can be easily adapted to give Theorem 6. (Fulton has also shown that this theorem can be proven directly from the Littlewood-Richardson rule.) Other proofs are known; for instance, one can combine the quantum version of (10) with Pieri's rule for tensoring a $U(n)$ representation with the tautological $\mathbb{C}^n$ representation to give an inductive proof of Theorem 6.

A quantum analogue of Theorem 4 is also known:

Theorem 7. *The number of times V_ν appears in the tensor product of $V_\lambda \otimes V_\mu$ is equal to the number of integral honeycombs with boundary values $(\lambda, \mu, -\nu)$. Equivalently, the dimension of the $U(n)$-invariant subspace of $V_\lambda \otimes V_\mu \otimes V_\nu$ is equal to the number of integral honeycombs with boundary values (λ, μ, ν).*

All the proofs of Theorem 6 mentioned above can also be used to prove Theorem 7. Theorem 4 can be viewed as a crude asymptotic version of Theorem 7. Variants of this theorem appear in [J], [BZ], and particularly in [GP], though honeycombs are not explicitly used in these papers. We remark that the representation theoretic quantities in Theorem 7 can also be calculated by the Steinberg product rule (for instance), though we do not know a proof of this theorem that goes via this rule.

Readers who are familiar with the representation theory of SL_2 (or $SU(2)$) may verify that the honeycomb rule given in Theorem 6 corresponds to the usual triangle inequalities for the weights. The fact that 2-honeycombs are uniquely determined by their boundary values corresponds to the fact that each irreducible representation of SL_2 appears exactly once in a tensor product of irreducibles.

As mentioned in the introduction, the saturation conjecture gives a complete solution to the (now equivalent) problems (5), (6), given by Horn's conjecture.

Proof of the Saturation Conjecture

In light of the theorems of the previous section, the saturation conjecture can be reduced to the following purely honeycomb-theoretic problem:

Theorem 8. *Let h be a (real-valued) honeycomb with integer boundary values. Then there exists an integer honeycomb h' with the same boundary values as h.*

Or in other words: if λ, μ, ν are integers and the polytope $\partial^{-1}(\lambda, \mu, \nu)$ is nonempty, then $\partial^{-1}(\lambda, \mu, \nu)$ must contain at least one integer point.

The most obvious thing to do is to look for a vertex of $\partial^{-1}(\lambda, \mu, \nu)$; however, one can give examples of vertices which are nonintegral even when λ, μ, ν are integers. Thus we have to be a little more careful as to how to locate our integer honeycomb.

We call a functional $f : \mathtt{HONEY}_n \to \mathbb{R}$ **superharmonic** if it increases when we dilate a hexagon (which one can do to any hexagon in any nondegenerate honeycomb, as in Figure 6).

Fix a generic superharmonic functional f, and define the **largest lift** of a triple (λ, μ, ν) as the honeycomb h that maximizes $f(h)$ subject to $\partial h = (\lambda, \mu, \nu)$. It is straightforward to prove that the largest-lift map $\mathtt{BDRY}_n \to \mathtt{HONEY}_n$ is uniquely defined (for a given generic f), continuous, and

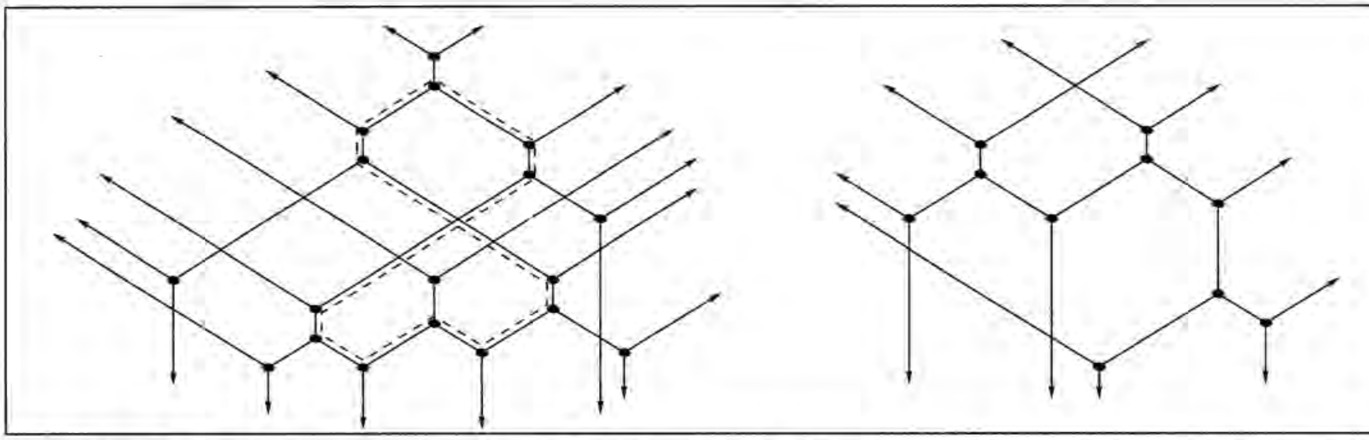


Figure 11. Two simply degenerate honeycombs, with black dots on the vertices of their underlying graphs. The left one has a loop that can breathe in and out (to, say, the dotted-line position), but the right has none.

piecewise-linear. To show Theorem 8, it then suffices to show that the largest-lift map takes integer boundary values to integer honeycombs.

We need some more notation. Say that a honeycomb h has **only simple degeneracies** if all its edges are multiplicity 1 and its vertices are either Ys (possibly upside-down) or crossings of two straight lines. In this case define the **underlying graph of** h as the graph whose vertices consist of the (possibly upside-down) Ys but *not* the crossings; the crossings we instead interpret as two edges missing one another. (In the examples in Figure 1, all vertices *except* the bottom right vertex of the right-hand honeycomb are only simple degeneracies.)

With this in mind, we can talk about **loops** in a simply degenerate honeycomb (meaning in the underlying graph) or call the honeycomb **acyclic** if there are none. For example, in the left honeycomb in Figure 11 there is a loop, whereas the honeycomb on the right is acyclic.

The importance of loops in simply degenerate honeycombs is that they can be breathed in and out, as in Figure 11, generalizing the case of dilating a single hexagon.

Call a largest lift *regular* if the boundary spectra λ, μ, ν each contain no repeated eigenvalues.

The main technical part of [KT] is to prove

Theorem 9. [KT] *Regular largest lifts can only have simple degeneracies.*

In particular, regular largest lifts come with underlying graphs. Roughly speaking, this theorem is proven by showing that every nonsimple degeneracy can be "blown up" in a way that increases the superharmonic functional.

Lemma 1. *The underlying graphs of regular largest lifts are acyclic.*

Sketch of proof. If a simply degenerate honeycomb has a loop, we can breathe it in and out; one direction will increase the value of any (generic) superharmonic functional. A largest lift is by assumption already at the maximum value of the functional, so there can be no loops. □

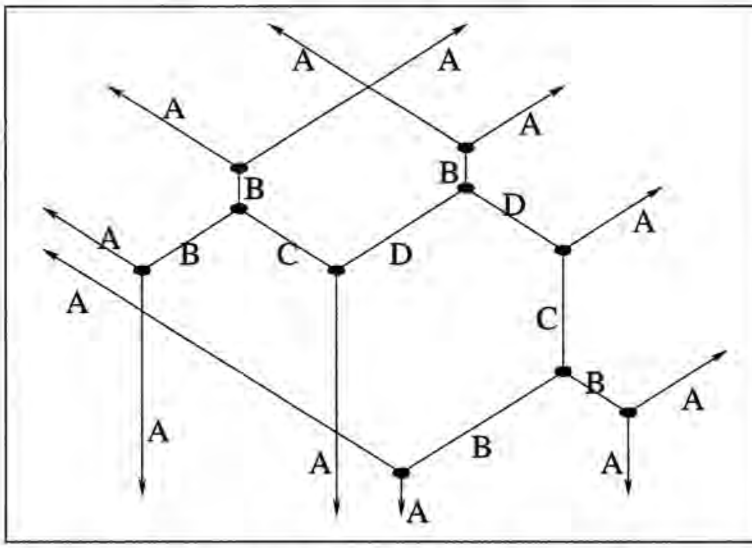


Figure 12. A honeycomb integrally determined by its boundary, in four stages: A, B, C, D.

From this lemma one can show that the coordinates of regular largest lifts are integral linear combinations of the boundary values. Those who wish to see the details should go to [KT], but the argument is intuitively clear. Given a honeycomb with some edges labeled by their constant coordinates and some still mysterious, look for vertices with two known constant coordinates. The remaining one is minus the sum of the other two. Label it such and repeat. The reader is invited to play this game on the honeycombs in Figure 11 to see how in the left-hand honeycomb one gets stuck exactly because of the loop.

In Figure 12 we have labeled the boundary edges "A", the edges whose constant coordinates can be determined from those "B", those at the next stage of this recursive algorithm "C", and so on.

Since every largest lift can be obtained as a limit of regular largest lifts, we thus have that the

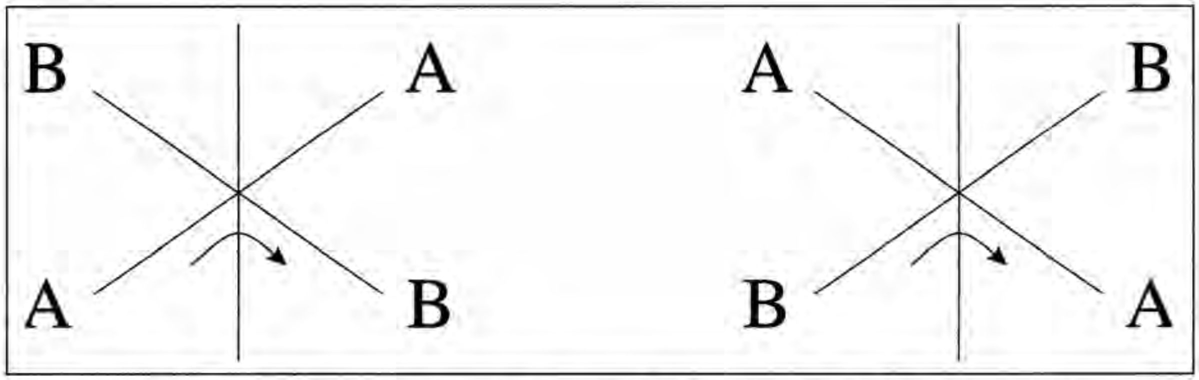


Figure 13. In the left figure, A turns clockwise to B, whereas in the right the reverse is true. Any transverse point of intersection of two overlaid honeycombs must look like exactly one of these.

co-ordinates of all largest lifts are integral linear combinations of their boundary values. In particular, if the boundary values are integral, then the largest lifts are also integral. This proves Theorem 8, which gives the saturation conjecture.

Klyachko's Result and Horn's Conjecture

In this section we restate Horn's conjecture in a convenient form and state a version of Klyachko's result (one direction of which was also proven by Helmke and Rosenthal). (We give slightly revisionist versions in order to avoid introducing Schubert calculus on Grassmannians, which is one of the equivalent problems explained in [F2].)

Horn [Ho] showed that the solution set to (5) must be given by (1) and a finite number of inequalities of the form

$$\lambda_{i_1+r} + \ldots + \lambda_{i_r+1} + \mu_{j_1+r} + \ldots + \mu_{j_r+1} \geq \nu_{k_1+r} + \ldots + \nu_{k_r+1} \tag{12}$$

where $1 \leq r < n$, and $i = (i_1 \geq \ldots \geq i_r)$, $j = (j_1 \geq \ldots \geq j_r)$, and $k = (k_1 \geq \ldots \geq k_r)$ are weakly decreasing sequences of integers between 0 and $n - r$ inclusive. Let us call triples (i, j, k) of this form *admissible*.

As an example, (2) is (12) for the admissible triple $((0), (0), (0))$, while Weyl's inequalities correspond to admissible triples of the form $((i), (j), (i + j))$. The inequality $\lambda_1 + \lambda_2 + \mu_1 + \mu_2 \geq \nu_1 + \nu_2$ corresponds to $((0, 0), (0, 0), (0, 0))$ and so forth.

Horn's conjecture can be easily shown by induction to be equivalent to

Conjecture 3. *Let λ, μ, ν be weakly decreasing sequences of real numbers. Then (5) holds if and only if (1) holds, and (12) holds whenever i, j, k are admissible and $i \boxplus j \sim_c k$.*

Helmke, Rosenthal, and Klyachko showed that Horn's conjecture was true provided that the $\sim_c$ relation on (i, j, k) was replaced by the quantum counterpart $\sim_q$:

Theorem 10. *Let λ, μ, ν be weakly decreasing sequences of real numbers obeying (1).*

1. [HR], [K1] *If (5) holds, then (12) holds whenever (i, j, k) are admissible triples obeying $i \boxplus j \sim_q k$.*
2. [Kl] *Conversely, if (12) holds whenever (i, j, k) are admissible triples obeying $i \boxplus j \sim_q k$, then (5) holds.*

So in a sense solvability of the "classical problem in dimension n" (about summing $n \times n$ Hermitian matrices) is determined by the solvability of the "quantum problem in dimension $m < n$" (about tensoring representations of $U(m)$). Given the saturation theorem proven in the last section, which says that each such quantum problem is solvable exactly if the corresponding classical problem (in the same dimension) is solvable, we have a recursive way to answer the problem.

Theorem 10 connects the classical and quantum problems in a way markedly different from the standard classical/quantum analogy as codified by Theorem 5. The proofs of this theorem are highly nontrivial and first proceed by showing (6) is equivalent to a certain intersection problem in the Schubert calculus of Grassmanians. We do not discuss this further here, but refer the interested reader to [F2]. More recently, a purely honeycomb-theoretic proof of Theorem 10 has been obtained, which we discuss briefly in the last section.

Other Consequences

We close with mention of a few other applications of honeycombs and their properties proven above.

Horn's proof that the solution set of (5) is determined by (1) and a finite number of inequalities of the form (12) is based on the following stronger fact: if (12) holds with equality and λ, μ, ν are regular, then the associated triple of matrices $(A, B, A + B)$ is necessarily block diagonalizable. Put another way, the Hermitian triple is the direct sum of two smaller Hermitian triples.

Given that we have already drawn an analogy between direct sums of matrices and overlaying of honeycombs, there should be a corresponding statement stating that the faces of BDRY_n correspond to honeycombs which are overlays.

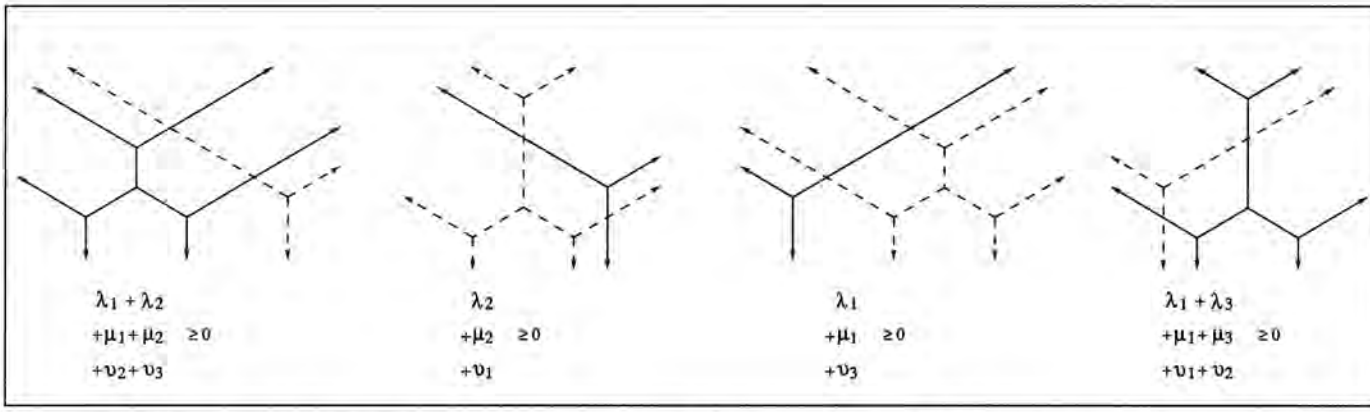


Figure 14. All the consistently clockwise overlays of size 3, up to rotation and deformation, and the associated inequalities on BDRY_3. In each one the solid honeycomb turns clockwise to the dashed honeycomb.

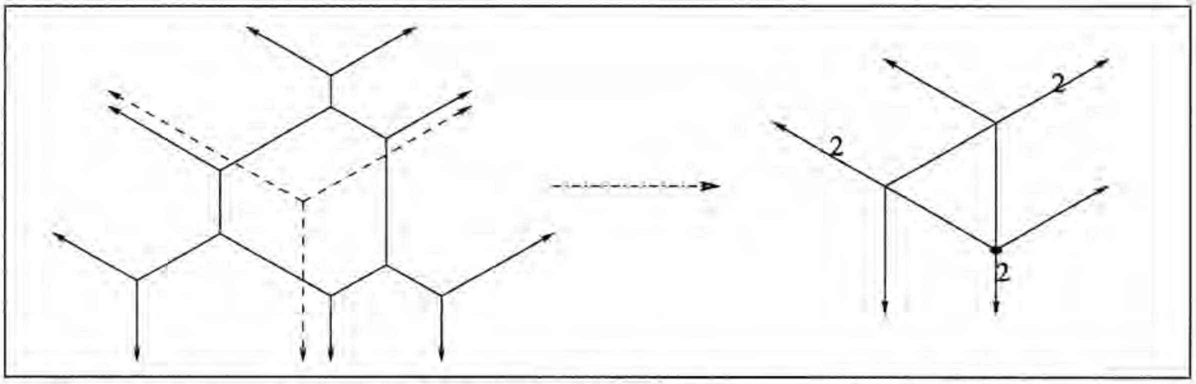


Figure 15. The honeycomb on the right comes from the solid honeycomb on the left, with each edge rescaled to the number of times it intersects the dashed honeycomb and translated to put the bottom right vertex at the origin (marked with a dot).

Not every direct sum of Hermitian matrices (or an overlay of two honeycombs) corresponds to an inequality (12) in Horn's list. However, we have

Theorem 11. [KTW] *Let h be a generic point in HONEY_n. Then $\partial(h)$ is on a facet of BDRY_n if and only if h is an overlay of two smaller honeycombs A and B, such that at each point of intersection some neighborhood of h looks like the left figure in Figure 13 ("A turns clockwise to B").*

In this case one can read off the inequality on BDRY_n directly from h: it says that the sum of the boundary coordinates of A is nonnegative. Some examples are in Figure 14.

If A always turns clockwise to B at the intersections, we can construct a new m-honeycomb A' by shifting A so the bottom right vertex is at $(0,0,0)$, replacing each of the edges of A by one whose length is the number of intersections with B, and removing B altogether. The result is in fact a new honeycomb, integral and of size m (an example is in Figure 15). This construction can be used to give a purely honeycomb-theoretic proof [KTW] of the results of Klyachko and Helmke-Rosenthal and gives enough additional insight to cut down Horn's overcomplete list of inequalities to the minimum possible.

An Open Question

The present proof of Theorem 4 is very unsatisfying; it comes as an asymptotic limit of Theorem 7, which itself is proved only indirectly.

Consider the horizontal projection of the 2-sphere of height $1/(2\pi)$ onto the diameter between the poles. Archimedes' theorem states that the length of an interval in that diameter equals the area of the preimage on the sphere. Today we say that the horizontal projection is *measure-preserving*, which at first seems marvelous, since the interval has only half the dimension of the sphere. The question is: is there a corresponding map which would give a direct proof of Theorem 4? In other words, is there a canonical measure-preserving map from the set $\{(A,B,C) \in \mathcal{O}_\lambda \times \mathcal{O}_\mu \times \mathcal{O}_\nu\}$ to $\partial^{-1}(\lambda,\mu,\nu)$? Such a map is also likely to give a direct proof of Theorem 7, especially if it is associated somehow with a group action.

References

[Bu] A. Buch, The saturation conjecture (after A. Knutson and T. Tao), *Enseign. Math.*, to appear.

[BZ] A. Berenstein and A. Zelevinsky, Triple multiplicities for $sl(r+1)$ and the spectrum of the exterior algebra of the adjoint representation, *J. Algebraic Combin.* **1** (1992), 7-22.

[DW] H. DERKSEN and J. WEYMAN, Semi-invariants of quivers and saturation for Littlewood-Richardson coefficients, *J. Amer. Math. Soc.*, to appear.

[F] W. FULTON, *Young Tableaux*, Cambridge Univ. Press, 1997.

[F2] W. FULTON, Eigenvalues, invariant factors, highest weights, and Schubert calculus, *Bull. Amer. Math. Soc. (N.S.)* **37** (2000), 209-249.

[GP] O. GLEIZER and A. POSTNIKOV, Littlewood-Richardson coefficients via Yang-Baxter equation, `math.QA/9909124`, to appear in *Internat. Math. Res. Notices*.

[He] G. J. HECKMAN, Projections of orbits and asymptotic behavior of multiplicities for compact connected Lie groups, *Invent. Math.* **67** (1982), 333-356.

[HR] U. HELMKE and J. ROSENTHAL, Eigenvalue inequalities and Schubert calculus, *Math. Nachr.* **171** (1995), 207-225.

[Ho] A. HORN, Eigenvalues of sums of Hermitian matrices, *Pacific J. Math.* **12** (1962), 225-241.

[J] S. JOHNSON, The Schubert calculus and eigenvalue inequalities for sums of Hermitian matrices, Ph.D. thesis, University of California Santa Barbara, 1979.

[Kl] A. A. KLYACHKO, Stable vector bundles and Hermitian operators, *Selecta Math. (N.S.)* **4** (1998), 419-445.

[Kn] A. KNUTSON, The symplectic and algebraic geometry of Horn's problem, `math.LA/9911088`, to appear in *Linear Algebra Appl.*

[KT] A. KNUTSON and T. TAO, The honeycomb model of $GL_n(C)$ tensor products I: Proof of the saturation conjecture, *J. Amer. Math. Soc.* **12** (1999), 1055-1090.

[KTW] A. KNUTSON, T. TAO, and C. WOODWARD, The honeycomb model of $GL_n(C)$ tensor products II: Facets of the Littlewood-Richardson cone, in preparation.

[L] B. V. LIDSKII, Spectral polyhedron of the sum of two Hermitian matrices, *Funct. Anal. Appl.* **16** (1982), 139-140.

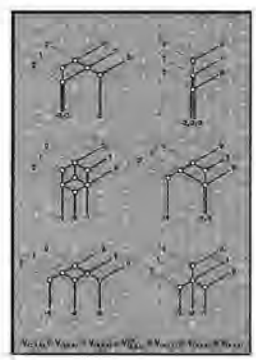
[W] H. WEYL, Das asymptotische Verteilungsgesetz der Eigenwerte lineare partieller Differentialgleichungen, *Math. Ann.* **71** (1912), 441-479.

[Wo] C. WOODWARD, Honeycomb associativity via scattering theory, preprint.

About the Cover

The cover illustrates one of the principal results from the work of Allen Knutson and Terry Tao. The figure itself is redrawn from one in a preprint of theirs, *The honeycomb model of* $GL_n(\mathbb{C})$. The theorem asserts a relationship between the decomposition of tensor products of representations and a certain collection of what they call "honeycombs". This particular example is concerned with the decomposition of the square of the representation of GL_3 parametrized by the weight vector (2, 1, 0). (The conventions about multiplicities are slightly different in the illustration from what they are in their article—multiplicities of edges are indicated here graphically.) There are some mysteries involved with this and similar pictures—when asked, for example, if there were any direct relationship between the components of such a figure and the decomposition, Knutson and Tao responded, "That's a very good question. We would love to have an interpretation of what the nodes and edge lengths actually mean. For instance, each honeycomb in the picture should correspond to a concrete copy of the appropriate irreducible representation in the tensor product of $V_{2,1,0}$ with itself, with explicit bases and coefficients, etc., but we have no idea how to construct such a canonical decomposition. Nor do we have a particularly good way to enumerate all the honeycombs which are associated with a given tensor product, other than applying off-the-shelf algorithms to enumerate lattice points in polytopes. There is a lot left to be understood in this area."

—*Bill Casselman* (covers@ams.org)



Presidential Views: Interview with Felix Browder

Every other year, when a new AMS president takes office, the *Notices* publishes interviews with the current president and with the president elect. What follows is an edited version of an interview with AMS president Felix E. Browder, whose term ends on January 31, 2001. The interview was conducted in October 2000 by *Notices* senior writer and deputy editor Allyn Jackson. The *Notices* plans to carry an interview with president elect Hyman Bass in the March 2001 issue.

Notices: *The main activity of your presidency was the organization of the meeting "Mathematical Challenges of the 21st Century", held at UCLA in August 2000. What reactions did you get to the meeting?*

Browder: Everybody was remarkably enthusiastic. Everyone was tremendously impressed, including people who I think didn't really expect it. I think they found this a very interesting meeting, because it exposed some of the strongest points on the contemporary mathematical scene. I was especially gratified that 160 young people were able to attend the conference thanks to a grant from the National Science Foundation, which supported their travel. The meeting was an important contribution to focusing the attention of the mathematical world on what probably are some of the most important trends and developments in mathematics. I am now working to try to get the speakers to write up articles for the conference proceedings to put this forward in a more long-lasting way to a general mathematical audience. One can argue that there were things that were not covered. I'm going to try to recruit articles from people who didn't speak, to cover some of these things, at the same level of quality. After all, we could have easily tried to secure forty speakers.

From my point of view, one of the things I wanted to do was to demonstrate that there is a very fundamental synergy between research mathematics—the frontier in the most advanced, strongly achieving areas—and the important potential areas of application of mathematics in other disciplines and in the world at large. To a large extent I think we did that. I regard the conference as symbolic of a broader set of issues: the future of mathematics, the sense of its unity, and the sense of its connections with its potential applications. What we tried to do is to bring together some of the most prestigious mathematicians in the current period who are working on some of these issues and whose voices would be taken seriously. You could have a lot of people talking about some of these things, but without the weight of the prestige of these people, I don't think the mathematical community as a whole would take such presentations as seriously. That was an important consideration in the kinds of speakers we chose. Some people suggested to me their friends: "I want my friend Mr. X as a speaker; he needs exposure." That's not the principle on which we chose. This was not a political exercise to help anybody, anybody at all—including me!

Notices: *There was a letter to the editor of the* Notices *by Lenore Blum, protesting the small number of women speakers.*

Browder: We had a much higher rate of declination among women who were invited than among men. Of the women who were invited, 60 percent declined. That's a lot. We invited 5 women, and 2 accepted. And of the men, altogether 43 were invited, and 28 accepted.

Notices: *Do you agree with what Blum wrote, that the small number of women speakers sends a bad message to young women mathematicians?*

Felix E. Browder

Browder: No, I don't agree with that. I don't think we should have a quota system for speakers. We were very anxious to get women speakers and would certainly have been happy to have more, but you can't run a conference of this sort on the basis of quotas. That gives the impression that the role of women is a political question, and I don't think that the future of women in mathematics is well served by making this a political issue. Basically, we tried very hard to get women speakers, and unfortunately some of the ones we tried to get declined. But that should not discourage young women mathematicians.

***Notices:** What else besides the UCLA meeting did you work on during your presidency?*

Browder: One thing that took place during my presidency, though I was not personally responsible for it, was the decision by the NSF [National Science Foundation] to sponsor a national mathematics initiative, a special concentration on mathematics in the NSF budget in fiscal years 2002–2006. This is an initiative of Rita Colwell, director of the NSF. The fact that it was approved by the National Science Board [on October 19, 2000] is a very important fact, not just in terms of getting money for mathematics, but in terms of raising the visibility of mathematics in the federal landscape. This will raise the visibility of mathematics in all institutions, including the universities. It will help make administrators in American universities conscious of the importance of mathematics as a component of the intellectual and institutional landscape.

This is a very important initiative from the point of view of the basic sciences. They have been arguing for years that there should be an initiative in basic, fundamental scientific research, as opposed to initiatives on very specific and applied objectives. Past initiatives, and present ones, include information technology, nanotechnology, and biocomplexity. We have been arguing for the fact that there ought to be initiatives that are not tied so sharply to immediate applications and technologies. This mathematics initiative, although some of it will impinge on applied research in various domains of mathematics, will be the first initiative centered on a basic discipline. At the same time, it's clear that it's going to have a major interdisciplinary component, because it's going to be related to hybrid mathematics as applied to many problems and objectives in other sciences, engineering, and medicine. One of the reasons that Rita Colwell is sponsoring this is that she believes mathematics has a tremendously important future role in biology. I think she expects that mathematicians will get strongly involved in that.

Many people worry about this because of the strong emphasis on interdisciplinary activities in mathematics. Many people want to carry on the old, noninterdisciplinary activities and are disturbed by a potential challenge to the pecking order in mathematics. I'm not sure what the pecking order is anyway. Some people have very preconceived notions: "It's what I am doing, and my friends are doing, and my immediate neighborhood." What's clear is, that is not the way it's going to be. And I think we have to live with that.

***Notices:** What problems do you see facing the mathematical community today?*

Browder: One thing I have observed is the tremendous damage done to individuals by their losing grant support. This happens to people of very high stature across the field. NSF now supports 70 percent of all federal university grants in the mathematical sciences, pure or applied. Funds in mathematics have not been going up—hopefully this will improve as the national initiative goes forward. However, there are lots of people of extremely high caliber who are not being supported, and for many people this does tremendous psychological damage. They are often demoralized by losing their grants. The whole grants system is intended to encourage mathematicians to be more productive at a higher level. The system of summer support, which essentially supports at this point nothing else, is peculiar to the United States. No other country on earth has tried to organize its mathematical activities using these principles. In fact, in many countries, people don't understand why we adopted it. It has its positive features: it encourages university administrators to take mathematics more seriously than they are accustomed to taking it. But at this point I am not sure that its negative features may not outweigh the positive features.

***Notices:** This seems strange, because people don't go into mathematics thinking, "I'm going to get a summer grant."*

Browder: But they acquire a certain ethos that tells them, "This is the way your work is measured." In many departments this *is* often the way the work is measured.

The panels that assess grant proposals at the NSF are very conservative. They have to be. They have to certify that the problems that these people are working on are in some sense clearly and unequivocally important problems. And quite frankly, some of the most interesting things are outside this framework. I don't know how you deal with that, but it's a very difficult situation. I'm just disturbed by the fact that when people receive negative judgments on their grant proposals, they are often very deeply psychologically disturbed by it. It may in fact damage their motivation and their creativity.

The AMS sees it as one of its prime missions to argue for research support from the NSF. Why should people who don't get research grants in mathematics see this as an interest of their own? In fact, it's a small fraction of the domestic membership of the AMS who have research grants—it might be less than 20 percent. There's a simple answer, that even if you don't get a grant, the extent to which the NSF and other agencies support mathematics has a tremendous impact on the way institutions, particularly universities and other institutions of higher education, perceive and react to mathematics and its importance within the framework of those institutions. If mathematics is taken exclusively or primarily as a service discipline to do elementary teaching, it will not receive enough resources to survive as a meaningful enterprise. It will not receive strong support in terms of its research and graduate training activities.

This is related to something that I've been complaining about for years and years. Mathematics departments make no systematic effort to have their seniors and beginning graduate students apply for NSF graduate fellowships—as opposed to the economists, who get four times as many fellowships as do the mathematicians. I can tell you that on the whole the mathematics students are superior. Mathematicians do a short-sighted calculation: "My students are not good enough to get these fellowships, and nobody who is going to get these fellowships will come to my department. Therefore, what interest is it of mine?" They fail to understand that the number of fellowships given in mathematics—which means the amount of encouragement given to people to be interested in mathematical careers at this level—depends completely, totally, without any other conditions, on proposal pressure. The group interest of mathematics as a profession depends vitally on the number of NSF fellowships given in mathematics. What matters to mathematics as a whole is that we need four times as many NSF fellowships in mathematics as we get now.

It is extremely important to encourage bright young people to stay in mathematics, and part of that encouragement is to try to get inducements in terms of things like fellowships up to the right level. And this is not understood. Some departments may think that if many students get these fellowships, then the best students who might apply to them for support might not come, but go instead to the more prestigious schools. There is a way to cure this. You can supplement NSF fellowships. It's perfectly legal. Don't practice any principle of egalitarianism. Try to buy the best students!

Notices: *What else did you work on as president?*

Browder: One of the big emphases was to be very strongly involved in the international posture of the AMS and of American mathematicians in the world community. We should regard ourselves as a world community of mathematicians, and while we have certain competitive situations with respect to other countries, this is much less important than what we have in common. The AMS and the American mathematical community have been very active in some cases in trying to help solve the problems of other mathematical communities, particularly in Russia, after the collapse of Communism. The support for science and mathematics almost vanished in Russia. The situation in Russian universities is deteriorating to an alarming extent. The AMS can't solve their problems for them, but we do give them assistance.

One of the things that went on when I was president, though I had only partial responsibility for it, was the establishment of relations with the European Mathematical Society, which is a coalition of around fifty national mathematical societies in Europe. Also, I have taken it as a principle that during my term as president I would go to every joint meeting that we have with another society or group of societies. This included meetings in Australia, Scandinavia, Mexico, and Hong Kong. These meetings reflect the fact that, despite many differences, we all have a common interest and a common problem: the welfare of mathematics and encouraging the lives and activities of mathematicians throughout the world. Mathematics is an international activity; there is no "national" mathematics distinct from one country to another. There are different national traditions, different strengths in different areas. But in general, almost every kind of mathematics has been worked on, and significant contributions have been made, in many different countries. Many people see competition between different societies and different communities, and some competition does exist, but I don't regard this as very important compared to our common interest. This is an important principle that the Society does and should continue to operate on.

NSF Launches Major Initiative in Mathematics

The National Science Foundation (NSF) has announced an initiative intended to increase dramatically its support of the mathematical sciences. If the initiative is funded at the level now being discussed, in six years NSF spending on the mathematical sciences will be four or five times the current budget of its Division of Mathematical Sciences (DMS).

The initiative was formally approved at an October 19, 2000, meeting of the National Science Board (NSB), the NSF's policymaking body. Up to that time the initiative had been discussed within the NSF, but specific dollar amounts had not been stated publicly. When NSF director Rita Colwell told the Board that she wanted the budget for the initiative to reach $400 to $500 million by fiscal year 2006 (which begins October 1, 2006), many were surprised that the amount she had in mind was so large. Securing such an increase for mathematics will depend on the success of the current drive to double the NSF budget over the next five years. At least this year the NSF seems to be on track for doubling its budget, with a 13.6 percent increase for fiscal year 2001 (which began October 1, 2000).

After the NSB approval, NSF officials discussed the mathematical sciences initiative with several groups, including the AMS Committee on Education, the Joint Policy Board for Mathematics, and the Board on Mathematical Sciences (BMS) of the National Academy of Sciences. In addition, Colwell delivered the keynote address at the BMS Mathematical Sciences Department Chairs' Colloquium, held at the academy in November 2000. There she discussed what she called the "vital and growing role of mathematics in all of science and engineering" and outlined the main themes of the initiative.

The "Mathematization" of Science

The driving force behind the initiative is the "mathematization" of all areas of science and engineering. In order for other disciplines to make effective use of mathematical and statistical methods and ideas, the thinking goes, the mathematical sciences must be a healthy and flourishing discipline and must also have strong connections to other disciplines. In addition, the nation needs high-quality education and training in the mathematical sciences, not just for those who plan to make a career in these areas but also for those who will work in other areas where the mathematical sciences are used. Following these themes, the initiative has three main components: support of fundamental mathematical sciences, support of connections between the mathematical sciences and other disciplines, and mathematical sciences education.

"Before mathematical concepts can be applied, they have to be developed," Colwell stated in her keynote address. "That's why boosting support for fundamental mathematics research is the first component, the most important component of the initiative." This component is not confined to those areas of the mathematical sciences that have direct applications in other disciplines, so all areas of the field could potentially benefit.

Colwell pointed to reports that have come out in recent years documenting the "fragile" state of the mathematical sciences in the United States. These reports have argued that the decline in the numbers of undergraduate and graduate students in mathematics is jeopardizing the health of the field and that reliance on foreign mathematical talent is not sustainable. At the same time, support for graduate students and postdoctoral researchers in the mathematical sciences lags behind that in other areas. The NSF initiative will aim to make the mathematical sciences more attractive by increasing support for graduate students and postdoctoral researchers.

Other emphases include increasing the size and duration of grants and expanding support for collaborations among mathematical sciences researchers. For years the mathematical sciences community has indicated that increasing the number of individuals supported on grants should be the highest funding priority for the field. The NSF has not explicitly made this priority part of the initiative. However, Robert Eisenstein, NSF assistant director for mathematical and physical sciences, said, "We hope to increase grant size and duration, as well as the number of people involved."

Although the first component of the initiative encompasses all areas of the mathematical scences, the second component, concerning connections between the mathematical sciences and other disciplines, is initially focused on three overarching themes: managing and analyzing large data sets, managing and modeling uncertainty, and modeling complex interacting nonlinear systems. Promoting links between the mathematical and biological sciences is often mentioned in connection with the initiative. In her keynote address Colwell noted that she had come to appreciate the importance of mathematics through her own research in biology.

The third component of the mathematical sciences initiative, concerning education, will emphasize research activities that integrate education and training, teacher preparation and development, new curricula, and research on learning mathematics. The NSF also hopes to find appropriate ways to involve mathematicians in precollege education. DMS director Philippe Tondeur, speaking before the BMS, pointed to a "paradox" in mathematics and science education: He said that there is a widening gap between, on the one hand, the increasingly sophisticated knowledge base and use of science, and, on the other hand, the teaching and learning of science that goes on in school classrooms. Tondeur pointed out that the nation spends over $500 billion annually on elementary and secondary education, compared to the entire NSF budget of $4.5 billion. "NSF can't be the only driver" in educational reform, he said, "but it has some significant responsibility. This paradox of education will not be resolved if the scientific community does not get involved."

Funds to Be Spread Across NSF

The NSF currently has four other ongoing initiatives: Biocomplexity in the Environment, Information Technology Research, Nanoscale Science and Engineering, and 21st Century Work Force. The mathematical sciences initiative will have ties to all of these. Tondeur pointed out that the mathematical sciences initiative is an NSF initiative, not a DMS initiative, so some of the new funds will be spread across the foundation. At this point it is not clear how those funds will be allocated among the three components of the initiative, and in particular it is not clear how large an increase the DMS will receive. "It will not all go to the mathematics division," said Eisenstein. "We hope for a large increase for DMS, but there will also be funds flowing to other parts of the NSF that will cooperate with DMS" on the initiative.

An internal working group consisting of representatives from all the directorates in the foundation has been charged with recommending the funding mechanisms and directions for the initiative. One member of the working group, DMS program officer Deborah Lockhart, said it is likely the DMS will have primary responsibility for the "fundamental mathematical sciences" component of the initiative. Among the programs to be emphasized are Focused Research Groups, VIGRE (Grants for the Vertical Integration of Research and Education), and new mathematical sciences institutes. The working group has recently been focusing on recommending funding mechanisms for the other two components of the initiative. These mechanisms are likely to include collaborative research groups, cross-disciplinary training, interdisciplinary centers, and activities that promote the integration of research and education.

Specifics about the initiative are still very much in flux, and NSF officials were calling for input from the mathematical sciences community. "We seek and need your advice on these and other mechanisms," Colwell stated in her address. "We have great hopes for our mathematical sciences initiative. But we have a really big challenge before us, and we can only succeed by working together." During the BMS meeting, board member Jennifer Chayes of Microsoft Research asked what mathematicians can do to help the initiative become a reality. Samuel M. Rankin III, director of the AMS Washington office, pointed out that members of Congress do not scrutinize NSF budget items at the level of the mathematical sciences initiative. Therefore, he said, the most effective thing to do is to encourage Congress to support the doubling of the NSF budget. The next step in the process of establishing the initiative is to make it part of the president's budget request, which will be sent to Congress in early 2001. Just how smoothly this step will go is uncertain, given the change in administration.

Although the NSF's five-year commitment to increasing support for the mathematical sciences is a positive sign, the reality is that Congress appropriates money year to year. It is impossible to know whether funding for the initiative will rise to the level now being discussed. Still, the existence of the initiative may help to raise the profile of the mathematical sciences on college and university campuses. "The very fact that Rita Colwell is

The Ultimate Cross-Cutting Discipline

What follows is an excerpt from the beginning of Rita Colwell's keynote address at the Board on Mathematical Sciences Department Chairs' Colloquium, delivered on November 10, 2000, at the National Academies.

Roger Bacon observed that mathematics is the door and the key to the sciences. For us, seven centuries later, his words ring with even deeper truth. A more recent observation about mathematics comes from E. O. Wilson, the biologist. He writes: "Mathematics seems to point arrow-like toward the ultimate goal of objective truth." Given the accelerating cross-pollination of mathematics and bioscience, I think it's not a coincidence that Wilson is a biologist. Indeed, mathematics is the ultimate cross-cutting discipline. It's the springboard for advances across the board. Mathematics is both a powerful tool for insight, and it's a common language for science. I refer to it as the "Esperanto" of science. Fundamental mathematics engenders concepts and structures that often turn out to be just the right framework for applications in what seem to be unrelated areas. A good example is the fractal, a famous as well as a beautiful illustration of how the inner principles of mathematics enable us to model many natural structures. Now cosmologists are beginning to draw a truly awesome portrait of the structure of the universe, and they use mathematics as the medium. On the other end of the scale, particle physicists begin to sketch quantum phenomena, again with mathematics as their brush and their palette. And just as telescopes probe outer space, the mathematical sciences give us the platform to explore the hidden universe of the imagination, which mysteriously permeates our real world. Newton's invention of calculus inaugurated a new role of mathematics, enabling mechanics to flourish and the physical sciences to thrive. And today we are watching mathematics empower new, exciting areas—biology, neuroscience, information technology, and nanotechnology... [I]f we take a quick trip across the disciplines, we find mathematics is a full partner everywhere we alight.

making the mathematical sciences initiative a high priority of NSF will change the way administrators view mathematics and statistics," said M. Gregory Forest of the University of North Carolina at Chapel Hill, who made a presentation at the Chairs' Colloquium. "We should position ourselves locally, at our home institutions, in the context of this national priority. Deans will be far more receptive to be part of a national initiative, since nobody wants to miss out on a popular trend—and in this case the trend happens to be a great idea!"

Why an Initiative Now?

Why does the NSF need a mathematical sciences initiative now? "For a host of reasons funding for mathematics has not kept pace with other branches of theoretical physical science," Eisenstein said. "Also, the 'value-added' that mathematics brings to other sciences is more visible today than it has been in the past. This 'value-added' that other sciences perceive is a major driver in this initiative."

Similar points have been made in the past but have not led to the director of the NSF speaking of quadrupling spending on the mathematical sciences. It is not clear why such arguments are now meeting with more success than they have in the past, but there are at least three contributing factors. One is that over the past few years the mathematical sciences community has become a much more visible force on the Washington science policy scene. This is due in part to the activities of the AMS Washington office, which have focused not on increasing funding for mathematics but rather on working with other scientific societies to argue for increasing the budget for the NSF overall. These activities did not directly affect the NSF's decision to launch a mathematical sciences initiative, but they did contribute to an atmosphere favorable for the initiative. Also contributing to the greater visibility of mathematics in Washington is the fact that some leaders in the mathematical sciences community have worked to establish relationships with the upper levels of management at the NSF.

The second factor is that over several years the DMS has worked hard to establish ties to other disciplines. For example, Tondeur's predecessor, D. J. Lewis of the University of Michigan, started a joint venture between the DMS and the mathematics program at DARPA (Defense Advanced Research Projects Agency), which focused on the use of mathematics in materials science. These kinds of activities helped to give the DMS credibility in the NSF as a division that reaches out to other areas and seizes opportunities.

The third factor is the effectiveness of DMS director Tondeur. One longtime NSF employee, noting the skill with which Tondeur parlayed the division's past successes into support for a major initiative, said: "I have never seen anything like it in my thirty years at NSF." The arguments on behalf of mathematics clearly have resonated with NSF director Colwell, who has embraced the initiative as something of a personal crusade. One mathematician at the Chairs' Colloquium remarked that Colwell seemed to have taken on the views of a mathematician. During the question period following her keynote address, Colwell mused about the current DMS budget: "$106 million. That's for all of mathematics in the United States? In a $1.9 trillion federal budget? A $9 trillion gross economy? It's tragic. We've got to really do something. And we have to work together."

—Allyn Jackson

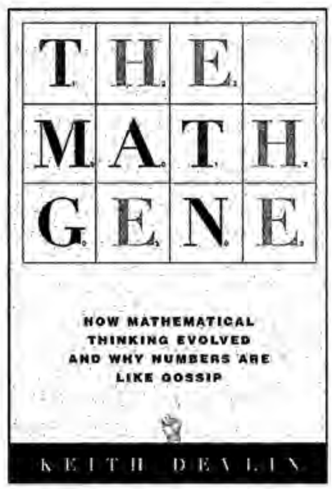
The Math Gene: How Mathematical Thinking Evolved and Why Numbers Are Like Gossip

Reviewed by Allyn Jackson

The Math Gene: How Mathematical Thinking Evolved and Why Numbers Are Like Gossip
Keith Devlin
Basic Books, 2000
ISBN 0-465-01618-9, Hardcover $25.00

In a way it all seems so improbable. According to Devlin's book, human beings have had a recognizable concept of abstract numbers for only about 8,000 years. Mathematics as an intellectual discipline, as opposed to a collection of calculation recipes, came into being with the Greeks about 2,500 years ago. And most of what is considered higher mathematics came after the birth of the calculus less than 400 years ago. On an evolutionary scale these time spans are like flaps of a butterfly's wings. How could human brains, honed by natural selection for the basics of survival, have constructed today's mathematics in all its abstract, elaborate glory?

In this fascinating book Devlin provides a possible explanation. A well-known expositor of mathematics and frequent contributor to National Public Radio, Devlin has in recent years become interested in how the mind conceives and understands mathematics. Among his other books are *Goodbye Descartes: The End of Logic and the Search for a New Cosmology of Mind* and *Infosense: Turning Information into Knowledge*. In the current book Devlin's long experience in writing for a general audience shows in his clear and well-constructed prose, which aims always at maximal communication with the reader and never at showing off. Devlin is a cheery, patient, and unpretentious guide as he describes his theory of how mathematical ability evolved.



Devlin argues that everyone has the "math gene"—that is, everyone has an innate capacity for mathematical thinking. He defines this capacity as consisting of a number of basic attributes, including number sense, the ability to handle abstraction, a sense of cause and effect, logical reasoning ability, and the ability to construct and follow a causal chain of facts or events. The strength of these abilities may vary from person to person, but everyone has them, even those who profess to be "bad at mathematics" (the only exceptions being people with genetic abnormalities or brain damage). One might therefore view the development of mathematics as a natural outgrowth of the enormous mathematical capacity inherent in the human race.

Early in the book Devlin discusses psychological experiments and case studies that have shed light on number sense in humans and animals. Some of the case studies are quite striking, such as the tale of an otherwise intelligent young man who cannot handle numbers even in a rudimentary way, such as telling which is the larger of two numbers. Every now and again Devlin throws in a task for the reader to do to make certain points

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about the way the brain handles mathematical information. The first of these asks the reader to perform four easy subtractions: $1-1, 4-1, 8-7$, and $15-12$. Then he asks the reader to pick a number between 12 and 5. "You picked 7, didn't you?" The idea is that the brain is in "subtraction mode", so it automatically subtracts 5 from 12. In fact, the number I picked was 9. Indeed, in every one of these little tasks the result I got differed from the result Devlin predicts. These tasks therefore tended to increase my skepticism, and I found I was less persuaded by these initial chapters than I was by the rest of the book. In particular, I found myself wondering about the validity of the conclusions in some of the psychological tests Devlin describes.

The book is aimed at a general, nonmathematical audience, so Devlin devotes one chapter, entitled "What Is This Thing Called Mathematics?", to showing the reader that mathematics consists of more than arithmetic. In addition to discussing such topics as fractals and the geometry of animal coat patterns, he talks about symmetry and provides a very accessible introduction to the concept of a group. The next chapter explores the question of whether mathematicians think differently from nonmathematicians. Devlin's conclusion is that they do not but that mathematicians are more accustomed to handling abstractions.

Devlin spends a chapter and the appendix discussing linguistic theories and the idea of a "fundamental language tree" that is said to be hard-wired into all human brains. Having set up this background, he asserts that the standard account of the evolution of language, which holds that language evolved mainly to facilitate communication, is wrong. Devlin argues: "Rather it arose, almost by chance, as a by-product of our ancestors acquiring the ability for an ever richer *understanding* of the world in which they found themselves—both the physical environment and their increasingly complex social world" (page 172; emphasis in the original).

For most of the rest of the book Devlin describes how this "richer understanding of the world" evolved and how it is connected to mathematical ability and to language ability. These two abilities are usually thought to be quite separate and to be controlled by different parts of the brain. Nevertheless, Devlin argues that the two abilities actually developed in parallel. A necessary precursor for both is what he calls "off-line thinking", which is the ability to reason abstractly in a "what if?" mode. Animals can engage in quite sophisticated "on-line thinking": A chimp can look at some fruit on a nearby tree and plan a path to the fruit that avoids predators. But a chimp is not capable of planning to save some seeds from the fruit in order to plant fruit trees in a safer location. This requires off-line thinking. The ability to make such elaborate plans is one thing that sets humans apart from animals.

Devlin draws an analogy between on-line thinking and what he calls "protolanguage", a rudimentary, "me Tarzan, you Jane" communication system that lacks syntax. Off-line thinking provides a combinatorial structure connecting representations of things in the world and allows one to consider relationships between those things, how things act on other things, how certain things precede others in time, and so forth. But, Devlin notes, this is exactly the function of syntax in language. "In other words, the combinatory machinery necessary to initiate and maintain off-line thinking is nothing other than syntax," he writes (page 244). "When you get off-line thinking, you get full language, and vice versa." Devlin attributes this key insight to linguistic theorist Derek Bickerton.

In the next chapter Devlin is ready to assert that "[M]athematics is an automatic consequence of off-line thinking" (page 252). But he goes a step further to ask *why* mathematics developed. He finds the answer in a surprising place: in the predilection for human beings to gossip. The negative connotations of the word "gossip" are to be ignored here. What Devlin is referring to is the propensity of people to talk about other people, their personalities, their relationships, their activities, and all other aspects of their lives. The ability to understand the complex web of connections that link humans together was an important survival tactic in early societies. But what does this have to do with mathematics? "[A] mathematician is someone for whom mathematics is a soap opera," Devlin explains (page 261). He does, on the next page, state his main thesis a little more soberly: "To put it simply, mathematicians think about mathematical objects and the mathematical relationships between them using the same mental faculties that the majority of people use to think about other people" (page 262). Just as nearly anyone could run a marathon if he or she really wanted to, anyone could use his or her "math gene" to understand the higher realms of mathematics. The decisive factors are interest and motivation. Near the end of the book Devlin discusses some implications his theory may have for mathematics teaching.

Someone once speculated that human beings did not start using fire because they needed it for warmth and cooking but rather because they were fascinated by the flame. And the same could be true of mathematics: Human beings developed mathematics not because it was useful but because of the fascination of the structures they found. Keith Devlin's provocative and absorbing book doesn't engage in such romantic speculations, but it does resonate with them.

2000 Annual Survey of the Mathematical Sciences

(First Report)

Report on the 2000 New Doctoral Recipients
Faculty Salary Survey

Don O. Loftsgaarden, James W. Maxwell, and Kinda Remick Priestley

The First Report of the 2000 Annual Survey gives information about the employment status of 1999–2000 new doctoral recipients from U.S. departments in the mathematical sciences and salary data on faculty members in U.S. departments of mathematical sciences in four-year colleges and universities. This report is based on information collected from a questionnaire distributed to departments in May 2000. A second questionnaire concerned with data on fall 2000 enrollments, majors, and departmental faculty size was distributed to departments in October 2000. Results from the second questionnaire will appear in a later report of the 2000 Annual Survey in a summer 2001 issue of the *Notices*. A questionnaire was also distributed to the individual new doctoral recipients in October 2000. This questionnaire will be used to update and revise results in this report, which are based on information from the departments that produced the new doctorates. Those results will be published in a later report of the 2000 Annual Survey in a summer 2001 issue of the *Notices*.

The 2000 Annual Survey represents the forty-fourth in an annual series begun in 1957 by the American Mathematical Society. The 2000 Survey is under the direction of the Annual Survey Data Committee, a joint committee of the American Mathematical Society, the American Statistical Association, the Institute of Mathematical Statistics, and the Mathematical Association of America. The current members of this committee are Lorraine Denby, J. Douglas Faires, Mary W. Gray, Alfred W. Hales, Peter E. Haskell, Ellen E. Kirkman, James M. Kister, James Lewis, Don O. Loftsgaarden (chair), James W. Maxwell (ex officio), and Yashaswini Mittal. The committee is assisted by AMS survey analyst Kinda Remick Priestley and survey coordinator Colleen Rose. Comments or suggestions regarding this Survey Report may be directed to the committee.

Report on the 2000 New Doctoral Recipients

This report presents a statistical profile of recipients of doctoral degrees awarded by departments in the mathematical sciences at universities in the United States during the period July 1, 1999, through June 30, 2000. It includes a preliminary analysis of the employment of 1999–2000 doctoral recipients and a demographic profile summarizing characteristics of citizenship status, sex, and racial/ethnic group. All information came from the departments that gave the degrees. Table 1 provides the departmental response rates for the 2000 Survey of New Doctoral Recipients. See page 208 for a description of the groups.

Table 1: Doctorates Granted Response Rates

Group I (Pu)	25 of 25 including 0 with 0 degrees
Group I (Pr)	22 of 23 including 0 with 0 degrees
Group II	56 of 56 including 2 with 0 degrees
Group III	68 of 74 including 17 with 0 degrees
Group IV	75 of 89 including 7 with 0 degrees
Group Va	18 of 20 including 1 with 0 degrees
Group Vb	No longer surveyed

Recent Changes in Procedures for the Annual Survey

Data used for the First Report of the Annual Survey is gathered from doctoral-granting departments starting in May each year. Updated information from the individual new doctoral recipients is gathered in the fall each year, and this information is used to update the results from the First Report in a later report, which will appear in an issue of the *Notices* the following summer. For the 1996 Annual Survey and earlier surveys, data from the individual new doctoral recipients was gathered earlier, and early responses were used in the First Report. This means that results in First Reports after 1996 are not strictly comparable with those in earlier reports.

Prior to 1999, Group V was comprised of Groups Va and Vb, with Group Va containing

Highlights

Based on responses from departments alone, the fall 2000 unemployment rate for the 943 new doctoral recipients from 1999-00 whose employment status is known is 4.6%. This figure will be revised using information collected from the new doctoral recipients themselves, and it will likely be between 3% and 4%. The fall 1999 unemployment rate was 6.2%.

Of the new doctoral recipients who have jobs, 58 (6.5%) have positions in the institution from which they received their degrees, though not necessarily in the same department, and 15 (1.7%) have part-time jobs.

Of the 796 new doctoral recipients employed in the U.S., 206 (25.9%) have jobs in business or industry. In 1998 this number was 219, and in 1999 it was 160. The number of new doctoral recipients taking U.S. academic positions was 551 in fall 2000, down slightly from 564 in fall 1999.

Females account for 302 (27.0%) of the 1,119 new doctoral recipients in 1999-00, down slightly from the record high of 318 (28.1%) in 1998-99. Of 537 U.S. citizen new doctoral recipients, 158 (29.4%) are females, down from the record 187 (33.8%) in 1998-99, but still the second highest percentage ever recorded.

Of the 1,119 new doctoral recipients in 1999-00, 537 (48.0%) are U.S. citizens, down slightly from 48.9% in 1998-99.

Among U.S. citizen new doctoral recipients, there are 15 Black or African Americans and 10 Hispanic or Latinos. The largest minority group is Asians with 29. The 54 new doctorates in these groups is up from 42 in 1998-99. Whites account for 479 (89.2%) of U.S. citizen new doctoral recipients.

Among new doctoral recipients hired in U.S. doctoral-granting departments, 48.1% are U.S. citizens. For other U.S. academic positions, 69.6% of the new doctoral recipients hired are U.S. citizens.

For the first time, a section on new doctoral recipients in Group IV, statistics departments, is included in this report. Group IV produced 284 new doctorates, of which 110 (38.7%) are females, compared to all other doctoral departments combined, where 192 of 835 (23.0%) are females.

For field of thesis, 351 of the 1,119 new doctoral recipients were in probability (41) or statistics (310). The next highest number was in algebra and number theory with 169.

Applied Mathematics/Applied Science doctoral departments and Vb containing Operations Research/Management Science doctoral departments. Response rates for Vb departments were always very poor, and many of the departments were inherently quite different from the other departments included in the Annual Surveys. Beginning with the 1999 Survey, the Annual Survey Data Committee decided to no longer survey Group Vb. Hence Group V now contains only Group Va, Applied Mathematics/Applied Science departments. The average number of doctoral degrees reported by responding Group Vb departments in 1995, 1996, 1997, and 1998 was 55. This change means the number of doctoral degrees in the First Reports since 1999 are not strictly comparable to those of earlier First Reports.

Also in 1999, 9 new statistics departments were added to Group IV, doctoral-granting statistics departments, to make this group more complete. The list of departments in Group IV has been under revision over the last three to four years and now contains a set of 89 departments appropriate for the Annual Survey. In addition, the number of Group IV departments responding to the Annual Survey has risen from 54 (67.5%) in 1995-96 to 75 (84.3%) in 1999-2000. A later section of this report is devoted to new doctoral recipients in Group IV.

Note:
Several tables in this report contain results for five years, 1995-96, 1996-97, 1997-98, 1998-99, and 1999-00. New doctoral recipients granted by Group Vb departments have been removed from most tables for the years 1995-96, 1996-97, and 1997-98. This is done because Group Vb departments are no longer a part of the Annual Survey beginning with 1998-99. Thus some numbers in this report will be slightly smaller than the corresponding numbers in the 1995-96, 1996-97, and 1997-98 First Reports. All results in this report are based on the actual numbers reported by the responding departments. No adjustments were made to account for nonresponding departments.

Doctoral Degrees Granted

Table 2 shows the number of new doctoral degrees granted by the different doctoral groups surveyed in the Annual Survey for the past five years. Since Group Vb was dropped from the Annual Survey in 1998-99, doctorates reported by Vb departments in earlier years are not shown in Table 2. The 1,119 new doctorates granted by these departments in 1999-2000 is a de-

Table 2: New Doctoral Degrees Awarded by Groups I-Va, Fall Count

Group	I (Pu)	I (Pr)	II	III	IV	Va	Total*
1995-96	325	174	222	124	172	81	1098
1996-97	297	187	238	132	197	72	1123
1997-98	306	174	264	129	213	77	1163
1998-99	292	152	241	136	243	69	1133
1999-00	256	157	223	132	284	67	1119

*Does not include Vb. See "Recent Changes in Procedures" on page 195.

Don O. Loftsgaarden is professor emeritus of mathematics at the University of Montana. James W. Maxwell is AMS associate executive director for Professional Programs and Services. Kinda Remick Priestley is AMS survey analyst.

Table 3A: Employment Status of 1999–2000 U.S. New Doctoral Recipients in the Mathematical Sciences by Field of Thesis

TYPE OF EMPLOYER	FIELD OF THESIS: Algebra Number Theory	Real, Comp., Funct., & Harmonic Analysis	Geometry/ Topology	Discr. Math./ Combin./ Logic/ Comp. Sci.	Probability	Statistics	Applied Math.	Numerical Analysis/ Approximations	Linear Nonlinear Optim./ Control	Differential, Integral, & Difference Equations	Math. Education	Other/ Unknown	TOTAL
Group I (Public)	16	15	12	10	3	1	7	4	1	6	0	0	**75**
Group I (Private)	15	3	19	4	5	0	3	4	0	5	0	0	**58**
Group II	8	13	7	5	1	2	1	1	2	7	0	0	**47**
Group III	7	4	2	1	0	9	1	0	1	2	2	0	**29**
Group IV	0	0	0	0	2	43	0	1	0	0	0	0	**46**
Group Va	0	0	0	1	2	0	4	1	4	1	0	0	**13**
Master's	13	8	8	4	1	3	4	3	1	4	4	0	**53**
Bachelor's	25	16	9	10	1	9	7	5	2	14	6	1	**105**
Two-Year College	2	1	3	1	0	1	2	3	0	1	0	1	**15**
Other Academic Dept.	1	2	1	3	2	47	11	2	1	6	2	1	**79**
Research Institute/ Other Nonprofit	10	2	0	1	1	13	0	3	0	1	0	0	**31**
Government	0	0	0	3	1	20	7	3	1	4	0	0	**39**
Business and Industry	20	8	9	11	10	93	29	9	4	13	0	0	**206**
Non-U.S. Academic	15	8	12	10	5	19	7	1	1	7	0	0	**85**
Non-U.S. Nonacademic	0	1	2	1	0	1	1	2	0	0	0	0	**8**
Not Seeking Employment	3	0	0	2	0	2	3	1	0	0	0	0	**11**
Still Seeking Employment	11	2	8	2	0	6	3	6	1	4	0	0	**43**
Unknown (U.S.)	10	9	10	13	4	29	10	4	4	9	0	0	**102**
Unknown (non-U.S.)*	13	5	9	1	3	12	6	6	7	9	3	0	**74**
Column Total	**169**	**97**	**111**	**83**	**41**	**310**	**106**	**59**	**30**	**93**	**17**	**3**	**1119**
Column Subtotals Male	133	80	91	63	33	189	81	45	23	68	9	2	**817**
Column Subtotals Female	36	17	20	20	8	121	25	14	7	25	8	1	**302**

*Includes those whose status is reported as "unknown" or "still seeking employment".

Table 3B: Employment Status of 1999–2000 U.S. New Doctoral Recipients in the Mathematical Sciences by Type of Degree-Granting Department

TYPE OF EMPLOYER	TYPE OF DOCTORAL DEGREE-GRANTING DEPARTMENT: Group I (Public) Math	Group I (Private) Math	Group II Math	Group III Math	Group IV Statistics	Group Va Applied Math	ROW TOTAL	ROW SUBTOTAL Male	ROW SUBTOTAL Female
Group I (Public)	38	21	11	4	1	0	**75**	63	12
Group I (Private)	24	27	3	0	2	2	**58**	50	8
Group II	19	8	15	3	1	1	**47**	40	7
Group III	8	0	7	6	7	1	**29**	22	7
Group IV	0	0	0	0	46	0	**46**	24	22
Group Va	0	2	0	1	0	10	**13**	11	2
Master's	8	2	25	14	2	2	**53**	34	19
Bachelor's	20	9	36	31	7	2	**105**	64	41
Two-Year College	5	0	2	7	1	0	**15**	12	3
Other Academic Dept.	4	5	7	8	48	7	**79**	52	27
Research Institute/ Other Nonprofit	7	4	6	1	11	2	**31**	17	14
Government	4	7	4	2	20	2	**39**	26	13
Business and Industry	31	23	34	25	79	14	**206**	166	40
Non-U.S. Academic	31	17	13	3	18	3	**85**	69	16
Non-U.S. Nonacademic	1	1	3	1	1	1	**8**	5	3
Not Seeking Employment	1	0	5	2	1	2	**11**	4	7
Still Seeking Employment	15	9	7	3	6	3	**43**	35	8
Unknown (U.S.)	22	8	28	14	21	9	**102**	66	36
Unknown (non-U.S.)*	18	14	17	7	12	6	**74**	57	17
Column Total	**256**	**157**	**223**	**132**	**284**	**67**	**1119**	**817**	**302**
Column Subtotals Male	197	139	157	100	174	50	**817**		
Column Subtotals Female	59	18	66	32	110	17	**302**		

*Includes those whose status is reported as "unknown" or "still seeking employment".

Table 3C: 1999–2000 New Doctoral Recipients: Field of Thesis by Type of Degree-Granting Department

TYPE OF DOCTORAL DEGREE-GRANTING DEPARTMENT	FIELD OF THESIS												TOTAL
	Algebra Number Theory	Real, Comp., Funct., & Harmonic Analysis	Geometry/ Topology	Discr. Math./ Combin./ Logic/ Comp. Sci.	Probability	Statistics	Applied Math.	Numerical Analysis/ Approxi-mations	Linear Nonlinear Optim./ Control	Differential, Integral, & Difference Equations	Math. Education	Other/ Unknown	
Group I (Public)	73	33	44	23	9	4	19	15	7	27	0	2	256
Group I (Private)	38	18	35	16	8	3	15	9	1	12	1	0	157
Group II	45	35	21	21	6	4	35	15	6	31	4	0	223
Group III	12	10	10	15	3	25	12	13	1	18	12	1	132
Group IV	0	0	0	0	9	269	4	1	1	0	0	0	284
Group Va	0	1	1	8	6	5	21	6	14	5	0	0	67
Total	**169**	**97**	**111**	**83**	**41**	**310**	**106**	**59**	**30**	**93**	**17**	**3**	**1119**

crease of 14 from 1998–99. Groups I (Pu), II, III, and Va showed decreases, while Group I (Pr) increased by 5 and Group IV increased by 41 from 1998–99. Much of the increase in number of new doctoral degrees in Group IV is almost certainly due to the increase in response rate for Group IV. The 1999–2000 numbers in Table 2 will be broken down in various ways, such as by sex, in later sections of this report. The names of the 1,119 new doctoral recipients are found on pages 219–38 of this issue of the *Notices.*

A quick glance at the Total column in Table 2 seems to indicate that nothing interesting has happened with the number of new doctoral recipients over the five years included there. However, a closer look yields some interesting information. Group IV doctoral degrees have increased by 112 (65.1%) since 1995–96. Much of this increase is due to adding departments to this group and an increase in the number of responding departments from 54 in 1995–96 to 75 in 1999–2000. Over these five years, Group I (Pu) is down 69 (21.2%), Group I (Pr) is down 17 (9.8%), Groups II and III are up slightly, 1 and 8 respectively, and Group Va is down 14 (17.3%). If Group IV is excluded, the other five groups have gone from 926 new doctoral recipients in 1995–96 to 835 in 1999–2000, a drop of 9.8%

Employment Status of U.S. New Doctoral Recipients, 1999–2000

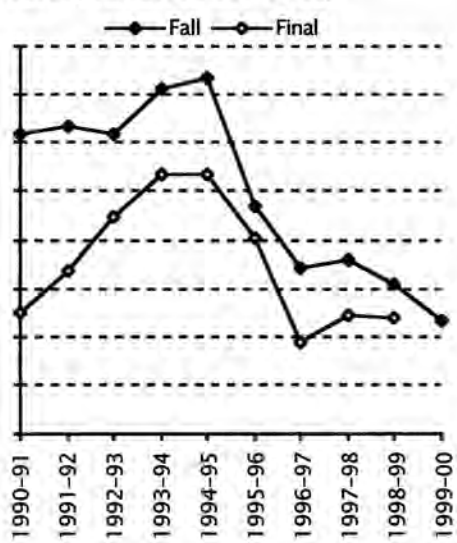
Table 3A gives a cross-tabulation of the 1,119 new doctoral recipients in the mathematical sciences: Type of Employer by Field of Thesis. Table 3B gives a cross-tabulation of the same data: Type of Employer by Type of Degree-Granting Department (Group). Table 3C gives a cross-tabulation of these same data: Type of Degree-Granting Department (Group) by Field of Thesis. This table gives a picture of the type of doctoral students being trained in the various groups. These tables contain a wealth of information about the employment of these new doctoral recipients, some of which will be discussed in this report. Keep in mind the results in this report come from the departments giving the degrees and not from the degree recipients themselves. These tables will be revised using information from the doctoral recipients themselves, and they will appear in a later report.

The last column (Total) in Table 3A can be used to find the overall unemployment rate. In this and other unemployment calculations in this report, the individuals whose employment status is not known (Unknown (U.S.) and Unknown (non-U.S.)) are first removed, and the unemployment fraction is the number still seeking employment divided by the total number of individuals left after the "Unknowns" are removed. The overall unemployment rate for these data is 4.6%. This figure will be updated with information gathered from the individual new doctoral recipients. The analogous figure for fall 1999 is 6.2%. Table/Graph 4A shows how this employment rate compares with other years over the past decade. The unemployment rate varies from group to group, with a high of 6.9% for Group I (Pu) and a low of 2.4% for Group IV.

Table/Graph 4A: Percentage of New Doctoral Recipients Unemployed (as reported in the respective Annual Survey Reports 1991–2000)

Report	Fall	Final
1990–91	12.4	5.0
1991–92	12.7	6.7
1992–93	12.4	8.9
1993–94	14.2	10.7
1994–95	14.7	10.7
1995–96	9.4	8.1
1996–97	6.8	3.8
1997–98	7.2	4.9
1998–99	6.2	4.7
1999–00	4.6	*

*To appear in the Second Report.
Caution: See "Recent Changes in Procedures" on page 195. The fall unemployment rate for 1997–98 excluding Group Vb was 7.6%.



There are 796 new doctoral recipients employed in the U.S. Of these, 551 (69.2%) hold academic positions, 39 (4.9%) are employed by government, and 206 (25.9%) hold positions in business and industry. In the First Report for fall 1999, there were 759 new doctoral recipients employed in the U.S., of which 564 (74.3%) held academic positions, 35 (4.6%) were in government, and 160 (21.1%) were in business and industry.

Table 4B: Number of New Doctoral Recipients Taking Positions in Business and Industry in the U.S. by Type of Degree-Granting Department, Fall 1998 to Fall 2000

Group	I (Pu)	I (Pr)	II	III	IV	Va	Total
Fall 1998	29	27	41	27	70	25	219
Fall 1999	28	19	23	19	57	14	160
Fall 2000	31	23	34	25	79	14	206

The number of new doctoral mathematicians taking jobs in business and industry, which had been rising for several years, dropped from 219 in fall 1998 to 160 in fall 1999. In fall 2000 the figure jumped back up to 206, close to its previous high. Table 4B shows the number of new doctoral recipients who took positions in business and industry by the type of department granting their degree for fall 1998 to fall 2000. Group I (Pu) has the smallest percentage (18.5%) taking jobs in business and industry and Group IV the highest at 35.1%. These percentages are based on the 796 new doctoral recipients known to have employment in the U.S.

Table 4C: Number of New Doctoral Recipients Taking U.S. Academic Positions by Type of Degree-Granting Department, Fall 1998 to Fall 2000

Group	I (Pu)	I (Pr)	II	III	IV	Va	Total
Fall 1998	117	97	122	49	84	32	**501**
Fall 1999	157	87	130	70	82	38	**564**
Fall 2000	133	78	112	75	126	27	**551**

Table 4C shows the number of new doctoral recipients who took academic positions in the U.S. by type of department granting their degree for fall 1998 to fall 2000, while Table 4D shows how many positions were filled with new doctoral recipients for each type of academic employer. The number taking academic positions in the U.S. remains high for the second consecutive year.

In 2000, 58 new doctoral recipients hold positions in the institution that granted their degree, although not necessarily in the same

Table 4D: U.S. Academic Positions Filled by New Doctoral Recipients by Type of Hiring Department, Fall 1998 to Fall 2000

Group	I-III	IV	Va	M&B	Other	Total
Fall 1998	177	35	7	177	105	**501**
Fall 1999	221	49	17	175	102	**564**
Fall 2000	209	46	13	158	125	**551**

department. This represents 6.5% of new doctoral recipients who are currently employed and 10.5% of the U.S. academic positions held by new doctoral recipients. In 1999 there were 72 such individuals, making up 8.2% of the new doctoral recipients who were employed at the time of the First Report. Fifteen new doctoral recipients took part-time positions in fall 2000.

Information about Females among the New Doctoral Recipients, 1999–2000

Tables 3A and 3B give male and female breakdowns of the new doctoral recipients in 1999–2000 by Field of Thesis, by Type of Degree-Granting Department, and by Type of Employer.

Overall, 302 (27.0%) of the 1,119 new doctoral recipients in 1999–2000 are females. In 1998–99, 318 (28.1%) of the new doctoral recipients were females. This percentage varies over the different groups, and these percentages are given in the first row of Table 4E. The percentage is lowest for Group I (Pr), at 11.5%, and highest for Group IV, statistics departments, at 38.7%. The second row of Table 4E gives the percentage of the new doctoral recipients hired who are female for each of the Groups I, II, III, IV and Va. In addition, 35.8% of the new doctoral recipients hired in Group M, master's departments, are female; 39.0% of the new doctoral recipients hired in Group B, bachelor's departments, are female; and 19.4% of new doctoral recipients hired in business and industry are female. The unemployment rate for all female new doctoral recipients is 3.2% compared to 5.0% for males and 4.6% overall.

Table 4E: Females as a Percentage of New Doctoral Recipients Produced by and Hired by Doctoral-Granting Groups, 1999–2000

%	I (Pu)	I (Pr)	II	III	IV	Va	Total
Produced	23.0	11.5	29.6	24.2	38.7	25.4	**27.0**
Hired	16.0	13.8	14.9	24.1	47.8	15.4	**21.6**

By field of thesis the percentage of female new doctoral recipients ranged from 17.5% in real, complex, functional, and harmonic analysis to 36.8% in probability or statistics and 47.1% in mathematics education.

Table 4F: Employment Status of 1999-2000 U.S. New Doctoral Recipients by Citizenship Status

TYPE OF EMPLOYER	CITIZENSHIP				TOTAL DOCTORAL RECIPIENTS
	U.S. CITIZENS	NON-U.S. CITIZENS			
		Permanent Visa	Temporary Visa	Unknown Visa	
U.S. Employer	439	68	241	48	796
U.S. Academic	326	40	150	35	551
Groups I, II, III, and Va	104	24	80	14	222
Group IV	25	3	15	3	46
Non-Ph.D. Department	181	11	44	16	252
Research Institute/Other Nonprofit	16	2	11	2	31
U.S. Nonacademic	113	28	91	13	245
Non-U.S. Employer	8	4	70	11	93
Non-U.S. Academic	8	3	64	10	85
Non-U.S. Nonacademic	0	1	6	1	8
Not Seeking Employment	7	2	2	0	11
Still Seeking Employment	20	5	15	3	43
SUBTOTAL	474	79	328	62	943
Unknown (U.S.)	63	19	17	3	102
Unknown (non-U.S.)*	0	3	56	15	74
TOTAL	537	101	401	80	1119

*Includes those whose status is reported as "unknown" or "still seeking employment".

Later sections in this First Report give more information about the female new doctoral recipients who are U.S. citizens and the female new doctoral recipients in Group IV.

Employment Information about New Doctoral Recipients by Citizenship and Type of Employer

Table 4F shows the pattern of employment within broad job categories broken down by citizenship status of the new doctoral recipients. The citizenship is known for all 1,119 new doctoral recipients in 1999-2000.

The unemployment rate for the 537 U.S. citizens is 4.2% compared to 6.0% in 1998-99. The unemployment rate for non-U.S. citizens is 4.9%. This varies by type of visa. The unemployment rate for non-U.S. citizens with a permanent visa is 6.3%, while that for non-U.S. citizens with a temporary visa is 4.6%.

Among U.S. citizens whose employment status is known, 92.6% are employed in the U.S. Among non-U.S. citizens with a permanent visa whose employment status is known, 86.1% have jobs in the U.S., while this percentage for

Table 4G: New Doctoral Recipients Having Employment in the U.S. by Type of Employer and Citizenship, 1999-2000

Employer	U.S.	Non-U.S.	Total
U.S. Academic, Groups I-Va	129	139	268
U.S. Academic, Other	197	86	283
U.S. Nonacademic	113	132	245
Total	439	357	796

Table 5: Sex, Race/Ethnicity, and Citizenship of U.S. New Doctoral Recipients, 1999-2000

RACIAL/ETHNIC GROUP	MALE					FEMALE					TOTAL
	U.S. CITIZEN	NON-U.S. CITIZEN Permanent Visa	NON-U.S. CITIZEN Temporary Visa	NON-U.S. CITIZEN Unknown Visa	Total Male	U.S. CITIZEN	NON-U.S. CITIZEN Permanent Visa	NON-U.S. CITIZEN Temporary Visa	NON-U.S. CITIZEN Unknown Visa	Total Female	
American Indian or Alaska Native	1	0	0	0	1	1	0	0	0	1	2
Asian	21	30	157	29	237	8	21	48	14	91	328
Black or African American	10	0	2	2	14	5	0	0	1	6	20
Hispanic or Latino	4	2	21	5	32	6	2	6	1	15	47
Native Hawaiian or Other Pacific Islander	0	0	0	0	0	0	0	1	0	1	1
White	343	36	132	18	529	136	8	33	7	184	713
Unknown	0	1	1	2	4	2	1	0	1	4	8
TOTAL	379	69	313	56	817	158	32	88	24	302	1119

Table 6: U.S. Citizen Doctoral Recipients

Year	Total Doctorates by U.S. Institutions	Total U.S. Citizen Doctoral Recipients	%
1975–76	965	722	75
1980–81	839	567	68
1985–86	755	386	51
1990–91	1061	461	43
1995–96	1150	493	43
1996–97	1158	516	45
1997–98*	1216	586	48
1998–99	1133	554	49
1999–00	1119	537	48

*Prior to this year, the counts include new doctoral recipients from Group Vb. The figure for 1997–98 excluding Vb is 1,163 new doctoral recipients, of which 565 are U.S. citizens. In addition, prior to 1982–83, the counts include recipients from computer science departments.

non-U.S. citizens with a temporary visa is 73.5%.

Table 4G is a cross-tabulation of the 796 new doctoral recipients who have employment in the U.S. by citizenship and broad employment categories. It is a condensed version of Table 4F.

Of the 796 new doctoral recipients having jobs in the U.S., 55.2% are U.S. citizens. Of the 268 new doctoral recipients who took jobs in U.S. doctoral-granting departments, 48.1% are U.S. citizens. Of the 283 who took other academic positions, 69.6% are U.S. citizens. Of the 245 who took nonacademic positions, 46.1% are U.S. citizens.

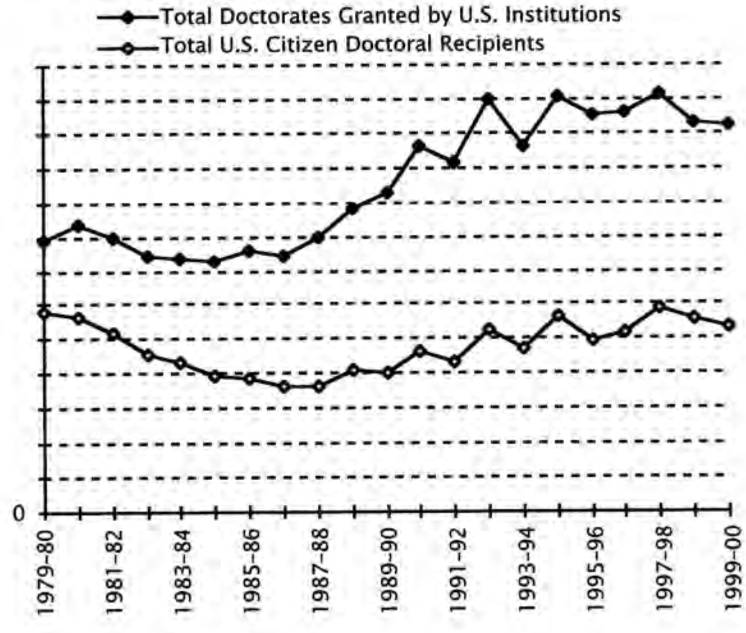
Of the 439 U.S. citizens employed in the U.S., 29.4% have jobs in a doctoral-granting department, 44.9% are in other academic positions, and 25.7% are in nonacademic positions. For the 357 non-U.S. citizens employed in the U.S., the analogous percentages are 38.9%, 24.1%, and 37.0% respectively.

Table 7: U.S. Citizen Doctoral Recipients by Sex

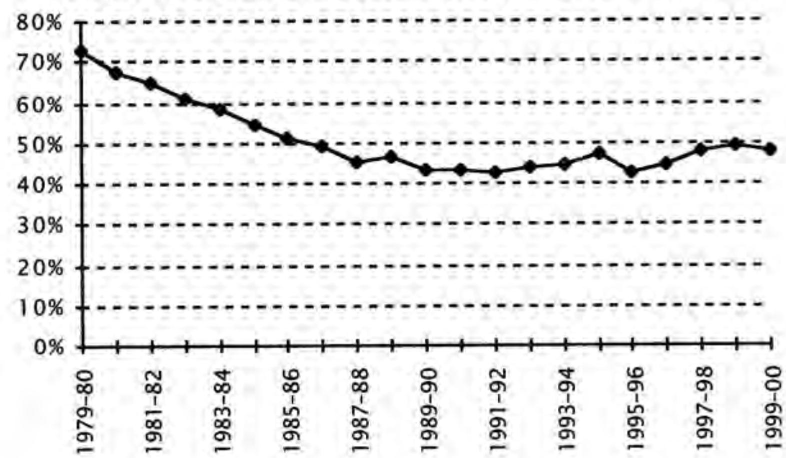
Year	Total U.S. Citizen Doctoral Recipients	Male	Female	% Female
1975–76	722	636	86	12
1980–81	567	465	102	18
1985–86	386	304	82	21
1990–91	461	349	112	24
1995–96	493	377	116	24
1996–97	516	368	148	29
1997–98	586	423	163	28
1998–99*	554	367	187	34
1999–00	537	379	158	29

*Prior to this year, the counts include new doctoral recipients from Group Vb. The figures for 1997–98 excluding Vb are 565 U.S. citizen new doctoral recipients, of which 409 are male and 156 are female. In addition, prior to 1982–83, the counts include recipients from computer science departments.

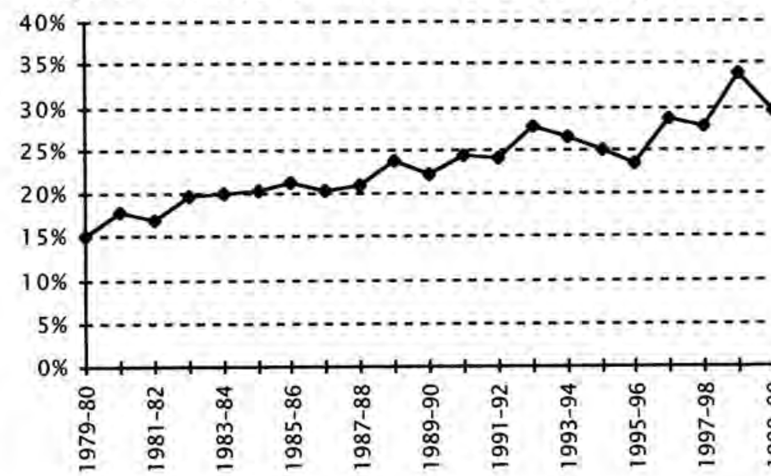
Graph 6A: U.S. Citizen Doctoral Recipients



Graph 6B: U.S. Citizen Doctoral Recipients by Percent



Graph 7: Female U.S. Citizen Doctoral Recipients by Percent



Sex, Race/Ethnicity, and Citizenship Status of U.S. New Doctoral Recipients, 1999–2000

Table 5 presents a breakdown according to sex, racial/ethnic group, and citizenship status of new doctoral recipients. The information reported in this table was obtained in summary form from the departments granting the degrees.

There were 537 (48.0%) U.S. citizens among the 1,119 new doctoral recipients in 1999–2000. Table 6 gives the number of new U.S. doctorates and the number of U.S. citizens back to 1975–76. The percentage of U.S. citizens has remained essentially the same over the last three years.

Among U.S. citizens, 29 are Asians (21 male and 8 female), 15 are Blacks or African Americans (10 male and 5 female), 10 are Hispanics or Latinos (4 male and 6 female), 479 are whites (343 male and 136 female), and 4 are other. Among non-U.S. citizens, there are 299 Asians, 37 Hispanics or Latinos, 234 whites, and 12 others.

Females make up 29.4% of the 537 U.S. citizens receiving doctoral degrees in the mathematical sciences in 1999–2000. This is down considerably from 33.8% in 1998–99, the highest percentage of females among U.S. citizen new doctoral recipients ever reported by the Annual Survey. For comparison, among the 582 non-U.S. citizen new doctoral recipients, 144 (24.7%) are females.

The number of male U.S. citizen new doctoral recipients increased by 12 from 1998–99. Table 7 gives the historical record of U.S. citizen new doctoral recipients, broken down by male and female for past years, going back to 1975–76.

New Doctoral Recipients in Group IV

Group IV contains U.S. departments (or programs) of statistics, biostatistics, and biometrics reporting a doctoral program. In the Annual Survey Reports, Group IV is referred to as the Statistics Group. In the past three to four years, substantial effort has gone into making Group IV an appropriate set of departments for the Annual Survey, making Group IV as complete as possible, and increasing the number of Group IV departments that respond to the Annual Survey. These efforts have been quite successful, as can be seen in Table 8, which contains five years of data for Group IV. Efforts are still ongoing to increase the response rate to the near 100% that the other doctoral groups have.

Group IV now has 89 departments, 15 more than the next largest doctoral group. It contains 31% of all doctoral departments surveyed, and the 75 departments responding to the Annual Survey produced 284 new doctorates, 25.4% of all new doctorates.

Table 8 gives five years of data for several variables in Group IV from 1995 to 2000. It is likely that most of the variation in numbers for Group IV during these five years is due to changes in Group IV mentioned in the first paragraph of this section.

Because of its size, it is clear that data from Group IV have a large effect on the overall results when all doctoral groups are combined. Furthermore, Group IV results are often quite different from those for Groups I (Pu), I (Pr), II, III, and Va; and Group IV results can mask important changes in the other doctoral groups. In the following paragraphs some of these differences are presented.

Of new doctoral recipients, 110 of 284 (38.7%) in Group IV are females and 192 of 835 (23.0%) are females in the other doctoral groups. Among the U.S. citizens, females account for 55 of the 143 (38.5%) Group IV new doctoral recipients, while for the other groups combined 103 of 394 (26.1%) are females.

Of 225 Group IV new doctoral recipients who have employment in the U.S., 79 (35.1%) took jobs in business or industry, while for the other doctoral groups 127 of 571 (22.2%) took jobs in business and industry.

Of 251 Group IV new doctoral recipients whose employment status is known, 6 (2.4%) are unemployed, while for the other doctoral groups 37 of 692 (5.3%) are unemployed. Twenty-two of 46 (47.8%) new doctoral recipients hired by Group IV departments are females. For the other doctoral groups, 36 of 222 (16.2%) new doctoral recipients hired are females.

Group IV had 278 new doctoral recipients with a field of thesis in probability (9) or statistics (269), and the other doctoral departments

Table 8: Five Years of Information about Group IV: Statistics and Biostatistics Departments

Year	Departments Surveyed	Departments Responding (percent)	New Doctorates in Group IV				New Doctorates in Probability or Statistics				New Doctorates Hired	
			Total	Females (percent)	Jobs in bus & ind	Percentage Unemployed	Total	Group IV	Other groups	Percentage Unemployed	Male	Female
1995–96	80	54 (67.5)	172	46 (26.7)	55	3.9	266	171	95	4.8	24	6
1996–97	81	60 (74.1)	197	74 (37.6)	70	4.2	292	187	105	5.1	24	9
1997–98	82	59 (72.0)	213	73 (34.3)	70	3.2	294	199	95	3.7	25	10
1998–99	91	72 (79.1)	243	87 (35.8)	57	4.9	320	240	80	5.8	29	20
1999–00	89	75 (84.3)	284	110 (38.7)	79	2.4	351	*278	**73	2.0	24	22

* Of 278, there were 269 in statistics and 9 in probability. For complete details, see Table 3C.

** Of 73, there were 41 in statistics and 32 in probability. For complete details, see Table 3C.

had 73 in probability (32) or statistics (41). The distribution of these 73 degrees among the various groups can be found in Table 3C. The number of new doctoral recipients with theses in probability or statistics (351) is larger than any other field, with algebra and number theory next with 169. The unemployment rate for the 351 new doctoral recipients in probability or statistics is 2.0%, compared to 5.8% for new doctoral recipients in all other fields combined.

Faculty Salary Survey

The charts on the following pages display faculty salary data for Groups I (Pu), I (Pr), II, III, IV, Va, M, and B: faculty salary distribution by rank, mean salaries by rank, information on quartiles by rank, and the number of returns for the group. Results reported here are summaries based on the departments who responded to this portion of the Annual Survey.

Table 9 provides the departmental response rates for the 2000 Faculty Salary Survey. Departments were asked to report for each rank the number of tenured and tenure-track faculty whose 2000–01 academic-year salaries fall within given salary intervals. Reporting salary data in this fashion eliminates some of the concerns about confidentiality but does not permit determination of actual quartiles. What can be determined is the salary interval in which the quartiles occur; the salary intervals containing the quartiles are denoted by <n, n+5>.

Table 9: Faculty Salary Response Rates

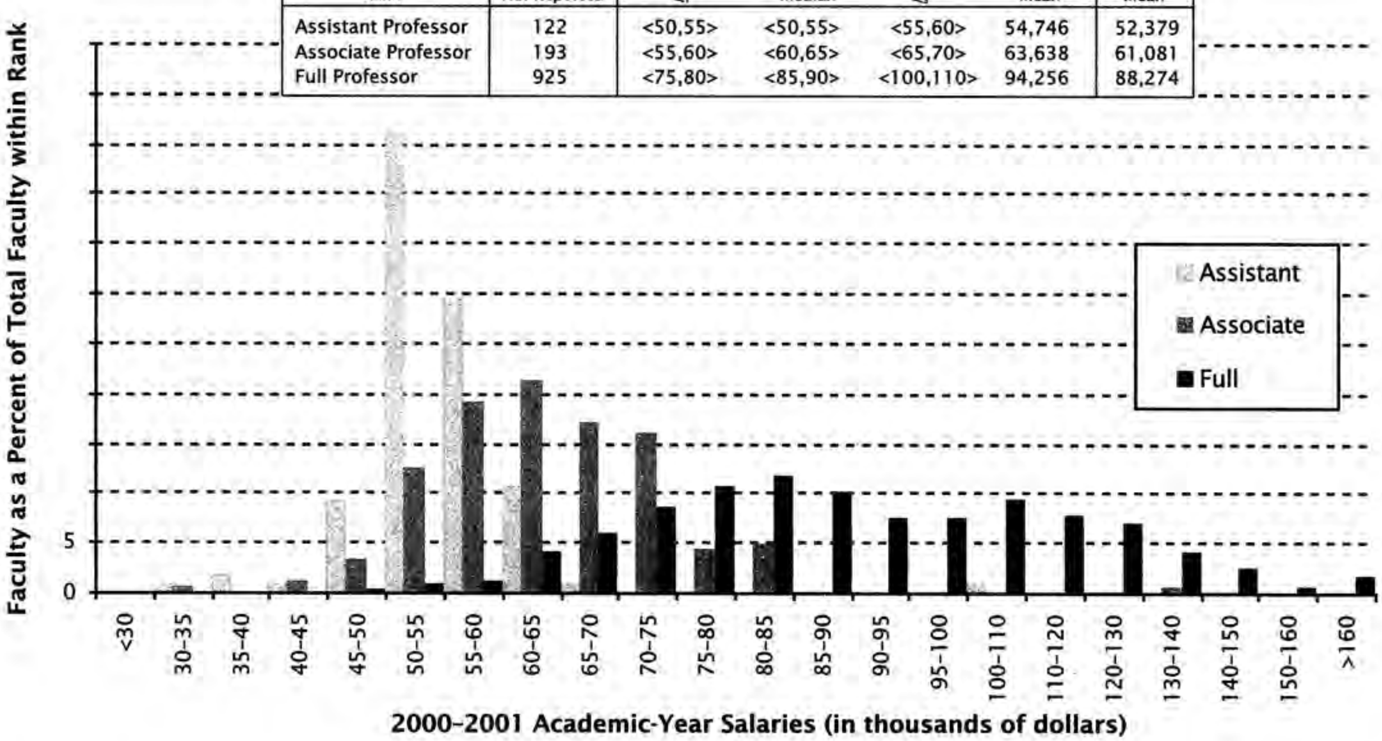
Departments	Number	Percent
Group I (Public)	25 of 25	100.0
Group I (Private)	16 of 23	69.6
Group II	46 of 56	82.1
Group III	58 of 74	78.4
Group IV	58 of 89	65.2
Group Va	10 of 17*	58.8
Group M	125 of 230	54.3
Group B	368 of 1018	36.1

* The population for Group Va is slightly less than for the Doctorates Granted Survey because some programs grant degrees but do not formally "house" faculty and their salaries.

Since departments in Groups I, II, and III were changed in 1995–96 (see definitions of the groups on page 208), comparisons are possible only to the last four years' data. In addition, prior to the 1998 survey, Groups Va and Vb were reported together as Group V.

Group I (Public) Faculty Salaries
Doctoral degree-granting departments of mathematics (25)
25 responses (100.0%)

Rank	No. Reported (2000–2001)	Q_1	Median	Q_3	Mean	1999–00 Mean
Assistant Professor	122	<50,55>	<50,55>	<55,60>	54,746	52,379
Associate Professor	193	<55,60>	<60,65>	<65,70>	63,638	61,081
Full Professor	925	<75,80>	<85,90>	<100,110>	94,256	88,274

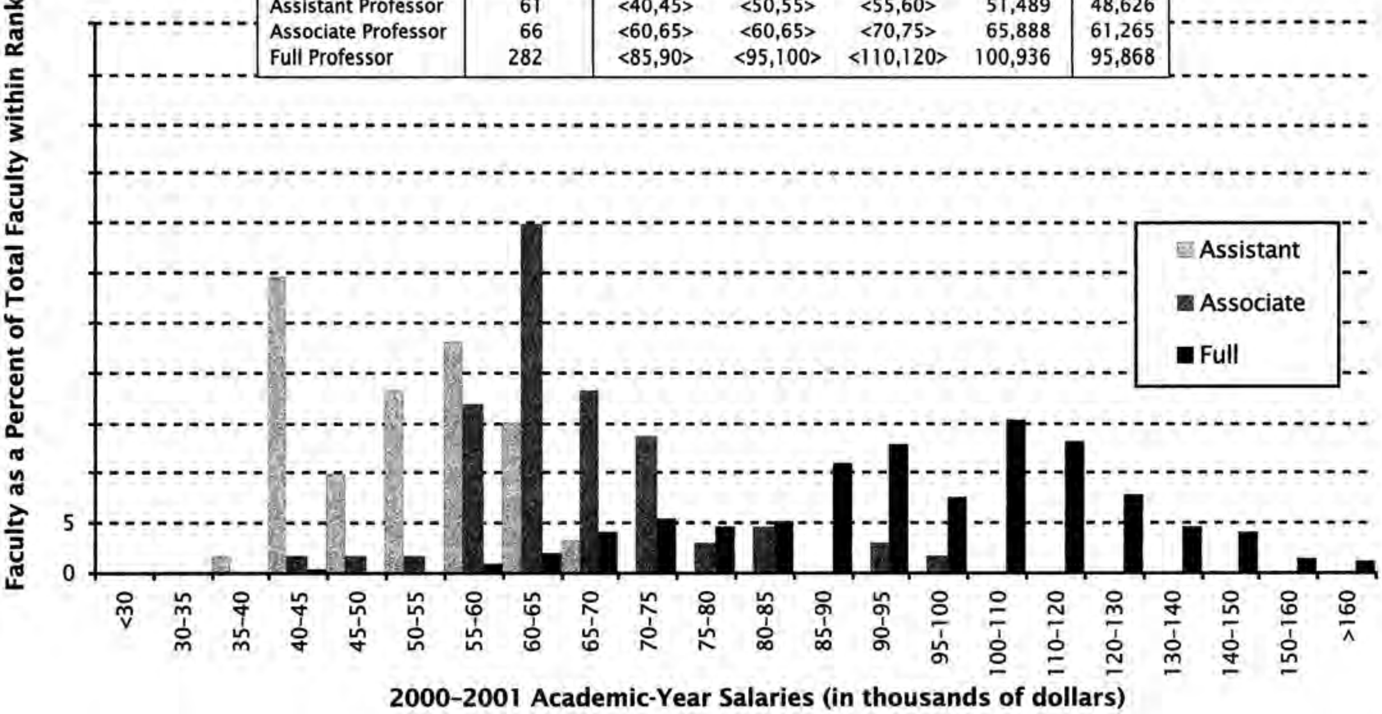


Group I (Private) Faculty Salaries

Doctoral degree-granting departments of mathematics (23)

16 responses (69.6%)

Rank	No. Reported	2000-2001 Q_1	2000-2001 Median	2000-2001 Q_3	2000-2001 Mean	1999-00 Mean
Assistant Professor	61	<40,45>	<50,55>	<55,60>	51,489	48,626
Associate Professor	66	<60,65>	<60,65>	<70,75>	65,888	61,265
Full Professor	282	<85,90>	<95,100>	<110,120>	100,936	95,868

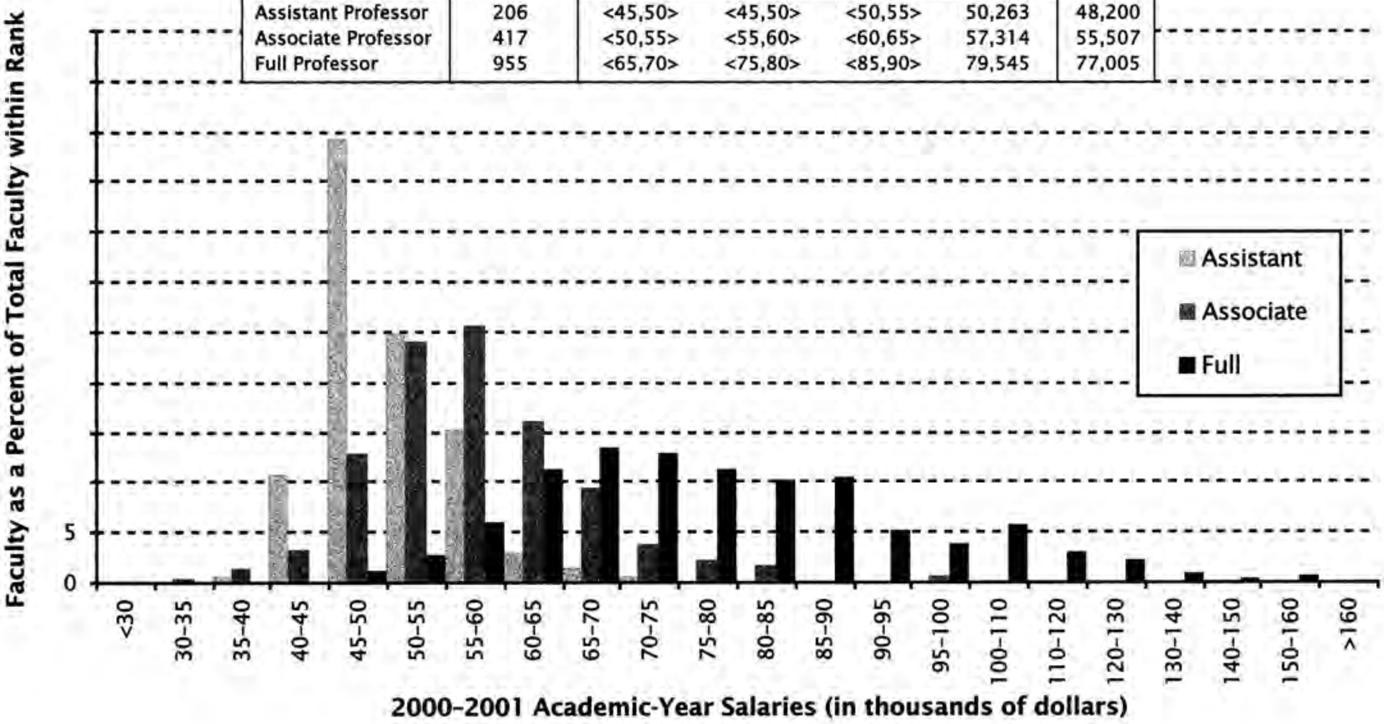


Group II Faculty Salaries

Doctoral degree-granting departments of mathematics (56)

46 responses (82.1%)

Rank	No. Reported	2000-2001 Q_1	2000-2001 Median	2000-2001 Q_3	2000-2001 Mean	1999-00 Mean
Assistant Professor	206	<45,50>	<45,50>	<50,55>	50,263	48,200
Associate Professor	417	<50,55>	<55,60>	<60,65>	57,314	55,507
Full Professor	955	<65,70>	<75,80>	<85,90>	79,545	77,005

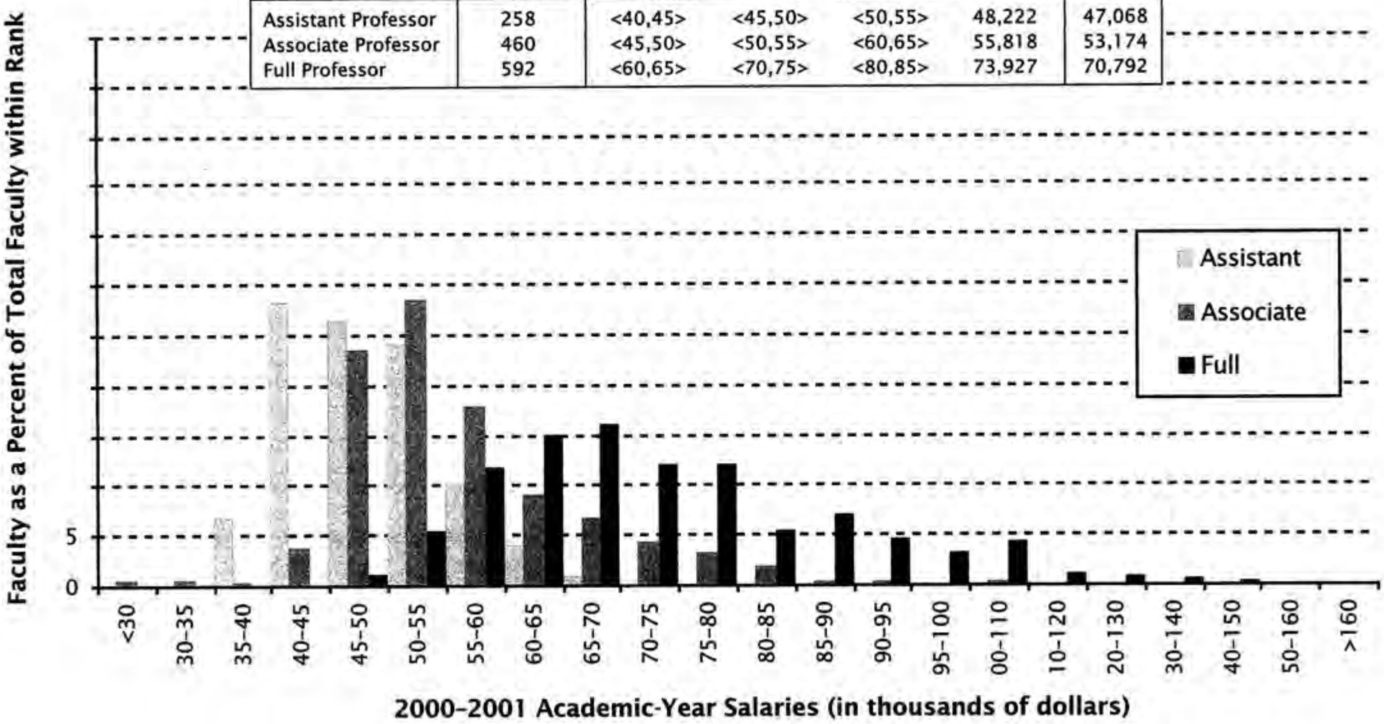


Group III Faculty Salaries

Doctoral degree-granting departments of mathematics (74)

58 responses (78.4%)

Rank	2000-2001 No. Reported	2000-2001 Q_1	2000-2001 Median	2000-2001 Q_3	2000-2001 Mean	1999-00 Mean
Assistant Professor	258	<40,45>	<45,50>	<50,55>	48,222	47,068
Associate Professor	460	<45,50>	<50,55>	<60,65>	55,818	53,174
Full Professor	592	<60,65>	<70,75>	<80,85>	73,927	70,792

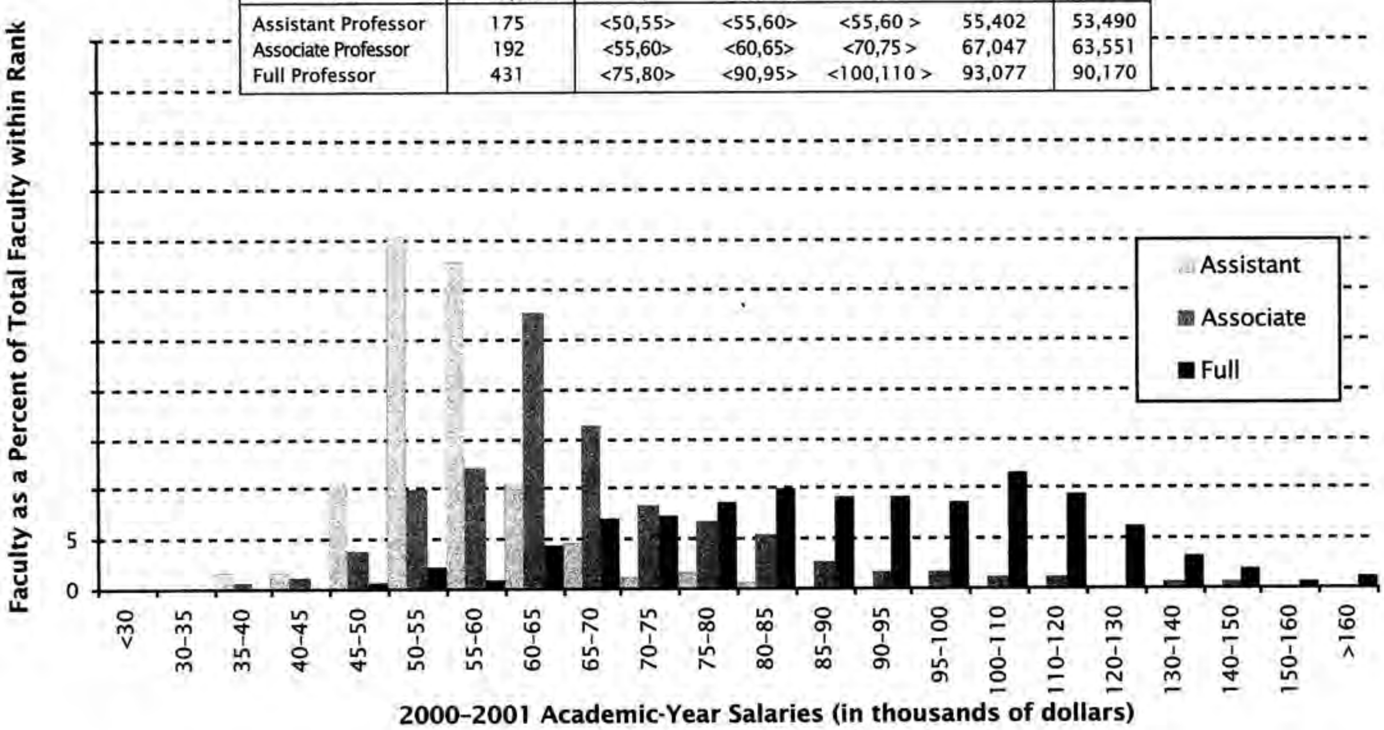


Group IV Faculty Salaries

Doctoral degree-granting departments of statistics, biostatistics, biometrics (89)

58 responses (65.2%)

Rank	2000-2001 No. Reported	2000-2001 Q_1	2000-2001 Median	2000-2001 Q_3	2000-2001 Mean	1999-00 Mean
Assistant Professor	175	<50,55>	<55,60>	<55,60 >	55,402	53,490
Associate Professor	192	<55,60>	<60,65>	<70,75 >	67,047	63,551
Full Professor	431	<75,80>	<90,95>	<100,110 >	93,077	90,170

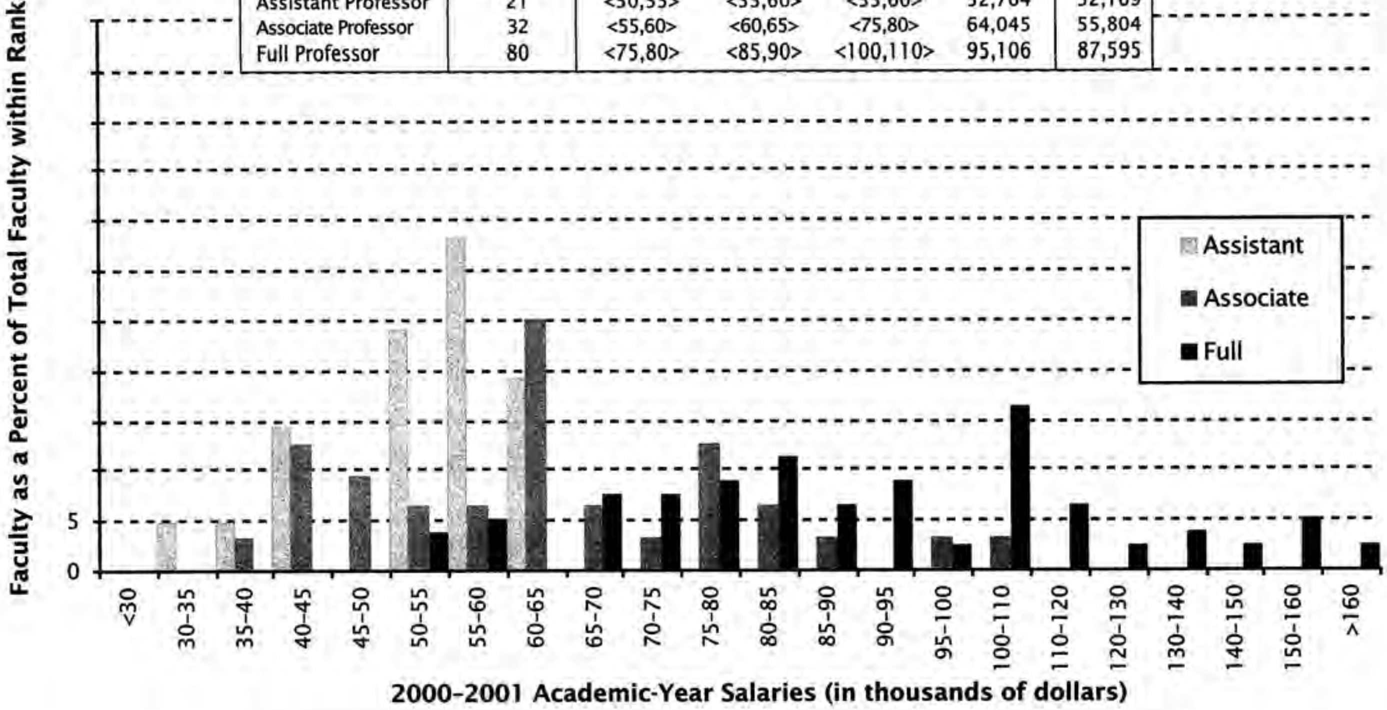


Group Va Faculty Salaries

Doctoral degree-granting departments of applied mathematics (17)

10 responses (58.8%)

Rank	2000–2001 No. Reported	2000–2001 Q_1	2000–2001 Median	2000–2001 Q_3	2000–2001 Mean	1999–00 Mean
Assistant Professor	21	<50,55>	<55,60>	<55,60>	52,764	52,169
Associate Professor	32	<55,60>	<60,65>	<75,80>	64,045	55,804
Full Professor	80	<75,80>	<85,90>	<100,110>	95,106	87,595

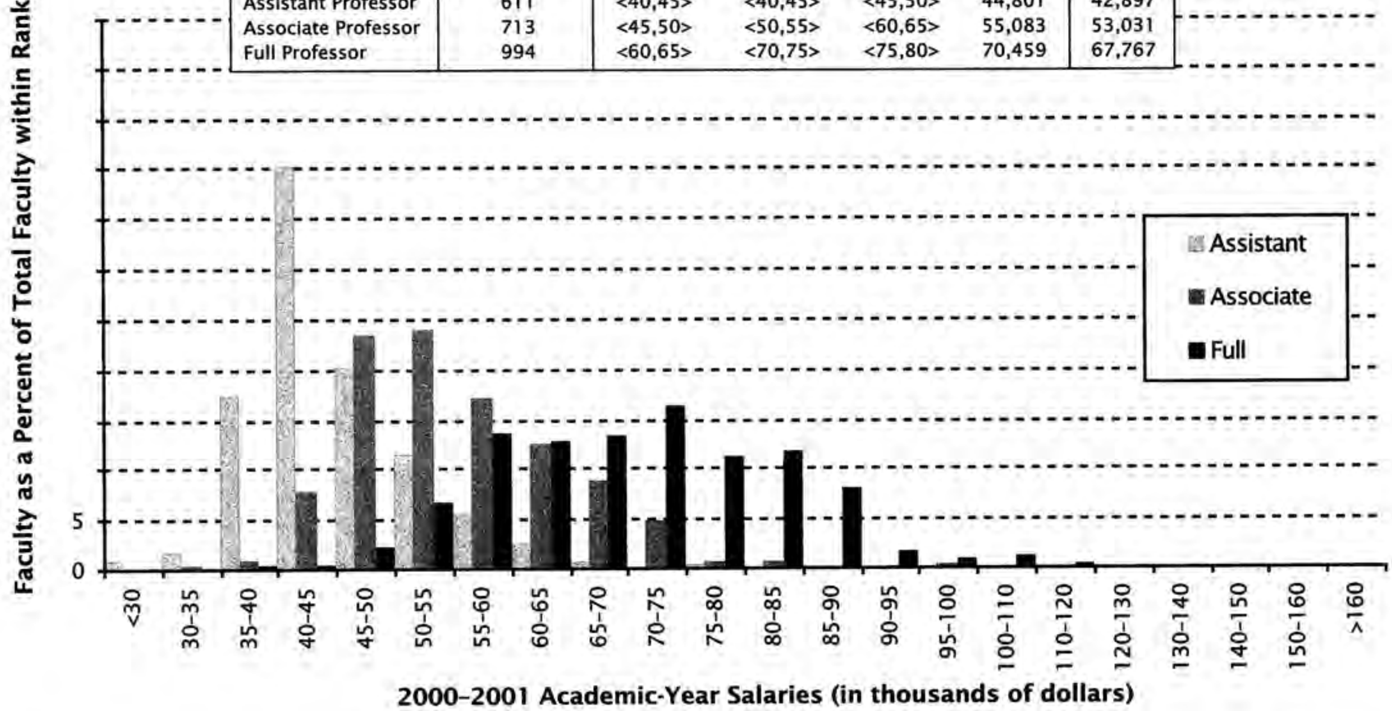


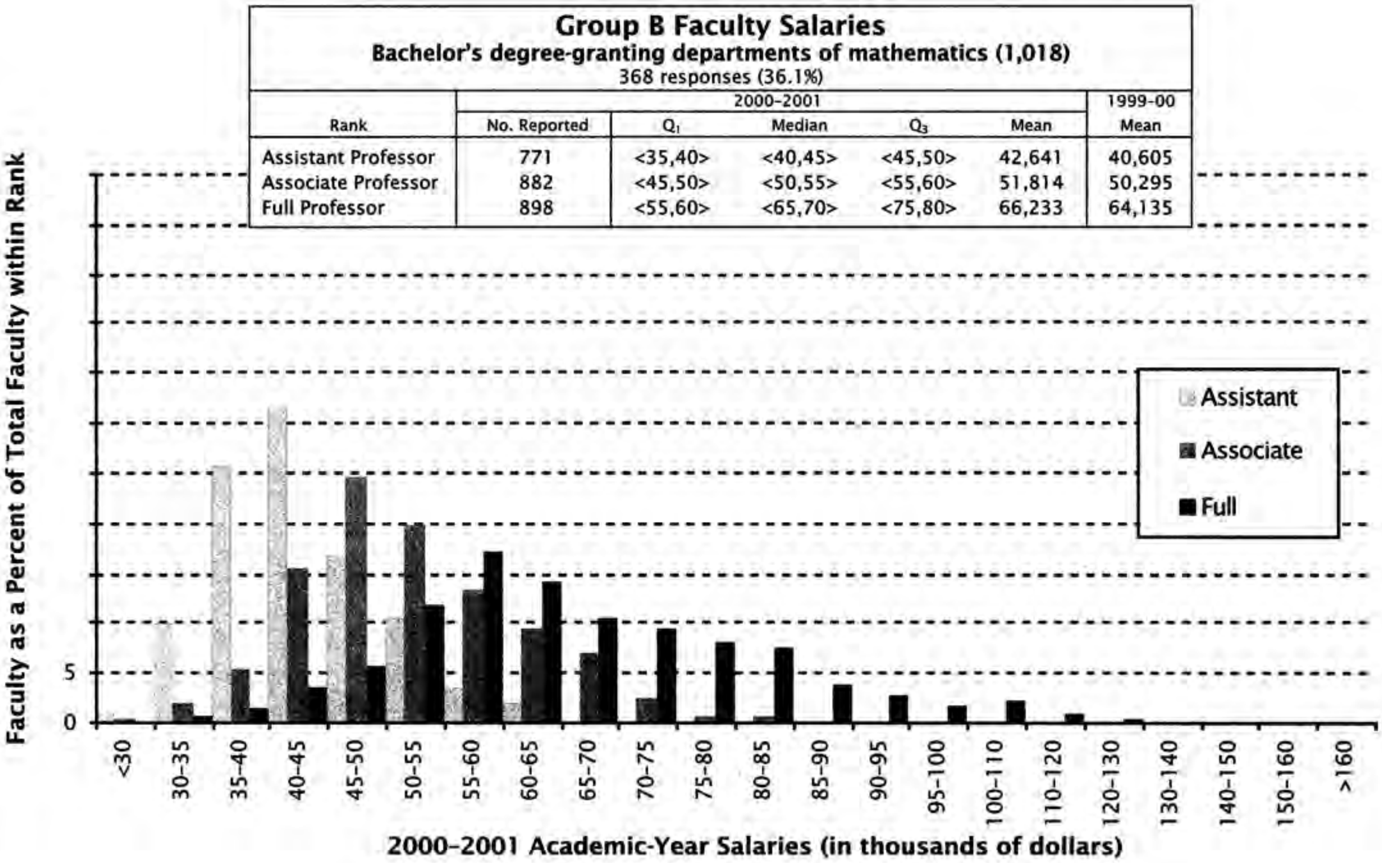
Group M Faculty Salaries

Master's degree-granting departments of mathematics (230)

125 responses (54.3%)

Rank	2000–2001 No. Reported	2000–2001 Q_1	2000–2001 Median	2000–2001 Q_3	2000–2001 Mean	1999–00 Mean
Assistant Professor	611	<40,45>	<40,45>	<45,50>	44,801	42,897
Associate Professor	713	<45,50>	<50,55>	<60,65>	55,083	53,031
Full Professor	994	<60,65>	<70,75>	<75,80>	70,459	67,767





Rank	No. Reported	Q_1	Median	Q_3	Mean	1999-00 Mean
	2000-2001					
Assistant Professor	771	<35,40>	<40,45>	<45,50>	42,641	40,605
Associate Professor	882	<45,50>	<50,55>	<55,60>	51,814	50,295
Full Professor	898	<55,60>	<65,70>	<75,80>	66,233	64,135

Acknowledgments

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

Other Data Sources

American Association of University Professors, *The Annual Report on the Economic Status of the Profession 1999-2000*, Academe: Bull. AAUP (March/April 2000), Washington, DC.

W. G. Bowen and N. L. Rudenstine, *In pursuit of the Ph.D.*, Princeton Univ. Press, Princeton, NJ, 1992.

Commission on Professionals in Science and Technology, *Supply and demand for engineers in the 1990s* (90-1), April 1990; *Who is in the pipeline? Science, math, and engineering education* (90-2), July 1990; *Recruiting doctoral scientists and engineers for the twenty-first century* (90-3), October 1990; *Women in science and engineering, an illustrated progress report* (90-4), December 1990; *Recruiting and retaining a diverse, quality technical work force* (91-1), April 1991; *By the year 2000: Myths and facts* (91-2), July 1991; *Cultural diversity in higher education* (91-3), October 1991; *Supply and demand in science and engineering* (91-4), January 1992; *American minorities in science and engineering* (92-1), April 1992; *Foreign citizens among U.S. scientists and engineers* (92-2), July 1992; *What's holding up the glass ceiling? Barriers in the work force* (92-3), October 1992; *Setting the record straight: Shortages in perspective* (92-4), January 1993; Occasional Papers, prepared by Betty M. Vetter, CPST, Washington, DC.

———, *Professional Women and Minorities—2000*, 13th ed., CPST, Washington, DC, 2000.

———, *Salaries of Scientists, Engineers, and Technicians: A Summary of Salary Surveys*, 18th ed., CPST, Washington, DC, 1998.

———, Employment of Recent Doctoral Graduates in S&E: Results of Professional Society Surveys, CPST, Washington, DC, 1998.

———, *Employment Outcomes of Doctorates in Science and Engineering: Report of a CPST Workshop*, CPST, Washington, DC, 1998.

Definitions of the Groups

As has been the case for a number of years, much of the data in these reports is presented for departments divided into groups according to several characteristics, the principal one being the highest degree offered in the mathematical sciences. Doctoral-granting departments of mathematics are further subdivided according to their ranking of "scholarly quality of program faculty" as reported in the 1995 publication *Research-Doctorate Programs in the United States: Continuity and Change.*[1] These rankings update those reported in a previous study published in 1982.[2] Consequently, the departments which now comprise Groups I, II, and III differ significantly from those used prior to the 1996 survey.

The subdivision of the Group I institutions into Group I Public and Group I Private was new for the 1996 survey. With the increase in number of the Group I departments from 39 to 48, the Annual Survey Data Committee judged that a further subdivision of public and private would provide more meaningful reporting of the data for these departments.

Brief descriptions of the groupings are as follows:

Group I is composed of 48 departments with scores in the 3.00–5.00 range. Group I Public and Group I Private are Group I departments at public institutions and private institutions respectively.

Group II is composed of 56 departments with scores in the 2.00–2.99 range.

Group III contains the remaining U.S. departments reporting a doctoral program, including a number of departments not included in the 1995 ranking of program faculty.

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

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

Group Va is applied mathematics/applied science; Group Vb, which is no longer surveyed as of 1998–99, was operations research and management science.

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

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

Listings of the actual departments which comprise these groups are available on the AMS Web site at www.ams.org/employment/.

[1]Research-Doctorate Programs in the United States: Continuity and Change, *edited by Marvin L. Goldberger, Brendan A. Maher, and Pamela Ebert Flattau, National Academy Press, Washington, DC, 1995.*

[2]*These findings were published in* An Assessment of Research-Doctorate Programs in the United States: Mathematical and Physical Sciences, *edited by Lyle V. Jones, Gardner Lindzey, and Porter E. Coggeshall, National Academy Press, Washington, DC, 1982. The information on mathematics, statistics, and computer science was presented in digest form in the April 1983 issue of the* Notices, *pages 257–67, and an analysis of the classifications was given in the June 1983* Notices, *pages 392–3.*

———, *Supply and Demand Indicators for New Science and Engineering Doctorates: Results of a Pilot Study*, CPST, Washington, DC, 1997.

D. O. Loftsgaarden, D. C. Rung, and A. E. Watkins, *Statistical abstract of undergraduate programs in the mathematical sciences in the U.S.*, Fall 1995 CBMS Survey, MAA Reports No. 2, 1997.

D. E. McClure, *Academic hiring survey, 1991–1992*, Notices Amer. Math. Soc. **39** (1992), 311–316.

———, *Employment experiences of 1990–1991 U.S. institution doctoral recipients in the mathematical sciences*, Notices Amer. Math. Soc. **42** (1995), 754–764.

National Research Council, *Strengthening the Linkage between the Sciences and the Mathematical Sciences*, National Academy Press, Washington, DC, 2000.

———, *U.S. Research Institutes in the Mathematical Sciences: Assessment and Perspectives*, National Academy Press, Washington, DC, 1999.

———, *Summary Report 1996, Doctorate Recipients from United States Universities*, National Academy Press, Washington, DC, 1998.

———, *Research-Doctorate Programs in the United States: Continuity and Change*, National Academy Press, Washington, DC, 1995.

National Science Board, *Science and Engineering Indicators—2000* (NSB 00-1), National Science Foundation, Arlington, VA, 2000.

National Science Foundation, *Science and Engineering Degrees: 1966–97* (NSF 00-310), Detailed Statistical Tables, Arlington, VA, 2000.

———, *Science and Engineering Degrees, by Race/Ethnicity of Recipients: 1989–97* (NSF 00-311), Detailed Statistical Tables, Arlington, VA, 2000.

———, *Science and engineering doctorate awards: 1998* (NSF 00-304), Detailed Statistical Tables, Arlington, VA, 2000.

———, *Graduate Students and Postdoctorates in Science and Engineering: Fall 1998* (NSF 00-322), Arlington, VA, 2000.

———, *Characteristics of Doctoral Scientists and Engineers in the United States: 1997* (NSF 00-308), Detailed Statistical Tables, Arlington, VA, 1999.

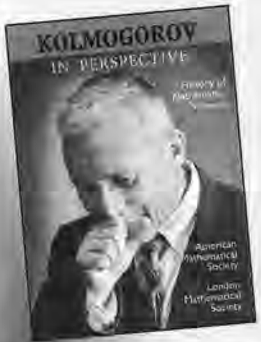
———, *Women, Minorities, and Persons with Disabilities in Science and Engineering: 1998* (NSF 99-338), Arlington, VA, 1999.

———, *Statistical Profiles of Foreign Doctoral Recipients in Science and Engineering: Plans to Stay in the United States* (NSF 99-304), Arlington, VA, 1998.

———, *Who Is Unemployed? Factors Affecting Unemployment among Individuals with Degrees in Science and Engineering*, Higher Education Surveys Report (NSF 97-336), Arlington, VA, 1997.

American Mathematical Society

Titles in General Interest from the AMS



Kolmogorov in Perspective

The editorial board for the History of Mathematics series has selected for this volume a series of translations from two Russian publications, *Kolmogorov in Remembrance* and *Mathematics and its Historical Development*. This book, *Kolmogorov in Perspective*, includes articles written by Kolmogorov's students and colleagues and his personal accounts of shared experiences and lifelong mathematical friendships. The book is illustrated with photographs and includes quotations from Kolmogorov's letters and conversations, uniquely reflecting his mathematical tastes and opinions.

Copublished with the London Mathematical Society. Members of the LMS may order directly from the AMS at the AMS member price. The LMS is registered with the Charity Commissioners.

History of Mathematics, Volume 20; 2000; 230 pages; Hardcover; ISBN 0-8218-0872-9; List $49; All AMS members $39; Order code HMATH/20NA

African Americans in Mathematics II

Nathaniel Dean and **Cassandra M. McZeal**, *Rice University, Houston, TX*, and **Pamela J. Williams**, *Sandia Laboratories, Livermore, CA*, Editors

This volume is the second published by the AMS (see DIMACS series, volume 34) presenting expository and research papers by distinguished African American mathematicians. In addition to filling the existing gap on African American contributions to mathematics, this book provides leadership direction and role models for students.

Contemporary Mathematics, Volume 252; 1999; 168 pages; Softcover; ISBN 0-8218-1195-9; List $35; Individual member $21; Order code CONM/252NA

The History of Mathematics from Antiquity to the Present: A Selective Annotated Bibliography, edited by Joseph W. Dauben

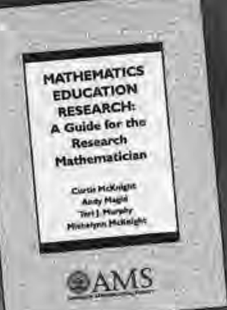
Revised Edition on CD-ROM edited by Albert C. Lewis, in cooperation with the International Commission on the History of Mathematics

Albert C. Lewis, *Indiana University-Purdue University, Indianapolis*, Editor

Thirty-eight experts from ten countries have critically annotated a selection of the literature within their respective specialties in the history of mathematics. The result is a comprehensive guide designed as a starting point for anyone wishing to learn more about any area of the history of mathematics.

Overall, this revised edition of *The History of Mathematics from Antiquity to the Present: A Selective Annotated Bibliography* on CD-ROM now makes it easier for both browsers and researchers to locate and search for the extended number of cited works that have been selected and annotated for this bibliography.

2000; CD-ROM; ISBN 0-8218-0844-3; List $49; All AMS members $39; Order code HMAPNA



A CLASSIC

Lectures on Mathematics

Felix Klein

In the late summer of 1893, following the Congress of Mathematicians held in Chicago, Felix Klein gave two weeks of lectures on the current state of mathematics. Rather than offering a universal perspective, Klein presented his personal view of the most important topics of the time. It is remarkable how most of the topics continue to be important today. Originally published in 1893 and republished by the AMS in 1911, we are pleased to bring this work into print once more with this new edition.

Klein's look at mathematics at the end of the 19th Century remains compelling today, both as history and as mathematics. It is delightful and fascinating to observe from a one-hundred year retrospect, the musings of one of the masters of an earlier era.

AMS Chelsea Publishing; 1894; 109 pages; Hardcover; ISBN 0-8218-2733-2; List $19; All AMS members $17; Order code CHEL/339.HNA

Mathematics Education Research: A Guide for the Research Mathematician

Curtis McKnight, **Andy Magid**, and **Teri J. Murphy**, *University of Oklahoma, Norman*, and **Michelynn McKnight**, *Norman, OK*

This book—the collaborative effort of a research mathematician, mathematics education researchers who work in a research mathematics department and a professional librarian—introduces research mathematicians to education research. The work presents a non-jargon introduction for educational research, surveys the more commonly used research methods, along with their rationales and assumptions, and provides background and careful discussions to help research mathematicians read or listen to education research more critically. The book will also be valuable to graduate students in mathematics who are planning academic careers, and to mathematics department chairs and their deans.

2000; 106 pages; Softcover; ISBN 0-8218-2016-8; List $20; All AMS members $16; Order code MERNA

The Fermat Diary

C. J. Mozzochi, *Princeton, NJ*

There are many important names in the recent history of Fermat's Last Theorem. This book puts faces and personalities to those names. The author also uncovers the details of certain key pieces of the story. For instance, we learn in Frey's own words the story of his conjecture, about his informal discussion and later lecture at Oberwolfach and his letter containing the actual statement. We learn from Faltings about his crucial role in the weeks before Wiles made his final announcement. An appendix contains the Introduction of Wiles's *Annals* paper in which he describes the evolution of his solution and gives a broad overview of his methods. Shimura explains his position concerning the evolution of the Shimura-Taniyama conjecture. Mozzochi also conveys the atmosphere of the mathematical community—and the Princeton Mathematics Department in particular—during this important period in mathematics. This eyewitness account and wonderful collection of photographs capture the marvel and unfolding drama of this great mathematical and human story.

2000; 196 pages; Hardcover; ISBN 0-8218-2670-0; List $29; All AMS members $23; Order code FERMATDNA

INDEPENDENT STUDY

Essays on Numbers and Figures

V. V. Prasolov, *Independent University of Moscow, Russia*

This is the English translation of the book originally published in Russian. It contains 20 essays, each dealing with a separate mathematical topic. The topics range from brilliant mathematical statements with interesting proofs, to simple and effective methods of problem-solving, to interesting properties of polynomials, to exceptional points of the triangle. The essays are independent of one another for the most part, and each presents a vivid mathematical result that led to current research in number theory, geometry, polynomial algebra, or topology.

Mathematical World, Volume 16; 2000; 75 pages; Softcover; ISBN 0-8218-1944-5; List $15; All AMS members $12; Order code MAWRLD/16NA

All prices subject to change. Charges for delivery are $3.00 per order. For optional air delivery outside of the continental U. S., please include $6.50 per item. *Prepayment required.* Order from: **American Mathematical Society**, P. O. Box 845904, Boston, MA 02284-5904, USA. For credit card orders, fax 1-401-455-4046 or call toll free 1-800-321-4AMS (4267) in the U. S. and Canada, 1-401-455-4000 worldwide. Or place your order through the AMS bookstore at www.ams.org/bookstore. Residents of Canada, please include 7% GST.

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Mathematics People

Operator Algebra Prize Awarded

The first Operator Algebra Prize of Japan is awarded to YASUYUKI KAWAHIGASHI of the University of Tokyo. Kawahigashi was chosen for his outstanding contributions to the theory of automorphism groups of injective von Neumann algebras and the subfactor theory and thus to the advancement of operator algebra theory. He will receive a cash award of 300,000 Japanese yen (about US$2,700), a certificate, and a medal.

The Operator Algebra Prize was established in April 1999 by senior Japanese researchers in order to encourage younger researchers in operator algebra theory and related fields. The prize is to be awarded every four years to a person age 40 years or younger either of Japanese nationality or primarily affiliated with a Japanese institution for outstanding contributions to operator algebra theory and related areas.

—Huzihiro Araki, chair, Operator Algebra Prize Committee

Benktander Prize Awarded

WERNER HÜRLIMANN, a mathematician at Winterthur Life and Pensions, has received the Gunnar Benktander Prize. The prize of 7,000 Swedish crowns (around US$700) is presented by the nonlife section of the International Actuarial Association. Gunnar Benktander is a Swedish actuary, now retired, who spent his life working for reinsurance companies and was one of the early researchers in actuarial science. Applicants for the prize had to submit a paper on a specific reinsurance issue. The title of Hürlimann's winning paper is "Financial Data Analysis with Two Symmetric Distributions".

—Allyn Jackson

PECASE Awards Announced

Fifty-nine young researchers have been chosen to receive the 2000 Presidential Early Career Awards for Scientists and Engineers (PECASE). This award is the highest honor bestowed by the U.S. government on outstanding young scientists, mathematicians, and engineers who are in the early stages of establishing their independent research careers.

The recipients were selected from nominations made by nine participating federal agencies. Each recipient receives a five-year grant of up to $500,000 to further his or her research and educational efforts.

Three mathematicians are among the awardees this year. RICHARD B. LEHOUCQ of Sandia National Laboratories was nominated by the Department of Energy. SARA C. BILLEY and GEORGIA PERAKIS, both of the Massachusetts Institute of Technology, were among the nominees of the National Science Foundation.

—From a White House announcement

NRC-Ford Foundation Minority Fellowships Awarded

The names of the recipients of Ford Foundation Minority Fellowships for 2000 have been announced. The fellowship programs are administered by the National Research Council for the purpose of increasing the presence of underrepresented groups among faculty members in colleges and universities. The recipients were selected from a field of about 1,000 applicants, based on merit and promise of future achievement.

Two students in the mathematical sciences were awarded 2000 Predoctoral Fellowships. This program provides students of demonstrated ability with the opportunity to engage in advanced study leading to the Ph.D. or Sc.D. degree in research-based doctoral programs. The recipients are NANDI OLIVE LESLIE of Princeton University and ERIKA TATIANA WIRKUS of Cornell University. Both are students in the field of applications of mathematics.

—From a National Research Council announcement

AAAS Fellows Elected

Five mathematicians have been elected as Fellows of the Mathematics Section of the American Association for the Advancement of Science. The new fellows are MICHEL L. LAPIDUS, University of California Riverside; KENNETH C. MILLETT, University of California Santa Barbara; FRANK QUINN, Virginia Polytechnic Institute and State University; DONALD G. SAARI, University of California Irvine; and MICHAEL SHUB, IBM T. J. Watson Research Center, Yorktown Heights, New York.

—From an AAAS announcement

Accademia dei Lincei Fellows Elected

The Accademia dei Lincei has announced the election of two new fellows in mathematics. They are CLAUDIO PROCESI, Istituto Guido Castelnuovo, University of Rome; and CARLO CERCIGNANI, Politecnico di Milano.

—From an Accademia dei Lincei announcement

Deaths

JOHN GREEN, professor emeritus, University of California Los Angeles, died on November 1, 2000. Born on March 8, 1914, he was a member of the Society for 63 years and secretary of the AMS from 1957 to 1966.

RUTH MICHLER, of the University of North Texas, died on November 1, 2000. Born on March 8, 1967, she was a member of the Society for 11 years.

ROBERT MIZNER, manager, Jackson National Life Insurance, Lansing, MI, died on July 20, 2000. Born on October 31, 1956, he was a member of the Society for 20 years.

HELGA SCHIRMER, professor emeritus, Carleton University, Canada, died on October 4, 2000. Born on October 18, 1927, she was a member of the Society for 33 years.

DIRK STRUIK, professor emeritus, Massachusetts Institute of Technology, died on October 21, 2000. Born on September 30, 1894, he was a member of the Society for 73 years.

CLASINE VAN WINTER, professor emeritus, University of Kentucky, Lexington, died on October 16, 2000. Born on April 8, 1929, she was a member of the Society for 31 years.

Mathematics Opportunities

NSF Programs to Support Research Equipment

The National Science Foundation has issued solicitations for proposals for funding of research equipment through two programs: SCREMS (Grants for Scientific Computing Research Environments for the Mathematical Sciences) and MRI (Major Research Instrumentation).

The SCREMS program plans to make a limited number of grants for the purchase and support of computing equipment dedicated to research in the mathematical sciences. If equipment is requested, the total discounted cost of the equipment portion should be at least $40,000. Some awards may be as high as $200,000, provided a case is made for substantial impact and cost effectiveness. The Division of Mathematical Sciences expects to provide about $1 million for this activity in fiscal year 2001, pending availability of funds. The most recent program solicitation for SCREMS is available on the World Wide Web, NSF Publication NSF 01-16, `http://www.nsf.gov/cgi-bin/getpub?nsf0116/`.

Information about the fiscal year 2001 MRI competition, including the new MRI solicitation, is available at `http://www.nsf.gov/od/oia/programs/mri/start.htm`. The MRI program assists in the acquisition or development of major research instrumentation by U.S. institutions. The maintenance and technical support associated with these instruments is also supported. Proposals may be for a single instrument, a large system of instruments, or multiple instruments that share a common or specific research focus. Approximately $75 million, pending availability of funds, will be available for the MRI program in FY 2001, distributed across all NSF directorates.

MRI is an NSF-wide program, whereas SCREMS is restricted to proposals from mathematical sciences departments. An institution may submit *only two* proposals for instrument acquisition in response to the MRI solicitation, plus a *third* for instrument development. Accordingly, groups of mathematical scientists might find it useful to communicate with related groups or other departments or schools in their respective institutions for preparation and submission of such joint proposals or proposals in which mathematical scientists might participate.

Proposers and institutions are urged to apply through the MRI program if possible; the NSF's Division of Mathematical Sciences will have all equipment proposals (SCREMS and MRI) reviewed together, and there will be no disadvantage to proposals that apply through the MRI. Identical proposals may *not* be sent to both programs. Nevertheless, proposals that do not receive MRI funding may still receive SCREMS funding in the current competition.

Questions can be sent to `screms@nsf.gov`. The deadline for SCREMS is **January 18, 2001**, and the deadline for MRI is **February 7, 2001**.

—From a DMS announcement

Travel Grants for Euler Institute Summer School

The Euler International Mathematical Institute in St. Petersburg, Russia, will host a European Summer School July 9–22, 2001. Sponsored by the European Mathematical Society, the summer school will focus on asymptotic combinatorics, with applications to mathematical physics. The AMS has received a grant from the National Science Foundation to provide travel and subsistence for approximately eight U.S. mathematics graduate students.

The program will be devoted to asymptotic combinatorics and its applications in the theory of integrable systems, random matrices, free probability, and quantum field theory. Attention will also be given to other related topics, including low-dimensional topology, new approaches in Riemann-Hilbert problems, asymptotics of orthogonal polynomials, symmetric functions, representation theory, and random Young diagrams.

The scientific committee for the summer school consists of: A. Vershik, St. Petersburg (chair); O. Bohigas, Paris; and R. Stanley, Cambridge, Massachusetts. The core of the program will be a series of lectures at the predoctoral level held Monday through Saturday mornings. The afternoons will be used for a limited number of talks and informal problem sessions.

To be eligible to apply for the travel grants, a candidate must be a graduate student in a mathematics doctoral program in the U.S. Awardees will be selected by a panel of mathematicians with expertise in the area of the summer school. Instructions for applying for the travel grants may be found at `http://www.ams.org/employment/Euler.html`.

The deadline for applications is **February 15, 2001.** Those with questions may call 800-321-4267, extension 4105.

—Allyn Jackson

IAS/Park City Mathematics Institute

The Institute for Advanced Study (IAS)/Park City Mathematics Institute (PCMI) will hold its 2001 summer session from July 8-28, 2001, in Park City, Utah. The topics are quantum field theory, supersymmetry, and enumerative geometry. The organizers are Daniel S. Freed (University of Texas, Austin), David R. Morrison (Duke University), and Isadore Singer (Massachusetts Institute of Technology). There will be courses on classical field theory, quantum field theory, general relativity, mirror symmetry, and enumerative geometry.

The IAS/PCMI began in 1991 at the University of Utah as a National Science Foundation Regional Geometry Institute. In 1993 the Institute for Advanced Study assumed sponsorship of the program. Each summer the PCMI offers an integrated set of programs for researchers, postdoctorates, graduate and undergraduate students, and teachers.

Further information on the summer program and other IAS/PCMI activities, as well as on application procedures, is available at the Web site http://www.admin.ias.edu/ma/SummerSession2001.htm.

—From an IAS/PCMI announcement

Career Awards for Research Addressing Biological Questions

In recognition of the vital role mathematical and physical scientists will play in furthering biomedical research, the Burroughs Wellcome Fund announces a new award program, Career Awards at the Scientific Interface. These awards are intended to foster the early career development of researchers with backgrounds in the physical, mathematical, and computational sciences whose work addresses biological questions and who are dedicated to pursuing a career in academic research.

Applicants are expected to draw from their training in a scientific field other than biology to propose innovative approaches to answer important questions in the biological sciences. Examples of approaches include, but are not limited to, physical measurement of biological phenomena, computer simulation of complex processes in physiological systems, mathematical modeling of self-organizing behavior, building probabilistic tools for medical diagnosis, developing novel imaging tools or biosensors, applying nanotechnology to manipulate cellular systems, predicting cellular responses to topological clues and mechanical forces, and developing a new conceptual understanding of the complexity of living organisms. Proposals that include experimental validation of theoretical models are particularly encouraged.

The awards provide up to $538,000 over five years to support up to two years of advanced postdoctoral training and the first three years of a faculty appointment. During both the postdoctoral and the faculty periods, awards must be taken at degree-granting institutions in the United States or Canada. Up to ten awards will be made.

Candidates must hold a Ph.D. degree in the fields of mathematics, physics, chemistry (physical, theoretical, or computational), computer science, statistics, or engineering. Exceptions will be made only if the applicant can demonstrate significant expertise in one of these areas, evidenced by publications or advanced coursework. Candidates who are not citizens of the United States or Canada must provide documentation of their visa status at the time of application. Permanent residents must provide a copy of their Alien Registration card (green card) for the United States or their Landed Immigrant Status form for Canada. Temporary residents must, at the time of application, present evidence (a copy of their I-797A approval notice and I-94 form) that lawful immigration status has been granted and that it will extend for the duration of the award.

The application deadline is **May 1, 2001**. For more information and complete application materials, visit the Web site http://www.bwfund.org/interfaces_in_science.htm. Additional questions about the program may be directed to Debi Linkous, program associate, at 919-991-5116.

—Burroughs Wellcome Fund announcement

Massachusetts Teacher Recruitment Program

Massachusetts has initiated a multi-faceted program to recruit, train, and retain high quality educators. The Massachusetts Signing Bonus program is open to qualified college seniors, recent graduates, and mid-career professionals in all academic areas, including mathematics, who have never been full-time public school teachers.

The program provides a $20,000 signing bonus. In addition, recipients will receive a scholarship for the Massachusetts Institute for New Teachers (MINT), an intensive seven-week teacher training program that includes 100 hours of student teaching and course work including methods of instruction, classroom management, and the use of technology.

The application deadline is **January 31, 2001**. For further information visit the Web site www.doe.mass.edu/tqe/, or contact the Massachusetts Department of Education by telephone at 781-338-3232 or by e-mail at eq@doe.mass.edu.

—From a Massachusetts Department of Education announcement

Inside the AMS

AMS Receives Grant to Support Travel to Euler Institute Summer School

The AMS has received a grant from the National Science Foundation (NSF) to support participation by U.S. mathematicians and graduate students in the European Summer School, to be held in July 2001 at the Euler International Mathematical Institute in St. Petersburg, Russia. The summer school, sponsored by the European Mathematical Society, will focus on asymptotic combinatorics, with applications to mathematical physics.

The AMS will use part of the NSF funds to establish small travel grants that will provide support for approximately eight U.S. mathematics graduate students to attend the summer school. Graduate students in mathematics doctoral programs in the U.S. may apply for the travel grants. Awardees will be selected by a panel of mathematicians with expertise in the area of the summer school. The remainder of the funds from the NSF will be used to support attendance in the summer school by two senior U.S. mathematicians.

The AMS has developed procedures for administration of other NSF-funded travel grants programs, such as those for the International Congress of Mathematicians in 1990, 1994, and 1998, and for the Society's meeting "Mathematical Challenges of the 21st Century", held in August 2000 at the University of California Los Angeles.

For information on how to apply for the graduate student travel grants, please see the "Mathematics Opportunities" section of this issue of the *Notices*.

—*Allyn Jackson*

ECBT Decision on Sectional Meeting Fees

At its meeting in November 2000 the AMS Executive Committee and Board of Trustees (ECBT) reconsidered the issue of registration fees for sectional meetings. The board let stand its 1999 decision to raise fees for members and nonmembers and at the same time voted to reduce the fees for graduate students.

The increase in registration fees for sectional meetings was deemed necessary because the AMS loses money in organizing and holding the meetings. Although the cost of each meeting is relatively small, with eight meetings held each year the total annual loss was substantial. The increase in fees was designed to offset, not eliminate, this loss.

The necessity of the fee increase was questioned at the May 2000 meeting of the ECBT. At that time the higher fees had already been established for the sectional meetings planned for the fall of 2000. The board decided to revisit the issue at its next meeting in November 2000. In the meantime the *Notices* published in the October 2000 issue an opinion piece by associate editor Susan Friedlander, who argued against the fee increase.

At its November 2000 meeting the ECBT reexamined the financial aspects as well as arguments for and against the increase. The board decided to leave in place the increase in fees for AMS members and for nonmembers. Those fees went from $30 to $40 and from $45 to $60 respectively. At the same time, the ECBT decided to reduce the fees for graduate students from $15 to $5. The hope is that this reduction will attract more students to sectional meetings.

By the time of the ECBT meeting last November, the registration fee schedule for sectional meetings to be held in the spring of 2001 had already been set with the higher $15 fee for graduate students. However, students will be able to register for those meetings for the lower $5 fee.

—*Allyn Jackson*

Reference and Book List

*The **Reference** section of the* Notices *is intended to provide the reader with frequently sought information in an easily accessible manner. New information is printed as it becomes available and is referenced after the first printing. As soon as information is updated or otherwise changed, it will be noted in this section.*

Contacting the *Notices*

The preferred method for contacting the *Notices* is electronic mail. The editor is the person to whom to send articles and letters for consideration. Articles include feature articles, memorial articles, communications, opinion pieces, and book reviews. The editor is also the person to whom to send news of unusual interest about other people's mathematics research.

The managing editor is the person to whom to send items for "Mathematics People", "Mathematics Opportunities", "For Your Information", "Reference and Book List", and "Mathematics Calendar". Requests for permissions, as well as all other inquiries, go to the managing editor.

The electronic-mail addresses are notices@math.tamu.edu in the case of the editor and notices@ams.org in the case of the managing editor. The fax numbers are 979-845-6028 for the editor and 401-331-3842 for the managing editor. Postal addresses may be found in the masthead.

Upcoming Deadlines

January 10, 2001: Applications for AAUW Selected Professions Fellowships. See http://www.aauw.org/3000/fdnfelgra/selectprofbd.html, or contact the AAUW Educational Foundation, Department 60, 2201 North Dodge Street, Iowa City, IA 52243-4030; telephone 319-337-1716, ext. 60.

January 15, 2001: Applications for AMS-AAAS Mass Media Fellowships. See http://ehr.aaas.org/ehr/ (click the "Projects" link), or contact AAAS Mass Media Science and Engineering Fellows Program, 1200 New York Avenue, NW, Washington, DC 20005; telephone 202-326-6760; fax 202-371-9849; or the AMS Washington Office, 1527 Eighteenth Street, NW, Washington, DC 20036; telephone 202-588-1100; fax 202-588-1853; e-mail: amsdc@ams.org.

January 15, 2001: Applications for the first competition for NRC Research Associateships. See http://www4.nationalacademies.org/osep/rap/, or contact the National Research Council, Associateship Programs (TJ 2114), 2101 Constitution Avenue, NW, Washington, DC 20418; telephone 202-334-2760; fax 202-334-2759; e-mail: rap@nas.edu.

January 16, 2001: Proposals for NSF institute competition. See http://www.nsf.gov/cgi-bin/getpub?nsf0086/, or contact Division of Mathematical Sciences, Room 1025, National Science Foundation, 4201 Wilson Boulevard, Arlington, VA 22230; telephone 703-306-1870.

January 18, 2001: Scientific Computing Research Equipment for the Mathematical Sciences (SCREMS) program of the NSF. See "Mathematics Opportunities" in this issue.

January 22-24, 2001: Full proposals for small projects for NSF Information Technology Research Program. See http://www.itr.nsf.gov/.

January 23, 2001: Applications for AWM Workshop at the SIAM meeting in San Diego, California. See http://www.awm-math.org/; telephone 301-405-7892; e-mail: awm@math.umd.edu.

Where To Find It

A brief index to information that appears in this and previous issues of the *Notices*.

January 26, 2001: Full proposals for NSF IGERT program. See `http://www.nsf.gov/cgi-bin/getpub?nsf0078/`, or contact NSF 00-78-IGERT Program, National Science Foundation, 4201 Wilson Boulevard, Arlington, VA 22230; telephone 703-306-1870.

February 1, May 1, October 1, 2001: Applications for NSF/AWM Travel Grants for Women. See `http://www.awm-math.org/travelgrants.html`; telephone 301-405-7892; e-mail: `awm@math.umd.edu`.

February 7, 2001: Major Research Instrumentation program of the NSF. See "Mathematics Opportunities" in this issue.

March 1, 2001: Applications for EDGE Summer Program. See `http://www.brynmawr.edu/Acads/Math/edge/edge.html`.

April 9-11, 2001: Full proposals for group projects for NSF Information Technology Research Program. See `http://www.itr.nsf.gov/`.

April 15, 2001: Applications for the second competition for NRC Research Associateships. See `http://www4.nationalacademies.org/osep/rap/`, or contact the National Research Council, Associateship Programs (TJ 2114), 2101 Constitution Avenue, NW, Washington, DC 20418; telephone 202-334-2760; fax 202-334-2759; e-mail: `rap@nas.edu`.

April 23-25, 2001: Full proposals for large projects for NSF Information Technology Research Program. See `http://www.itr.nsf.gov/`.

May 1, 2001: Burroughs Wellcome Fund Career Awards at the Scientific Interface. See "Mathematics Opportunities" in this issue.

August 15, 2001: Applications for the third competition for NRC Research Associateships. See `http://www4.nationalacademies.org/osep/rap/`, or contact the National Research Council, Associateship Programs (TJ 2114), 2101 Constitution Avenue, NW, Washington, DC 20418; telephone 202-334-2760; fax 202-334-2759; e-mail: `rap@nas.edu`.

October 1, 2001: Nominations for the Emanuel and Carol Parzen Prize. Submit nominations to J. H. Matis, Department of Statistics, Texas A&M University, College Station, TX 77873-3143.

National Science Board

The National Science Board is the policymaking body of the National Science Foundation. The names and affiliations of the board members follow.

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Director, Life Sciences Consortium
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University Park, PA

Pamela A. Ferguson
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Grinnell College
Grinnell, IA

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University of California
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Payson Center for International Development and Technology Transfer
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Dartmouth College
Hanover, NH

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Wayne and Gladys Valley Professor of Marine Biology
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Professor of Physics
Department of Physics
Cornell University
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Hanley Distinguished Professor of Biological Sciences
Department of Biological Sciences
Purdue University
West Lafayette, IN

Vera C. Rubin
Research Staff
Department of Terrestrial Magnetism
Carnegie Institution
Washington, DC

Maxine Savitz
General Manager
Honeywell and Technology Partnerships
Torrance, CA

Luis Sequeira
J. C. Walker Professor Emeritus
Department of Bacteriology and Plant Pathology
University of Wisconsin
Madison, WI

Daniel Simberloff
Nancy Gore Hunger Professor of Environmental Science
Department of Ecology and Evolutionary Biology

The contact information for the Board is: National Science Board, National Science Foundation, 4201 Wilson Boulevard, Suite 1225, Arlington, VA 22230; telephone 703-292-7000; fax 703-292-9008; World Wide Web `http://www.nsf.gov/nsb/`.

Book List

The ***Book List*** *highlights books that have mathematical themes and hold appeal for a wide audience, including mathematicians, students, and a significant portion of the general public. When a book has been reviewed in the* Notices, *a reference is given to the review. Generally the list will contain only books published within the last two years, though exceptions may be made in cases where current events (e.g., the death of a prominent mathematician, coverage of a certain piece of mathematics in the news) warrant drawing readers' attention to older books. Suggestions for books to include on the list may be sent to the managing editor, e-mail:* `notices@ams.org`.

The Advent of the Algorithm: The Idea That Rules the World, by David Berlinski. Harcourt, March 2000. ISBN 0-151-00338-6.

Angles of Reflection: Logic and a Mother's Love, by Joan L. Richards. W. H. Freeman, May 2000. ISBN 0-7167-3831-7.

The Bride of Science, by Benjamin Woolley. MacMillan, August 1999. ISBN 0-333-72436-4.

Chance Rules: An Informal Guide to Probability, Risk, and Statistics, by Brian S. Everitt. Springer, August 1999. ISBN 0-387-98768-1.

The Crest of the Peacock: The Non-European Roots of Mathematics, by George Gheverghese Joseph. Princeton University Press, October 2000 (new edition). ISBN 0-691-00659-8.

Divine Harmony: The Life and Teachings of Pythagoras, by John Strohmeier and Peter Westbrook. Berkeley Hills Books, November 1999. ISBN 0-965-37745-8.

The Dots and Boxes Game, by Elwyn Berlekamp. A K Peters, July 2000. ISBN 1-568-81129-2.

Duelling Idiots and Other Probability Puzzlers, by Paul J. Nahin. Princeton University Press, October 2000. ISBN 0-691-00979-1.

Education of a Mathematician, by Philip J. Davis. A K Peters, August 2000. ISBN 1-568-81116-0. (Reviewed January 2001.)

Einstein in Love: A Scientific Romance, by Dennis Overbye. Viking Press, October 2000. ISBN 0-670-89430-3.

Excursions into Mathematics: Millennium Edition, by Anatole Beck, Michael N. Cleicher, and Donald W. Crowe. A K Peters, 2000. ISBN 1-56881-115-2.

The Fermat Diary, by C. J. Mozzochi. AMS, 2000. ISBN 0-8218-2670-0.

The Game's Afoot! Game Theory in Myth and Paradox, by Alexander Mehlmann. AMS, 2000. ISBN 0-8218-2121-0.

Geometry from Africa: Mathematical and Educational Explorations, by Paulus Gerdes. Mathematical Association of America, April 1999. ISBN 0-88385-715-4.

Gödel: A Life of Logic, by John L. Casti and Werner DePauli. Perseus, August 2000. ISBN 0-738-20274-6.

Gödel Meets Einstein: Time Travel in the Gödel Universe, by Palle Yourgrau. Open Court, November 1999. ISBN 0-812-69408-2.

Hex Strategy: Making the Right Connections, by Cameron Browne. A K Peters, May 2000. ISBN 1-568-81117-9.

A History of Algorithms: From the Pebble to the Microchip, edited by Jean-Luc Chabert. Springer, September 1999. ISBN 3-540-63369-3.

Infosense: Turning Data and Information into Knowledge, by Keith Devlin. W. H. Freeman, June 1999. ISBN 0-716-73484-2.

John von Neumann: The Scientific Genius Who Pioneered the Modern Computer, Game Theory, Nuclear Deterrence, and Much More, by Norman Macrae. AMS, October 1999. ISBN 0-8218-2064-8.

The Kingdom of Infinite Number: A Field Guide, by Bryan Bunch. W. H. Freeman, January 2000. ISBN 0-716-73388-9.

Mathematical Sorcery: Revealing the Secrets of Numbers, by Calvin C. Clawson. Plenum Press, May 1999. ISBN 0-306-46003-3.

The Math Gene: How Mathematical Thinking Evolved and Why Numbers Are Like Gossip, by Keith Devlin. Basic Books, August 2000. ISBN: 0-465-01618-9. (Reviewed in this issue.)

Mathematics As Sign: Writing, Imagining, Counting, by Brian Rotman.

Stanford University Press, September 2000. ISBN 0-804-73684-7.

* *Mathematics: Frontiers and Perspectives*, V. Arnold, M. Atiyah, P. Lax, and B. Mazur, editors. AMS, December 1999. ISBN 0-8218-2697-2.

Mathematics Success and Failure among African American Youth: The Roles of Sociohistorical Context, Community Forces, School Influence, and Individual Agency, by Danny B. Martin. Lawrence Erlbaum Associates, December 1999. ISBN 0-805-83042-1.

Mathematics Unlimited: 2001 and Beyond, Björn Engquist and Wilfried Schmid, editors. Springer, September 2000. ISBN 3-540-66913-2.

My Numbers, My Friends: Popular Lectures on Number Theory, by Paulo Ribenboim. Springer, February 2000. ISBN 0-387-98911-0.

The Mystery of the Aleph: Mathematics, the Kabbalah, and the Human Mind, by Amir D. Aczel. Four Walls Eight Windows, November 2000. ISBN 1-568-58105-X.

Newton's Gift: How Sir Isaac Newton Unlocked the System of the World, by David Berlinski. Free Press, October 2000. ISBN 0-684-84392-7.

Niels Hendrik Abel and His Times: Called Too Soon by Flames Afar, by Arild Stubhaug; translated by R. Daly. Springer, May 2000. ISBN 3-540-66834-9.

The Nothing That Is: A Natural History of Zero, by Robert Kaplan. Oxford University Press, October 1999. ISBN 0-195-12842-7.

Number: From Ahmes to Cantor, by Midhat Gazalé. Princeton University Press, March 2000. ISBN 0-691-00515-X.

Philosophy of Mathematics: An Introduction to a World of Proofs and Pictures, by James Robert Brown. Routledge, August 1999. ISBN 0-415-12274-0. (Reviewed November 2000.)

* *The Parrot's Theorem*, by Denis Guedj. Weidenfeld & Nicolson, June 2000. ISBN 0-297-64578-1.

Proofs and Confirmations: The Story of the Alternating Sign Matrix Conjecture, by David M. Bressoud. MAA Spectrum Series, published jointly with Cambridge University Press, August 1999. ISBN 0-521-66646-5.

The Pursuit of Perfect Packing, by Tomaso Aste and Denis Weaire. Institute of Physics Publishing, July 2000. ISBN 0-750-30648-3.

Riemann, Topology, and Physics, by Michael Monastyrsky; translated by Roger Cooke, James King, and Victoria King. Birkhäuser, second edition, May 1999. ISBN 3-764-33789-3.

Small Worlds: The Dynamics of Networks between Order and Randomness, by Duncan J. Watts. Princeton University Press, November 1999. ISBN 0-691-00541-9. (Reviewed September 2000.)

Squaring the Circle: The War between Hobbes and Wallis, by Douglas M. Jesseph. University of Chicago Press, December 1999. ISBN 0-226-39899-4 (hardcover), 0-226-39900-1 (paperback).

Stephen Smale: The Mathematician Who Broke the Dimension Barrier, by Steve Batterson. AMS, February 2000. ISBN 0-8218-2045-1. (Reviewed December 2000.)

Surfing through Hyperspace: Understanding Higher Universes in Six Easy Lessons, by Clifford A. Pickover. Oxford University Press, September 1999. ISBN 0-195-13006-5.

The Symbolic Universe: Geometry and Physics 1890–1930, edited by Jeremy Gray. Oxford University Press, September 1999. ISBN 0-198-50088-2.

Two Millennia of Mathematics: From Archimedes to Gauss, by George M. Phillips. Springer, July 2000. ISBN 0-387-95022-2.

Uncle Petros and Goldbach's Conjecture by Apostolos Doxiadis. Bloomsbury USA, February 2000. ISBN 1-582-34067-6. (Reviewed November 2000.)

The Universal Computer: The Road from Leibniz to Turing, by Martin Davis. W. W. Norton & Company, October 2000. ISBN 0-393-04785-7.

**The Universal History of Computing: From the Abacus to the Quantum Computer*, by Georges Ifrah (translated from the French and with notes by E. F. Harding; assisted by Sophie Wood, Ian Monk, Elizabeth Clegg, and Guido Waldman). John Wiley & Sons, November 2000. ISBN 0-471-39671-0.

The Universal History of Numbers: From Prehistory to the Invention of the Computer, by Georges Ifrah; translated from the French by David Bellos, E. F. Harding, Sophie Wood, and Ian Monk. John Wiley & Sons, December 1999. ISBN 0-471-37568-3.

The Unknowable, by Gregory Chaitin. Springer, August 1999. ISBN 9-814-02172-5.

What Are the Odds? Chance in Everyday Life, by Michael Orkin. W. H. Freeman, December 1999. ISBN 0-716-73560-1.

* *Where Mathematics Comes From: How the Embodied Mind Brings Mathematics into Being*, by George Lakoff and Rafael Nuñez. Basic Books, October 2000. ISBN 0-465-03770-4.

The Wild Numbers, by Philibert Schogt. Four Walls Eight Windows, April 2000. ISBN 1-568-58166-1. (Reviewed November 2000.)

Women Becoming Mathematicians: Creating a Professional Identity in Post-World War II America, by Margaret A. M. Murray. MIT Press, September 2000. ISBN 0-262-13369-5.

Wonders of Numbers: Adventures in Math, Mind, and Meaning, by Clifford A. Pickover. Oxford University Press, September 2000. ISBN 0-195-13342-0.

Zero: The Biography of a Dangerous Idea, by Charles Seife. Viking Press, February 2000. ISBN 0-670-88457-X. (Reviewed October 2000.)

Cultural Event

Proof, a play performed by Manhattan Theatre Club. Walter Kerr Theatre, 219 West 48th Street, New York, NY. World Wide Web: `http://www.ProofonBroadway.com/`. Opened October 24, 2000. (Reviewed October 2000.)

**Added to "Book List" since the list's last appearance.*

Doctoral Degrees Conferred

1999–2000

ALABAMA

Auburn University (7)

DISCRETE AND STATISTICAL SCIENCES

Küçükçifçi, Selda, The number of 8-cycles in 2-factorizations of K_n.

McGee, James R. III, Embedding and covering of 2-paths.

Roblee, Kenneth, Problems in external coding theory.

MATHEMATICS

Casabianca, Frank Jr., Orthogonal bases of symmetrized tensor spaces and units in Hecke algebras.

Gonzalez, Thomas, On K-to-1 maps.

Kosmatov, Nickolai, Multiple positive solutions of a nonlinear boundary value problem.

Naughton, Dominic, Simple modules for the Hamiltonian algebra.

University of Alabama, Birmingham (3)

MATHEMATICS

Le, Tuan, An inverse problem in ground water modeling.

Maner, Andrew, Boundaries of conformal rotation domains.

van den Bedem, Henry, Chaotic models in nonequilibrium statistical mechanics.

University of Alabama, Huntsville (1)

MATHEMATICAL SCIENCES

Trees, Eric, LP-Matrix partition theorem and its application to fractional domination and domatic parameters.

University of Alabama, Tuscaloosa (4)

MANAGEMENT SCIENCE AND STATISTICS

Linna, Kenneth Jr., Control chart performance under linear covariate measurement processes.

Wang, Xiaohong "Daniel", Performance of lack of fit tests in linear regression models.

MATHEMATICS

Nettles, Elizabeth, T-Systems of the Mathieu group M.

Ratkovich, Thomas, The algebra and topology of extensions of finitely generated profinite groups.

ARIZONA

Arizona State University (3)

MATHEMATICS

Buskirk, Trent, Using nonparametric methods for density estimation with complex survey data.

Drinen, Douglas, Flow equivalence and graph groupoid isomorphism.

Zhang, Xuerong, Degree-light-free graphs and Hamiltonian cycles.

University of Arizona (17)

APPLIED MATHEMATICS

Amir, Orna, Gaussian analysis of unsaturated flow in randomly heterogeneous porous media.

Bauer, Karl, Projection based image restoration, super resolution and error correction codes.

Liu, Li, Hierarchical structures in fully developed turbulence.

Mercado Sanchez, Gema, Modeling hotspot dynamics in microwave heating.

Murray, Regan, Traveling waves and oscillating fronts in a model for biodegradation.

Ropp, David, A numerical study of shallow water models with variable topography.

Woo, Jung Min, Two mathematical problems in discorded system.

MATHEMATICS

Alzoubi, Maref, A dispersal model for structured populations.

Avila de Brau, Guadalupe, Controlled Markov chains with exponential risk-sensitive criteria; Modularity, structured policies and applications.

Brau Rojas, Agustin, Controlled Markov chains with risk-sensitive average cost criterion.

Cunningham, Geoffrey, Sums of squares in function fields of elliptic curves.

Dai, JiaLing, Conjugacy classes, characters, coadjoint orbits of Diff + S1.

Ekstrom, Aaron, On the infinitude of elliptic Carmichael numbers.

Jackson, Jack, Splitting in finite metacyclic groups.

Marshall, David, Galois groups and Greenberg's conjecture.

Sakamoto, Scott, The Cranmer abacus: Its use in teaching mathematics to students with visual impairments.

Wang, Chunnan, Analysis of a bivariate distribution in reliability theory.

ARKANSAS

University of Arkansas (2)

MATHEMATICAL SCIENCES

Lakew, Dejenie, Elliptic boundary value problems, Cl_{0_n} complete function systems and the Clifford II operator.

Liu, Hong, The Clifford analysis techniques for spherical PDE.

CALIFORNIA

California Institute of Technology (8)

APPLIED MATHEMATICS

Park, Peter, Multiscale numerical methods for the singularity perturbed convection-diffusion equation.

Si, Helen (Hui), Numerical study of interfacial flow with surface tension in two and three dimensions.

CONTROL AND DYNAMICAL SYSTEMS

Parrilo, Pablo, Structured semidefinite programs and semialgebraic geometry methods in robustness and optimization.

Pekarsky, Sergey, Discrete reduction of mechanical systems and multisymplectic geometry of continuum mechanics.

The above list contains the names and thesis titles of recipients of doctoral degrees in the mathematical sciences (July 1, 1999, to June 30, 2000) reported in the 2000 Annual Survey of the Mathematical Sciences by 237 departments in 158 universities in the United States. Each entry contains the name of the recipient and the thesis title. The number in parentheses following the name of the university is the number of degrees listed for that university. A supplementary list, containing names received since compilation of this list, will appear in a summer 2001 issue of the *Notices*.

Wang, Yong, Effects of actuator limits in bifurcation control with applications to active control of fluid instabilities in turbomachinery.

MATHEMATICS

Asparouhov, Tihomir, Sequential fixed width confidence intervals.

Kovrijkine, Oleg, Some estimates of Fourier transforms.

Li, Tao, Immersed surfaces, Dehn surgery and essential laminations.

Claremont Graduate University (4)

MATHEMATICS

Lai, Yongzeng, Quasi-Monte Carlo methods and their applications.

Lavretsky, Eugene, Neural networks for function approximation and control design.

Nguyen, Dong, Reliability modeling and evaluation in computer networks and distributed systems.

Switkes, Jennifer, The geographic mosaic theory in relation to coevolutionary interactions.

Naval Postgraduate School (1)

MATHEMATICS

Huber, Michael, A boundary-layer mode of thermal capillary flow in a cold corner.

University of California, Berkeley (32)

BIOSTATISTICS

Chen, John Jiangtian, Analysis of human disease data: Several statistical approaches.

Kamanou-Goune, Marie-Gisele, An index of household material wealth based on principal components of disease indicators.

Ngo, Long, Model selection in linear mixed-effects models.

MATHEMATICS

Abrams, Aaron, Configuration spaces and braid groups of graphs.

Agashe, Amod, The Birch-Dyer formula for modular abelian varieties of analytic rank zero.

Anshelevich, Michael, Free stochastic measures.

Bigelow, Stephen, Homological representations of braid groups.

Borger, James, On conductors over discrete valuation rings with general residue fields.

Calegari, Danny, Functions and the geometry of three-manifolds.

Collins, Pieter, Dynamics of surface maps with homoclinic and heteroclinic tangles.

Goldman, Deborah, Algorithmic aspects of protein folding and protein structure similarity.

Goldstein, Darin, Algorithms on networks of finite-state automata.

Gomes, Diogo, Hamilton-Jacobi equations, viscosity solutions and asymptotics of Hamiltonian systems.

Gomez, Emiliano, Deformations of pseudorepresentations.

Heitsch, Christine, Computational complexity of generalized pattern matching.

Ko, Sungjoon, More about tight contact structures on lens space.

Maclagan, Diane, Structures on sets of monomial ideals.

Marks, Gregory, 2-primal rings.

Miller, Ezra, Resolutions and duality for monomial ideals.

Neaderhouser, Johanna, Classifying one-dimensional attractors in rows on surfaces.

Oliveira, Marcelo, The canonical kernel function and representation theory of Lie groups.

Romano, David, Galois groups of strongly Eisenstein polynomials.

Smithline, Lawren, Slopes of p-adic modular forms.

Stein, William, Explicit approaches to modular Abelian varieties.

Thurston, Dylan, Wheeling: A diagrammatic analogue of the Duflo isomorphism.

Tsai, Harrison, Algorithms for algebraic analysis.

Wright, Jeffrey, A numerical study of two-dimensional Faraday oscillations in inviscid fluids.

Xu, Chong-Ye, Asymptotic stability for equilibria of nonlinear semi-flows with applications to rotating rods.

STATISTICS

Ling, Shiying, Constructing genetic maps for outbred experimental crosses.

Ostland, Michael, A Monte Carlo EM algorithm applied to travel time estimation and vehicle matching.

Virag, Balint, Random walks and geometry on graphs of exponential growth.

Yeh, Ru-Fang, Statistical issues in genomic mapping and sequencing.

University of California, Davis (8)

MATHEMATICS

Konetchnyi, Anatoly, Noncommutative geometry and Yang-Mills theory.

Meyer, Maike, Legendrian and Langrangian knots.

Nelsenador, Matthew, Numerical simulation of blood flow in coronary arteries.

Chan, Samuel, Reaction-diffusion equation in oscillatory media.

Wong, Meng-kai, Glimm method and Riemann problem extended to conservation laws with source terms.

STATISTICS

Hardin, Johanna, Multivariate outlier detection and robust clustering with minimum covariance determinant estimation and S-estimation.

He, Guozhong, Statistical methods for curve data.

Ji, Ming, Statistical issues related to medical screening tests.

University of California, Irvine (2)

MATHEMATICS

Clabane, Dana, Composition operators on holomorphic function spaces in several complex variables.

Luo, Wallace, Theory of holomorphic Besov spaces in domains of complex Euclidean spaces.

University of California, Los Angeles (18)

MATHEMATICS

Brown, Alexander, Hecke correspondences on Picard modular surfaces.

Caiden, Rachel, A numerical method for two phase flow consisting of separate compressible and incompressible regions.

Cheng, Li-Tien, The level set method applied to geometrically based motion, materials science, and image processing.

Ching, Avery, Positive dimensional components of higher graded pieces of Chow groups.

Cleveland, Christopher John, Rotation for attractors in the Lozi family.

DeLeon, Doreen, Wavelet operators applied to multigrid methods.

Della Rocca, Giulio, Classification of UHF algebras: The role of groupoid in the new approach to classification theory.

Hu, Xinqwei, Authority distributions and interactions in irreducible organizations.

Kitisin, Nataphau, The partial regularity of minimizing biharmonic maps to spheres.

Knightly, Andrew, Representations of unitary groups and associated Galois representations.

Ng, Ping Wong, Completely contractive projections on $\mathbf{R}^*$.

Perez-Fernández, Pablo A., The electromagnetic inverse medium problem.

Pomeranteen, Michael, Moduli spaces of 2- and 3-instantons.

Salzano, Maria, The contact process on graphs.

Shim, Hyeseon, Level set based simulations of two-phase oil-water flows in pipes.

Yoshinobu, Stan Taira, Large sets of zero analytic capacity.

Yu, Yin Bon, Regularity of intrinsic biharmonic maps to spheres.

Zhou, Haomin, Wavelet transforms for discontinuous functions and its applications in image processing.

University of California, Riverside (5)

MATHEMATICS

Li, Zhiwen, Burau representation for string links.

STATISTICS

Burns, Colleen, Search designs for factor screening experiments with factors at three levels.

Roque, Gina, Masking microdata with mixtures of normal distributions.

Teschmacher, Lance, The pairwise comparison of search designs using three new criteria based on search probabilities.

Wang, Min-Jay, Effective implications of nonparametric nonlinear time series analysis.

University of California, San Diego (13)

MATHEMATICS

Barclay, Alexander, SQP methods for large-scale optimization.

Bartels, Arthur C., Link homotopy in codimension two.

Conant, James Roger, A knot bounding a grope of n is $n/2$ trivial.

Han, Ilseop, Tractability of algebraic function fields in one variable over global fields.

Knight, Robert Dean, Using Laguerre geometry to discover Euclidean theorems.

Kojcinovic, Slobodan, Extensions of CR mappings between generic algebraic submanifolds.

Kronewitter, F. Dell, Noncommutative computer algebra in linear algebra and control theory.

Lamel, Bernhard R., Mappings of real submanifolds in complex spaces in different dimensions.

Leibon, Gregory D., Random Delaunay triangulations, the Thurston-Andreev theorem, and metric uniformization.

Shepler, Anne V., Semi-invariant forms.

Skogman, Howard, Jacobi forms over number fields.

Wagner, Jennifer D., The combinatorics of the permutation enumeration of wreath products between cyclic and symmetric groups.

Willenbring, Jeb Faulkner, Stability properties of q-multiplicities and branching formulas for representations of the classical groups.

University of California, Santa Barbara (5)

MATHEMATICS

Jiang, Bin, Non-overlapping domain decomposition and heterogeneous modeling used in solving free boundary problems.

White, Matthew, Some bounds for closed hyperbolic 3-manifolds.

STATISTICS AND APPLIED PROBABILITY

Kim, David, Quantile decomposition of a density.

Mackey, Howard, Diagnostics for binary response mixed models.

Wu, Dongfeng, Some contributions to the study of wavelet regression.

University of California, Santa Cruz (2)

MATHEMATICS

Georgiou, Ion, Fluid problems with diffusion.

Zeitlhoefler, Thomas, A Poincaré theorem and a slice theorem for Teichmueller theory of punctured surfaces.

University of Southern California (1)

MATHEMATICS

Khan, Taufiquar, Inverse problems, identification and control of distributed parameter systems: Applications to space structures with active materials.

COLORADO

Colorado State University (5)

MATHEMATICS

Lahme, Brigitte, Karhunen-Loeve decomposition in the presence of symmetry.

Livingston, Co, Periodic existence theorems in optimal control.

Seibert, James, The dimension of planar linear systems.

STATISTICS

Leecaster (nee: Van Caster), Molly, The autologistic model with covariates for sample data and robust sampling designs using predicted probability of presence.

Paige, Robert, Saddlepoint methods in neural networks.

University of Colorado, Boulder (5)

APPLIED MATHEMATICS

Ghrist, Michelle, High-order finite difference methods for wave equations.

MATHEMATICS

Chiaramonte, Robert, Almost-equivariant finite asymptotic dimension and the Baum-Connes conjecture.

Courter, Jennifer, Construction of dilation-d orthonormal wavelets.

Schaffer, Sharon, Generalized multiresolution analyses and applications of their multiplicity functions to wavelets.

Schipperns, Rene, Countable partition ordinals.

University of Colorado, Denver (5)

BIOSTATISTICS

LaFleur, Bonnie, Application of permutation methods to the generalized linear model.

Pan, Zhaoxing, Surrogate markers for survival time in clinical trials: A proposed class of intermediate events as marker variables.

MATHEMATICS

Heberton, Caroline, Eulerian-Lagrangian localized adjoint method and smoothed aggregations algebraic multigrid.

Nesliturk, Ali, Approximating the incompressible Navier Stokes equations using a two level finite element method.

Siewert, Daluss, Biclique covers and partitions of bipartite graphs and digraphs and related matrix ranks of $\{0,1\}$-matrices.

University of Denver (1)

MATHEMATICS AND COMPUTER SCIENCE

Breznay, Peter, Tightly connected hierarchical interconnection networks.

University of Northern Colorado (4)

MATHEMATICAL SCIENCES

Belloso, Rafael, A measurement model using path analysis with latent variables to assess the student affective domain before the learning of intro. statistics.

Lee, Wan-I, The relationship between students' proof writing ability and van Hiele levels of geometric thought in college geometry.

Strickland, Jeffrey, How students make meaning in a reform calculus course.

Yuan, Yuan, The impact of student learning style and classroom environment interactions on the development of the function concept in college algebra students.

CONNECTICUT

University of Connecticut (10)

MATHEMATICS

Chueh, Chin-Mei, Stochastic economic modeling for the deferred annuity (accumulation) line of business.

Derado, Josip, Multivariate refinable interpolating functions.

Fei, Guihua, Periodic solutions of Hamiltonian system and minimal period problem.

Gao, Fuchang, Majorizing measures and their applications in harmonic analysis.

Gonzales, Reo, Integral equation method for the continuous spectrum Schrödinger equation.

Kang, Yow-Ming, Analysis of the provision for adverse deviation (PAD) for pay-out annuities.

Kim, Eun Heui, On the existence of positive solutions of quasilinear elliptic boundary value problems.

STATISTICS

Holler, Keith, Time series of random convex bodies.

Klesczewski, Kenneth, Extending the asymptotic properties of the maximum likelihood estimator to applications with random sample sizes.

Wang, Fei, Sample size determination under Bayesian modeling.

Yale University (12)

BIOSTATISTICS

Kamina, Ayumi, Modeling the emergence of drug-resistant mutants: Implications for treatment strategies of HIV-1 infection.

MATHEMATICS

Chen, Fang, Mixing and lifting of random walk on graph.

Hill, Jennifer Ann, Torsion theories and local cohomology.

Karlsson, Bengt Anders, Semicontractions, nonpositive curvature, and multiplicative ergodic theory.

Kiem, Young-Hoon, Cohomology of quotients and moduli spaces of vector bundles.

Kolm, Petter Nils, Quadruple and octuple layer potentials in two dimensions.

Lerman, Gilad Meir, Geometric transcriptions of sets and their applications to data analysis.

Nahon, Michel Rene, Phase evaluation and segmentation.

Protsak, Victor, A notion of rank for enveloping algebras and local theta correspondence.

Roitman, Michael, On conformal and vertex algebras.

STATISTICS

Carter, Andrew, Asymptotic equivalence of nonparametric experiments.

Thiry, Alexandra, Bayesian regression with coefficients probably zero.

DELAWARE

University of Delaware (3)

MATHEMATICAL SCIENCES

Favinger, Thomas, Variational methods for boundary integral equations of the second kind.

Nigam, Nilima, Variational methods for a class of boundary value problems exterior to a thin domain.

Panchenko, Alexander, Some problems of continuum mechanics and materials science.

DISTRICT OF COLUMBIA

American University (5)

MATHEMATICS AND STATISTICS

Beyers, John, How do we get there from here? An investigation of NCTM standards-based reform and implementation issues in an urban systemic initiative.

Higginbotham, Joyce, The impact of the use of the curriculum and evaluation standards for school mathematics: Addenda Series: Grades 5–8.

Lan, Feng, Sequential adaptive sampling designs to estimate abundance in rare populations.

Popowitz Geyer, Susan, Predicting spatial hotspot regions.

Stylianou, Mario, Sequential analysis of Durham and Flournoy's Biased Coin Design (BCD) for phase I clinical trials.

George Washington University (10)

MATHEMATICS

Collier, William, Applications of variational principles to modeling partially inflated scientific research balloons.

Hansen, Clifford, Dynamics of multidimensional substitutions.

Pirnazar, Amir, Girth, genus, and fractional coloring of graphs.

Qin, Hongxun, Tutte polynomials and matroid constructions.

Sokolov, Maxim, Quantum invariants, skein modules, and periodicity of 3-manifolds.

Tsukamoto, Tatsuya, The fourth skein module of 3-dimensional manifolds.

STATISTICS

Diaz, Tirso, Simultaneous testing and estimation of trend in proportion using historical control.

Le, Chenxiong, Application of auto regressive heteroscedastic (ARCH) models to the analysis of longitudinal data.

Li, Jun, A stochastic model for option pricing.

Zheng, Gang, Fisher information in order statistics and ordered randomly censored data.

FLORIDA

Florida Institute of Technology (1)

MATHEMATICAL SCIENCES

Kermani, Sassan, Extended trigonometric hyperbolic functions and control theory.

Florida State University (4)

MATHEMATICS

Szecsei, Denise, A convolution property of some measures with self-similar fractal support.

STATISTICS

Jagger, Thomas, Space-time models for count processes with application to hurricane activity.

Laird, Glen, Nonparametric inference for the proportionality function in the randomly censored model.

Wang, Dagang, Nonparametric dynamic regression models with applications to financial data analysis.

University of Central Florida (2)

MATHEMATICS

Brown, Kevin, Linear and nonlinear Kelvin-Helmholtz instabilities of high velocity magnetized shear layers with generalized polytrope laws.

El Hor, Aicha, Statistical estimation of the locations of lightning events.

University of Florida (13)

MATHEMATICS

Brask, David, Arbitrage pricing of several new exotic options: The partial tunnel and get-out options.

Chastain, Stacey, Geometric evolution equations.

DelaCruz, Omar, Three topics in set theory: Finiteness and choice, cardinality of compact spaces, and singular Jonsson cardinals.

Swearingon, Michael, The risk-spread option in a potential theoretic framework.

Van, Tri Pham Minh, Approximation methods in fiber optics.

Vanderbilt, Amy, Common derivations in locally determined nonmonotonic rule systems and their complexity.

Zapata, Jaime, The generalized matrix product and fast Fourier transform for permutohedral aggregates.

STATISTICS

Gueorguieva, Ralitza, Models for repeated measures of a multivariate response.

Hartzel, Jonathan, Random effects models for nominal and ordinal data.

Kowalski, Scott, The design and analysis of split-plot experiments in industry.

Lee, Juneyoung, Design comparisons and modeling aspects for unbalanced random models.

McGoff, Philip, A unified approach to process optimization.

Wang, Chen-Pin, Bayesian analysis of competing risks models.

University of Miami (1)

MATHEMATICS AND COMPUTER SCIENCE

Ruth, Kevin, Favorable red and black on the integers with a minimum wager.

University of South Florida (2)

MATHEMATICS

Ivanov, Ivan, Linear discrete operators and recovery in uniform algebras.

Roberts, Henry, Predicting the performance of software systems via the power law process.

GEORGIA

Emory University (6)

BIOSTATISTICS

Baughman, Andrew, Latent structure models for evaluating diagnostic agreement using replicate binary measurements.

Hudgens, Michael, HIV, interval censoring and competing risks.

Vijapurkar, Ujjwala, Temporal and spatial prediction using quasi-likelihood regression models.

MATHEMATICS AND COMPUTER SCIENCE

Kochengin, Sergey, Reflector construction problems.

Nagle, Brendan, Regularity properties for triple systems.

Wagner, Michelle, A constructive version of the blow-up.

Georgia Institute of Technology (7)

MATHEMATICS

Bloomer, Lisa, Random probability measures with given mean and variance.

Heckman, Christopher, Independent sets in graphs of bounded degree.

Hlineny, Peter, Planar covers of graphs: Negami's conjecture.

Kerce, James, Geometric problems relating evolution equations and variational principles.

Klabjan, Diego, Topics in airline crew scheduling and long scale optimization.

Walls, Barrett, Coloring girth restricted graphs on surfaces.

Weedermann, Marion, On perturbation of delay-differential equations with periodic orbits.

University of Georgia (7)

MATHEMATICS

Fuller, Edgar, The geometric and topological structure of holonomic knots.

Pootheri, Sridar, Characterizing and counting classes of unlabeled 2-connected graphs.

Watkins, Mark, Class numbers of imaginary quadratic fields.

Yu, Gang, Average size of the 2-Selmer groups of certain families of elliptic curves over $\mathbb{Q}$.

STATISTICS

Chen, Yinpu, Laws of large numbers for random sets and fuzzy random sets.

Wang, Ye, Parameter estimation of space time bilinear processes.

Zhou, Wenjiong, Generalized linear models for spatially correlated data.

HAWAII

University of Hawaii (3)

MATHEMATICS

Heeney, Xiang Xia, Small lattices.

Sun, Shuhao, Sheaf representations of general rings.

Zheng, Lixin, The essential norm and spectrum of composition operators on space of bounded analytic function.

IDAHO

University of Idaho (3)

MATHEMATICS

Bailey, Allen, Rings whose Krull dimensions are larger than their cardinalities.

Huang, Lixin, On generators of the symmetric and alternating groups and an application to Galois theory.

Mills, Harry, Positive solutions to a second-order boundary value problem.

ILLINOIS

Northern Illinois University (4)

MATHEMATICAL SCIENCES

Cassidy, Jean, Solving the TLS problem via rank revealing *LU* factorization.

Devarajan, Karthik, Inference for a nonproportional hazards regression model and applications.

Mugdadi, Abdel-Razzaq, Nonparametric curve fitting of the probability density functions of random variables with applications.

Thrun, Jason, College student's rational-number-as-operator strategies: A focus on students' coordination of units and distributivity of operators in problem-solving situations.

Northwestern University (3)

MATHEMATICS

Borghesi, Simone, Higher degree formula.

Gutman, Gary, Elliptic calculations in algebraic topology.

Scorichenko, Alexander, Stable K-theory and functor homology.

Southern Illinois University, Carbondale (3)

MATHEMATICS

Sears, Bradley, Two-element generation of unitary groups over finite fields.

Su, Meng, Some nonlinear boundary value problems of evolution equations.

Yan, Feng, Topics on stochastic differential equations.

University of Chicago (21)

MATHEMATICS

Andrianov, Fedor, Clifford algebras and Shimura's lift for theta-series.

Baranovsky, Vladimir, Moduli of sheaves on surfaces and action of the oscillator algebra.

Buch, Anders, Combinatorics of degeneracy loci.

Chen, Linda, Quantum cohomology of flag manifolds.

Hagelstein, Paul, Local integrability of strong and iterated maximal functions.

Hallstrom, Christopher, Heat transfer in rotating infinite Prandtl number convection.

Hunsicker, Eugenie, L^2-cohomology and L^2-harmonic forms for complete Kähler and warped product metrics.

Isaksen, Daniel, A model structure on the category of pro-simplicial sets.

Miller, Russell, Computable model theory and automorphisms of the computably enumerable set.

Nevins, Thomas, Topology of moduli spaces of framed sheaves on ruled surfaces.

Pergler, Martin, Point stabilizers of connection preserving actions.

Przeworski, Andrew, Tubes in hyperbolic 3-manifolds.

Przezdziecki, Adam, Homotopical localization at a space.

Robertson, Ian, The Euler class group of a line bundle on an affine algebraic variety over a real closed field.

Rowland, Todd, Smooth holomorphic curves in S^6.

Sun, Jian, K Matrix on manifolds.

Thomas, Hugh, An action of equivariant Cartier divisors on invariant cycles for toric varieties.

Wald, Kevin, Automorphisms and noninvariant properties of the computable enumerable sets.

Wittwer, Janine, A sharp estimate on the norm of the Martingale transform.

Zhao, Wenhua, Generalization of genus zero two dimensional conformal field theory; some results on Jacobian and intersection number of affine curves in $\mathbb{C}^2$.

STATISTICS

Hayashi, Takaki, Hedging of contingent claims under model uncertainty.

University of Illinois, Chicago (12)

MATHEMATICS, STATISTICS AND COMPUTER SCIENCE

Cogolludo-Agustin, Jose, Topological invariants of the complement to arrangements of rational plane curves.

Fields, Joseph, On extremal self dual codes.

Freitas, Pedro, On the action of the symplectric group on the Siegel upper half plane.

Gyuris, Viktor, Variations of algebraizability.

Hedman, Shawn, Finitary axiomatizations of categorical theories.

Hu, Junda, Deformation to the normal bundle in arithmetic geometry.

Kern, Daniel, An optimal control policy for groundwater remediation using systematic perturbations.

Porta, Gaspar, On the convergence of the product of the exponential of two compact operators.

Robieson, Weining, On weighted kappa and concordance correlations coefficients.

Shell, Amy, In service to mathematics: The life and work of Mina Rees.

Syed, Zamir, Algorithms for stochastic games and related topics.

Wottreng, Kristen, Computer methods in descriptive and differential geometry: Monge's legacy.

University of Illinois, Urbana-Champaign (21)

MATHEMATICS

Axenovich, Maria Alex, Extremal problems in combinatorics—covering and coloring problems.

Bedenikovic, Anthony, The complements of 2-complexes in the 4-ball.

Branson, William Balko, Global analysis of meromorphic vector fields in the plane.

Chen, Ya-Chen, Extremal problems in graph theory: Hamiltonicity, minimum vertex-diameter-2-critical graphs and decomposition.

Eichhorn, Dennis, Some results on the congruential and gap-theoretic study of partition functions.

Ho, Jeffrey, On the quantum cohomology of Fano toric manifolds and the intersection cohomology of singular symplectic quotients.

Kalikakis, Dimitrios Emmanuel, Saddle surfaces.

Kim, Seon-Hong, Sums of polynomials, minmax problems and number theory.

Kuhlman, Douglas Andrew, On the orders of Jacobians of hyperelliptic curves.

Kundgen, Andre, Problems in extremal graph theory.

Liaw, Wen-Chin, Contributions to Ramanujan's theories of modular equations, Ramanujan-type series for $1/\pi$, and partitions.

Maneesawarng, Chaiwat, External problems for curves in metric spaces of curvature bounded above.

McLallen, Nicola Whitley, The mod-3 cohomology ring of the O'Nan sporadic simple groups.

Perry, David Michael, Maximal 2-extensions of number fields.

Richert, Benjamin, Monomial ideals, N-lists, and smallest graded Betti numbers.

Saveliev, Peter, Fixed points and coincidences.

Schwartz, Gary Keith, A reduction for Dade's conjecture.

Song, Joung-Min, Sums of multiplicative functions over 4-smooth numbers and related differential difference equations.

Troitsky, Vladimir, Invariant subspace problem and spectral properties of bounded linear operators on Banach spaces, Banach lattices, and topological vector spaces.

STATISTICS

Fu, Limin, Unified ordinal regression: Model assessment and semiparametric analysis.

Gao, Yonghong, Rank-based procedures for some multivariate problems.

INDIANA

Indiana University, Bloomington (11)

MATHEMATICS

Biswas, Animikh, On the lifting of intertwining operators and their parameterization.

Cheng, Wenfang, An under-resolved scheme for certain partial differential equations with boundary layer.

Danner, Norman, Ordinal notations in typed lambda-calculi.

Guo, Daniel Xiangdong, Fully discretized fractional-step methods and applications to ocean primitive equations.

Ju, Ning, Numerical analysis for the parabolic p-Laplacian problem.

Kulkarni, Rajesh, On the Clifford algebra of a binary form.

McCooey, Michael, Symmetry groups of four-manifolds.

Olson, Eric John, The orthogonal projection of fractal sets.

Swanson, David, Continuity properties of Sobolev functions.

Tamulis, Andrius, Concordance of classical knots.

Verma, Kaushal, The reflection principle and boundary regularity of correspondences.

Indiana University-Purdue University, Indianapolis (1)

MATHEMATICAL SCIENCES

Hansen, Karin, Hochschild homology of Morita equivalent étale groupoids.

Purdue University (10)

MATHEMATICS

Brown, Nathanial, AF embeddability and topological entropy in noncommutative dynamical systems.

Chipalkatti, Jaydeep, A generalization of Castelnuovo regularity for Grassmann manifolds.

Leisner, Christopher, Nonlinear wavelet approximation in anisotropic Besov spaces.

Lewis, Kathryn, Toeplitz operators and hyponormality.

Mylnikov, Anatoly, p-Adic subanalytic preparation and cell decomposition theorem.

Rashid, Suliman, Factorization of birational toric morphisms and its extension to the toroidal case.

Tang, Siu-Hung, Some results on the existence of resonances for perturbations of the Euclidean Laplacian.

Xu, Jianwei, Smooth dependence of solutions of the ∂-Neumann problem on parameters.

STATISTICS

Stover, Jason Hooper, Filtering and estimation of noise-contaminated chaotic time series.

Zang, Chuanbo, Estimation, testing, and forecasting for long memory processes.

University of Notre Dame (5)

MATHEMATICS

Allen, Brian, Linear systems analysis and decoding of convolutional codes.

Badzioch, Bernard, Algebraic theories in homotopy theory.

Lazarovici, Laurentiu, Elliptic sectors in surface theory and the Carathéodory-Loewner conjectures.

McCoy, Charles, Relativization, categoricity, and dimension.

Miller, Charles, New types of soliton solutions in nonlinear evolution equations.

IOWA

Iowa State University (22)

MATHEMATICS

Baccam, Prasith (Sid), Genetic variation and evolution of equine infectious anemia virus rev quasispecies during long term persistent infection.

Chun, Changbum, Error estimates for the bifurcation function for semilinear elliptic boundary value problem.

James, Edna, Stochastic models for surface adsorption and reaction processes.

Mills, Mark, The intersection of some classical equivalence classes of matrices.

Pamuk, Serdal, Two dimensional models of tumor angiogenesis.

STATISTICS

Abbitt, Pamela J., Quantile estimation using auxiliary information with application to soil texture data.

Barnet, Barbara Dombroski, A comparison of the effects of using interactive computer simulations versus hands-on activities on the conceptual understanding and attitudes of introductory statistics students.

Chiang, Andy Kok-Leong, Confidence intervals for functions of variance components.

Dodd, Kevin Wayne, Estimation of a distribution function from survey data.

Dubinin, Thomas, Likelihood-based inference in some partially non-regular exponential families.

Gabrosek, John, The effect of locational uncertainty in geostatistics.

Goyeneche, Juan-Jose, Estimation of the distribution function using auxiliary information.

Hawkins, Richard, Numerical optimization of recursive systems of equations with an application to optimal swine genetic selection.

Kwon, Sun-Hee, Clustering in multivariate data: Visualization case and variable reduction.

Lewin-Koh, Sock-Cheng, Heteroscedastic factor analysis.

Peternelli, Luiz Alexandre, Genetic covariances between inbred progenies and their testcrosses.

Roy, Anindya, Estimation for autoregressive processes.

Schuckers, Michael Edward, Bayesian analysis of hierarchical models for polychotomous data from a multi-stage cluster sample.

Tsao, L. Claire, Statistical methods for count data from designs with nested structure.

Wright, Deanne Lynn (Reber), Inference for extremes with applications to animal breeding and disease mapping.

Wright, Kevin Douglas, Applications of interval analysis to selected topics in statistical computing.

Zheng, Zugeng, Studies in heavy traffic and in production systems.

University of Iowa (15)

APPLIED MATHEMATICAL AND COMPUTATIONAL SCIENCE

Aulwes, Rob, Computational methods in dual representations and invariant theory.

BIOSTATISTICS

Kirchner, H. Lester, Simultaneous estimation of intra- and pairwise inter-rater agreement under class exchangeability and order restricted properties for multiple raters.

Manos, George, A mixed effects generalized linear model approach to the analysis of binary longitudinal data subject to informative drop-out using Markov chain Monte Carlo methods.

Slager, Susan, Linkage disequilibrium mapping of complex disorders: Investigating statistical power to detect linkage.

Tang, Shenghui, Analysis of longitudinal data with informative competing causes of dropout.

West, Colin, An approach to longitudinal studies involving repeated categorical outcome variables with missing data.

MATHEMATICS

Chen, Jiuhua, Numerical analysis of some contact problems for elastic-viscoplastic materials.

Forman, Sylvia, Two star operations and their induced lattices.

Huang, Da, Nested sequence of balls and almost locally uniform rotundity.

Misaghian, Manouchehr, Theta correspondences (U(1),U(2)) over a p-adic local field.

Stefan, Marius, On the hyperfinite and abelian dimensions of free group factors.

Tran, Thai-Duong, Invariant theory for infinite-dimensional classical groups.

STATISTICS AND ACTUARIAL SCIENCE

Carolan, Christopher, Asymptotic behavior of order restricted estimators under equality.

Jordan, Joy, A test of marginal homogeneity versus stochastic ordering in contingency tables.

Kim, Jong Sung, Proportional hazards model with arbitrarily interval-censored data.

KANSAS

Kansas State University (9)

MATHEMATICS

Canning, Eric, A smoothness property of wavelet paraproducts.

Garth, David, Small limit points of sets of algebraic interest.

Kasikova, Anna, On hyperplanes of hexagonic geometries.

Laird, Richard, The mod-2 cohomology of the Sylow-2 subgroup of the Higman-Sims sporadic simple group.

Mosbo, Magdalena, Compression of stereo audio data with vector-valued wavelets.

Rodnianski, Igor, Pseudoholomorphic curves in almost complex manifolds.

STATISTICS

Brown, Duane, Multiresponse lack-of-fit tests for non-replicated data.

Chen, Yihfen, Significance tests for unreplicated experiments.

McCarter, Kevin S., Estimation and prediction for the Birnbaum-Saunders distribution using type-II censored samples, with a comparison to the inverse Gaussian distribution.

University of Kansas (4)

MATHEMATICS

Lawner, Richard, Urysohn connectifications of Hausdorff spaces.

Matache, Mihaela (Dora), From reality to abstract in stochastic processes applied to telecommunications.

Taylor, Amelia, Initial ideals and the inverse problem in Groebner basis theory.

Toda, Magdalena, Pseudospherical surfaces via moving frames and loop groups.

Wichita State University (1)

MATHEMATICS AND STATISTICS

Kunyansky, Leonid, Numerical and analytical study of problems of photonic crystals theory.

KENTUCKY

University of Kentucky (12)

MATHEMATICS

Aldrich, Stephen, Exact and semisimple differential graded algebras and modules.

Aossey, Cynthia, 3PC$(\cdot,\cdot)$-free Berge graphs are perfect.

Bevelacqua, Anthony J., Isotropy of 4-dimensional torsion quadratic forms over $F(x,y)$ for certain fields F.

Faulkner, Leanne, Engel properties for modular group algebras.

Lutzer, Carl, On the extraction of topological and geometric data from the spectrum of the Dirichlet to Neumann operator.

Riley, Douglas A., Global existence of strong solutions to the three-dimensional incompressible Navier-Stokes equations with special boundary conditions.

Skipper, Daphne, Combinatorial scheduling models.

Sykes, Jeffery D., Regularity of solutions of the mixed boundary problem for Laplace's equation on a Lipschitz graph domain.

Zaman, Naveed, Minimal generators.

STATISTICS

Fang, Hui, Empirical likelihood ratios in survival analysis.

Hawkins, Dollena, Determining the number of components in mixtures of linear models.

Johnson, Kjell, Influence function analysis for multivariate structure-seeking methodologies.

LOUISIANA

Louisiana State University, Baton Rouge (6)

MATHEMATICS

Lu, Bin, General Riemann integrals and their computation via domains.

Ru, Xueping, Applications of the method of quasi-reversibility to some ill-posed problems for the heat equation.

Stan, Aurel, On harmonic analysis for white noise distribution theory.

Turner, Galen, Structure and minors in graphs and matroids.

Whipple, Gretchen, Totally ordered monoids.

Whitaker, John, Integral kernel operators in the Cochran-Kuo Sengupta space.

Tulane University (8)

BIOSTATISTICS

Dean, Hazel, Time series models to develop statistical process control markers in HIV and AIDS surveillance.

DeSilvio, Michelle, A variance ratio statistic for assessing the missing data mechanism: An empirical study.

Elkasabany, Abdalla, Non-differential misclassification for polychotomous exposure in case control studies.

Hernandez-Molinar, Raul, Parametric and nonparametric asymptotic maximum likelihood estimation of extremes.

Shi, Runhua, A comparison of the power of two cutpoint methods to test for a dose-response relationship: A simulation study.

Sung, Jung-Hye, Trends in ischemic heart disease mortality in Korea from 1980–1994: Age-period-cohort analysis.

MATHEMATICS

Alexeev, Dmitri, Quasi-projective modules over integral domains.

Martin, Keye, A foundation for computation.

University of Louisiana at Lafayette (7)

MATHEMATICS

Benton, Denise (Fuselier), Inferences in multivariate calibration.

Devillier, Chris, Conditional Cauchy equations of the cylindrical type and applications.

Huang, Feng-Kuo, Polynomials and polynomial functions.

Lewallen, John, Left self distributively generated algebras.

McClendon, Michael, A non-strongly normal regular digital picture space.

Wang, Liwen, The generalized quasilinearization method and blow-up results for nonlinear problems.

Zhao, Chenglin, Blow-up and quenching for solutions of some parabolic equations.

MARYLAND

Johns Hopkins University (17)

BIOSTATISTICS

Blume, Jeffrey, On the probability of observing misleading evidence in sequential trials.

Chiu, Yen-Feng, Multipoint linkage detection in the presence of heterogeneity.

Garrett, Elizabeth, Graphical diagnostic tools for standard latent class and latent class regression model assessment with an application in describing depression and validating diagnostic criteria for depression.

Huang, Guan-Hua, Analysis of multiple indicators using marginal models and latent class regressions.

Kou, Jingyee, A predictive spatial-temporal model for boreal forest succession.

Miglioretti, Diana, Template mixture models for functional brain mapping.

Xu, Jane, Surrogate endpoints in the analysis of longitudinal data.

MATHEMATICAL SCIENCES

Chen, Dalei, Borrowed strength density estimation and applications.

Cheng, Christine, Three problems in graph labeling.

Deeney, Megan, Optimal location of mesometric facilities.

Huang, Jacqueline, American options and complementarity problems.

Metzler, Carolyn, Complementarity models of competitive oligopolistic electric power distribution markets.

Tao, Peng, The generalized borrowed strength method and the application to image recognition.

Wagner, Christopher, Graph visualization and network routing.

MATHEMATICS

Cheltsov, Ivan, Log models of birationally rigid varieties.

Neuheisel, Joshua, The asymptotic distribution of nodal sets on spheres.

Socolinsky, Diego, A variational approach to image fusion.

University of Maryland, Baltimore (3)

MATHEMATICS AND STATISTICS

Gu, Xiaonong, Some contributions to principal points, self-consistency and optimal vector quantization.

Lee, Yi-Tzu, Tolerance regions in univariate and multivariate linear models.

Sun, Yijun, Statistical meta-analysis with applications.

University of Maryland, College Park (19)

MATHEMATICS

Alvarez-Parrilla, Alvaro, Fourier coefficient relations and geodesics flow invariant distribution.

Arnold, Elizabeth, Computing Graebner bases with Hilbert lucky primes.

Charette, Virginie, Proper actions of discrete groups on 2 + 1 space time.

Frohman, Thomas F., Buckling of elastic structures.

Guha-Roy, Pallabi, Multiple objective linear programming: Finding compromise and candidate solutions.

Gurski, Katharine Fortune, Decay rates of internal waves in viscous near-critical fluids.

Konikov, Mikhail, Parameter estimation with appreciation to finance.

Kozinster, Boris, Computations with Gaussian random fields.

Levitan, Svetlana, Mathematical modeling of lateralization and asymmetrics in cortical maps.

Marmolejo-Olea, Emilio, Morera type problems in Clifford analysis.

Pfander, Götz, Periodic wavelet transforms and periodicity detection.

Shklover, Vladimir, Schiffer problem and isoparametric hypersurfaces.

Tempkin, Joshua, Spurions Lyapunov exponents computed using the Eckmann-Ruelle procedure.

Treiber, Oliver, Affine data representations and filter banks.

Wilber, John P., Global attractors for a degenerate partial differential equation from nonlinear viscoelasticity.

Wyss-Gallifent, Justin O., Discreteness of triangle groups in complex hyperbolic space.

Yi, Inhyeop, Canonical symbolic dynamics for one-dimensional generalized solenoids.

MEASUREMENT, STATISTICS AND EVALUATION

Fein, Melissa, Comparison of HLM and ML win multilevel analysis software packages: A Monte Carlo investigation into quality of estimates.

Nevitt, Jonathan, Evaluating small sample approaches for mode test statistics in structural equation modeling.

MASSACHUSETTS

Boston University (5)

BIOSTATISTICS

Nam, Byung Ho, Discrimination and calibration in survival analysis: Extension of area under the ROC curve for discrimination and chi-square test for calibration.

MATHEMATICS AND STATISTICS

Cheung, Kin, Semiparametric estimation of the long memory parameter in Farima models.

Hayes, Michael, Geometric analysis of delayed bifurcation.

Mihaela, Vajiac, Gauge theory techniques in quantum cohomology.

Zhang, Shaowei, On exponential maps.

Brandeis University (2)

MATHEMATICS

Lanave, Gabrielle, Stable models of elliptic surfaces with sections.

Rosas, Mercedes, A combinatorial overview of the theory of MacMahon symmetric functions and a study of the Kronecker product of Schur functions.

Harvard University (23)

BIOSTATISTICS

Cai, Tian Xi, Analysis of correlated failure time data.

Cheng, Debbie (Mein-Pay), Analysis of data from eradication studies of chronic viral infections.

Corcoran, Christopher, Computational methods for exact inference with correlated and uncorrelated binary data.

Fitzgerald, Anthony, Modeling response to anti-viral treatment using non-linear mixed effects models.

Foster, Aaron, Auxiliary information for strengthening predictions and nonparametric transformation estimation.

Foulkes, Andrea, Prediction based classification: Characterizing the relationship between HIV-1 genotype and response to treatment.

Herring, Amy, Missing covariates in survival analysis.

Horvath, Stefan, Dealing with missing data in family-based allelic association studies.

Legedza, Anna, Contributions to the design of phase I clinical trials.

Shera, David, Bayesian factor analysis.

Slasor, Peter, Joint models for survival and repeated measures data.

ENGINEERING AND APPLIED SCIENCES

Endo, Yasuhiro, Improving interactive systems using TIPME.

Khaneja, Navin, Geometric control in classical and quantum systems.

Wang, Shie-Yuan, Decoupling control from data for TCP congestion control.

MATHEMATICS

Bernhard, James, Equivariant de Rham theory and stationary phase expansions.

Cohn, Henry, New bounds of sphere packings.

Dickinson, Mark, On the modulity of certain 2-adic Galois representations.

Dowker, Ian, PU(2) monopoles on Kähler surfaces.

Leingang, Mathew, Symmetric space valued moment maps.

Starr, Jason, Rational curves on hypersurfaces in P^n.

Taylor, Christine, Compact manifolds with exceptional holonomy.

Weston, Thomas, On Selmer groups of geometric Galois representations.

Zipser, Nina, The global nonlinear stability of the trivial solution of the Einstein-Maxwell equations.

Massachusetts Institute of Technology (16)

MATHEMATICS

Bakalov, Bojko, An algebraic approach to the operator product expansion.

Dodds, Peter Sheridan, Geometry of river networks.

Fann, George, Efficient multiwavelet representation of the projector on divergence free functions.

Fong, Wungkum, Triangulations and combinatorial properties of convex polytopes.

Gorsich, David, Nonparametric modeling of dependencies for spatial interpolation.

Kedlaya, Kiran, Descent theorems for overconvergent F-crystals.

Kogan, Mikhail, Schubert geometry of flag manifolds and Gel'fand-Cetlin theory.

Kuo, Wentang, Principal nilpotent orbits and reducible principal.

Noohi, Behrang, Fundamental groups of algebraic stacks.

Pascovici, Dana, Regular functions on principal nilpotent orbits and R-groups; Representation theory of real Lie groups.

Skandera, Mark, Chain polynomials and permutation statistics.

Soloviev, Alexander, Set-theoretical solutions to the quantum Yang-Baxter equation.

Vadhan, Salil, A study of statistical zero-knowledge proofs.

Yang, Baozhong, Yang-Mills connections with isolated singularities.

Zara, Catalin, One skeleta and the equivariant cohomology of GKM manifolds.

Zhang, Zhaohui, On moduli stacks of finite group schemes.

Northeastern University (6)

MATHEMATICS

Bratus, Sergey, Recognition of finite black box groups.

El-Hashash, Mahmoud, Long cycles and Hamiltonian cycles in subgraphs of hypercubics.

Gassler, Robert, Segre numbers and hypersurface singularities.

Heilman, Ward, On the toughness of cross products of paths and cycles.

Matei, Daniel, Fundamental groups of links and arrangements.

Zhai, Shaohui, Combinatorial and information-theoretic aspects of search models.

University of Massachusetts, Amherst (5)

BIOSTATISTICS AND EPIDEMIOLOGY

May, Susanne, Score based goodness-of-fit tests and the Cox proportional hazards model.

Sulsky, Sandra, Knee-related injuries and disabilities in the U.S. Army, 1980–1997.

MATHEMATICS AND STATISTICS

Eszter, Edgardo, Evans function analysis of the stability of periodic travelling wave solutions of the FitzHugh-Nagumo system.

Kho, Alvin, Multi-scale analysis for microscopic models in materials science and cell biology.

Murray, Maura, Sign codes from number fields.

Worcester Polytechnic Institute (1)

MATHEMATICAL SCIENCES

Velo, Ani, Optimal design of gradient fields with applications to electrostatics.

MICHIGAN

Central Michigan University (3)

MATHEMATICS

Becker, Paul, Investigation of non-abelian (120, 35, 10) difference sets.

Dennis, Kevin, Co-hyponormality of composition operators on the Hardy space.

Hein, Derek, On the λ-design conjecture for $v = 5p + 1$ points.

Michigan State University (11)

MATHEMATICS

Belchev, Eugene, Finite-time blow-up of nonlinear wave equations.

Gao, Tangan, Finding all isolated roots of polynomial systems in $\mathbb{C}^n$ via stable mixed volume.

Kang, Joon Hyuk, The uniqueness of positive solution to generalized Lotka-Volterra competition model.

Mark, Thomas, Torsion, TQFT, and Seiberg-Witten invariants of three-manifolds.

Wang, Tianjun, Determining the Jordan normal form of a matrix.

STATISTICS AND PROBABILITY

Demopolos, James A., Continuous time arbitrage approached as a problem in constrained hedging.

Dey, Jyotirmoy, Some properties and characterizations of neutral to the right priors and beta processes.

Geraldes, Margarida C., Covariates in adaptive designs for clinical trials.

Park, Chanho, Super-replication of European exotic options.

Sundaram, Rajeshwari, Estimation in two sample doubly censored scale model.

White, Alexander, Exponentiated gradient portfolios in continuous time.

University of Michigan, Ann Arbor (29)

BIOSTATISTICS

Elliot, Michael, Models and methods for three problems in survey statistics: Subsampling callbacks to improve survey efficiency; model-based alternatives to weight trimming and methods for combining information from a census, a coverage measurement survey.

Heeringa, Steve, Multivariate imputation of coarsened survey data on household wealth.

Johanns, Jewel, The statistical analysis of index variables containing missing data.

Langefeld, Carl, The application of statistical methods for highly stratified data to linkage and association analyses of complex genetic traits.

Li, Yi, Inference in frailty measurement error models.

Ombao, Hernando, Statistical analysis of non-stationary time series.

Somayaji, Veena, Marginal regression models for analyzing mixed discrete and continuous responses.

Stringham, Heather, Bayesian solutions to problems of uncertainty in genetic data.

MATHEMATICS

Dabija, Marius, Algebraic and geometric dynamics in several complex variables.

Evans, Richard, Deformation spaces of hyperbolic 3-manifolds: Strong convergence and tameness.

Faridi, Sara, Closure operations on ideals.

Fields, Bruce, Length functions determined by killing powers of several ideals in a local ring.

Hall, Eric, Generic extensions of permutation models of set theory.

Holt, John, The global topology of deformation of spaces of Kleinian groups.

Johnston, Bryan, The values of the Milnor genus on smooth irreducible projective varieties over the complex numbers.

Karnik, Satyajit, Group actions on moduli of vector bundles.

Keeler, Dennis, Noncommutative ample divisors.

Knapp, Michael, Forms in many variables over p-adic fields.

Palen, Joseph, Bounds for class numbers of cyclotomic function fields.

Ranganathan, Nandini, Splitting in module-finite extension rings and the vanishing conjecture for maps of Tor.

Robertson, John, Complex dynamics in higher dimensions.

Scott, Uriel, Sparse systems of parameters for graded rings.

Smith, Kendrick, The mod 2 cohomology of some classifying spaces of compact Lie groups.

Vraciu, Adela, Tight closure and local cohomology.

STATISTICS

Biswas, Debjit, Generalized two-color urn processes and approximations.

Dong, Xiaobin, Contributions to statistical process control and robust parameter design.

Hou, Xiaoli (Shirley), Modeling, analysis and optimization in parameter design.

Hunter, David, Optimization transfer algorithms in statistics.

Namesnik, Kirsten, Statistical shape analysis of facial motions.

Wayne State University (1)

MATHEMATICS

Liu, Qingguo, Exponential bounds and asymptotic expansions for singularly perturbed Markov chains.

Western Michigan University (3)

MATHEMATICS AND STATISTICS

Coffey, David, An investigation into relationships between alternative assessment and preservice elementary teachers' beliefs about mathematics.

Eroh, Linda, Rainbow Ramsey numbers.

Walker, Rebecca, Students' conceptions of mathematics and the transition from a standards-based reform curriculum to college mathematics.

MINNESOTA

University of Minnesota, Minneapolis (24)

BIOSTATISTICS

Conlon, Erin, Estimation and flexible correlation structures in spatial hierarchical models of disease mapping.

Huppler Hullsiek, Katherine, Modeling strategies for the causal analysis of observational data.

MATHEMATICS

Belik, Pavel, Computational methods for martensitic thin films.

Dunlop, Anthony, Degrees of unsolvability in relative computability of real numbers.

Foursov, Mikhail, On integrable evolution equations in commutative and noncommutative variables.

Haile, Haile, Homomorphisms of polynomial rings and the semigroups and minimal resolutions associated with them.

Kogan, Irina, Inductive approach to Cartan's moving frame method with applications to classical invariant theory.

Liakhova, Julia, A theory of magnetostrictive thin films with applications.

Martinez, Salome, Diffusion and cross-diffusion in the multi-species Lotka-Volterra competitive system.

Mitrea, Irina, Spectral properties of elliptic layer potentials on nonsmooth domains.

Ouyang, Yi, Group cohomology of the universal ordinary distribution and its application.

Roman, Luis, On numerical solutions of stochastic differential equations.

Rudnaya, Svetlana, Analysis and optimal design of diffractive optical elements.

Villarroel-Flores, Rafael, Equivalent homotopy type of categories and preordered sets.

Walther, Hans Ulrich, Algorithmic computation of local and DeRham cohomology—an application of D-module theory to algebraic geometry and commutative algebra.

Yan, Xiaodong, Topics in regulatory of non-linear elliptic and parabolic systems.

Yang, Xiangrong, Analysis of numerical methods for nonlinear hyperbolic conservation laws.

Yi-Ju, Chao, Diffusion approximation of a sequence of semimartingales and its application in exploring the asymptotic behavior of some queueing networks.

STATISTICS

Brown, Brandon Scott, A noninformative Bayes approach to nonparametric binary estimation.

Fan, Sheng-hua, Optimal designs of multivariate responses.

Kim, Donghoh, Likelihood inference for spatial lattice processes.

Musser, Bret, Extensions to recursive partitioning.

Tsai, Chin-Pei, Bayesian experimental design with multiple prior distributions.

Wallstrom, Garrick, Consistency and strong inconsistency of inference.

MISSISSIPPI

Mississippi State University (4)

MATHEMATICS AND STATISTICS

Al-Mahmoud, Ahmad M., Prediction intervals and regions for some measures of location.

Cao, Lilun, An efficient numerical algorithm for solving nonlinear reaction-diffusion equation.

Chhetri, Maya, Solvability of classes of semipositone problems.

Singh, Pradeep, Multivariate regression model with random intercepts.

University of Mississippi (1)

MATHEMATICS

Hunt, Daniel, Threshold dose-response models in teratology.

MISSOURI

St. Louis University (1)

MATHEMATICS AND COMPUTER SCIENCE

Jeevanjee, Theresa, The mapping class group and isometries of orbifolds which are double-covered by lens spaces and which contain DNA knots.

University of Missouri, Columbia (8)

MATHEMATICS

Choi, Jaedong, Warped product spaces with non-smooth warping functions.

Morian, Christine, Partial differential equations on time scales.

Stanislovova, Milena, Spectral mapping theorems and invariant manifolds for infinite-dimensional Hamiltonian systems.

Unal, Bulent, Doubly warped products.

Vershynin, Roman, Representing structures in Banach spaces.

STATISTICS

Bengtsson, Thomas, Time series discrimination signal comparison testing and model selection in the state-space framework.

Molitor, John, Bayesian analysis with order restrictions.

Tra, Yolande, Bayesian analysis for avian nest survival models.

University of Missouri, Kansas City (1)

MATHEMATICS AND STATISTICS

Silvey, Rick, Hybrid symmetric QR algorithms.

Washington University (14)

MATHEMATICS

Bownik, Marcin, Anisotropic Hardy spaces and wavelets.

Czaja, Wojciech, Applications of local autocovariance matrices.

Lampe, Peter, Dynamics, Cartan geometries, and rigidity.

Rzeszotnik, Ziemowit, Characterization theorems in the theory of wavelets.

SYSTEMS SCIENCE AND MATHEMATICS

Cusick, Travis, Simulation and optimization of a military airfield system.

Kong, Mingqi, Motion estimation and motion-based segmentation in digital image sequences.

Li, Sicong, Human-machine cooperative control of telerobotic systems.

Mitra, Raja, Stability and performance analysis for hybrid manufacturing systems.

Ozcan, Ibrahim, Computational methods for the calculation of feasibility boundary in power systems.

Serrani, Andrea, Robust output regulation of nonlinear systems: Semi-global, global and adaptive.

Tunay, Ilker, Extremum-seeking based antiskid control and functional principal components.

Wang, Wen-Liang, Stability analysis of state feedback control for open-loop unstable systems with saturating.

Yang, Tzann-Shinn, Efficient comparison and selection algorithms in the simulation of discrete event dynamic systems.

Zhang, Mingjun, Integrability conditions and hybrid control for a class of second order nonholonomic systems: Underactuated mechanical systems.

MONTANA

Montana State University (5)

MATHEMATICAL SCIENCES

Beaudrie, Brian, Analysis of group problem-solving tasks in a geometry course for teachers using computer-mediated conferencing.

Riley, Kyle, Two-level preconditioners for regularized ill-posed problems.

Thomas, Cynthia, Understanding of statistical data analysis among elementary education majors.

Webb, Derek, Randomization restrictions and the inadvertent split plot in industrial experimentation.

Willse, Alan, Parametric classification with non-normal data.

NEBRASKA

University of Nebraska, Lincoln (8)

MATHEMATICS AND STATISTICS

Bell, Daryl, The uniform bifurcation of n-front traveling waves in the singularly perturbed FitzHugh-Nagumo equations.

Gierke, Paul, Discrete approximations of differential operators by Sinc methods.

Ira, Michael, Steiner trigraphical designs and block-size bound.

Leuschke, Graham, Finite Cohen-Macaulay type.

Pollis, Timothy, Hamilton paths and 2-factors in self-complementary graphs.

Taylor, Krista, A look at chaotic attractors in one-dimension generated by a singular Sil'nikov orbit.

Wagstrom, Rikki, Well-posedness of a nonlinear, nonlocal problem arising in ion transport.

Wan, Shu-Mei, Jackknife method in small area estimation and related problems.

NEW HAMPSHIRE

Dartmouth College (4)

MATHEMATICS

Montague, Laura, Join congruence relations on geometric lattices.

Rosenhouse, Jason, Isoperimetric numbers of certain Cayley graphs associated to $PSL(2, Z_m)$.

Rosson, Holly, Theta series of quaternion algebras over function fields.

Shuman, Karen, Signal processing bases and the Jacobi group.

NEW JERSEY

New Jersey Institute of Technology (5)

MATHEMATICAL SCIENCES

Fu, Li, Active feedback control of a wake flow via forced oscillations based on a reduced model.

Gomez, Juan Carlos, Models of droplet borning.

Hou, Peiwen, Numerical study of particle dynamics in a falling-ball viscometer.

Schenk, Susan, A mathematical model of wheelchair racing.

Wang, Chengwen, Multiple periodic solutions for non-autonomous asymptotically linear Hamiltonian systems.

Princeton University (10)

APPLIED AND COMPUTATIONAL MATHEMATICS

Guskov, Igor, Irregular subdivision and its applications.

MATHEMATICS

Anderson, Jared, On Mirkovic and Vilonen's intersection homology cycles for the loop Grassmannian.

Foschi, Damiano, On the regularity of multilinear forms associated to the wave equation.

Gamburd, Alexander, On spectral gap for infinite index "Congruence" subgroups of $SL_2(\mathbb{Z})$.

Goldberg, David, On braid orbits of branched covers of the torus.

Grossman, Daniel, Path geometries and second-order ordinary differential equations.

Howard, Ronald, A parametrix for a subelliptic operator.

Koenig, Kenneth, On maximal Sobolev and Hölder estimates for the tangential Cauchy-Riemann operator and boundary Laplacian.

Paul, Sean, Geometric analysis of Chow Mumford stability.

Smith, Derek, On finitely-generated quantum logic.

Rutgers University, New Brunswick (15)

MATHEMATICS

Girardi, Theresa, Icosahedral extensions of $\mathbb{Q}$ and elliptic curves.

Guo, Xin, Inside information and stock fluctuations.

Krichman, Mikhail, A Lyapunov approach to detectability of nonlinear systems.

Kuusela, Pirkko, Learning theory techniques in control theory.

Lenci, Marco, Classical billiards and quantum large deviations.

Liu, Yi, A linear representation of the mapping class group of a surface.

Malisoff, Michael, Viscosity solution of the Bellman equation for optimal control problems with exit times.

Nahay, John, Linear differential resolvents.

O'Donnell, Paul, High girth unit distance graphs.

Soffer, Sara, On the Loebl-Komlós-Sós conjecture.

Yu, Yang, On two combinatorial problems: posets and permanents.

STATISTICS

Ju, Wen-Hua, Statistical modeling of UNIX users and processes with application to computer intrusion detection.

Kim, Hongki, Application of sliced inverse regression to Bayesian computing.

Teng, Huey-Chung, New methodology in regression and multivariate quality control via data depth.

Wang, Ting Chuan, Dynamic graphics methodology for response surface analysis.

Rutgers University, Newark (3)

MATHEMATICS AND COMPUTER SCIENCE

Cao, Weili, Algebraic studies of averaging operators.

Chengwen, Wang, On the periodic solutions for asymptotically nonlinear Hamiltonian systems.

Jiang, Yicheng, Complexity of the Fuchsian group discreteness algorithm.

NEW MEXICO

New Mexico State University (1)

MATHEMATICAL SCIENCES

Larmour, Douglas, A Springer theorem for Hermitian forms and involutions.

University of New Mexico (3)

MATHEMATICS AND STATISTICS

Anderson, Amber, Extimation of cluster parameters for spatial poent processes with applications in cell biology.

Nelson, Leila, A comparison of classification methods for trauma scoring and prediction outcome.

Snyder, John, A mathematical analysis of induced defenses in a plant-herbivore environment.

NEW YORK

City University of New York, Graduate Center (12)

MATHEMATICS

Abu Tabanjeh, Mohammad, Efficient Cauchy-like computations.

Baba, Srinath, Diophantine properties of Arkin-Lehner quotients of Shimura curves.

Bellahnid, Abdellatif, A general Pollard type result for restricted sums.

Bulatovic, Aleksandar, Forgetful mappings between Teichmueller spaces.

Chen, Zhao Qin, On some numerical and algebraic computations with matrices and polynomials.

Cherif, Chokri, An application of the fixed point theorem to image compression.

Crandall, Gordon, Isoperimetry and lattices on groups of Heisenberg type.

Han, Shu-Ping ("Sandie"), Studies in the structure of sumsets.

Raffer, Sidney, Some Diophantine properties of ordered polynomial rings.

Rami, Youssef, Structured matrices and Newton's iteration: Unified approach.

Siegel, Evan, Ruling Euclidean 3-space.

Zablow, Joel, Loops, waves, and algebra for Heegaard splittings.

Columbia University (19)

BIOSTATISTICS

Chen, Xun, Estimation methods for semiparametric models in risk-based allocation trials.

Lin, I-Feng, Case-control studies data analyses with selection bias.

MATHEMATICS

Ajoodanian, Mehrzad, Morse theory and taut foliations.

Bertin, Marie-Amelie, On the regularity of varieties having an extremal secant line.

Blumenstein, Jay, Minimizing risk in discrete models: Theory and computation.

Carr, Richard, Using boxes to kill squares and other results on negative partition relations.

Chen, Nan, Positivity of central values of twisted L-functions.

Chinta, Gautam, On the analytic rank of elliptic curves over cyclotonic fields.

Dzhamay, Anton, Real-normalized Whitham hierarchies and the WDVV equations.

Pa'l, Ambrus, Drinfeld modular curves, Heegner points and interpolation of special values.

Safari, Pedram, A gluing theorem for Seiberg-Witten moduli spaces.

Sonnenfeldt, Lawrence, The heat kernel for real and complex hyperbolic spaces.

Teodorescu, Titus, Semistable torsion-free sheaves over curves of arithmetic genus one.

STATISTICS

Hou, Chunli, Lost-square approximation of random variables by stochastic integrals.

Liu, Xin, The likelihood method for family-based studies in human genetics.

Mokliatchouk, Oksana, Family based tests of association with censored survival data and complex pedigrees.

Reilly, Cavan, Topics in spatial and temporal statistics.

Wang, Hui, Topics in stochastic control with discretionary stopping.

Yang, Qiong, Several topics in statistical genetics.

Cornell University (14)

APPLIED MATHEMATICS

Lee, Jaewook, Trajectory-based methods for global optimization: Theory and algorithms.

Richman, Michael, Time frequency and multicomponent signal analysis.

Van Den Berg, Eric, Heavy tail modeling in time series and telecommunications.

Wirkus, Stephen, Asymptotic behavior of sample correlation function of stable processes.

Xue, Fang, Asymptotic behavior of sample correlation function of stable processes.

MATHEMATICS

Bullock, Stephen, Warped cohomology.

Caldararu, Andrei, Derived categories of twisted sheaves on Calabi-Yau manifolds.

Fung, Maria G., Twisted torsion on compact hyperbolic spaces: A representation-theoretic approach.

Hirschfeldt, Denis, Degree spectra of relations on computable structures.

Jarai, Antal, Incipient infinite clusters in 2D percolation.

Mitra, Sudeb, Teichmuller theory and holomorphic motions.

O'Shea, Luis, Abelian sesquisymplectic convexity for orbifolds.

Stephenson, David M., Asymptotic density in an n-threshold randomly coalescing and annihilating random walk on the d-dimensional integer lattice.

STATISTICAL SCIENCES

Newton, Elizabeth, The epidemic threshold and contact number with implications for optimal vaccination strategies.

New York University, Courant Institute (21)

MATHEMATICAL SCIENCES

Baik, Jinho, Riemann-Hilbert problems and random permutations.

Blank, Ivan, Sharp results for the regularity and stability of the free boundary in the obstacle problem.

Chang, Nai-Heng, Schrodinger maps with applications to the ferromagnetic equations.

Chechkin, Fedor, Convergence of wave maps and regularity of Yang-Mills solutions.

Connell, Cameron, Coarsening of step bunches in step flow growth: A reaction-diffusion model and its sharp interface limit.

Fast, Petri, Dynamics of interfaces in non-Newtonian Hele-Shaw flow.

Friedman, Craig, The method of multiple probability measures in mathematical finance: No arbitrage securities markets, Cartright claim pricing, and model calibration.

Garcia Cervera, Carlos, Magnetic domains and magnetic domain walls.

Goodman, Roy, Asymptotics for the leading edges of midlatitude storm tracks.

Huang, Yi-Hong, Theory and numerical simulations of slender-body dynamics in 3D Stokes flow.

Jensen, Leif, Large deviations of the asymmetric simple exclusion process.

Jung, Eunok, 2-D simulations of valueless pumping using the immersed boundary method.

Kruk, Lukasz, Optimization problems for diffusion processes: Some aspects of singular stochastic control and minimum relative entropy calibration.

Lui, Yuan Samson, Numerical methods for incompressible flows in vorticity formulation with application to combustion.

Menguy, Xavier, Examples of manifolds and spaces with positive Ricci curvature.

Nykamp, Duane, A population density approach that facilitates large-scale modeling of neural networks.

Ramirez, José, Short time asymptotics in Dirichlet spaces.

Rodrigues, Savio, Plane wave analysis of shear flows.

Shim, Sang-Yeun, Prediction of large-scale coherent structures in quasi-geostrophic flows.

Stefanica, Dan, Domain decomposition methods for Mortar finite elements.

Xu, Wen-Qing, Stiff well-posedness and asymptotic convergence for a class of relaxation systems in a quarter plane.

New York University (3)

STATISTICS AND OPERATIONS RESEARCH

Christou, Nicolas, Spatial regression models using inter region distance in a non-random context.

Fan, Zhen Hong, Essays of application of extreme value theory in finance.

Giloni, Avi, Essays on optimization in data analysis and in operations research.

Polytechnic University (2)

MATHEMATICS

Umanskiy, Vladimir, Positive solutions of Hill's equation.

Weinless, Martin A., Geominimal surface areas in the Brunn-Minkowski-Firey theory.

Rensselaer Polytechnic Institute (3)

MATHEMATICAL SCIENCES

Maserumule, Motodi, On the eigenvalue problems of Poiseuille flows in a circular pipe.

Smith, Gregory, A general symbolic method with physical applications.

Wu, Donghui, Large margin classification methods for data mining.

State University of New York, Albany (2)

MATHEMATICS AND STATISTICS

Gill, Brian, Properties of the hyperbolic metric in planar domains.

Neagu, Readu, High-resolution time-frequency representations: with application to spectral estimation and non-stationary multi-component signal analysis.

State University of New York, Binghamton (3)

MATHEMATICAL SCIENCES

Farley, Daniel, Finiteness and CAT(0) properties of diagram groups.

Laun, Elizabeth, Constants and splicing systems.

Su, Changchao Joanna, Homotopy theory of modules.

State University of New York, Buffalo (3)

MATHEMATICS

Fries, Michael, The possible values of certain cardinal characteristics.

Huang, Chih-Chien, On rotating vortex blobs.

Zaritski, Roman, Models of complex dynamics in glomerular filtration rate.

State University of New York, Stony Brook (13)

APPLIED MATHEMATICS AND STATISTICS

Aghili, Arman, Mixed boundary value problems of quarter-plane.

Dai, Zhenyu, Compound optimal designs.

Ho, Tsung-Chin, Simplification of polygonal surface models.

Kim, Hongjoong, Computational methods for statistical aspects of flow in porous media.

Moon, Hojin, Testing incidence of occult tumors by attributing tumor lethality in the absence of cause-of-death information.

Sendersky, Dmitry, Statistical characterization of planar two-dimensional Rayleigh-Taylor mixing layers.

VanDerWoude, Glenn, A 3-dimensional front-tracking algorithm for etching and deposition processes.

Zsifkov, Nicholas, Numerical simulation of a Johnson-Segalman flow.

MATHEMATICS

Anjos, Silvia, Homotopy type of symplectomorphism groups of $S^2 \times S^2$.

Herrera-Guzman, Haydee, Gromov invariants of symplectic fibrations.

Santos, Pedro, Algebraic cycles on real varieties and $\mathbb{Z}_2$-equivariant homotopy theory.

Stelling, Luisa, Fixed points of non-Hamiltonian symplectomorphisms.

del Rio, Heberto, Seiberg-Witten invariants of non-simple type.

Syracuse University (2)

MATHEMATICS

Davidenko, Susana, Learning mathematics in English: ESL and non-ESL students' perspectives.

Wiesner, Jill, A boundedly controlled finiteness obstruction.

University of Rochester (5)

BIOSTATISTICS

Natarajan, Rajeshwari Natarajan, An investigation of the inverse Gaussian distribution with an emphasis on Gaussian analogies.

Yang, Bo, Applications of saddlepoint approximations for small sample inference.

MATHEMATICS

Culakova, Eva, The structure of operations of excess n, as a module over Steenrod algebra.

Peng, Tiantang, Lubkin's conjectures about lifted cohomology theory.

Sondhi, Vivekananda, Distribution of powers modulo a prime.

NORTH CAROLINA

Duke University (8)

MATHEMATICS

Horja, Richard-Paul, Hypergeometric functions and mirror symmetry in toric varieties.

Solodovnikov, Alexander, Absolute intensity independence in a directional hearing model.

Taalman, Laura, Monomial generators for the Nash sheaf of a complete resolution.

STATISTICS AND DECISION SCIENCES

Inoue, Lurdes, Bayesian design and analysis of clinical experiments.

Lopes, Hedibert Freitas, Bayesian analysis in latent factor and longitudinal models.

Lourdes, Viridiana, Bayesian modelling and analysis of multivariate time series, with applications in finance and health policy.

Paddock, Susan, Randomised Polya trees: Bayesian nonparametrics for multivariate data analysis.

Swall, Jenise, Nonstationary spatial modeling using a process convolution approach.

North Carolina State University, Raleigh (24)

MATHEMATICS

Cho, Eun Hea, Computation for Markov chains.

Choi, Melissa, Analysis and implementation of a model for radio-frequency bonding of adhesives in composites.

Choi, Tony, Bound constrained optimization.

Yankosky, George, Topics on nilpotent Lie algebras.

STATISTICS

Baik, Jungmin, Optimization of distance-based criteria for space-filling designs.

Bang, Heejung, Estimating medical costs with censored data and its efficiency study.

Blankenship, Erin, Statistical methods for constructing ozone exposure metrics.

Chao, Hui-Ping, Modeling nonlinearity in U.S. livestock cycles.

Chen, Di, Semiparametric estimation with empirical likelihood and estimating equations for censored data.

Fenner, Joel, Multi-systems operation and control.

Gan, Nianci, General zero-inflated models and their applications.

Ko, Hyejin, Missing and mismeasured covariates in nonlinear mixed effects models.

Kopit, Justin, More powerful exact tests from confidence set p values and interim analysis when the data are subject to delay.

Latour, Robert James, Populations modeling of red drum (Sciaenops ocellatus) in South Carolina waters.

Monks, Stephanie, Family-based methods which rely on association for the mapping of genes in human populations.

Mukhopadhyay, Pabak, Bayesian analysis of failure time data with applications in quality adjusted lifetime (QAL) and zero-inflated regression models.

Oberg, Ann, Estimating data transformations in mixed effects models.

Schliekelman, Paul David, Assessing new methods for autocidal control.

Silva, Carlos, A proposed framework for establishing optimal genetic designs for estimating narrow-sense heritability.

Szumiloski, John, A family of response surface models for assessing drug interaction utilizing an interaction-standardizing transformation.

Tebbs, Joshua, A group-testing approach to making inferences about small proportions that are isotone.

Yang, Li, Efficiency study of estimators for treatment effects in a pretest-posttest trial with missing data.

Yang, Qing, Dimension reduction of large data with template modeling.

Zaykin, Dmitri, Statistical analysis of genetic associations.

University of North Carolina, Chapel Hill (15)

BIOSTATISTICS

Bowman, Fredrick, A strategy for obtaining inferences about projected completors in longitudinal studies with nonignorable dropout.

Coffey, Chris, Internal pilot study design and analysis for linear models with Gaussian errors and fixed predictors.

Cox, Terry, Regression analysis of binary data with misclassified responses.

Helms, Laura, Multiple imputation in clinical trials.

Keys, Lynette, Small-sample approximate test for fixed effects in the general linear mixed model.

MacDougall, James, Nonparametric rank-based analysis of longitudinal data.

Sanhueza, Antonio, Robust M-procedures in nonlinear regression models.

Wilkens, Lynn, Behavior of measurement error correction models: An application to nutritional epidemiology.

Zhong, Ming, Measurement error in the Cox regression model.

MATHEMATICS

Keller, Robert, Generic transitions of relative critical sets in parametrized families with applications to image analysis.

Mazzucato, Anna, Analysis of the Navier-Stokes and other non-linear evolution equations with initial data in Besov-type spaces.

STATISTICS

Derr, Robert, Statistical modeling of microstructure with applications to effective property computation in materials science.

Skoulakis, Georgios, Superprocesses over a stochastic flow.

Zhang, Chunming, Generalized likelihood ratio test with applications to financial models.

Zhang, Jin-Ting, Smoothed functional data analysis.

University of North Carolina, Charlotte (1)

MATHEMATICS

Sun, Yingjun, High order methods for evaluating convertible bonds.

NORTH DAKOTA

North Dakota State University (2)

MATHEMATICS

Dib, Khaled, Oscillations and asymptotic behavior of solutions of neutral delay differential equations.

Litvinov, Semyon, Weighted ergodic theorems in von Neumann algebras.

OHIO

Air Force Institute of Technology (1)

MATHEMATICS AND STATISTICS

Duckro, Donald, Multiple comparison pruning of neural networks.

Bowling Green State University (5)

MATHEMATICS AND STATISTICS

Carson, John, General multivariate hypotheses testing using extensions of Hotelling's T-squared.

Curtiss, Phyllis, Characterizations of several multivariate discrete distributions and applications to goodness-of-fit tests.

Preston, Norman, Bayesian model selection and criticism in generalized linear models.

Steele, John, Reliable systems from unreliable components.

Tang, Shengrong (Tony), Mixed finite volume methods for elliptic problems.

Case Western Reserve University (1)

MATHEMATICS

Huang, Rongpei, Affine and subaffine elastic curves in $\mathbb{R}^2$ and $\mathbb{R}^3$.

Kent State University (2)

MATHEMATICS AND COMPUTER SCIENCE

Stitz, Carl, Linking numbers and Jones polynomials for lens spaces and other 3-manifolds.

Straney, Timothy, Boolean functions on finite Abelian groups.

Ohio State University (16)

MATHEMATICS

Arenas, Luis, Spinor genera under field extensions for skew-Hermitian forms and cohomology.

Cashy, John, Irreducible graphs for the Klein bottle.

Gonciulea, Constantin, Virtual epimorphisms of coxeter groups onto free groups.

Gorokhovsky, Alexander, Explicit formulae for characteristic classes in noncommutative geometry.

Gries, Daniel, On the cohomology of the hyperelliptic mapping class group.

Ragozzine, Charles, On Hopf algebras generated by coalgebras.

Ralfs, Arthur, Electrically coupled relaxation oscillators with applications to biophysics.

Roberts, Joel, Explicit families of elliptic curves with prescribed mod six representations.

Siap, Irfan, Generalized r-fold weight enumerators for linear codes and new linear codes with improved minimum distances.

Snyder, Brian, Hyperdifferential operators on function fields and their applications.

Yang, Zifeng, Non-Archimedean analysis over function fields with positive characteristic.

Yeh, Jieh-Shan, The large sets of T-(v, k, λ) designs.

STATISTICS

Bortnick, Steven Mark, Searching for designs that are optimal for simultaneous inference when comparing multiple test treatments with a control in the presence of one way heterogeneity.

Miller, Jacqueline B., The quest for the constructivist statistics classroom: Viewing practice through constructivist theory.

Swift, Dionne Pratt, WISE: Weighted imputation for standard errors. An alterative imputation method.

Tsai, Hsing-Chuan, Optimal designs for drug combination experiments.

Ohio University (1)

MATHEMATICS

Chen, Yuquing, Nonlinear operators and differential equations in abstract spaces.

University of Cincinnati (2)

MATHEMATICAL SCIENCES

Coles, Crista, Numerical identification of parameters in inverse heat conduction and inverse Euler Bernoulli beam theory.

Sullivan, Theresa S., Generalizations of the Chordarc condition.

University of Toledo (3)

MATHEMATICS

Ghanam, Ryad, The holonomy of groups of four-dimensional neutral metrics.

Ma, Jingjing, Lattice-ordered rings.

Xiao, Zhengchu, Theory and applications of multiwavelet approximation.

OKLAHOMA

Oklahoma State University (1)

MATHEMATICS

Laszlo, Geza, Peak functions on pseudoconvex domains of finite type in $\mathbb{C}^2$.

University of Oklahoma, Health Science Center (1)

BIOSTATISTICS AND EPIDEMIOLOGY

Burgin, Christie, Alternate techniques for confidence intervals in probit analysis: Statistical properties and recommendations.

University of Oklahoma (5)

MATHEMATICS

Alazman, Abdulrahman, A comparison of solutions of a Boussinesq system and the Benjamin-Bona-Mahony equation.

Braddy, Linda, Constructing graphs to meet specified conditions: A generalizability study.

Jiang, Weigong, Projection functions and classes of centrally symmetric convex bodies.

Juan, Lourdes, A generic Picard-Vessiot extension for $GL_n(C)$ and the inverse differential Galois problem.

Mirafzali, Ali, Regularity for elliptic systems and the angle condition.

OREGON

Oregon State University (8)

MATHEMATICS

Biskup, Igor, Logical implications between different flavors of asphericity.

Fredericks, Julia, Local indicability and relative presentations of groups.

Kaul, Anton, Rigidity for a class of coxeter groups.

Le, Hung, Maximal operators along surfaces of revolution.

STATISTICS

Coubois, Jean-Yeves, Tools for environmental statistics: Creative visualization and estimating variance from complex surveys.

Munoz, Breda, The design-based empirical orthogonal functions model. An alternative for the analysis of spatio-temporal data.

Smith, Ruben, Statistical estimation for initiative petitions and performance of the decision rule for Oregon state petitions.

Usner, Dale, Persistence and heterogeneity in habitat association.

University of Oregon (6)

MATHEMATICS

Brazfield, Christopher, Artin-Schetter regular algebras of global dimension four with two degree one generators.

Firkins, Jennifer, Generalized quivers and representations of locally Artinian serial rings.

Lackey, Joshua, Properties of ideals in the exterior algebra.

Pearson, Kelly, Cohomology of the Orlik-Solomon algebras.

Schirmer, Sonia, Theory of control of quantum systems.

Zhang, Tan, Manifolds with indefinite metrics whose skew-symmetric curvature operator has constant eigenvalues.

PENNSYLVANIA

Carnegie Mellon University (10)

MATHEMATICAL SCIENCES

Boats, Jeffery, Linear algebra textbook implementing instructional technology.

Chough, Byungduck, Numerical techniques for macroscopic dynamics of particle system: Dilute gases.

Greenfield, Yuri, Hedging of the credit risk embedded in derivative transactions.

Jara, Diego, An extension of Lèvy's theorem and applications to financial models based on future prices.

Tsikas, Aggelos, Solid state mass diffusion with crystalline interfacial energy.

Virga, Roberto, Higher-order rewriting with dependent types.

Zhao, Lei, Disjoint-paths in random graphs.

STATISTICS

Cork, Dan, The juvenile homicide epidemic: Spatio-temporal dynamics of homicide in American cities.

Gitelman, Alix, Treatment integrity concerns comparative education studies.

Seltman, Howard, Hidden stochastic models for biological rhythm data.

Lehigh University (3)

MATHEMATICS

Narayan, Darren, The reversing number of a digraph.

Phy, Lyn, Applications of weak*-basic sequences and biorthogonal systems to questions in Banach space theory.

Rose, Daniel, Asymptotic behaviour of combinatorial optimization and proximity graphs on random point sets.

Pennsylvania State University (19)

MATHEMATICS

Hall, Rachel, Hecke C^*-algebras.

Josic, Kresimir, Synchronization of chaotic systems.

Kim, Hwan-Ho, Some new multigrid methods for convection diffusion problems.

Lu, Jianqun, On the stability of numerical solution for water-wave equations.

Madureira, Alexandre, Asymptotics and hierarchical modeling of thin domains.

Maharaj, Hiren, Algebraic function fields with asymptotically many rational places and improvements of the Gilbert-Varshamov bound.

Mezhirov, Alexander, Expanding periodic points of one-dimensional maps and boundary behavior of arbitrary mappings.

Sysoeva, Inna, On the irreducible representations of Braid groups.

Tamarkin, Dmitry, Operadic proof of M. Kontsevich's formality theorem.

Yaskolko, Sergey, Rigidity of lattice actions on boundaries. Coincidence of various dimensions associated with metrics and measures.

STATISTICS

Banga, Senin, A risk analysis of benchmark dose for continuous response and sensitivity to model specification.

Chao, Chang-Tai, Adaptive sampling designs.

Dryver, Arthur, Adaptive sampling designs and associated estimators.

Du, Yunling, A fully nonparametric analysis of covariance method for censored data.

McGrath, Richard, Dispersion effects in unreplicated fractional factorials.

Nadar, Mustafa, Multivariate sign and rank methods based on the Oja criterion function.

Olsen, Maren, A two-part random-effects model for semicontinuous longitudinal data.

Pittman, Jennifer, Adaptive splines and genetic algorithms for optimal statistical modeling.

Yucel, Recai, Computational tools for missing values in multivariate longitudinal and clustered data.

Temple University (7)

MATHEMATICS

Johnston, Hans, Efficient computation of viscous incompressible flow.

STATISTICS

Delucca, Paul, Effect of investigator/patient bias on the properties of statistical tests when measuring subjective responses.

Joshi, Alaknanda, Stochastic models for medical screening and associated optimal screening designs.

Liu, Qi, Randomization tests for clustered binary data.

Peng, Chung-Yang, Directions or arrival estimation and association detection in unknown noise fields.

Railkar, Radha, Alternative strategies for analyzing stratified comparative binomial trials.

Wang, Wubao, A class of general linear mixed models with application to the assessment of individual bioequivalence.

University of Pennsylvania (8)

MATHEMATICS

Dergachev, Vladimir, Index of Lie algebras and associative algebras.

Dickinson, William, Curvature properties of the positively curved Eschenburg spaces.

Fang, Weimin, Left invariant metrics on simple compact Lie groups and metrics on spheres.

Liu, Xiong, Separating projections and contractivity in von Neumann algebras.

Masenten, Robert, Generalized exponents of $sl_n(C)$.

Pries, Rachel, Formal patching and deformation of wildly ramified covers of curves.

Zharkov, Ilya, Torus fibrations of Calabi-Yau hypersurfaces in toric varieties.

STATISTICS

Li, Yunfei, Optimal balanced matching.

University of Pittsburgh (13)

BIOSTATISTICS

Chen, Wei, Utilization of non-compliance information in clinical trial.

Lang, Wei, Application of copula to repeated measures data.

Yu, Kai, Statistical methods for analyzing tetrad crossover probabilities.

MATHEMATICS

Ai, Shangbing, Multipulse orbits for a singularly perturbed nearly integrable system.

Bennett, Therese L., Best approximation in quotient spaces with application to the finishing of optical surfaces.

Iliescu, Traian, Large eddy simulation for turbulent flows.

Kirat, Ibrahim, Integral self-affine tiles and expanding matrices.

Liakos, Anastasios, Weak imposition of boundary conditions in the Stokes and Navier-Stokes equations.

Shahmohamad, Hossein, On nowhere-zero flows, chromatic equivalence and flow equivalence of graphs.

Wu, Xiaojun, Enumeration over q-semirings of formal power series.

Xu, You, Fractals and tilings.

STATISTICS

Houngbedji, Aurele, Jump diffusion processes: Discrete-time option replication and pricing European call options in the presence of transaction costs.

Wendt, David Arthur, Analysis of multidimensional categorical data.

RHODE ISLAND

Brown University (11)

APPLIED MATHEMATICS

Buche, Robert, Stochastic approximation: Rate of convergence for constrained algorithms; asynchronous algorithms and analysis of a competitive resource sharing problem.

Du, Yiqing, Parallel DNS of electromagnetic flow control.

Huang, Jinggang, Statistics of images and models.

Marmanis, Haralabos, Analogy between the electromagnetic and hydromagnetic equations: Application to turbulence.

MATHEMATICS

Akhtar, Reza, Milnor K-theory and zero-cycles on algebraic varieties.

Fridman, Arthur, Mixed Markov fields.

Getachew, Selemon, Galois theory of polynomial iterates.

Ih, Su-ion, Height uniformity for algebraic and integral points on curves.

Lepsky, Olga, High order numerical approximations of nonlinear Hamilton-Jacobi equations and approximation of elasticity problems using Stokes problems.

Muscalu, Florin, L_p estimates for multilinear operators given by singular symbols.

Reid, Michael, Investigations into Gross' generalized class number formula and the p-adic Stark conjecture.

University of Rhode Island (3)

MATHEMATICS

Briden, William, On some nonautonomous difference equations of the max type.

Prokup, Norman, Boundedness, global stability and periodicity of some difference equations.

Teixeira, Christopher, Existence, stability and periodicity of some difference equations.

SOUTH CAROLINA

Clemson University (6)

MATHEMATICAL SCIENCES

Chen, Xibin, Method of feasible directions for non-linear programming.

Clark, Steven, Stochastic control of a research and development project.

Hadavas, Paul, Exploiting network substructures and persisting in solving 0-1 and general non-convex optimization problems.

Lawson, Linda, Multigrid dynamic programming.

Mills, Donald, Root-based polynomial compositions over finite fields.

Schandl, Bernd, Norm-based evaluation and approximation in multicriteria programming.

Medical University of South Carolina (6)

BIOMETRY AND EPIDEMIOLOGY

Daehler-Wilking, Richard, Numeric modeling of subsurface groundwater flow to examine pesticide transport from agricultural fields toward estuaries and tidal marshes on Wadmalaw Island of South Carolina.

Richardson, William Harrington Jr., Development of an optimization process for dose treatment planning for multiple arc sterotactic radiosurgery.

Schubauer-Berigan, Mary Katherine, Dose variablility and risk-benefit analysis of mammography screening.

Schwacke, Lorelei Hoffman, A framework for the assessment of health risks for bottlenose dolphins (Tursiops truncatus) associated with exposure to polychlorinated biphenyls (PCBs).

Shaban, Sami Fuad, A knowledge-based approach to the design and automated generation of clinical trial management systems.

Thompson, Richard Eugene, A probabilistic model for predicting polycyclic aromatic hydrocarbon (PAH) bioavailability to American oysters (Crassostrea virginia) inhabiting South Carolina estuarine environments.

University of South Carolina, Columbia (7)

EPIDEMIOLOGY AND BIOSTATISTICS

Brandon, Dennis L., Data analysis methods for ecological risk assessment bioassays.

MATHEMATICS

Andrianov, Alexander, Nonlinear Haar approximation of some multivariate classes of functions.

Petrova, Guergana, Transport, equations and velocity averages.

Popov, Bojan, Linear transport equations.

Presser, Kimberly, An analysis of the maximal growth of Hilbert functions.

STATISTICS

Solorzano, Eleanne, Simultaneous comparisons with more than one control.

Surles, James Gunn, The scaled Burr type X distribution: Inferences and the stress-strength problem.

TENNESSEE

University of Memphis (7)

MATHEMATICAL SCIENCES

Bogner, Myles, Realizing 'consciousness' in software agents.

Cascaval, Radu, Global well-posedness for a class of dispersive equations.

Hernandez, German, Asymptotic behavior of evolutionary algorithms.

Nino, Luis, Random iterated neural networks: Properties, evolutionary design and applications.

Seshadri, Roopa, Bayesian analysis of clustered binary data: Applications to opthalmology and otolaryngology clinical trials.

Vu, David Dung, Performance modeling of IPV6 protocol.

Weinreich, David, Simple questions about properties of graphs and knots.

University of Tennessee (7)

MATHEMATICS

Chatham, R. Douglas, Going down pairs of commutative rings.

Deng, Qingping, Modeling a fish population with diffusion and advection movement in a spatial environment.

Gaff, Holly, Spatial heterogeneity in ecological models: Two case studies.

Halverson, Denise, Detecting codimension one manifold factors with the disjoint homotopies property.

Kiihne, Patricia, Factorization and ring-theoretic properties in subrings of $K[X]$ and $K[[X]]$.

Knotts-Zides, Charlotte, Extremal properties of eigenvalues.

Prajitura, Gabriel, Permanence of invariant subspaces under functional calculus and related topics.

Vanderbilt University (5)

MATHEMATICS

Blount, Kevin, On the structure of residuated lattices.

Dinsenbacher, Thomas, Multivariate nonhomogeneous refinement: Existence, uniqueness, regularity and application to image compression.

Howard, Keith, Size and maturity structured models of cell population dynamics exhibiting chaotic behavior.

Mortin, Tanya, Error bounds for solving pseudodifferential equations on spheres by collocation with zonal kernels.

Timar, Cary, Spanning walls in infinite planar graphs.

TEXAS

Rice University (7)

COMPUTATIONAL AND APPLIED MATHEMATICS

Hicks, Illya, Branch decompositions and their applications.

Ji, Lin, The inverse problem of neuron identification.

Qian, Jianliang, Geometrical optics for quasi-P waves: Theories and numerical methods.

Velazquez, Leticia, A global optimization technique for zero-residual nonlinear least-square problems.

Villalobos, Cristina, The behavior of Newton's method on two equivalent systems from linear and nonlinear programming.

MATHEMATICS

Ganzel, Sanford, Complexity of exotic R's.

Wang, Yuan, Mathematical modeling of seismic data: Multiscale noise removal and recognition algorithm.

Southern Methodist University (3)

STATISTICAL SCIENCE

Etzel, Carol J., Meta-analysis for genetic linkage studies.

Kuo, Jo-Kang, Mapping quantitative trait loci: Sampling considerations using bivariate data.

Pitblado, Jeffrey, Estimating partially variable bandwidths in local linear regression using an information criterion.

Texas A&M University (15)

MATHEMATICS

Diener, Andrew, Distributive elements in centralizer near-rings.

Farag, Mark, On the structure of polynomial near-rings.

Gopalakrishnan, Jayadeep, On the mortar finite element method.

Harris, Roy Joseph, Quadratic convexity.

Huang, Hong, Mixed finite element approximations for obstacle problems with applications to American options.

Sopasakis, Alexandros, Theory of the Prigogine-Herman kinetic equation of vehicular traffic.

Turner, Christian, The mechanics of ecosystems.

Wilmarth, Steven, A probabilistic method for rigid body motion planning using sampling from the medial axis of the free space.

STATISTICS

Al-Khouli, Abeer, Robust estimation and bootstrap testing for the delta distribution with applications in marine sciences.

Hrafnkelsson, Birgir, Principal component time series and autoregressive estimates.

Klipple, Karon, Error variance estimation and testing for homoscedasticity in partially linear models.

Lee, Cherng-Luen (Alan), Robustness properties of time series cross-validation.

Olmsted, Ann Vlalls, Algorithms using chi-squared and other goodness of fit tests to identify a high-expectation subset of independent Poisson random variables, or a subset of multinomial cells having relatively high probabilities, with application in chromosomal fragile site identification.

Park, Inho, The use of sample survey data for estimation of the tails of distribution functions.

Reese, Shane, Statistical methodology for environmental applications.

University of Houston (2)

MATHEMATICS

Qawasnu, Ahmad, Regularity of the Hodge-Weyl decomposition.

Tecarro, Edwin, Qualitative analysis of a model of the mammalian cell cycle's G1 phase.

University of North Texas (3)

MATHEMATICS

Huff, Cheryl, Countable additivity, exhaustivity, and the structure of certain Banach lattices.

Sawyer, Cameron, On the cohomology of the complement of a toral arrangement.

Smith, John Carl (Trey), Computing ultrapowers by supercompactness measures.

University of Texas, Arlington (5)

MATHEMATICS

Chen, Shianc-Jiun, The finite element method of least squares type.

Durmus, Soner, The effects of the use of the technology of college algebra students' achievement and attitude toward mathematics: A constructive approach.

Erol, Yilmaz, Computations in algebraic geometry.

Flint, Donna, Nonlinear ordinary differential equations with discontinuities.

Hand, Jeffrey, Minimization of residual vectors in photogrammetry using the Chebyshev norm.

University of Texas, Austin (10)

COMPUTATIONAL AND APPLIED MATHEMATICS

Riviere, Beatrice, Discontinuous Galerkin methods for solving the miscible displacement problem in porous media.

Vardapetyan, Leon, hp-Adaptive finite element method for electromagnetics with applications to waveguiding structures.

Xu, Wei, Multiresolution representation of arbitrary triangular meshes.

MATHEMATICS

Blue, Meredith, Generic Galois extensions for groups of order p^3.

Chern, Shey-Jey, Estimates for the number of polynomials with bounded degree and bounded measure.

Gibney, Angela, Fibrations of $\overline{M}_{g,n}$.

Haskins, Mark, Constructing special Langrangian cones.

Kang, Cong, On Lang's Diophantine conjecture for surfaces of general type.

Pak, Hee Chue, Two distributed capacitance models.

Zhang, Zuoshun, Proper posterior distributions for some hierarchical models and roundoff effects in the Gibbs sampler.

University of Texas, Dallas (2)

MATHEMATICAL SCIENCES

Chen, Zhenwu, Trimmed and Winsorized M- and Z-estimators, with applications to robust estimation in neural network models.

Ramirez-Perez, Filemon, Contributions to shot noise on cluster processes with cluster marks.

University of Texas, Houston (4)

BIOMETRY

Barnholtz, Jill, Traditional linkage analysis in admixed families.

Chang, Chung-chi, Analysis of recurrent failure times: A time-dependent Yule process approach.

Chen, Dung-Tsa, Mixed effects model in negative exponential curve.

McGhee, Charles Reed, Forecasting cost based on a stochastic utilization plan and a fixed cost function.

UTAH

Brigham Young University (2)

MATHEMATICS

Chen, Fengxin, On the nonlocal phase field models.

Wang, Junping, Bifurcation from simple eigenvalues of some elliptic equations and topics in nonlocal phase field systems.

University of Utah (3)

MATHEMATICS

Brinkmann, Peter, Mapping tori of automorphisms of hyperbolic groups.

Grabovsky, Irina, Asymptotic analysis in change point problems.

Sather-Wagstaff, Sean, A dimension inequality for excellent Cohen-Macaulay rings related to the positivity of Serre's intersection multiplicity.

Utah State University (1)

MATHEMATICS AND STATISTICS

Hillyard, Cinnamon, Construction and analysis of a family of numerical methods for hyperbolic conservation laws with stiff source terms.

VERMONT

University of Vermont (2)

MATHEMATICS AND STATISTICS

LaVarnway, Gerard, Almost-periodic functions in a half-plane.

Stevens, Scott, Supraclavicular, lumped-parameter models for dynamic intracranial pressures.

VIRGINIA

George Mason University (2)

INFORMATION TECHNOLOGY AND ENGINEERING

Flanagan, Brian, Self-calibration of antenna arrays with application to direction of arrival estimation.

Zarnich, Robert, A unified method for the measurement and tracking of narrowband contacts from an array of sensors.

Old Dominion University (2)

MATHEMATICS AND STATISTICS

Arnold, Julia, Diffusion problems in wound healing and a scattering approach to immune system interactions.

Hannon, Patrick, Estimation of parameters for the truncated exponential distribution.

University of Virginia (8)

MATHEMATICS

Boner, Christopher, Characterization of absolute summands of categories of divisible codes.

Hodge, Terrell, Some structures utilizing involutions on algebraic groups in characteristic p.

Richman, Alexander, Subnormality and composition operators on weighted Bergman spaces.

Siemers, Troy, Some Krein space realizations of generalized Schur functions.

Theoret, Julie, Geometry of a cubic Jordan algebra.

STATISTICS

Dunbar, Stephanie Allison, Order restricted inference with an application to phase I studies in oncology.

Gregory, Krag R., General linear processes induced by orthogonal polynomial expansions.

Prescott, Katherine E., Some tests for ordered alternatives in generalized linear models.

Virginia Polytechnic Institute and State University (15)

MATHEMATICS

Atwell, Jeanne, Proper orthogonal decomposition for reduced order control of partial differential equations.

Chudoung, Lerawan, Robust control for hybrid nonlinear system.

Galinaitis, William, Two methods for modeling scalar hysteresis and their use in controlling actuators with hysteresis.

Hulsing, Kevin, Methods for computing functional gains for LQR control of partial differential equations.

Jilcott, Steven, Time-dependent perturbation and the Born-Oppenheimer approximation.

Moss, George, Mathematical models of the alpha-beta phase transition of quartz.

Schenck, David, Some formation problems for linear elastic materials.

Song, Degong, On spectrum of neutron transport equations with reflecting boundary conditions.

Stanley, Lisa, Computational methods for sensitivity analysis with applications to elliptic boundary value problems.

STATISTICS

Burt, David, Bandwidth selection concerns for jump point discontinuity preservation in the regression setting using-M-smoothers and the extension to hypothesis testing.

Darken, Patrick, Testing for changes in trend in water quality data.

Kathman, Steven, Discrete small sample asymptotics.

Lin, Hefang, One-stage and Bayesian two-stage optimal designs for mixture models.

Starnes, Alden, Asymptotic results for model robust regression.

Steeno, Gregory, Robust and nonparametric methods for topology error identification and voltage calibration in power systems engineering.

WASHINGTON

University of Washington (17)

APPLIED MATHEMATICS

Kim, Arnold, Optical pulse propagation, diffusion and depolarization in discrete random media.

Martin, Mark, The influence of seasonal and climatic environmental changes on plankton in the marine mixed layer.

Yong, Darryl, Solving boundary-value problems for systems of hyperbolic conservation.

BIOSTATISTICS

Alonzo, Todd, Assessing accuracy of a continuous medical diagnostic or screening test in the presence of verification bias.

Braun, Thomas, Optimal analysis of group randomized trials with permutation tests.

Hamblett, Nicole, A regression modeling approach for describing patterns of HIV genetic variation.

McClelland, Robyn, Regression-based variable clustering for data reduction.

Nelson, Jennifer, A graphical methodology for describing interrater variability in ordinal assessments among many raters.

MATHEMATICS

Johnson, Mark W., Enriched sheaf theory as a framework for stable homotopy theory.

Keynes, Michael, A closed form for the Kazhdan-Lusztig polynomials for real reductive Lie groups with the Cayley singleton property.

Pennanen, Teemu, Dualization of monotone generalized equations.

Tanner, Stephen, Non-tangential and conditioned Brownian convergence of pluriharmonic functions.

STATISTICS

Bellone, Enrica, Nonhomogeneous hidden Markov models for downscaling synoptic atmospheric patterns to precipitation amounts.

Browning, Sharon, Monte Carlo likelihood calculation for identity by descent data.

Poole, David, Bayesian inference for noninvertible deterministic simulation models, with application to bowhead whale assessment.

Ridgeway, Gregory, Generalization of boosting algorithms and applications of Bayesian inference for massive datasets.

Stanford, Derek, Fast automatic unsupervised image segmentation and curve detection in spatial point processes.

Washington State University (4)

PURE AND APPLIED MATHEMATICS

Blitz, Brian, Topics concerning regular maps.

Gomez-Wulschner, Claudia, Completeness of inductive limits.

Raghavan, Jayathi, Iterative techniques for convection dominated flow problems.

Wig, Jennifer, p-Regular and p-topological Cauchy completions.

WEST VIRGINIA

West Virginia University (2)

MATHEMATICS

Qian, Sixin, A hydrodynamic model of semiconductors.

Szyszkowski, Marcin, Symmetrically continuous functions.

WISCONSIN

Marquette University (1)

MATHEMATICS, STATISTICS AND COMPUTER SCIENCE

Pustejovsky, Susan F., Beginning calculus students' understanding of the derivative: Three case studies.

University of Wisconsin, Madison (17)

MATHEMATICS

Behn, Antonio F., Group rings whose principal ideals are projective and groups with bounded representation degree.

Egge, Eric S., A generalization of the Terwilliger algebra.

Franklin, Bradbury, The limit of the normalized error in SDEs and SPDEs.

Jeon, Woo, Generalized Cartan type algebras and their derivations.

McKinzie, Mark B., The Halley-Euler method.

Park, Jeng Yune, The weight hierarchies of product codes and outer product codes.

Ponomarkeno, Vadim, Some results on jump systems and Rota's conjecture.

Teixeira, Joao, Elliptic differential equations and their discretions.

Wang, Dejia, Saturation properties in the computably enumerable degrees.

Ziebarth, Jennifer J., On the mod p cohomology of the symplectic group $Sp_4(\mathbb{F}_p)$ and the general linear group $GL_3(\mathbb{F}_p)$.

STATISTICS

Cheang, Wai Kwong, Issues on estimation of time series regression model with autocorrelated noise.

Chiang, Alan (Yuch-Hung), Partial spline models and their applications to climate change detection and attribution.

Gao, Fangyu, Penalized multivariate logistic regression with a large data set.

Hoff, Peter, Constrained nonparametric estimation via mixtures.

Jalaluddin, Muhammad, Robust inference for the Cox's proportional hazards model with frailties.

Li, Shun-Hwa, Stationary distributions of Markov processes as statistical models: Baddeley's time-invariance method of estimation.

Zeng, Yong, A class of partially-observed models with discrete, clustering and non-clustering noises: Application to micro-movement of stock prices.

University of Wisconsin, Milwaukee (3)

MATHEMATICAL SCIENCES

Dubas, Saeed, High order schemes for the Navier-Stokes equations.

Siriwardana, Nihal, High order numerical methods for the Navier-Stokes equations.

Wilson, Julia, Non-uniqueness of boundaries of CAT(0) groups.

WYOMING

University of Wyoming (2)

MATHEMATICS

Parashkevov, Rossen, Iterative methods in the divergence-free subspace for mixed finite elements.

STATISTICS

Stoevska-Kojouharov, Daniela, Simulation models-optimal resource allocation via uncertainty analysis.

Doctoral Degrees Conferred 1998–1999

Supplementary List

The following list supplements the list of thesis titles published in the 2000 *Notices*, pages 253–271.

ALABAMA

University of Alabama, Tuscaloosa (1)

MATHEMATICS

Libis, Carl, Sums of powers and generalizations of Bernoulli and related polynomials.

COLORADO

University of Northern Colorado (1)

MATHEMATICAL SCIENCES

Su, Robert, The effects of enhanced web-based instruction on preservice teachers' mathematics achievement and attitude changes toward mathematics and toward computers in Taiwan.

FLORIDA

Florida Institute of Technology (2)

MATHEMATICAL SCIENCES

Rizzo, Rebecca, Variational comparison method and stability theory of hybrid systems.

Stephens, Desmond, ELMRES: An oblique projection method to solve sparse nonsymmetric linear systems.

MICHIGAN

Wayne State University (2)

MATHEMATICS

Jankunas, Andrius, Estimation of parameters and difference equations.

Lababidi, Samir, Nonparametric estimation with small noise diffusion processes.

NEW JERSEY

New Jersey Institute of Technology (1)

MATHEMATICAL SCIENCES

Samulyak, Roman, Dynamical systems associated with particle flow models: Theory and numerical methods.

NORTH CAROLINA

Duke University (1)

STATISTICS AND DECISION SCIENCES

Stroud, Jonathan, Bayesian analysis of nonlinear time series models.

From the AMS Secretary

2000 Election Results

In the elections of 2000 the Society elected a vice president, a trustee, five members at large of the Council, two members of the Editorial Boards Committee, and three members of the Nominating Committee. Terms for these positions are three years beginning on 1 February 2001 and ending on 31 January 2004, except for the trustee, whose term is for five years ending on 31 January 2005. Members elected to the Nominating Committee begin serving immediately, and their terms end on 31 December 2003.

Vice President

Elected as the new vice president is **Ingrid Daubechies** from Princeton University.

Trustee

Elected as the new trustee is **John B. Conway** from the University of Tennessee, Knoxville.

Members at Large of the Council

Elected as new members at large of the Council are

Walter L. Craig from McMaster University

Keith J. Devlin from St. Mary's College

Irene Fonseca from Carnegie Mellon University

Alexander Nagel from the University of Wisconsin-Madison

Louise Arekeliian Raphael from Howard University

Editorial Boards Committee

Elected as new members of the Editorial Boards Committee are

Tony F. Chan from the University of California Los Angeles

Jane P. Gilman from Rutgers University, Newark

Nominating Committee

Elected as new members of the Nominating Committee are

Cora Sadosky from Howard University

Irwin Kra from the State University of New York, Stony Brook

Steven H. Weintraub from Louisiana State University

Suggestions for elections to be held in the fall of 2001 are solicited by the 2001 Nominating Committee. The Nominating Committee met during the Annual Meeting in New Orleans, Louisiana, in January. Positions to be filled in the 2001 election are: president elect, vice president, trustee, and five members at large of the Council. Suggestions should be sent to the secretary.

Suggestions for nominations for two positions on the Editorial Boards Committee and three positions on the 2002 Nominating Committee can also be sent to the secretary.

CALL FOR SUGGESTIONS

There will be a number of contested seats in the 2001 AMS Elections. Your suggestions are wanted by:

The Nominating Committee
for vice president, trustee,
and five members at large of the council

and by

The President
for three Nominating Committee members
and two Editorial Boards Committee members.

In addition

The Editorial Boards Committee
requests suggestions for appointments to
various editorial boards of Society publications.

Send your suggestions for any of the above to:

Robert J. Daverman
American Mathematical Society
Department of Mathematics
University of Tennessee
Knoxville, TN 37996-1330
e-mail: `daverman@math.utk.edu`

2001 AMS Election

Nominations by Petition

Vice President or Member at Large

One position of vice president and member of the Council *ex officio* for a term of three years is to be filled in the election of 2001. The Council intends to nominate at least two candidates, among whom may be candidates nominated by petition as described in the rules and procedures.

Five positions of member at large of the Council for a term of three years are to be filled in the same election. The Council intends to nominate at least ten candidates, among whom may be candidates nominated by petition in the manner described in the rules and procedures.

Petitions are presented to the Council, which, according to Section 2 of Article VII of the bylaws, makes the nominations. The Council of 23 January 1979 stated the intent of the Council of nominating all persons on whose behalf there were valid petitions.

Prior to presentation to the Council, petitions in support of a candidate for the position of vice president or member at large of the Council must have at least 50 valid signatures and must conform to several rules and operational considerations, which are described below.

Editorial Boards Committee

Two places on the Editorial Boards Committee will be filled by election. There will be four continuing members of the Editorial Boards Committee.

The president will name at least four candidates for these two places, among whom may be candidates nominated by petition in the manner described in the rules and procedures.

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

Nominating Committee

Three places on the Nominating Committee will be filled by election. There will be six continuing members of the Nominating Committee.

The president will name at least six candidates for these three places, among whom may be candidates nominated by petition in the manner described in the rules and procedures.

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

Rules and Procedures

Use separate copies of the form for each candidate for vice president, member at large, or member of the Nominating and Editorial Boards Committees.

1. To be considered, petitions must be addressed to Robert J. Daverman, Secretary, American Mathematical Society, 312 D Ayres Hall, University of Tennessee, Knoxville, TN 37996-1330, and must arrive by 28 February 2001.
2. The name of the candidate must be given as it appears in the *Combined Membership List* (CML). If the name does not appear in the list, as in the case of a new member or by error, it must be as it appears in the mailing lists, for example, on the mailing label of the *Notices*. If the name does not identify the candidate uniquely, append the member code, which may be obtained from the candidate's mailing label or from the Providence office.
3. The petition for a single candidate may consist of several sheets, each bearing the statement of the petition, including the name of the position, and signatures. The name of the candidate must be exactly the same on all sheets.
4. On the next page is a sample form for petitions. Copies may be obtained from the secretary; however, petitioners may make and use photocopies or reasonable facsimiles.
5. A signature is valid when it is clearly that of the member whose name and address is given in the left-hand column.
6. The signature may be in the style chosen by the signer. However, the printed name and address will be checked against the *Combined Membership List* and the mailing lists. No attempt will be made to match variants of names with the form of name in the CML. A name neither in the CML nor on the mailing lists is not that of a member. (Example: The name Robert J. Daverman is that of a member. The name R. Daverman appears not to be.)
7. When a petition meeting these various requirements appears, the secretary will ask the candidate to indicate willingness to be included on the ballot. Petitioners can facilitate the procedure by accompanying the petitions with a signed statement from the candidate giving consent.

Nomination Petition for 2001 Election

The undersigned members of the American Mathematical Society propose the name of

____

as a candidate for the position of (check one):

- ☐ **Vice President**
- ☐ **Member at Large of the Council**
- ☐ **Member of the Nominating Committee**
- ☐ **Member of the Editorial Boards Committee**

of the American Mathematical Society for a term beginning 1 February, 2002.

Name and address (printed or typed)	
	Signature
	Signature
	Signature
	Signature
	Signature
	Signature

Add this Cover Sheet to all of your Academic Job Applications

How to use this form

1. Using the facing page or a photocopy, (or a TEX version which can be downloaded from the e-math "Employment Information" menu, `http://www.ams.org/employment/`), fill in the answers which apply to *all* of your academic applications. Make photocopies.

2. As you mail each application, fill in the remaining questions neatly on one cover sheet and include it *on top of* your application materials.

The Joint Committee on Employment Opportunities has adopted the cover sheet on the facing page as an aid to job applicants and prospective employers. The form is now available on e-math in a TEX format which can be downloaded and edited. The purpose of the cover form is to aid department staff in tracking and responding to each application.

Mathematics Departments in Bachelor's, Master's and Doctorate granting institutions have been contacted and are expecting to receive the form from each applicant, along with any other application materials they require. Obviously, not all departments will utilize the cover form information in the same manner. Please direct all general questions and comments about the form to: `emp-info@ams.org` or call the Professional Programs and Services Department, AMS, at 800-321-4267 extension 4105.

JCEO Recommendations for Professional Standards in Hiring Practices

The JCEO believes that every applicant is entitled to the courtesy of a prompt and accurate response that provides timely information about his/her status. Specifically, the JCEO urges all institutions to do the following after receiving an application:

(1) Acknowledge receipt of the application—immediately; and
(2) Provide information as to the current status of the application, as soon as possible.

The JCEO recommends a triage-based response, informing the applicant that he/she
(a) is not being considered further;
(b) is not among the top candidates; or
(c) is a strong match for the position.

Academic Employment in Mathematics

AMS STANDARD COVER SHEET

Last Name ______________________________

First Name ______________________________

Middle Names ______________________________

Address *through next June* ______________________________ **Home Phone** ______________

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______________________________ **e-mail Address** ______________

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Current Institutional Affiliation ______________________________ **Work Phone** ______________

Highest Degree and Source ______________________________

Year of Ph.D. (optional) ______________________________

Ph.D. Advisor ______________________________

If the Ph.D. is not presently held, date on which you expect to receive ______________

Indicate *the mathematical subject area(s) in which you have done research using, if applicable, the Mathematics Subject Classification printed on the back of this form or on e-MATH. If listing more than one number, list first the one number which best describes your current primary interest.*

Primary Interest ______________________________

Secondary Interests *optional* ______________________________

Give a brief synopsis *of your current research interests (e.g. finite group actions on four-manifolds). Avoid special mathematical symbols and please do not write outside of the boxed area.*

____

____

Most recent, if any, position held *post Ph.D.*

University or Company ______________________________

Position Title ______________________________

Indicate the position for which you are applying and position posting code, if applicable

____

If unsuccessful for this position, would you like to be considered for a temporary position?

☐ Yes ☐ No If yes, please check the appropriate boxes.

☐ Postdoctoral Position ☐ 2+ Year Position ☐ 1 Year Position

List the names, affiliations, and e-mail addresses *of up to four individuals who will provide letters of recommendation if asked. Mark the box provided for each individual whom you have already asked to send a letter.*

☐ ______________________________

☐ ______________________________

☐ ______________________________

☐ ______________________________

This form is provided courtesy of the American Mathematical Society.

This cover sheet is provided as an aid to departments in processing job applications. It should be included with your application material.

Please print or type. Do not send this form to the AMS.

AMERICAN MATHEMATICAL SOCIETY FOUNDED 1888

2000 Mathematics Subject Classification

00 General
01 History and biography
03 Mathematical logic and foundations
05 Combinatorics
06 Order, lattices, ordered algebraic structures
08 General algebraic systems
11 Number theory
12 Field theory and polynomials
13 Commutative rings and algebras
14 Algebraic geometry
15 Linear and multilinear algebra, matrix theory
16 Associative rings and algebras
17 Nonassociative rings and algebras
18 Category theory, homological algebra
19 *K*-theory
20 Group theory and generalizations
22 Topological groups, Lie groups
26 Real functions
28 Measure and integration
30 Functions of a complex variable
31 Potential theory
32 Several complex variables and analytic spaces
33 Special functions
34 Ordinary differential equations
35 Partial differential equations
37 Dynamical systems and ergodic theory
39 Difference and functional equations
40 Sequences, series, summability
41 Approximations and expansions
42 Fourier analysis
43 Abstract harmonic analysis
44 Integral transforms, operational calculus
45 Integral equations
46 Functional analysis
47 Operator theory
49 Calculus of variations and optimal control, optimization
51 Geometry
52 Convex and discrete geometry
53 Differential geometry
54 General topology
55 Algebraic topology
57 Manifolds and cell complexes
58 Global analysis, analysis on manifolds
60 Probability theory and stochastic processes
62 Statistics
65 Numerical analysis
68 Computer science
70 Mechanics of particles and systems
74 Mechanics of deformable solids
76 Fluid mechanics
78 Optics, electromagnetic theory
80 Classical thermodynamics, heat transfer
81 Quantum theory
82 Statistical mechanics, structure of matter
83 Relativity and gravitational theory
85 Astronomy and astrophysics
86 Geophysics
90 Operations research, mathematical programming
91 Game theory, economics, social and behavioral sciences
92 Biology and other natural sciences
93 Systems theory, control
94 Information and communication, circuits
97 Mathematics education

Mathematics Calendar

The most comprehensive and up-to-date Mathematics Calendar information is available on e-MATH at `http://www.ams.org/mathcal/`.

February 2001

* 1-March 2 **CIRM Residential Session: Dynamical Systems, The Dynamic Odyssey (SD2001),** Centre International de Rencontres Mathématiques, Marseille, France.

Aims: The purpose of SD2001 is to bring together researchers from various mathematical areas who share a common interest in dynamical systems, with openmindedness to interaction between different fields in- and outside the dynamical world. The main themes of SD2001 will be: Ergodic geometry, horocyclic and geodesic flows; Interval exchange transformations and higher dimensional generalizations; Polygonal billiards; Holomorphic dynamics in several variables; Adic systems from automata and number theory; Continued fractions and arithmetic applications; Group actions, multidimensional substitutions; Dynamical systems with sigma-finite preserving measures. The organizers hope that this first CIRM Residential Session meeting will encourage and stimulate further research on dynamical systems and stimulate collaboration between mathematicians and computer scientists.

The session is likely to be relevant to a wide range of people. There will be approximately fifteen permanent invited visitors during the session. There will be both survey lectures and workshops as well as conference lectures on latest research developments, with the remaining time used for informal discussions and joint cooperation.

Organizers: X. Bressaud, J.-Y. Briend, J. Cassaigne, P. Hubert, P. Liardet, J. Los, M. Lustig, C.-A. Pillet, S. Troubetzkoy, S. Vaienti.

Information: More information (program, speakers, etc.) is available on the SD2001 Web site, `http://www.cmi.univ-mrs.fr/sd2001/`.

* 2-4 **International Conference on Special Functions and Their Applications,** Institute of Management & Development, Aligang, Lucknow, India.

Organizer: Society for Special Functions and Their Applications (SSFA).

Information: Notice of confirmation of participation along with the registration fee may be sent to the local organizing secretary: K. Srinivasa Rao, Convenor Senior Professor, The Inst. of Math. Sci., C.I.T. Campus, Chennai 600 113, India; tel. +91 044 2351856 (off.), 4411347 (res.); e-mail: `rao@imsc.ernet.in`. S. Ahmad Ali, Local Organizing Secretary Head, Dept. of Math., Amiruddaula Islamia Degree College, Lucknow 226 001, India; tel. +91 0522 272139 (off.), 323905 (res); e-mail: `aalii@usa.net`.

* 23-24 **2001 Conference on Applied Mathematics (CAM),** University of Central Oklahoma, Edmond, OK.

Program: There will be concurrent sessions in Wavelets & Signal Processing, Dynamical Systems & Differential Equations, Applied Mathematics, and a student session.

Invited Addresses: The program will feature invited addresses by I. Daubechies, Princeton Univ., and M. Golubitsky, Univ. of Houston.

Organizers: J. Byrne (`jbyrne@ucok.edu`) and C. Simmons (`cksimmons@ucok.edu`), Univ. of Central Oklahoma.

Deadline: The deadline for submitting an abstract to give a talk is January 26, 2001.

Information: For more information please contact one of the organizers or visit our Web site at `http://204.154.117.159/index.html`.

* 23-24 **XVI Inter-University Seminar on Research in the Mathematical Sciences,** University of Puerto Rico, Humacao, Puerto Rico.

Description: a) A talk by J. Gallian, Univ. of Minnesota, Duluth, for students; b) a poster session for undergraduate and graduate stu-

This section contains announcements of meetings and conferences of interest to some segment of the mathematical public, including ad hoc, local, or regional meetings, and meetings and symposia devoted to specialized topics, as well as announcements of regularly scheduled meetings of national or international mathematical organizations. A complete list of meetings of the Society can be found on the last page of each issue.

An announcement will be published in the *Notices* if it contains a call for papers and specifies the place, date, subject (when applicable), and the speakers; a second announcement will be published only if there are changes or necessary additional information. Once an announcement has appeared, the event will be briefly noted in every third issue until it has been held and a reference will be given in parentheses to the month, year, and page of the issue in which the complete information appeared. Asterisks (*) mark those announcements containing new or revised information.

In general, announcements of meetings and conferences held in North America carry only the date, title of meeting, place of meeting, names of speakers (or sometimes a general statement on the program), deadlines for abstracts or contributed papers, and source of further information. Meetings held outside the North American area may carry more detailed information. In any case, if there is any application deadline with respect to participation in the meeting, this fact should be noted. All communications on meetings and conferences in the mathematical sciences should be sent to the Editor of the *Notices* in care of the American Mathematical Society in Providence or electronically to `notices@ams.org` or `mathcal@ams.org`.

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.

The complete listing of the Mathematics Calendar will be published only in the September issue of the *Notices*. The March, June, and December issues will include, along with new announcements, references to any previously announced meetings and conferences occurring within the twelve-month period following the month of those issues. New information about meetings and conferences that will occur later than the twelve-month period will be announced once in full and will not be repeated until the date of the conference or meeting falls within the twelve-month period.

The Mathematics Calendar, as well as Meetings and Conferences of the AMS, is now available electronically through e-MATH on the World Wide Web. To access e-MATH, use the URL: `http://e-math.ams.org/` (or `http://www.ams.org/`). (For those with VT100-type terminals or for those without WWW browsing software, connect to e-MATH via Telnet (`telnet e-math.ams.org`; login and password `e-math`) and use the Lynx option from the main menu.)

dents; c) plenary talks by J. Gallian, and S. Landau, Sun Microsystems Laboratories; d) several parallel sessions of contributed talks in the general areas of pure and applied mathematics, computer science, statistics and mathematics education; d) exhibition booths with books, computers, and recruiters from universities with graduate programs.

Abstracts: Abstracts for contributed talks or posters should be sent by e-mail to sidim@cuhwww.upr.clu.edu in any one of the standard formats: TeX, LateX (preferred), MS Word, Word Perfect, etc., or on diskette to the following address: SIDIM 2001, Attn: Pablo V. Negrón, Department of Mathematics, University of Puerto Rico, Humacao, PR 00791-4300. The deadline for abstract submission is January 15, 2001.

Information: Further details and information about the activities (preliminary program, hotels, etc.) can be obtained from the SIDIM 2001 Web page at http://cuhwww.upr.clu.edu/~sidim/.

March 2001

* 9-11 **Around Dynamics, A Conference to Celebrate Jack Milnor's 70th Birthday**, SUNY at Stony Brook, New York.

Confirmed Speakers: A. Douady, Y. Eliashberg, E. Ghys, M. Gromov, J. Kiwi, N. Makarov, M. Shishikura, Y. Sinai, J. Smillie, D. Sullivan, J. C. Yoccoz, S. Zakeri.

Contact Address: J. Fest, Institute for Math. Sciences, SUNY, Stony Brook, NY 11794; fax: 631-632-7631; e-mail: ims@math.sunysb.edu.

* 10-13 **2001 ASL Annual Meeting**, Philadelphia, Pennsylvania.

Invited Speakers: J. Feigenbaum, H. Gaifman, J.-Y. Girard, W. Henson, D. Hirschfeldt, C. Jockusch, S. Kripke, S. Kuhlmann, J. C. Mitchell, E. Schimmerling, and P. Welch. A Retiring Presidential Address will be delivered by D. A. Martin, and the Twelfth Annual Gödel Lecture will also be given. There will be several Special Sessions on topics including Linear Logic, organized by M. Kanovich; Geometric Model Theory and Applications, organized by M. Laskowski and A. Pillay; Reverse Mathematics, organized by S. Simpson; and Large Cardinals, organized by E. Schimmerling and P. Welch.

Information: The official Web site for the meeting is http://www.ircs.upenn.edu/asl2001/.

* 25-30 **Sixth International Conference in Approximation and Optimization in the Caribbean**, Guatemala City, Guatemala.

Information: We invite you to visit our Web site, http://wwp.mathematik.hu-berlin.de/~kerger/tagungen/guatemala/apopt6.html.

April 2001

* 2-6 **Finite Volume Upwind and Centred Methods for Hyperbolic Conservation Laws**, Barcelona, Spain.

Lecturer: E. F. Toro, Obe.

Organizers: Numeritek Limited UK.

Topics: Basics on conservation laws and numerical methods; exact and approximate Riemann solvers, the upwind method of Godunov, MUSCL-Hancock, PLM, GRP and WAF; TVD methods. Approximate Riemann solvers include: Roe's method, Osher-Solomon, Harten-Lax-van Leer (HLL) and the HLLC variant; schemes for source terms and multidimensions. Special topics include: centred methods, nonconservative methods, ENO schemes, ADER schemes, gridding approaches, implicit methods, application to multiphase flows. Full program available at http://www.numeritek.com/. Participants who will benefit from the course include: research scientists and engineers in industry, research laboratories, consultancy and academic organizations; postdoctoral research assistants and Ph.D. students; academics and scientists in managerial positions.

Information: Further details on the course will be mailed on request. Please send e-mail to: course@numeritek.com.

* 2-6 **International Conference on Mathematical Modeling and Scientific Computing**, Middle East Technical University, Ankara, Selcuk University, Konya, Turkey.

Organizing Committee: F. Bornemann, Munich Univ. of Technology, Germany; H. Bulgak, Selcuk Univ., Konya, Turkey; V. Ganzha, Munich Univ. of Technology, Germany; B. Karasozen, METU, Ankara, Turkey; A. Sinan, Selcuk Univ., Konya, Turkey; C. Zenger, Munich Univ. of Technology, Germany.

Invited Speakers: J. Behrens, Munich Univ. of Technology, Germany; F. Bornemann, Munich Univ. of Technology, Germany; H. Bulgak, Selcuk Univ., Turkey; G. Demidenko, Novosibirsk, Russia; P. Deuflhard, Konrad Zuse Zentrum Berlin, Germany; F. Durst, The Friedrich Alexander Univ. Erlangen-Nuremberg, Germany; R. Fayzullin, Omsk Univ., Russia; V. Ganzha, Munich Univ. of Technology, Germany; M. Guenther, Technical Univ. Karlsruhe, Germany; R.H.W. Hoppe, Univ. of Augsburg, Germany; R. Korn, Univ. of Kaiserslautern, Germany; R. Liska, Czech Technical Univ. in Prague, Czech Republic; A. Meirmanov, Univ. da Beira Interior, Portugal; V. Vaskevitch, Novosibirsk, Russia; V. Yudovich, Rostov State Univ., Russia; C. Zenger, Munich Univ. of Technology, Germany.

Focus: The conference focuses on various aspects of mathematical modeling and scientific computing for solutions of modern problems of science and engineering. It aims, in particular, to foster cooperation among practitioners and theoreticians in this field. Another important aim of the conference is the creation and maintenance of contacts between scientists from Turkey and other countries in the field of scientific computing. During the conference a roundtable discussion will be organized on "Scientific Computing Graduate Study Programs". The meeting will cover all aspects of scientific computing and mathematical modeling: analysis of numerical methods; parallel algorithms and parallel computing; application of computational methods to engineering and various scientific disciplines; aspects of mathematical modeling in science, engineering, finance and economics.

Call for Papers: The program will consist of eight invited one-hour plenary lectures, contributed papers of 20 minutes each, and poster sessions. Authors are kindly invited to submit titles and abstracts related to the topics of the conference by February 15, 2001, using the conference Web page or via e-mail in LaTeX or TeX to either B. Karasozen, bulent@metu.edu.tr, or H. Bulgak, bulgk@selcuk.edu.tr.

Information: The Web page of the conference, http://www.math.metu.edu.tr/~bulent/mmsci2001/index.htm, contains up-to-date information, including electronic forms for submission of the abstracts of presentations.

* 5-7 **National Convention for Kappa Mu Epsilon, National Mathematics Honor Society**, Washburn University, Topeka, Kansas.

Information: P. Costello, matcostello@acs.eku.edu.

* 18-20 **3rd Postgraduate Group Theory Conference 2001**, Imperial College, London, UK.

Organizers: J. Fairley and A. Reuter.

Speakers: R. Carter and D. Segal.

Information: http://www.ma.ic.ac.uk/~jtf98/pggtc2001/.

* 27-29 **The Eleventh Midwest Geometry Conference, 2001**, Wichita State University, Wichita, Kansas.

Program: Geometric analysis, geometry of complex domains, elliptic equations and their geometric applications, geometry and geodesics.

Main Speakers: M. Agranovsky, Bar Ilan Univ., Tel Aviv; J. P. D'Angelo, Univ. of Illinois Urbana-Champaign; L. Del Riego, Univ. Autonoma de San Luis Potosi, Mexico; R. Howard, Univ. of South Carolina; S. Helgason, MIT; S. G. Krantz, Washington Univ., St. Louis; F.-H. Lin, Courant Institute, NYU; S. Novikov, Univ. of Maryland, College Park; W. P. Ziemer, Indiana Univ., Bloomington.

Information: http://www.math.twsu.edu/mgc2001/.

* 27-29 **The Second DMJ/IMRN Conference**, Duke University, Durham, North Carolina.

Sponsors: Duke University Press, the Mathematical Sciences Research Institute, the mathematics departments of Duke University and the University of North Carolina at Chapel Hill.

Organizers: R. Hain (Duke), J. Wahl (UNC).

Scientific Committee: R. Bryant (Duke), P. Sarnak (Princeton).
Speakers: J. Baik (Princeton), H. Bray (MIT), B. Conrad (Michigan), D. Gaitsgory (Harvard), A. Knutson (Berkeley), D. Kreimer (Mainz), P. Seidel (Palaiseau), W. Werner (Orsay).
Support: Subject to NSF funding, there will be support for young mathematicians to attend. Please send enquiries to: dmj-imrn@math.duke.edu.
Information: http://www.math.duke.edu/conferences/dmj-imrn/.

May 2001

*3-5 **2001 ASL Spring Meeting (with APA),** Minneapolis, Minnesota.
Program: This will be a joint meeting with the Central Division of the American Philosophical Association during its annual meeting on May 3-5, 2001. The program chair of the ASL meeting is M. Detlefsen (detlefsen.1@nd.edu). There will be symposia on reverse mathematics and computability, history and philosophy of mathematics, formal methods in philosophy and proof theory, and constructivism.
Abstracts: Abstracts must be received by the deadline of January 26, 2001, at the new ASL business office: ASL, Box 742, Vassar College, 124 Raymond Avenue, Poughkeepsie, NY 12604; fax: +1-845-437-7830; e-mail: asl@vassar.edu.

*18-19 **Fifth Mississippi State Conference on Differential Equations & Computational Simulations**, Mississippi State University.
Organizers: Department of Mathematics and Statistics, and Engineering Research Center, Mississippi State University.
Co-Sponsors: *Electronic Journal of Differential Equations* and Institute for Mathematics and its Applications.
Principal Speakers: P. Bates, Brigham Young Univ.; C. Castillo-Chavez, Cornell Univ.; J. Goldstein, Univ. of Memphis; A. Ingraffea, Cornell Univ.; J. Keener, Univ. of Utah; D. Keyes, Old Dominion Univ.; H. Matano, Univ. of Tokyo; S. Menon, Georgia Inst. of Technology; W.-M. Ni, Univ. of Minnesota; G. Papanicolaou, Stanford Univ.; R. Varga, Kent State Univ.
Conference Banquet Speaker: G. M. Lyles, Advanced Space Transportation Program Manager, NASA Marshall Space Flight Center; Topic: "Highway to Space".
Description: This interdisciplinary conference, held biannually, provides a joint forum where mathematicians, scientists, and engineers from academia and industry can exchange research ideas involving theoretical and applied developments in differential equations and computational simulations. In addition to the eleven principal lectures, there will be sessions of contributed talks. Reviewed manuscripts will be published as a special issue of the *Electronic Journal of Differential Equations.*
Abstracts: Abstracts for contributed papers should be submitted no later than March 31, 2001, through the conference Web site. Preregistration deadline is May 1, 2001.
Information: For further information on the conference organization, program, and submission of abstracts, visit the conference Web page at http://www.msstate.edu/Dept/Math/conf.html, or contact the program chair, Dr. J. Zhu, at jzhu@math.msstate.edu or the organizers: R. Shivaji, Dept. of Mathematics & Statistics, Mississippi State Univ., shivaji@ra.msstate.edu; tel: 662-325-3414; fax: 662-325-0005; or B. Soni, Engineering Research Center, Mississippi State Univ., bsoni@erc.msstate.edu; tel: 662-325-8278; fax: 662-325-7692.

June 2001

*6-10 **The 3rd International Conference on Mathematical Biology,** Tajik State University, Dushanbe, Tajikistan.
Program: A report by M. Yunusi devoted to the mathematical model of populations with regard to time-age and space distributions. Also, protection of plants and rare biological population problems will be formulated and investigated.

*14-21 **Graphs and Patterns in Mathematics and Theoretical Physics, A Conference to Celebrate Dennis Sullivan's 60th Birthday,** SUNY at Stony Brook, New York.
Organizers: A. de Carvalho, D. Gromoll, B. Lawson, M. Lyubich, J. Milnor, A. Phillips, L. Takhtajan.
Description: Graphs occur as organizing objects in several fields of mathematics and theoretical physics. Each field interprets them in its language. As a consequence, parallel developments are often played out in isolation from each other. In this conference experts in each of the areas will deliver lectures and minicourses to an audience including specialists in other areas as well as graduate students.
Topics: Graphs and universal algebra; graphs and discrete Riemannian geometry or gauge theory; graphs and bifurcation patterns in dynamical systems; graphs and quantum field theory-topology.
Confirmed Speakers: J. Baez, A. de Carvalho, R. Forman, J. Hubbard, D. Kreimer, C. McMullen, Y. Minsky, P. van Nieuwenhauizen, D. Sullivan, A. Voronov.
Information: We hope to have some funds to support a number of participants, particularly graduate students and postdocs. You can apply for support via e-mail or on the Web at http://www.math.sunysb.edu/patterns/. Applications of graduate students and postdocs should be backed by one recommendation letter. If you are interested in attending this meeting, please send a message to: Patterns Conference, Institute for Math. Sciences, SUNY at Stony Brook, Stony Brook, NY 11794; e-mail: patterns@math.sunysb.edu; fax: 631-632-7631; c/o G. Sciulli.

*25-29 **Workshop on Groups and 3-Manifolds**, Centre de Recherches Mathématiques, Université de Montréal, Montréal (Québec), Canada.
Organizer: S. Boyer (UQAM).
Program: This workshop will focus on recent progress on various open topological and geometric classification problems as well as some of the newer research directions. There will be four 50-minute talks per day, leaving plenty of time for informal discussions amongst the participants.
Participants: M. Boileau (Univ. Paul Sabatier), D. Calegari (Harvard Univ.), A. Casson (Yale Univ.), D. Cooper (Univ. of California Santa Barbara), M. Culler (Univ. of Illinois at Chicago), D. Gabai, (California Institute of Technology), C. McA. Gordon (Univ. of Texas at Austin), S. Kerchoff (Stanford Univ.), M. Lackenby (Univ. of Oxford), D. Long (Univ. of California Santa Barbara), J. Luecke (Univ. of Texas at Austin), Y. Moriah (Technion), J. Porti (Univ. Autonoma de Barcelona), A. Reid (Univ. of Texas at Austin), H. Rubinstein (Univ. of Melbourne), P. Shalen (Univ. of Illinois at Chicago), Y.-Q. Wu (Univ. of Iowa), X. Zhang (State Univ. of New York at Buffalo).

*27-29 **MAA Summer Short Course**, Ashland University, Ashland, Ohio.
Description: The Ohio Section of the MAA has engaged William Dunham to present the 2001 Summer Short Course titled "A Mathematical Sampler: 1669-1900". This workshop examines a collection of mathematical landmarks from the middle of the seventeenth through the end of the nineteenth centuries. The theorems are the original work of such towering figures as Newton, the Bernoulli brothers, Euler, Gauss, and Cantor and come from the fields of analysis, number theory, algebra, geometry, complex variables, and the theory of sets. They give historical perspective to topics encountered in college mathematics, and some can be transferred intact to the undergraduate classroom. Most importantly, these theorems represent the beauty of mathematics at its best.
Information: http://www.maa.org/Ohio/ (follow link for Summer Short Course) or http://eagleweb.ashland.edu/~cswanson/maashort.htm.

July 2001

*2-6 **Singapore International Symposium on Topology and Geometry (SISTAG)**, Singapore.
Information: For more information visit the Web site at http://www.math.nus.edu.sg/sistag.htm. For queries contact the administrator at sistag@math.nus.edu.sg.

* 2–7 **4th Operator Algebras International Conference: Operator Algebras and Mathematical Physics**, Constanta, Romania.
Organizing Committee: F. Boca, BocaFP@cardiff.ac.uk; G. Nenciu, Gheorghe.Nenciu@imar.ro; R. Purice, Radu.Purice@imar.ro; B. Ramazan, ramazan@imar.ro; S. Stratila, stratila@imar.ro.
Main Topics: Structure and classification of operator algebras, spectral and propagation properties for quantum systems.
Information: Speakers and details are on the Web page http://www.imar.ro/~ramazan/oamp/.

* 3–5 **Mathematics and Design 2001**, Deakin University, Geelong, Australia.
Information: http://rosassa.deakin.edu.au/MD2001/.

* 8–13 **Second ICMS Workshop on Algebraic Graph Theory**, International Centre for Mathematical Sciences, Edinburgh, Scotland.
Organizers: P. Rowlinson (Stirling), International Centre for Mathematical Sciences (Edinburgh).
Scientific Committee: D. Cvetkovic (Belgrade), W. Haemers (Tilburg), P. Rowlinson (Stirling).
Main Topics: The new fullerenes, eigenspace techniques, generalizations from distance-regular graphs, topological considerations.
Key Speakers: N. L. Biggs (London School of Economics), P. J. Cameron (Queen Mary & Westfield College), D. Cvetkovic (Belgrade), P. W. Fowler (Exeter), M. A. Fiol (Barcelona), W. Haemers (Tilburg), P. Hansen (Directeur du GERAD, Montreal), B. Mohar (Ljubljana), B. Shader (Wyoming).
Call for Papers: http://www.ma.hw.ac.uk/icms/current/graph/call.html.
Information: http://www.ma.hw.ac.uk/icms/current/graph/index.html.

* 9–13 **Workshop on Geometric Group Theory**, Centre de Recherches Mathématiques, Université de Montréal, Montréal (Québec), Canada.
Organizer: D. Wise (Brandeis & McGill Univ.).
Description: The theory of infinite groups was revolutionized by an infusion of geometric ideas from geometry and topology. This has led to the resolution of many old problems and the formulation of new problems and methods which have broadened the scope of the field. This workshop will focus on these new developments in geometric group theory. There will be four 50-minute talks per day, leaving plenty of time for informal discussions amongst the participants.
Participants: W. Ballmann (Univ. Bonn), M. Bestvina (Univ. of Utah), B. Bowditch (Univ. of Southampton), M. Bridson (Univ. of Oxford), R. Charney (Ohio State Univ.), B. Farb (Univ. of Chicago), M. Feighn (Rutgers Univ.), I. Kapovich (Univ. of Illinois at Urbana-Champaign), M. Kapovich (Univ. of Utah), O. Kharlampovich (McGill Univ.), J. McCammond (Texas A&M), A. Myasnikov (CCNY), P. Papazoglou (Univ. Paris-Sud), M. Sapir (Vanderbilt Univ.), M. Sageev (Technion), Z. Sela (Hebrew Univ.)

August 2001

* 6–11 **2001 ASL European Summer Meeting (Logic Colloquium '01)**, Vienna, Austria.
Speakers: Tutorials will be given by I. Neeman and A. Leitsch. Invited plenary speakers include T. Arai, S. Awodey, J. Cummings, R. Downey, H. Friedman, W. Goldfarb, O. Kharlampovich, J. Knight, M. van Lambalgen, C. Miller, S. Shelah, J. Väänänen, F. Wagner, and S. Wainer.
Abstracts: Abstracts of contributed talks must be received by the deadline of May 1, 2001; they should be sent to the official meeting address below.
Information: The official address of the meeting is: Logic Colloquium '01, Kurt Gödel Society, c/o Institut für Computersprachen, Technische Universität Wien (185), Favoritenstrasse 9, A-1040 Vienna, Austria; e-mail: lc2001@logic.at; http://www.logic.at/LC2001/.

* 7–10 **The 4th Conference on Information Fusion**, Montreal, Quebec, Canada.
Conference Topics: FUSION 2001 will provide a forum for the presentation of research and technological advances by scientists and engineers working in all aspects of information and data fusion techniques and systems. The conference will also feature keynote speeches and plenary talks. Topics include, but are not limited to, the following: (1) Theoretical and Technical Advances in Information Fusion, (2) Algorithms and Systems, and (3) Applications.
Information: communications@crm.umontreal.ca.

September 2001

* 1–6 **2001 WSES International Conference on Simulation (SIM'01)**, Malta.
Sponsor: The World Scientific and Engineering Society (WSES); co-sponsored by HIEST (Highest Institute of Education, Science and Technology, Athens, Greece).
Information: http://www.worldses.org/ or http://wses.tripod.com/.

* 18–22 **The Fifth International Workshop on Differential Geometry and Its Applications**, Timisoara, Romania.
Invited Speakers: (confirmed until the end of October 2000): W. Bertram (France), M. Bordoni (Italy), K. Buchner (Germany), P. Gauduchon (France), C. S. Gordon (USA), M. Goze (France), T. Hangan (France), E. Macias Virgos (Spain), S. Marchiafava (Italy), P. T. Nagy (Hungary), J.-P. Ortega (Switzerland), T. Pirashvili (Georgia), Th. M. Rassias (Greece), T. S. Ratiu (Switzerland), K. Richardson (USA), A. Savo (Italy), D. Schueth (Germany), L. Vanhecke (Belgium).
Organizers: M. Craioveanu, West Univ. of Timisoara, e-mail: craiov@math.uvt.ro; R. Iordanescu, Institute of Math. of the Romanian Academy-Bucharest, e-mail: Radu.Iordanescu@imar.ro; M. Puta, West Univ. of Timisoara; e-mail: puta@math.uvt.ro; D. Acu, ASTRA Association, e-mail: dacu@science.sibiu.ro.

* 22–26 **Applications of Discrete Mathematics**, Australian National University, Canberra, Australia.
Description: "Applications of Discrete Mathematics" will be a special session of the 45th Annual Meeting of the Australian Mathematical Society at the Australian National University in Canberra, Australia, Saturday, Sept. 22 (noon), until Wednesday evening, Sept. 26.
Information: Visit http://www.maths.anu.edu.au/conferences/AustMS2001/.

* 26–28 **First SIAM Conference on Imaging Science**, Boston Park Plaza Hotel, Boston, Massachusetts.
About the Conference: Current developments in the technology of imaging have led to an explosive growth in the interdisciplinary field of imaging science. With the advent of new devices capable of seeing objects and structures not previously imagined, the reach of science and medicine have been extended in a multitude of different ways. The impact of this technology has been to generate new challenges associated with the problems of formation, acquisition, compression, transmission, and analysis of images. By their very nature, these challenges cut across the disciplines of physics, engineering, mathematics, biology, medicine, and statistics. While the primary purpose of this conference is to focus on mathematical issues, the biomedical aspects of imaging will also play an important role.

This conference represents the first official function organized by the newly formed SIAM Activity Group on Imaging Science (SIAG/IS). This SIAG and the SIAG on the Life Sciences were both created in recognition of the fact that the mathematics community should participate more directly in these nontraditional areas. Since these two activity groups have such a strong overlap in the area of biomedical imaging, this conference has been scheduled to overlap with the Conference on the Life Sciences, chaired by James Collins, set for September 24–26, 2001.
Conference Themes: Imaging Acquisition and Formation; Image Storage, Compression and Retrieval; Imaging Coding and Transmission; Imaging Processing; PDEs in Image Processing; Image Modeling

and Analysis; Image Restoration; Statistical Aspects of Imaging; Biomedical Imaging; Applications.

Invited Plenary Speakers: Electromagnetic Inverse Problems: M. Cheney, Rensselaer Polytechnic Institute; Mathematical Morphology and Genomic Regulation: E. R. Dougherty, Texas A&M Univ.; Sparse Geometrical Image Representations for Processing: S. Mallat, École Polytechnique, France, and Courant Institute of Mathematical Sciences, New York Univ.; Stochastic Models for Natural Images: D. Mumford, Brown Univ.; Level Set/PDE-Based Algorithms for Image Restoration, Surface Interpolation and PDEs on Manifolds: S. Osher, Univ. of California Los Angeles.

Minisymposia: A minisymposium is a two-hour session consisting of four presentations on a well-focused topic. A number of minisymposia have been solicited by the conference organizing committee to supplement the conference themes. The organizing committee also encourages proposals for minisymposia in areas related to the conference themes. Prospective minisymposium organizers are asked to submit a proposal consisting of a title, a description (not to exceed 100 words), and a list of speakers and titles of their presentations using the Conference Management System available at `http://www.siam.org/meetings/is01/part.htm`. Deadline for submission of minisymposium proposals is March 2, 2001.

Contributed Presentations in Lecture Format: Contributed presentations in lecture format are invited in all areas of imaging science consistent with the conference themes. A lecture format involves a 15-minute oral presentation with an additional 5 minutes for discussion. Deadline for submission of contributed abstracts for a lecture: April 6, 2001.

Contributed Presentations in Poster Format: A poster presentation consists of the use of visual aides on a 4' x 6' poster board presented in a two-hour informal session that allows presenters to discuss their research with attendees. Deadline for submission of contributed abstracts for a poster: April 6, 2001.

Electronic Submission: Every presenter of a contributed or poster presentation must submit a 75-word abstract, which must be sent electronically using the Conference Management System available at `http://www.siam.org/meetings/is01/part.htm`. The 75-word abstract will appear in the final program.

Information: `ross@siam.org`.

October 2001

* 24–26 **DIMACS Workshop on Analysis of Gene Expression Data**, DIMACS Center, Rutgers University, Piscataway, New Jersey.

Sponsors: DIMACS Center.

Organizers: L. Heyer, Davidson College; G. Stolovitsky, IBM; S. Yooseph, Celera Genomics.

Short Description: The gene expression array is a significant new technology aimed at providing a top-down picture of the intimate genetic processes of an organism. It allows quantification of transcription levels of large numbers of genes simultaneously. There remain unsolved image processing as well as computational and mathematical difficulties associated with extraction and validation of data from gene expression microarray assays. This workshop will address the research areas and problems associated with this topic.

Contacts: S. Yooseph, Celera Genomics, `shibu.yooseph@celera.com`; local arrangements: J. Herold, DIMACS Center, `jessicah@dimacs.rutgers.edu`, 732-445-5928.

Information: `http://dimacs.rutgers.edu/Workshops/index.html`.

New Publications Offered by the AMS

Forthcoming from the AMS!

Triangle of Thoughts

Alain Connes, André Lichnerowicz, and **Marcel Paul Schützenberger**

In these "conversations", Connes, Lichnerowitz and Schützenberger, all members of the French Academy, closely examine the relationships that connect mathematics, physics and philosophy. The book may make you think again about things that you thought were familiar.

June 2001, approximately 234 pages, Hardcover, ISBN 0-8218-2614-X, LC 00-065064, 2000 *Mathematics Subject Classification*: 00A30, **All AMS members $24**, List $30, Order code TOTN

Algebra and Algebraic Geometry

Quadratic Forms and Their Applications

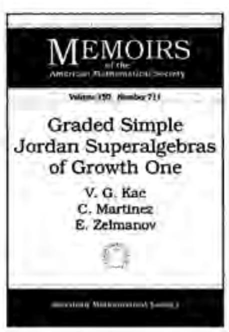
Eva Bayer-Fluckiger, *CNRS, Université de Franche-Comte, Besançon, France,* **David Lewis**, *University College, Dublin, Ireland,* and **Andrew Ranicki**, *University of Edinburgh, Scotland,* Editors

This volume outlines the proceedings of the conference on "Quadratic Forms and Their Applications" held at University College Dublin. It includes survey articles and research papers ranging from applications in topology and geometry to the algebraic theory of quadratic forms and its history. Various aspects of the use of quadratic forms in algebra, analysis, topology, geometry, and number theory are addressed. Special features include the first published proof of the Conway-Schneeberger Fifteen Theorem on integer-valued quadratic forms and the first English-language biography of Ernst Witt, founder of the theory of quadratic forms.

Contents: E. Bayer-Fluckiger, Galois cohomology of the classical groups; **A.-M. Bergé**, Symplectic lattices; **J. H. Conway**, Universal quadratic forms and the Fifteen Theorem; **M. Bhargava**, On the Conway-Schneeberger Fifteen Theorem; **M. Epkenhans**, On trace forms and the Burnside ring; **A. Fröhlich** and **C. T. C. Wall**, Equivariant Brauer groups; **D. W. Hoffmann**, Isotropy of quadratic forms and field invariants; **O. Izhboldin** and **A. Vishik**, Quadratic forms with absolutely maximal splitting; **A. F. Izmailov**, 2-regularity and reversibility of quadratic mappings; **C. Kearton**, Quadratic forms in knot theory; **I. Kersten**, Biography of Ernst Witt (1911–1991); **M. Knebusch** and **U. Rehmann**, Generic splitting towers and generic splitting preparation of quadratic forms; **M. Mischler**, Local densities of hermitian forms; **V. Powers** and **B. Reznick**, Notes towards a constructive proof of Hilbert's theorem on ternary quartics; **W. Scharlau**, On the history of the algebraic theory of quadratic forms; **V. P. Snaith**, Local fundamental classes derived from higher *K*-groups: III; **R. G. Swan**, Hilbert's theorem on positive ternary quartics; **C. T. C. Wall**, Quadratic forms and normal surface singularities.

Contemporary Mathematics, Volume 272

January 2001, 311 pages, Softcover, ISBN 0-8218-2779-0, LC 00-053584, 2000 *Mathematics Subject Classification*: 11Exx, 01Axx, **Individual member $47**, List $79, Institutional member $63, Order code CONM/272N



Graded Simple Jordan Superalgebras of Growth One

V. G. Kac, *Massachusetts Institute of Technology, Cambridge,* **C. Martinez**, *Universidad de Oviedo, Spain,* and **E. Zelmanov**, *Yale University, New Haven, CT*

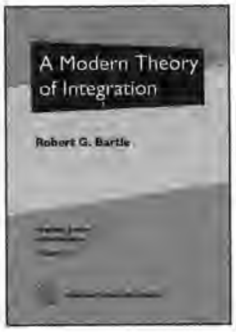
Contents: Introduction; Structure of the even part; Cartan type; Even part is direct sum of two loop algebras; A is a loop algebra; J is a finite dimensional Jordan superalgebra or a Jordan superalgebra of a superform; The main case; Impossible cases; Bibliography.

Memoirs of the American Mathematical Society, Volume 150, Number 711

March 2001, 140 pages, Softcover, ISBN 0-8218-2645-X, LC 00-053582, 2000 *Mathematics Subject Classification*: 17C70, 17B70; 17B60, 17B65, 17B66, 17B68, **Individual member $29**, List $49, Institutional member $39, Order code MEMO/150/711N

Analysis

Recommended Text



A Modern Theory of Integration

Robert G. Bartle, *Eastern Michigan University, Ypsilanti,* and *University of Illinois, Urbana*

The theory of integration is one of the twin pillars on which analysis is built. The first version of integration that students see is the Riemann integral. Later, graduate students learn that the Lebesgue integral is "better" because it removes some restrictions on the integrands and the domains over which we integrate. However, there are still drawbacks to Lebesgue integration, for instance, dealing with the Fundamental Theorem of Calculus, or with "improper" integrals.

This book is an introduction to a relatively new theory of the integral (called the "generalized Riemann integral" or the "Henstock-Kurzweil integral") that corrects the defects in the classical Riemann theory and both simplifies and extends the Lebesgue theory of integration. Although this integral includes that of Lebesgue, its definition is very close to the Riemann integral that is familiar to students from calculus. One virtue of the new approach is that no measure theory and virtually no topology is required. Indeed, the book includes a study of measure theory as an application of the integral.

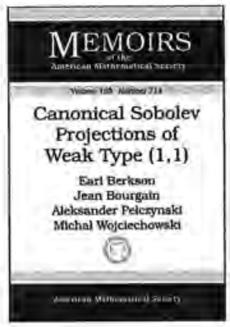
Part 1 fully develops the theory of the integral of functions defined on a compact interval. This restriction on the domain is not necessary, but it is the case of most interest and does not exhibit some of the technical problems that can impede the reader's understanding. Part 2 shows how this theory extends to functions defined on the whole real line. The theory of Lebesgue measure from the integral is then developed, and the author makes a connection with some of the traditional approaches to the Lebesgue integral. Thus, readers are given full exposure to the main classical results.

The text is suitable for a first-year graduate course, although much of it can be readily mastered by advanced undergraduate students. Included are many examples and a very rich collection of exercises. There are partial solutions to approximately one-third of the exercises.

Contents: *Integration on compact intervals:* Gauges and integrals; Some examples; Basic properties of the integral; The fundamental theorems of calculus; The Saks-Henstock lemma; Measurable functions; Absolute integrability; Convergence theorems; Integrability and mean convergence; Measure, measurability, and multipliers; Modes of convergence; Applications to calculus; Substitution theorems; Absolute continuity; *Integration on infinite intervals:* Introduction to Part 2; Infinite intervals; Further reexamination; Measurable sets; Measurable functions; Sequences of functions; Limits superior and inferior; Unbounded sets and sequences; The arctangent lemma; Outer measure; Lebesgue's differentiation theorem; Vector spaces; Semimetric spaces; Riemann-Stieltjes integral; Normed linear spaces; Some partial solutions; References; Index; Symbol index.

Graduate Studies in Mathematics, Volume 32

April 2001, approximately 448 pages, Hardcover, ISBN 0-8218-0845-1, LC 00-065063, 2000 *Mathematics Subject Classification:* 26-01; 26A39, 26A42, 28-01, **All AMS members $47**, List $59, Order code GSM/32N



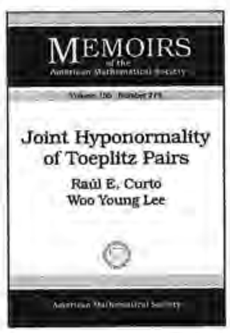
Canonical Sobolev Projections of Weak Type $(1,1)$

Earl Berkson, *University of Illinois, Urbana,* **Jean Bourgain,** *Institute for Advanced Study, Princeton, NJ,* and **Aleksander Pelczynski** and **Michal Wojciechowski,** *Polish Academy of Sciences, Warszawa*

Contents: Introduction and notation; Some properties of weak type multipliers and canonical projections of weak type $(1,1)$; A class of weak type $(1,1)$ rational multipliers; A subclass of $L^\infty(\mathbb{R}^2)\backslash M_1^{(w)}(\mathbb{R}^2)$ induced by $L^\infty(\mathbb{R})$; Some combinatorial tools; Necessity proof for the second order homogeneous case: A converse to Corollary (2.14); Canonical projections of weak type $(1,1)$ in the $\mathbb{T}^n$ model: Second order homogeneous case; The non-homogeneous case; Reducible smoothnesses of order 2; the canonical projection of every two-dimensional smoothness is of weak type $(1,1)$; References.

Memoirs of the American Mathematical Society, Volume 150, Number 714

March 2001, 75 pages, Softcover, ISBN 0-8218-2665-4, LC 00-053580, 2000 *Mathematics Subject Classification:* 26C15, 42B15, 46E30, 46E35, 47F05; 42B10, 46F10, **Individual member $26**, List $43, Institutional member $34, Order code MEMO/150/714N



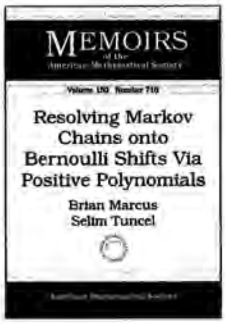
Joint Hyponormality of Toeplitz Pairs

Raúl E. Curto, *University of Iowa, Iowa City,* and **Woo Young Lee**, *Sung Kyun Kwan University, Suwan, Korea*

Contents: Introduction; Hyponormality of Toeplitz pairs with one coordinate a Toeplitz operator with analytic polynomial symbol; Hyponormality of trigonometric Toeplitz pairs; The gap between 2-hyponormality and subnormality; Applications; Concluding remarks and open problems; References; List of symbols.

Memoirs of the American Mathematical Society, Volume 150, Number 712

March 2001, 65 pages, Softcover, ISBN 0-8218-2653-0, LC 00-053583, 2000 *Mathematics Subject Classification:* 47B20, 47B35, 47A63; 47B37, 47B47, **Individual member $24**, List $40, Institutional member $32, Order code MEMO/150/712N



Resolving Markov Chains onto Bernoulli Shifts via Positive Polynomials

Brian Marcus, *IBM Almaden Research Center, San Jose, CA*, and **Selim Tuncel**, *University of Washington, Seattle, WA*

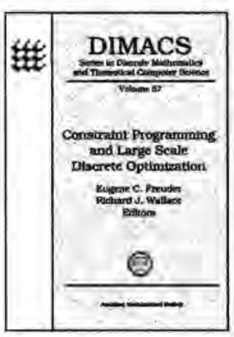
This item will also be of interest to those working in probability.

Contents: *Part A. Resolving Markov Chains onto Bernoulli Shifts:* Introduction; Weighted graphs and polynomial matrices; The main results; Markov chains and regular isomorphism; Necessity of the conditions; Totally conforming eigenvectors and the one-variable case; Splitting the conforming eigenvector in the one-variable case; Totally conforming eigenvectors for the general case; Splitting the conforming eigenvector in the general case; Bibliography; *Part B. On Large Powers of Positive Polynomials in Several Variables:* Introduction; Structure of $\mathbf{Log}(p^{\mathbf{n}})$; Entropy and equilibrium distributions for $\mathbf{w} \in \mathbf{W}(\mathbf{p})$; Equilibrium distributions and coefficients of $(p^{\mathbf{n}})$; Proofs of the estimates; Bibliography.

Memoirs of the American Mathematical Society, Volume 150, Number 710

March 2001, 98 pages, Softcover, ISBN 0-8218-2646-8, LC 00-053581, 2000 *Mathematics Subject Classification*: 28D20, 11C08; 05A10, 94A17, **Individual member $27**, List $45, Institutional member $36, Order code MEMO/150/710N

Applications



Constraint Programming and Large Scale Discrete Optimization

Eugene C. Freuder and **Richard J. Wallace**, *University of New Hampshire, Durham*, Editors

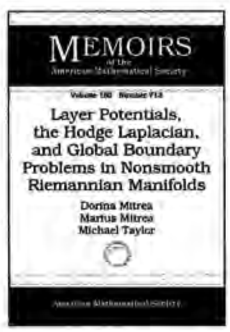
Constraint programming has become an important general approach for solving hard combinatorial problems that occur in a number of application domains, such as scheduling and configuration. This volume contains selected papers from the workshop on Constraint Programming and Large Scale Discrete Optimization held at DIMACS. It gives a sense of state-of-the-art research in this field, touching on many of the important issues that are emerging and giving an idea of the major current trends. Topics include new strategies for local search, multithreaded constraint programming, specialized constraints that enhance consistency processing, fuzzy representations, hybrid approaches involving both constraint programming and integer programming, and applications to scheduling problems in domains such as sports scheduling and satellite scheduling.

Contents: R. J. Wallace and **E. C. Freuder**, Introduction to DIMACS workshop on Constraint Programming and Large Scale Discrete Optimization; *General methods:* **A. Nareyek**, Using global constraints for local search; **C. Voudouris** and **E. Tsang**, Guided local search joins the elite in discrete optimisation; **F. Zabatta**, Multithreaded constraint programming: A hybrid approach; *CP approaches to scheduling:* **H. Meyer auf'm Hofe**, Nurse rostering as constraint satisfaction with fuzzy constraints and inferred control strategies; **J. C. Pemberton** and **F. Galiber, III**, A constraint-based approach to satellite scheduling; **J.-C. Régin**, Minimization of the number of breaks in sports scheduling problems using constraint programming; **B. M. Smith**, **C. J. Layfield**, and **A. Wren**, A constraint programming pre-processor for a bus driver scheduling system; *LSCO and software methodology:* **C. Gervet**, Large scale combinatorial optimization: A methodological viewpoint.

DIMACS: Series in Discrete Mathematics and Theoretical Computer Science, Volume 57

March 2001, 175 pages, Hardcover, ISBN 0-8218-2710-3, LC 00-066354, 2000 *Mathematics Subject Classification*: 65K10, 68T20; 90B35, 90B36, 90B50, 90C27, **Individual member $33**, List $55, Institutional member $44, Order code DIMACS/57N

Differential Equations



Layer Potentials, the Hodge Laplacian, and Global Boundary Problems in Nonsmooth Riemannian Manifolds

Dorina Mitrea and **Marius Mitrea**, *University of Missouri, Columbia*, and **Michael Taylor**, *University of North Carolina, Chapel Hill*

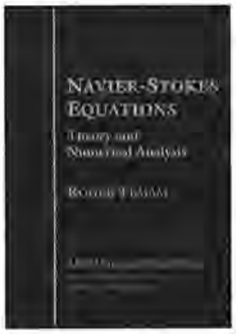
This item will also be of interest to those working in geometry and topology.

Contents: Introduction; Singular integrals on Lipschitz submanifolds of codimension one; Estimates on fundamental solutions; General second-order strongly elliptic systems; The Dirichlet problem for the Hodge Laplacian and related operators; Natural boundary problems for the Hodge Laplacian in Lipschitz domains; Layer potential operators on Lipschitz domains; Rellich type estimates for differential forms; Fredholm properties of boundary integral operators on regular spaces; Weak extensions of boundary derivative operators; Localization arguments and the end of the proof of Theorem 6.2; Harmonic fields on Lipschitz domains; The proofs of the Theorems 5.1–5.5; The proofs of the auxiliary lemmas; Applications to Maxwell's equations on Lipschitz domains; Analysis on Lipschitz manifolds; The connection between d_∂ and $d_{\partial\Omega}$; Bibliography.

Memoirs of the American Mathematical Society, Volume 150, Number 713

March 2001, 120 pages, Softcover, ISBN 0-8218-2659-X, LC 00-053585, 2000 *Mathematics Subject Classification*: 35J55, 42B20, 58J05, 58J32, 58A14; 31B10, 31C12, 45E05, 78A30, **Individual member $28**, List $47, Institutional member $38, Order code MEMO/150/713N

A Classic!



Navier-Stokes Equations

Theory and Numerical Analysis

Roger Temam, *Indiana University, Bloomington*

From a review for the First Edition:

This book, in many ways remarkable, gives a detailed account of a number of results concerned with the theory and numerical analysis of the Navier-Stokes equations of viscous incompressible fluids.
—Zentralblatt für Mathematik

This book was originally published in 1977 and has since been reprinted four times (the last reprint was in 1985). The current volume is reprinted and fully retypeset by the AMS. It is very close in content to the 1985 edition. The book presents a systematic treatment of results on the theory and numerical analysis of the Navier-Stokes equations for viscous incompressible fluids. Considered are the linearized stationary case, the nonlinear stationary case, and the full nonlinear time-dependent case. The relevant mathematical tools are introduced at each stage.

The new material in this book is Appendix III, reproducing a survey article written in 1998. This appendix contains a few aspects not addressed in the earlier editions, in particular a short derivation of the Navier-Stokes equations from the basic conservation principles in continuum mechanics, further historical perspectives, and indications on new developments in the area. The appendix also surveys some aspects of the related Euler equations and the compressible Navier-Stokes equations. Readers are advised to peruse this appendix before reading the core of the book.

This book presents basic results on the theory of Navier-Stokes equations and, as such, continues to serve as a comprehensive reference source on the topic.

This item will also be of interest to those working in applications.

Contents: The steady-state Stokes equations; Steady-state Navier-Stokes equations; The evolution Navier-Stokes equation; Appendix I: Properties of the curl operator and application to the steady-state Navier-Stokes equations; Appendix II (by F. Thomasset): Implementation of non-conforming linear finite elements (Approximation APX5—Two-dimensional case); Appendix III: Some developments on Navier-Stokes equations in the second half of the 20th century; Bibliography to Appendix III; Comments; Additional comments to the revised edition; Bibliography; Index.

AMS Chelsea Publishing

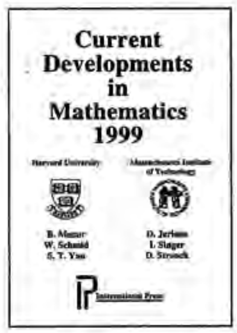
April 2001, approximately 424 pages, Hardcover, ISBN 0-8218-2737-5, 2000 *Mathematics Subject Classification*: 76-02; 65-02, 76D05, 35Q30, **All AMS members $53**, List $59, Order code CHEL-TEMAMN

General and Interdisciplinary

Current Developments in Mathematics—A Series of Books from International Press

Each year in November, the mathematics departments of Harvard and MIT host a small, yet remarkable, conference highlighting some of the most important mathematical developments of the previous year. Usually, the speakers have played leading roles in the work they discuss.

The lectures are addressed to a wide mathematical audience. And the speakers generally give an overview of the subject, placing the new results in context both mathematically and historically. They explain why the results are interesting and give a sense of the methods of proof. The proceedings of these conferences provide attractive introductions to the important mathematical research of today.



Current Developments in Mathematics, 1999

B. Mazur, **W. Schmid**, and **S.-T. Yau**, *Harvard University, Cambridge, MA*, **D. Jerison**, **I. Singer**, and **D. Stroock** *Massachusetts Institute of Technology, Cambridge*, Editors

A publication of the International Press.

These are the proceedings of the joint MIT-Harvard conference, Current Developments in Mathematics, held in 1999. Included are the following:

Hubert L. Bray and Richard M. Schoen: "Recent Proofs of the Riemannian Penrose Conjecture". The proofs are by Huisken and Ilmanen and by Bray. The conjecture is a statement about the mass of black holes in a three-dimensional space-like slice of a spacetime, first proposed by Penrose as a test of cosmic censorship. The proof by Huisken and Ilmanen is by way of a generalized inverse mean curvature flow. The proof by Bray is quite different, relying on the positive mass theorem and conformal deformations of metrics.

J. H. Conway, C. Goodman-Strauss, and N. J. A. Sloane: "Recent Progress in Sphere Packing". The packings are for spheres in dimensions less than 24, with certain better results in dimensions 9 and below. Many of the best packings come from laminated lattices, which are described here as sections of the Leech lattice.

Guy Henniart: "A Report on the Proof of the Langlands Conjectures for $GL(N)$ over p-adic Fields". The conjectures relate Galois representations and automorphic representations. The first objects are, roughly, representations of the Galois group of the algebraic closure of a p-adic field. The second are representations of the p-adic $GL(N)$ satisfying certain conditions. The original proof was by Michael Harris and Richard Taylor.

Later, Henniart provided another method which was somewhat more direct.

Gérard Laumon: "The Langlands Correspondence for Function Fields Following Laurent Lafforgue". Here, the correspondence between Galois representations and automorphic representations assumes that the ground field is the field of functions of a finite field. The methods here are quite different from those for the p-adic case. For instance, Drinfeld shtukas play a central role.

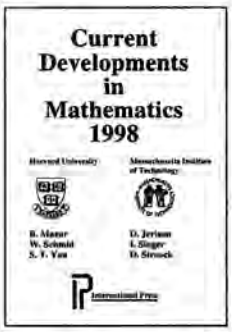
The proceedings of the Current Developments in Mathematics conferences from 1995, 1996, 1997, and 1998, published by International Press, are also available through the AMS. See the list of International Press books at www.ams.org/bookstore.

This item will also be of interest to those working in mathematical physics, discrete mathematics and combinatorics, and number theory.

Distributed worldwide, except in Japan, by the American Mathematical Society.

International Press

December 2000, 132 pages, Hardcover, ISBN 1-57146-043-8, 2000 *Mathematics Subject Classification*: 00B25, **All AMS members $34**, List $42, Order code INPR/43N



Current Developments in Mathematics, 1998

B. Mazur, W. Schmid, and **S.-T. Yau,** *Harvard University, Cambridge, MA,* **D. Jerison, I. Singer,** and **D. Stroock,** *Massachusetts Institute of Technology, Cambridge,* Editors

A publication of the International Press.

These are the proceedings of the joint MIT-Harvard conference Current Developments in Mathematics, held in 1998.

There were two talks on mirror symmetry. Brian Greene gives a review of the first ten years of mirror symmetry, including its origins in string theory and its current applications in complex algebraic geometry. The paper by Bong H. Lian, Kefeng Liu, and S.-T. Yau goes into some detail about the mirror principle and its proof, which are important pieces of the mirror symmetry setup.

Peter Kronheimer talks about the recent uses of symplectic techniques in topology. He explains the theory of J-holomorphic curves, which lies behind some of the important results of Gromov, and Donaldson's work on symplectic submanifolds.

Lou Van Den Dries describes the role of o-minimal structures in real analytic geometry. The theory of o-minimal structures was begun as a way of studying the real exponential field. It was clear in the 1980s that subanalytic geometry falls under the roof of o-minimality. In the 1990s o-minimal expansions of the real field allowed for new results in geometry. One application was the proof by Schmid and Vilonen of the Barbasch-Vogan conjecture in representation theory.

Horng-Tzer Yau discusses asymptotic solutions to dynamics of many-body systems and classical continuum equations. There is a review of some basic ideas from classical, stochastic, and quantum dynamics of large systems. The limiting classical equations are the Boltzmann, Euler, and incompressible Navier-Stokes equations. The analytic tools reviewed include perturbation theory, large deviations, the relative entropy method, the logarithmic Sobolev inequality, renumalization, and multiscale analysis.

Lai-Sang Young looks at the mathematics that lies at the confluence of the geometric theory of ordinary differential equations and ergodic theory. Rather than an exhaustive survey, Young concentrates on recent results in four areas: billiards and related physical systems; examples of strange attractors; entropy, Lyapunov exponents and dimension; and correlation decay and related statistical properties. Background material is provided for readers who are not specialists in dynamics.

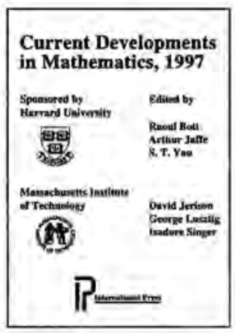
The proceedings of the Current Developments in Mathematics conferences from 1995, 1996, 1997, and 1999, published by International Press, are also available through the AMS. See the list of International Press books at www.ams.org/bookstore.

This item will also be of interest to those working in mathematical physics, geometry and topology, logic and foundations, and differential equations.

Distributed worldwide, except in Japan, by the American Mathematical Society.

International Press

December 2000, 278 pages, Hardcover, ISBN 1-57146-077-2, 2000 *Mathematics Subject Classification*: 00B25, **All AMS members $34**, List $42, Order code INPR/42N



Current Developments in Mathematics, 1997

Raoul Bott, Arthur Jaffe, and **S.-T. Yau,** *Harvard University, Cambridge, MA,* **David Jerison, George Lusztig,** and **Isadore Singer,** *Massachusetts Institute of Technology, Cambridge,* Editors

A publication of the International Press.

These are the proceedings of the joint MIT-Harvard conference, Current Developments in Mathematics, held in 1997. Included are the following:

- Alain Connes, "Trace Formula on the Adele Class Space and Weil Positivity". This is a survey of Connes's approach to the Riemann Hypothesis. The zeroes of the zeta function are related to the eigenvalues for the action of the idele class group on the adele class space, a noncommutative space. The positivity of the Weil distribution can be proved in this setting, provided a conjectured analogue of the Selberg trace formula holds.
- Lawrence C. Evans, "Partial Differential Equations and Monge-Kantorovich Mass Transfer". Recently, progress has been made on some problems in the calculus of variations by using techniques from differential equations. An important example of this is the Monge-Kantorovich mass transfer, a problem which dates back to the 18th century. Evans examines this problem, using tools from both analysis and geometry, in two situations: first, where the cost function is uniformly convex and then for a nonuniformly convex cost function.
- Peter Sarnak, "Quantum Chaos, Symmetry and Zeta Functions". In physics, quantum chaos is the study of the chaotic

- behavior of eigenvalues of Hamiltonian systems as Planck's constant goes to zero. Arithmetic quantum chaos relates to similar ideas applied to Hamiltonian flows on an arithmetic hyperbolic manifold. The behavior of the eigenvalues is related to properties of the Riemann zeta function and L-functions.
- W. Soergel, "Character Formulas for Tilting Modules over Quantum Groups at Roots of One". Using his earlier results on character formulas for tilting modules for Kac-Moody algebras, Soergel proves a character formula for tilting modules for quantum groups at roots of unity.
- A. Suslin, "Voevodsky's Proof of the Milnor Conjecture". Milnor's conjecture asserts that a certain map from the Milnor K-theory of a field to the Galois cohomology of the Galois group of its separable closure with coefficients in $\mathbf{Z}/2$ is an isomorphism. The proof is remarkable, adapting tools from algebraic topology to the problem at hand, such as a homotopy theory for schemes and Steenrod operations for motivic cohomology.

The proceedings also contains four lists of open problems. The topics of the problems and their editors are: Mathematical and Applied Physics, A. Jaffe and D. Stroock; Number Theory, B. Mazur; Geometry and Topology, C. Taubes; Analysis, D. Jerison.

The proceedings of the Current Developments in Mathematics conferences from 1995, 1996, 1998, and 1999, published by International Press, are also available through the AMS. See the list of International Press books at www.ams.org/bookstore.

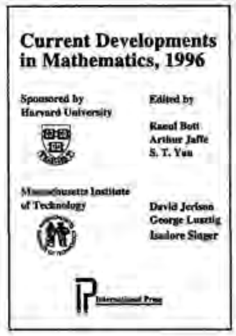
This item will also be of interest to those working in differential equations, algebra and algebraic geometry, and geometry and topology.

Distributed worldwide, except in Japan, by the American Mathematical Society.

Contents: *Part I: Lectures:* **A. Connes**, Trace formula on the adele class space and Weil positivity; **L. C. Evans**, Partial differential equations and Monge-Kantorovich mass transfer; **P. Sarnak**, Quantum chaos, symmetry and zeta functions, I: Quantum chaos; **P. Sarnak**, Quantum chaos, symmetry and zeta functions, II: Zeta functions; **W. Soergel**, Character formulas for tilting modules over quantum groups at roots of one; **A. Suslin**, Voevodsky's proof of the Milnor conjecture; *Part II: Open Problems:* Open problems in mathematical and applied physics, collected by A. Jaffe and D. Stroock; Open problems in number theory, collected by B. Mazur; Open problems in geometry and topology, collected by C. Taubes; Open problems in analysis, collected by D. Jerison.

International Press

December 2000, 266 pages, Hardcover, ISBN 1-57146-078-0, 2000 *Mathematics Subject Classification*: 00B25, **All AMS members $34**, List $42, Order code INPR/41N



Current Developments in Mathematics, 1996

Raoul Bott, Arthur Jaffe, and **S.-T. Yau,** *Harvard University, Cambridge, MA,* **David Jerison, George Lusztig,** and **Isadore Singer,** *Massachusetts Institute of Technology, Cambridge,* Editors

A publication of the International Press.

These are the proceedings of the joint MIT-Harvard conference, Current Developments in Mathematics, held in 1996.

Richard Borcherds writes about his well-known work on automorphic forms and Lie algebras. The algebras involved include Kac-Moody algebras and vertex algebras. The main character is the "fake monster Lie algebra", with a strong supporting role played by the Leech lattice. There is a brief discussion of how results such as the no-ghost theorem and Frenkel's upper bound are used to prove the moonshine conjectures. Borcherds shows how the fake monster Lie algebra can be used to construct special types of (generalized) automorphic forms.

Gerrit Heckman and Eric Opdam write about harmonic analysis for affine Hecke algebras. Here, the goal is to establish Reeder's proposed version of Lusztig's classification of unipotent representations of a p-adic group by computing formal degrees via a residue calculation.

Ehud Hrushovski describes one of the recent striking results in pure mathematics which is proved using model theory. In particular, he shows how to to prove the Mordell-Lang conjecture for function fields. Once he has reviewed the requisite model theory, the proof is much less difficult than the earlier proof of the Mordell conjecture using the deep machinery of arithmetic algebraic geometry.

Yves Meyer focuses on the application of wavelet analysis to the Navier-Stokes equations. The general problem is the existence and uniqueness of solutions to the equations for initial conditions in a given function space. The analysis includes a careful look at wavelets in this setting, as well as a careful look at the subtleties of the Navier-Stokes equations.

The proceedings of the Current Developments in Mathematics conferences from 1995, 1997, 1998 and 1999, published by International Press, are also available through the AMS. See the list of International Press books at www.ams.org/bookstore.

This item will also be of interest to those working in number theory, logic and foundations, analysis, and differential equations.

Distributed worldwide, except in Japan, by the American Mathematical Society.

International Press

December 2000, 212 pages, Hardcover, ISBN 1-57146-035-7, 2000 *Mathematics Subject Classification*: 00B25, **All AMS members $34**, List $42, Order code INPR/40N

Forthcoming from the AMS!

Triangle of Thoughts

Alain Connes, André Lichnerowicz, and
Marcel Paul Schützenberger

In these "conversations", Connes, Lichnerowitz and Schützenberger, all members of the French Academy, closely examine the relationships that connect mathematics, physics and philosophy. The book may make you think again about things that you thought were familiar.

June 2001, approximately 234 pages, Hardcover, ISBN 0-8218-2614-X, LC 00-065064, 2000 *Mathematics Subject Classification*: 00A30, **All AMS members $24**, List $30, Order code TOTN

Research in Collegiate Mathematics Education. IV

Ed Dubinsky, Alan H. Schoenfeld, *University of California, Berkeley*, **Jim Kaput**, *University of Massachusetts at Dartmouth, North Dartmouth*, Editors

This fourth volume of *Research in Collegiate Mathematics Education*(RCME IV) reflects the themes of student learning and calculus. Included are overviews of calculus reform in France and in the U.S. and large-scale and small-scale longitudinal comparisons of students enrolled in first-year reform courses and in traditional courses. The work continues with detailed studies relating students' understanding of calculus and associated topics. Direct focus is then placed on instruction and student comprehension of courses other than calculus, namely abstract algebra and number theory. The volume concludes with a study of a concept that overlaps the areas of focus, quantifiers. The book clearly reflects the trend towards a growing community of researchers who systematically gather and distill data regarding collegiate mathematics' teaching and learning.

This series is published in cooperation with the Mathematical Association of America.

Contents: M. Artigue, Teaching and learning calculus: What can be learned from education research and curricular changes in France?; **B. Darken, R. Wynegar**, and **S. Kuhn**, Evaluating calculus reform: A review and a longitudinal study; **S. L. Ganter** and **M. R. Jiroutek**, The need for evaluation in the calculus reform movement. A comparison of two calculus teaching methods; **K. E. Schwingendorf, G. P. McCabe**, and **J. Kuhn**, A longitudinal study of the C^4L calculus reform program: Comparisons of C^4L and traditional students; **M. A. McDonald, D. M. Mathews**, and **K. H. Strobel**, Understanding sequences: A tale of two objects; **M. J. Zandieh**, A theoretical framework for analyzing student understanding of the concept of derivative; **A. Selden, J. Selden, S. Hauk**, and **A. Mason**, Why can't calculus students access their knowledge to solve non-routine problems?; **W. O. Martin**, Lasting effects of the integrated use of graphing technologies in precalculus mathematics; **J. Hannah**, Visual confusion in permutation representations; **R. Zazkis**, Factors, divisors, and multiples: Exploring the web of students' connections; **E. Dubinsky** and **O. Yiparaki**, On student understanding of AE and EA quantification.

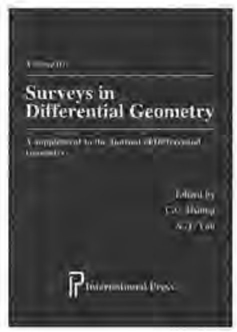
CBMS Issues in Mathematics Education, Volume 8

January 2001, 291 pages, Softcover, ISBN 0-8218-2028-1, 2000 *Mathematics Subject Classification*: 00-XX, 97-XX, **All Individuals $29**, List $49, Order code CBMATH/8N

Geometry and Topology

Surveys in Differential Geometry—A Series of Books from International Press

Surveys in Differential Geometry is a series of books published by International Press and sponsored in part by the *Journal of Differential Geometry* (Lehigh University, Bethleham, PA). Each volume in the series is devoted to one or several topics and comprises survey and research articles written by leading specialists in the area. For a full listing of the volumes in this International Press series that are available through the AMS, go to www.ams.org/bookstore.



Surveys in Differential Geometry, Volume III

Chuan C. Hsiung, *Lehigh University, Bethlehem, PA*, and **Shing-Tung Yau**, *Harvard University, Cambridge, MA*, Editors

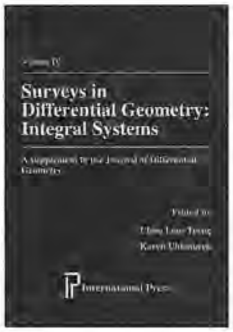
A publication of the International Press.

This volume features surveys based on lectures given at Harvard University in 1996. Topics include local index theory, eta invariants, and holomorphic torsion, Thurston's hyperbolization of Haken manifolds, quasi-minimal semi-Euclidean laminations in 3-manifolds, embedded surfaces and gauge theory in three and four dimensions, and the geometry of the Seiberg-Witten invariants.

Distributed worldwide, except in Japan, by the American Mathematical Society.

International Press

December 2000, 339 pages, Hardcover, ISBN 1-57146-067-5, 2000 *Mathematics Subject Classification*: 58-06; 57-06, **All AMS members $38**, List $48, Order code INPR/44N



Surveys in Differential Geometry, Volume IV: Integral Systems

Chuu-Lian Terng, *Northeastern University, Boston, MA*, and **Karen Uhlenbeck**, *University of Texas at Austin*, Editors

A publication of the International Press.

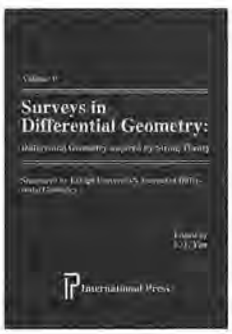
Topics in this volume include integrable systems in Riemannian geometry, Seiberg-Witten integrable systems, soliton equations, geometry of the space of orbits of a Coxeter group, differential geometry of moduli spaces, symplectic forms in the theory of solitons, Poisson actions and scattering theory for integrable systems, loop groups and equations of KdV type, and scattering and inverse scattering for first order systems.

This item will also be of interest to those working in differential equations.

Distributed worldwide, except in Japan, by the American Mathematical Society.

International Press

December 2000, 519 pages, Hardcover, ISBN 1-57146-066-7, 2000 *Mathematics Subject Classification*: 37J35, 35K10, 35K15, **All AMS members $38**, List $48, Order code INPR/45N



Surveys in Differential Geometry, Volume V: Differential Geometry Inspired by String Theory

Shing-Tung Yau, *Harvard University, Cambridge, MA*, Editor

A publication of the International Press.

The articles in this volume are devoted to geometrical aspects of the modern development of string theory. The geometric ideas initiated by consideration of string theory have been tremendously successful; this volume surveys the subject. Articles in this volume reflect rigorous and important interaction between string theory and geometry.

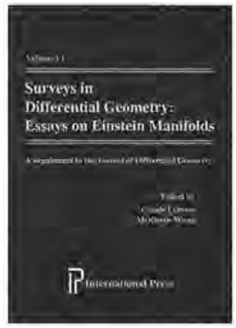
This item will also be of interest to those working in mathematical physics.

Distributed worldwide, except in Japan, by the American Mathematical Society.

Contents: P. S. Aspinwall, K3 surfaces and string duality; **J.-M. Bismut** and **F. Labourie**, Symplectic geometry and the Verlinde formulas; **J. Bryan** and **N. C. Leung**, Counting curves on irrational surfaces; **M. Gross**, Special Lagrangian fibrations II: Geometry. A survey of techniques in the study of special Lagrangian fibrations; **B. H. Lian, K. Liu**, and **S.-T. Yau**, Mirror principle I; **B. H. Lian, K. Liu**, and **S.-T. Yau**, Mirror principle II; **B. H. Lian** and **S.-T. Yau**, Differential equations from mirror symmetry; **K. Liu**, Heat kernels, symplectic geometry, moduli spaces and finite groups; **G. Tian** and **J. Li**, A brief tour of GW invariants.

International Press

December 2000, 569 pages, Hardcover, ISBN 1-57146-070-5, 2000 *Mathematics Subject Classification*: 00B15; 14-06, 53-06, **All AMS members $38**, List $48, Order code INPR/46N



Surveys in Differential Geometry, Volume VI: Essays on Einstein Manifolds

Claude LeBrun, *State University of New York at Stony Brook, NY*, and **McKenzie Wang**, *McMaster University, Hamilton, ON, Canada*, Editors

A publication of the International Press.

The main topic of the articles in this volume is the theory of Einstein manifolds. The articles are centered around three main themes:

- Einstein manifolds and special holonomy,
- The general theory of Einstein manifolds, and
- Einstein manifolds and general relativity.

The book offers a comprehensive overview of this vital area of differential geometry.

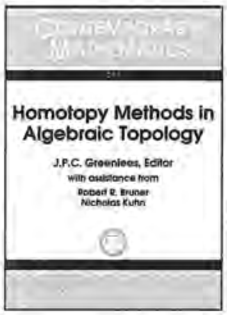
This item will also be of interest to those working in mathematical physics.

Distributed worldwide, except in Japan, by the American Mathematical Society.

Contents: *Part I: Einstein Manifolds and Special Holonomy:* **S.-T. Yau**, Einstein manifolds with zero Ricci curvature; **A. Dancer**, Hyper-Kähler manifolds; **D. Joyce**, Compact Riemannian manifolds with exceptional holonomy; **G. Tian**, Kähler-Einstein manifolds of positive scalar curvature; **S. Salamon**, Quaternion-Kähler geometry; **C. Boyer** and **K. Galicki**, 3-Sasakian manifolds; *Part II: Towards a General Theory of Einstein Manifolds:* **B. Chow**, Ricci flow and Einstein metrics in low dimensions; **P. Petersen**, Rigidity and compactness of Einstein metrics; **O. Biquard**, Einstein deformations of hyperbolic metrics; **C. LeBrun**, Four-dimensional Einstein manifolds, and beyond; **M. Wang**, Einstein metrics from symmetry and bundle constructions; *Part III: Relativity Revisited:* **K. Tod**, General relativity; **D. Christodoulou**, The stability of Minkowski space-time; **D. Calderbank** and **H. Pedersen**, Einstein-Weyl geometry.

International Press

December 2000, 423 pages, Hardcover, ISBN 1-57146-068-3, 2000 *Mathematics Subject Classification*: 53C25; 83Cxx, **All AMS members $38**, List $48, Order code INPR/47N



Homotopy Methods in Algebraic Topology

J. P. C. Greenlees, *University of Sheffield, UK,* **Editor,** with assistance from **Robert K. Bruner,** *Wayne State University, Detroit, MI,* and **Nicholas Kuhn,** *University of Virginia, Charlottesville*

This volume presents the proceedings from the AMS-IMS-SIAM Summer Research Conference on Homotopy Methods in Algebraic Topology held at the University of Colorado.The conference coincided with the sixtieth birthday of J. Peter May. An article is included reflecting his wide-ranging and influential contributions to the subject area. Other articles in the book discuss the Adams E_2 term for elliptic cohomology, mapping class groups and function spaces, rational SO(3) equivariant cohomology theories, toral groups and classifying spaces of p-compact groups, dual calculus for functors to spectra, flatness for the E_∞ tensor product, and further related areas. The book offers a true comprehensive source on modern aspects of homotopy theoretic methods exported to algebraic settings.

Contents: **A. Baker**, On the Adams E_2-term for elliptic cohomology; **C.-F. Bödigheimer**, **F. R. Cohen**, and **M. D. Peim**, Mapping class groups and function spaces; **R. R. Bruner**, Extended powers of manifolds and the Adams spectral sequence; **W. G. Dwyer** and **C. W. Wilkerson**, Centers and Coxeter elements; **B. Gray**, On the homotopy type of the loops on a 2-cell complex; **J. P. C. Greenlees**, Rational $SO(3)$-equivariant cohomology theories; **L. Hesselholt** and **I. Madsen**, On the K-theory of nilpotent endomorphisms; **P. Hu**, The Ext^0-term of the real-oriented Adams-Novikov spectral sequence; **K. Ishiguro**, Toral groups and classifying spaces of p-compact groups; **N. J. Kuhn**, Stable splittings and the diagonal; **R. McCarthy**, Dual calculus for functors to spectra; **M. Mahowald**, **D. Ravenel**, and **P. Shick**, The triple loop space approach to the telescope conjecture; **M. A. Mandell**, Flatness for the E_∞ tensor product; **I. Moerdijk**, On the Connes-Kreimer construction of Hopf algebras.

Contemporary Mathematics, Volume 271

March 2001, approximately 344 pages, Softcover, ISBN 0-8218-2621-2, LC 00-052604, 2000 *Mathematics Subject Classification*: 55-06, **Individual member $47**, List $79, Institutional member $63, Order code CONM/271N

Seiberg Witten and Gromov Invariants for Symplectic 4-Manifolds

Clifford Henry Taubes, *Harvard University, Cambridge, MA*

A publication of the International Press.

This book provides the complete proof of the remarkable relationship between Seiberg-Witten and Gromov invariants on symplectic 4-manifolds. It is a companion to *Topics on Symplectic 4-manifolds*, published by the International Press (Cambridge, MA) in 1998 (available from the AMS, see International Press Books, Number 29), and brings together articles published in the *Journal of the American Mathematical Society* and the *Journal of Differential Geometry*.

The book forms the second volume from the International Press Lecture Series held at the University of California at Irvine. It is written at a graduate mathematics level and will be essential reading for mathematicians everywhere.

Distributed worldwide, except in Japan, by the American Mathematical Society.

Contents: SW ⇒ Gr; Counting pseudo-holomorphic submanifolds in dimension 4; Gr ⇒ SW; $Gr = SW$.

International Press

December 2000, 401 pages, Hardcover, ISBN 1-57146-061-6, 2000 *Mathematics Subject Classification*: 53D45, 57R57, **All AMS members $34**, List $42, Order code INPR/36N

Hyperkahler Manifolds

Misha Verbitsky, *Harvard University, Cambridge, MA,* and **Dmitri Kaledin**

A publication of the International Press.

Hyperkahler manifolds first appeared within the framework of differential geometry as Riemannian manifolds with holonomy of a special type. Recently, they have exhibited diverse and unexpected links with various branches of mathematics and also have played a very important role in modern versions of string theory—the potential basis of future unified field theory and quantum gravity.

In this book, the authors introduce hyperkahler manifolds to those who have not previously studied them. They present new classes of examples of hyperkahler manifolds, extending the research knowledge in the field.

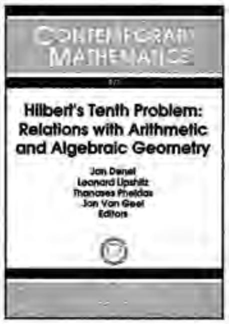
Distributed worldwide, except in Japan, by the American Mathematical Society.

Contents: **M. Verbitsky**, Hyperholomorphic sheaves and new examples of hyperkähler manifolds; **D. Kaledin**, Hyperkähler structures on total spaces of holomorphic cotangent bundles.

International Press

December 2000, 257 pages, Hardcover, ISBN 1-57146-071-3, 2000 *Mathematics Subject Classification*: 53C26, **All AMS members $34**, List $42, Order code INPR/37N

Logic and Foundations



Hilbert's Tenth Problem: Relations with Arithmetic and Algebraic Geometry

Jan Denef, *Katholieke Universiteit, Leuven, Belgium*, **Leonard Lipshitz**, *Purdue University, West Lafayette, IN*, **Thanases Pheidas**, *University of Crete, Greece*, and **Jan Van Geel**, *University of Ghent, Belgium*, Editors

This book is the result of a meeting that took place at the University of Ghent (Belgium) on the relations between Hilbert's tenth problem, arithmetic, and algebraic geometry. Included are written articles detailing the lectures that were given as well as contributed papers on current topics of interest.

The following areas are addressed: an historical overview of Hilbert's tenth problem, Hilbert's tenth problem for various rings and fields, model theory and local-global principles, including relations between model theory and algebraic groups and analytic geometry, conjectures in arithmetic geometry and the structure of diophantine sets, for example with Mazur's conjecture, Lang's conjecture, and Bücchi's problem, and results on the complexity of diophantine geometry, highlighting the relation to the theory of computation.

The volume allows the reader to learn and compare different approaches (arithmetical, geometrical, topological, model-theoretical, and computational) to the general structural analysis of the set of solutions of polynomial equations. It would make a nice contribution to graduate and advanced graduate courses on logic, algebraic geometry, and number theory.

This item will also be of interest to those working in number theory and algebra and algebraic geometry.

Contents: Y. Matiyasevich, Hilbert's tenth problem: What was done and what is to be done; **T. Pheidas** and **K. Zahidi**, Undecidability of existential theories of rings and fields: A survey; **A. Shlapentokh**, Hilbert's tenth problem over number fields, a survey; **M. Prunescu**, Defining constant polynomials; **L. Darnière**, Decidability and local-global principles; **L. Moret-Bailly**, Applications of local-global principles to arithmetic and geometry; **J. Schmid**, Regularly T-closed fields; **M. Jarden**, **A. Razon**, and **W.-D. Geyer**, Skolem density problems over large Galois extensions of global fields; **T. Pheidas**, An effort to prove that the existential theory of **Q** is undecidable; **G. Cornelissen** and **K. Zahidi**, Topology of Diophantine sets: Remarks on Mazur's conjectures; **P. Vojta**, Diagonal quadratic forms and Hilbert's tenth problem; **J. M. Rojas**, Algebraic geometry over four rings and the frontier to tractability; **A. Pillay**, Some model theory of compact complex spaces; **K. H. Kim** and **F. W. Roush**, Double coset decompositions for algebraic groups over $K[t]$; **C. D. Bennett**, **L. K. Elderbrock**, and **A. M. W. Glass**, Zero estimates for polynomials in 3 and 4 variables using orbits and stabilisers.

Contemporary Mathematics, Volume 270

January 2001, 367 pages, Softcover, ISBN 0-8218-2622-0, LC 00-052575, 2000 *Mathematics Subject Classification*: 00B25, 03B25, 03D20, 03D35, 11U05, 14Gxx, 65Y20, 68Q15, **Individual member $53**, List $89, Institutional member $71, Order code CONM/270N

Previously Announced Publications

Supplementary Reading

Number Theoretic Density and Logical Limit Laws

Stanley N. Burris, *University of Waterloo, ON, Canada*

This book shows how a study of generating series (power series in the additive case and Dirichlet series in the multiplicative case), combined with structure theorems for the finite models of a sentence, lead to general and powerful results on limit laws, including $0-1$ laws. The book is unique in its approach to giving a combined treatment of topics from additive as well as from multiplicative number theory, in the setting of abstract number systems, emphasizing the remarkable parallels in the two subjects. Much evidence is collected to support the thesis that local results in additive systems lift to global results in multiplicative systems.

All necessary material is given to understand thoroughly the method of Compton for proving logical limit laws, including a full treatment of Ehrenfeucht-Fraissé games, the Feferman-Vaught Theorem, and Skolem's quantifier elimination for finite Boolean algebras. An intriguing aspect of the book is to see so many interesting tools from elementary mathematics pull together to answer the question: What is the probability that a randomly chosen structure has a given property? Prerequisites are undergraduate analysis and some exposure to abstract systems.

This item will also be of interest to those working in number theory.

Mathematical Surveys and Monographs, Volume 86

January 2001, 289 pages, Hardcover, ISBN 0-8218-2666-2, LC 00-048512, 2000 *Mathematics Subject Classification*: 03C13, 05A15, 05A16, 05C30, 11M41, 11M45, 11N45, 11N80, 11P82, 11U09, **Individual member $41**, List $69, Institutional member $55, Order code SURV/86RT102

Supplementary Reading

Large Deviations

Jean-Dominique Deuschel, *Technical University of Berlin, Germany*, and **Daniel W. Stroock**, *Massachusetts Institute of Technology, Cambridge*

From a review for the First Edition ...

The book provides a sound base for Large Deviations Theory and answers questions and clears up technical problems found in articles previously written on the subject ... Here you will find the interesting material, the reward for having read so far. One could liken the experience to that of climbing a mountain. After struggling with difficult technical demands, you then get to enjoy a grandiose view over a crystal landscape, where you can perceive traces of life way off in the distance.

—Zentralblatt für Mathematik

This is the second printing of the book first published in 1988. The first four chapters of the volume are based on lectures given by Stroock at MIT in 1987. They form an introduction to the basic ideas of the theory of large deviations and make a suitable package on which to base a semester-length course for advanced graduate students with a strong background in analysis and some probability theory. A large selection of exercises presents important material and many applications. The last two chapters present various non-uniform results (Chapter 5) and outline the analytic approach that allows one to test and compare techniques used in previous chapters (Chapter 6).

AMS Chelsea Publishing

February 2001, 283 pages, Hardcover, ISBN 0-8218-2757-X, LC 00-049583, 2000 *Mathematics Subject Classification*: 60F10, 60F17, 28D20, 28D05, **All AMS members $35**, List $39, Order code CHEL/342.HRT102

Stochastic Processes, Physics and Geometry: New Interplays. I, and II

Volumes in Honor of Sergio Albeverio

Fritz Gesztesy, *University of Missouri, Columbia*, **Helge Holden**, *Norwegian University of Science and Technology, Trondheim*, **Jürgen Jost**, *Max Planck Institut für Mathematik, Leipzig, Germany*, **Sylvie Paycha**, *Université Blaise Pascal, Aubiere, France*, **Michael Röckner**, *Universität Bielefeld, Germany*, and **Sergio Scarlatti**, *Universitá G. D'Annunzio, Pescara, Italy*, Editors

These volumes present state-of-the-art research currently unfolding at the interface between mathematics and physics. Included are select articles from the international conference held in Leipzig (Germany) in honor of Sergio Albeverio's sixtieth birthday. The theme of the conference, "Infinite Dimensional (Stochastic) Analysis and Quantum Physics", was chosen to reflect Albeverio's wide-ranging scientific interests. The articles in these books reflect that broad range of interests and provide a detailed overview highlighting the deep interplay among stochastic processes, mathematical physics, and geometry.

The contributions are written by internationally recognized experts in the fields of stochastic analysis, linear and nonlinear (deterministic and stochastic) PDEs, infinite dimensional analysis, functional analysis, commutative and noncommutative probability theory, integrable systems, quantum and statistical mechanics, geometric quantization, and neural networks. Also included are applications in biology and other areas.

Most of the contributions are high-level research papers. However, there are also some overviews on topics of general interest. The articles selected for publication in these volumes were specifically chosen to introduce readers to advanced topics, to emphasize interdisciplinary connections, and to stress future research directions. Volume I contains contributions from invited speakers; Volume II contains additional contributed papers.

These items will also be of interest to those working in mathematical physics.

Members of the Canadian Mathematical Society may order at the AMS member price.

Volume I (CMSAMS/28) contributors include: F. Gesztesy, H. Holden, J. Jost, S. Paycha, M. Röckner, S. Scarlatti, P. Blanchard, G. B. Arous, A. F. Ramirez, Z. Brzez´niak, S. Peszat, A. M. Chebotarev, V. P. Maslov, G. Da Prato, A. Debussche, G. F. Dell'Antonio, R. Figari, A. Teta, C. Drumond, M. de Faria, L. Streit, D. Dürr, S. Teufel, E. B. Dynkin, K. D. Elworthy, X.-M. Li, V. Z. Enolskii, M. Fukushima, D. Hundertmark, W. Kirsch, G. Jona-Lasinio, Yu. G. Kondratiev, R. A. Minlos, G. V. Shchepan'uk, Z.-M. Ma, H. Ouerdiane, A. Rezgui, M. Piccioni, M. Sanz-Solé, M. Sarrà, B. Simon, and B. Zegarliński.

Volume II (CMSAMS/29) contributors include: V. Adamyan, B. Pavlov, I. Ya. Aref'eva, I. V. Volovich, L. V. Bogachev, S. A. Molchanov, Yu. A. Makhnovskii, A. M. Berezhkovskii, B. Booss-Bavnbek, S. Borac, R. Seiler, J. F. Brasche, M. M. Malamud, H. Neidhardt, J. Brüning, L. Cattaneo, U. Cattaneo, F. Cipriani, Ph. Clément, G. Gripenberg, V. Högnäs, M. Demuth, B. K. Driver, B. C. Hall, G. G. Emch, A. Z. Jadczyk, P. Exner, R. Fan, K. Lange, F. Figliolini, D. Guido, L. Gawarecki, V. Mandrekar, F. Gesztesy, K. A. Makarov, A. K. Motovilov, V. A. Geyler, V. A. Margulis, R. Gielerak, P. Ługiewicz, G. A. Goldin, U. Moschella, K. Gustafson, K. Habermann, A. Hilbert, R. Léandre, F. Hiroshima, H. Holden, K. H. Karlsen, K.-A. Lie, Y. Hu, B. Øksendal, T. Zhang, P. Imkeller, G. W. Johnson, L. Nielsen, N. A. Kachanovsky, G. Karner, W. Karwowski, V. Koshmanenko, A. Khrennikov, B. Tirozzi, Y. Kozitsky, P. Kurasov, K. Watanabe, K. Kuwae, B.-H. Li, Y.-Q. Li, X. D. Li, V. Liebscher, J. M. Lindsay, S. J. Wills, I. Mitoma, L. M. Morato, G. Morchio, F. Strocchi, D. Noja, A. Posilicano, N. Obata, Y. Oshima, H. Osswald, G. Panati, A. Teta, B. Rüdiger, J.-L. Wu, A. Sergeev, O. G. Smolyanov, H. v. Weizsäcker, O. Wittich, R. F. Streater, M. Takeda, M. Zähle, W. Zheng, and W. Zhengdong.

Conference Proceedings, Canadian Mathematical Society, Volume 28 and 29

November 2000, 333 pages, Softcover, ISBN 0-8218-1959-3, LC 00-046237, 2000 *Mathematics Subject Classification*: 58J20, 58J65, 60G15, 60G20, 60H07, 60H10, 60H15, 60H30, 60H40, 60J60, 60J65, 82B31, 82B44, **Individual member $45**, List $75, Institutional member $60, Order code CMSAMS/28RT102
November 2000, 647 pages, Softcover, ISBN 0-8218-1960-7, LC 00-046237, 2000 *Mathematics Subject Classification*: 58J20, 58J65, 60G15, 60G20, 60H07, 60H10, 60H15, 60H30, 60H40, 60J60, 60J65, 82B31, 82B44, **Individual member $75**, List $125, Institutional member $100, Order code CMSAMS/29RT102

Recommended Text

A Classic!

Differential Geometry and Symmetric Spaces

Sigurdur Helgason, *Massachusetts Institute of Technology, Cambridge*

Remarkably well written ... might be used as a textbook for how to write mathematics.

—Bulletin of the AMS

Sigurdur Helgason's *Differential Geometry and Symmetric Spaces* was quickly recognized as a remarkable and important book. For many years, it was the standard text both for Riemannian geometry and for the analysis and geometry of symmetric spaces. Several generations of mathematicians relied on it for its clarity and careful attention to detail.

Although much has happened in the field since the publication of this book, as demonstrated by Helgason's own three-volume expansion of the original work, this single volume is still an excellent overview of the subjects. For instance, even though there are now many competing texts, the chapters on differential geometry and Lie groups continue to be among the best treatments of the subjects available. There is also a well-developed treatment of Cartan's classification and structure theory of symmetric spaces. The last chapter, on functions on symmetric spaces, remains an excellent introduction to the study of spherical functions, the theory of invariant differential operators, and other topics in harmonic analysis. This text is rightly called a classic.

Sigurdur Helgason was awarded the Steele Prize for *Groups and Geometric Analysis* and the companion volume, *Differential Geometry, Lie Groups and Symmetric Spaces.*

This item will also be of interest to those working in algebra and algebraic geometry and analysis.

AMS Chelsea Publishing

February 2001, 487 pages, Hardcover, ISBN 0-8218-2735-9, LC 00-048511, 2000 *Mathematics Subject Classification*: 22E15, 53C35, 22E46, 22F30, 43A85, 43A90, 53C20, 53C30, **All AMS members $44**, List $49, Order code CHEL/341.HRT102

Spectral Problems Associated with Corner Singularities of Solutions to Elliptic Equations

V. A. Kozlov and **V. G. Maz'ya**, *University of Linköping, Sweden*, and **J. Rossmann**, *University of Rostock, Germany*

This book focuses on the analysis of eigenvalues and eigenfunctions that describe singularities of solutions to elliptic boundary value problems in domains with corners and edges. The authors treat both classical problems of mathematical physics and general elliptic boundary value problems.

The volume is divided into two parts: The first is devoted to the power-logarithmic singularities of solutions to classical boundary value problems of mathematical physics. The second deals with similar singularities for higher order elliptic equations and systems.

Chapter 1 collects basic facts concerning operator pencils acting in a pair of Hilbert spaces. Related properties of ordinary differential equations with constant operator coefficients are discussed and connections with the theory of general elliptic boundary value problems in domains with conic vertices are outlined. New results are presented. Chapter 2 treats the Laplace operator as a starting point and a model for the subsequent study of angular and conic singularities of solutions. Chapter 3 considers the Dirichlet boundary condition beginning with the plane case and turning to the space problems. Chapter 4 investigates some mixed boundary conditions. The Stokes system is discussed in Chapters 5 and 6, and Chapter 7 concludes with the Dirichlet problem for the polyharmonic operator.

Chapter 8 studies the Dirichlet problem for general elliptic differential equations of order $2m$ in an angle. In Chapter 9, an asymptotic formula for the distribution of eigenvalues of operator pencils corresponding to general elliptic boundary value problems in an angle is obtained. Chapters 10 and 11 discuss the Dirichlet problem for elliptic systems of differential equations of order 2 in an n-dimensional cone. Chapter 12 studies the Neumann problem for general elliptic systems, in particular with eigenvalues of the corresponding operator pencil in the strip $|\Re\lambda - m + /2n| \leq 1/2$. It is shown that only integer numbers contained in this strip are eigenvalues.

Applications are placed within chapter introductions and as special sections at the end of chapters. Prerequisites include standard PDE and functional analysis courses.

Mathematical Surveys and Monographs, Volume 85

October 2000, 436 pages, Hardcover, ISBN 0-8218-2727-8, LC 00-045110, 2000 *Mathematics Subject Classification*: 31B30, 35J05, 35J40, 35J55, 35P15, 35Q30, 47A75, 74B05, **Individual member $57**, List $95, Institutional member $76, Order code SURV/85RT102

Asymptotic Statistical Methods for Stochastic Processes

Yu. N. Lin′kov, *Institute of Applied Mathematics and Mechanics, Donetsk, Ukraine*

The asymptotic properties of the likelihood ratio play an important part in solving problems in statistics for various schemes of observations. In this book, the author describes the asymptotic methods for parameter estimation and hypothesis testing based on asymptotic properties of the likelihood ratios in the case where an observed stochastic process is a semimartingale.

Chapter 1 gives the general basic notions and results of the theory under consideration. Chapters 2 and 3 are devoted to the problem of distinguishing between two simple statistical hypotheses. In Chapter 2, certain types of asymptotic distinguishability between families of hypotheses are introduced. The types are characterized in terms of likelihood ratio, Hellinger integral of order ϵ, Kakutani-Hellinger distance, and the distance in variation between hypothetical measures, etc. The results in Chapter 2 are used in Chapter 3 in statistical experiments generated by observations of semimartingales. Chapter 4 applies the general limit theorems on asymptotic properties of maximum likelihood and Bayes estimates obtained by Ibragimov and Has'minskii for observations of an arbitrary nature to observations of semimartingales. In Chapter 5, an unknown parameter is assumed to be random, and under this condition, certain information-theoretic problems of estimation of parameters are considered.

This English edition includes an extensive list of references and revised bibliographical notes.

Translations of Mathematical Monographs, Volume 196

November 2000, 216 pages, Hardcover, ISBN 0-8218-1183-5, LC 00-045349, 2000 *Mathematics Subject Classification*: 62Mxx; 60Gxx, **Individual member $51**, List $85, Institutional member $68, Order code MMONO/196RT102

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Yoav Benyamini, *Technion—Israel Institute of Technology, Haifa*, and **Joram Lindenstrauss**, *Hebrew University, Jerusalem, Israel*

Volume 48; 2000; ISBN 0-8218-0835-4; 488 pages; Hardcover; **All AMS members $52**, List $65, Order Code COLL/48CT102

Recommended Text

Frobenius Manifolds, Quantum Cohomology, and Moduli Spaces

Yuri I. Manin, *Director, Max-Planck-Institut für Mathematik, Bonn, Germany*

The book is certainly one which should be in every mathematical library. I would also recommend it to any mathematician (from graduate student to professor) interested in trying to learn about these important and fascinating subjects.

—Bulletin of the London Mathematical Society

Volume 47; 1999; ISBN 0-8218-1917-8; 303 pages; Hardcover; **All AMS members $44**, List $55, Order Code COLL/47CT102

Global Solutions of Nonlinear Schrödinger Equations

J. Bourgain, *Institute for Advanced Study, Princeton, NJ*

Volume 46; 1999; ISBN 0-8218-1919-4; 182 pages; Hardcover; **Individual member $21**, List $35, Institutional member $28, Order Code COLL/46CT102

Random Matrices, Frobenius Eigenvalues, and Monodromy

Nicholas M. Katz and **Peter Sarnak**, *Princeton University, NJ*

[F]or research workers interested in the Riemann Hypothesis, or in the arithmetic of varieties over finite fields, this work has important messages which may help to shape our thinking on fundamental issues on the nature of zeta-functions.

—Bulletin of the London Mathematical Society

Volume 45; 1999; ISBN 0-8218-1017-0; 419 pages; Hardcover; **Individual member $41**, List $69, Institutional member $55, Order Code COLL/45CT102

The Book of Involutions

Max-Albert Knus, *Eidgenössische Technische Hochschule, Zürich, Switzerland*, **Alexander Merkurjev**, *University of California, Los Angeles*, **Markus Rost**, *Universität Regensburg, Germany*, and **Jean-Pierre Tignol**, *Université Catholique de Louvain, Louvain-la-Neuve, Belgium*

This volume is a compendious study of algebras with involution, a subject with many facets which becomes particularly interesting for central simple algebras. The book is excellently written, and the chapters on algebraic groups and Galois cohomology alone would make the book an ideal read for aspiring postgraduate students of an algebraic persuasion. In addition, there is plenty of material to enlighten even those of us who already know something about the subject. All in all, this book recommends itself to anyone who wants a thorough reference source, complete with an ample selection of enlightening exercises and historical notes, which deals with exceptional Jordan algebras, Clifford algebras and modules, Tits' algebras and algebraic groups in a modern manner.

—Bulletin of the London Mathematical Society

The book under review is an important work which records many of the significant advances in the theory of algebras with involution that have taken place in recent years. Much of the material has not previously appeared in a book before; indeed, there is a substantial amount that has not appeared anywhere before. There is an interesting selection of exercises for each chapter which cover many ancillary results not included in the body of the text. Additionally, there are carefully prepared and highly informative notes at the end of each chapter which give historical commentary and sources for the topics covered. Overall, this book is an outstanding achievement. It will be an indispensable reference for the specialist, and a challenging but highly rewarding introduction for the novice.

—Mathematical Reviews

Volume 44; 1998; ISBN 0-8218-0904-0; 593 pages; Hardcover; **All AMS members $55**, List $69, Order Code COLL/44CT102

Fully Nonlinear Elliptic Equations

Luis A. Caffarelli and **Xavier Cabré**, *Institute for Advanced Study, Princeton, NJ*

The book marks an important stage in the theory of nonlinear elliptic problems. Its timely appearance will surely stimulate fresh attacks on the many difficult and interesting questions which remain.

—Bulletin of the London Mathematical Society

Interesting and well written ... contains material selected with good taste ... likely to be highly appreciated both by researchers and advanced students.

—Mathematical Reviews

Well written, with the arguments clearly presented. There are helpful remarks throughout the book, and at several points the authors give the main ideas of the more technical proofs before proceeding to the details ... will certainly be of interest to researchers and graduate students in the field of nonlinear elliptic equations.

—Bulletin of the American Mathematical Society

Volume 43; 1995; ISBN 0-8218-0437-5; 104 pages; Softcover; **All AMS members $23**, List $29, Order Code COLL/43CT102

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2001 Analysis Search Committee
Department of Mathematics
University of California, Riverside
Riverside, CA 92521-0135

by Friday, February 2, 2001. The University of California, Riverside, is an Affirmative Action/Equal Opportunity Employer.

DELAWARE

UNIVERSITY OF DELAWARE
Chair, Department of Mathematical Sciences

The University of Delaware seeks applications for the position of professor and chair of the Department of Mathematical Sciences. The department currently has approximately 40 faculty and professional staff and offers programs for the B.A., B.S., M.S., and Ph.D. degrees in mathematics and applied mathematics. Salary is competitive, and an attractive fringe benefits package is included. The focus of the department has been in applied mathematics/applied analysis and, more recently, has involved increased involvement in industrial applied mathematics. The department also has a very active discrete mathematics group, small groups in several other areas, and an ongoing commitment to secondary math education.

Applicants should have a Ph.D. in some area of mathematical sciences commensurate with the research strengths of the department; a distinguished record of scholarship and a proven record of obtaining outside funding; a commitment to excellence in instruction at all levels; and sufficient experience to indicate the ability to work cooperatively and effectively with faculty, professional staff, and the administration. The department expects to fill a number of new positions within the next few years, and the chair should be a dynamic individual with a vision for the future to help the department advance its reputation and visibility as well as further its ties with the College of Engineering and the Department of Computer Science.

Applications received by February 15, 2001, are guaranteed full consideration, and we anticipate making an appointment effective on or about July 1, 2001. Applicants should submit a C.V., a statement of academic leadership philosophy, and the names and addresses of four references to: Chair Search Committee, Department of Mathematical Sciences, University of Delaware, Newark, DE 19716. The University of Delaware is an AA/EOE Employer. For more information: `http://www.math.udel.edu/openings/html`.

Suggested uses for classified advertising are positions available, books or lecture notes for sale, books being sought, exchange or rental of houses, and typing services.

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Upcoming deadlines for classified advertising are as follows: March 2001 issue–December 27, 2000; April 2001 issue–January 25, 2001; May 2001 issue–February 23, 2001; June/July issue–April 25, 2001; August 2001 issue–May 24, 2001; September 2001 issue–June 26, 2001.

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Situations wanted advertisements from involuntarily unemployed mathematicians are accepted under certain conditions for free publication. Call toll-free 800-321-4AMS (321-4267) in the U.S. and Canada or 401-455-4084 worldwide for further information.

Submission: Promotions Department, AMS, P. O. Box 6248, Providence, Rhode Island 02940; or via fax: 401-331-3842; or send e-mail to `classads@ams.org`. AMS location for express delivery packages is 201 Charles Street, Providence, Rhode Island 02904. Advertisers will be billed upon publication.

ILLINOIS

THE UNIVERSITY OF ILLINOIS AT CHICAGO
Department Head, Department of Mathematics, Statistics, and Computer Science

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The head is the chief administrative officer of the department with responsibilities for recruitment; instructional programs; administrative, budgetary, and promotion decisions; and for providing leadership in the development of research, teaching, and public service. The successful candidate will have an outstanding research program, a strong commitment to teaching, demonstrated leadership and administrative skills, and will be eligible for appointment as a full professor.

Although the search will continue until the position is filled, applications should be received by February 23, 2001, to receive fullest consideration. Applications from women and minorities are particularly encouraged. Applications and nominations should be sent to:

Professor David Marker
Search Committee for Head of
Mathematics, Statistics, and
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College of Liberal Arts and
Sciences, M/C 228
The University of Illinois at Chicago
601 S. Morgan Street
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MASSACHUSETTS

BOSTON UNIVERSITY
Program in Mathematical and Computational Neuroscience

Announcing New Program: Program in Mathematical and Computational Neuroscience at Boston University; Co-directors: Howard Eichenbaum and Nancy Kopell.

A newly created program supported by an award from the Burroughs Wellcome Fund has predoctoral and postdoctoral positions available over the next year. These positions are designed to facilitate the transition of a small and outstanding set of predoctoral and postdoctoral fellows from the mathematical and physical sciences to a range of areas in neuroscience. The program features special seminars, mentoring by more advanced students, and a dynamic and well-networked intellectual life provided by multiple supporting institutional modules. Predoctoral fellows will enroll in one of two Ph.D. programs that focus on the combination of experimental and computational neuroscience. Burroughs Wellcome Postdoctoral Fellows will design individualized programs that include neuroscience courses and one or more research projects that emphasize combined computational and experimental approaches to neuroscience. In addition, all fellows may participate in the Center for BioDynamics (CBD, `http://cbd.bu.edu/`), which helps physical scientists and engineers to address research problems at the interfaces among mathematics, physics, biology, and engineering. For further information see our Web site at `http://PMCN.bu.edu/` and/or write to `pmcn@bu.edu`.

WORCESTER POLYTECHNIC INSTITUTE
Mathematical Sciences Department

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WPI is a private and highly selective technological university with an enrollment of 2,700 undergraduates and about 1,100 full- and part-time graduate students. Worcester, New England's second largest city, offers ready access to the diverse economic, cultural, and recreational resources of the region.

The Mathematical Sciences Department has 24 tenured/tenure-track faculty and supports B.S., M.S., and Ph.D. programs in applied and computational mathematics and applied statistics. For additional information, see `http://www.wpi.edu/+math/`.

Nominations and applications should be sent to: Search Committee, Mathematical Sciences Department, WPI, 100 Institute Road, Worcester, MA 01609-2280. To be complete, applications must include a detailed curriculum vitae, a brief statement of specific teaching and research objectives, and the names of four references with mail/e-mail addresses and telephone/fax numbers.

Applications will be considered on a continuing basis beginning December 1, 2000, until the position is filled.

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MICHIGAN

UNIVERSITY OF MICHIGAN
Department of Mathematics

The Department seeks candidates for a lecturer position beginning September 2001, involving the operation and direction of its introductory program in precalculus and calculus and the training of instructors for these courses. Duties will include the direction of one large multisection precalculus or calculus course per semester; the teaching of one or two sections of the course being directed; assistance with our program to train and supervise new teachers in the introductory program; and general help with the planning, direction, and administration of the program. Applicants should have demonstrated excellence in the teaching of college mathematics, experience directing multisection courses in the first two years of college mathematics, and expertise in modern pedagogical methods. Experience in working with outreach programs is also desirable. Those who do not precisely fit this description but who are very strong in several of these areas will also be considered. A doctorate in mathematics or a closely related area is preferred, but all strong candidates will be considered. Preference will be given to candidates who are also involved in mathematical research or scholarship, including mathematics education. Rank and salary commensurate with experience. Nondiscriminatory Affirmative Action Employer.

Applicants should send a C.V./bibliography, description of experience, a statement on teaching, and three letters of recommendation to: Professor B. A. Taylor, Chair, Department of Mathematics, University of Michigan, Ann Arbor, MI 48109-1109; e-mail: `mathchr@math.lsa.umich.edu`. Further information is available on our home page, `http://www.math.lsa.umich.edu/`. Applicants considered on a continuing basis.

NEVADA

UNIVERSITY OF NEVADA
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Applicants should submit a detailed curriculum vitae and a statement addressing administrative philosophy, research, and teaching interests. Also, names, addresses, and e-mails of five references should be sent to: Dr. George Miel, Chair of the Search Committee, Department of Mathematical Sciences, University of Nevada, Las Vegas, 4505 Maryland Parkway, Box 454020, Las Vegas, NV 89154-4020; phone: 702-895-0360; e-mail: miel@nevada.edu. Review of completed applications will begin January 20, 2001, and will continue until the position is filled.

UNIVERSITY OF NEVADA
Department Head

Professor and Founding Chair, Mathematics. The University of Nevada, Las Vegas, invites applications for the position of professor and founding chair of a new academic department in mathematics. The faculty is seeking a dynamic leader with proven administrative abilities, significant and current record of research, and excellent teaching credentials at the undergraduate and graduate levels. The chair will direct and facilitate further development and growth of this newly organized department, currently consisting of fifteen faculty with a variety of research interests in mathematics. For more information see the UNLV World Wide Web site at http://www.unlv.edu/. Salary is commensurate with qualifications and experience. Position is contingent upon funding and pending institutional and system approval of the new department. Twelve-month-per-year position. A Ph.D. in the mathematical sciences required.

Applicants should submit a detailed curriculum vitae; a statement that addresses administrative philosophy, research, and teaching interests; and the names and addresses (including e-mail) of five references to: Professor David G. Costa, Chair of the Search Committee, Department of Mathematical Sciences, University of Nevada, Las Vegas, 4505 Maryland Parkway, Box 454020, Las Vegas, NV 89154-4020; phone: 702-895-0359; e-mail: costa@nevada.edu. Review of completed applications will begin January 20, 2001, and will continue until the position is filled.

NEW JERSEY

RICHARD STOCKTON COLLEGE OF NEW JERSEY
Computational Science

Assistant/assoc. professor, tenure-track, September 2001. Ph.D. in computational science, a physical science, or mathematics; demonstrated successful teaching experience at the college level; and practical experience in computational science required. We seek an excellent, versatile teacher to provide a central role in developing a new B.S. degree program in computational science with a strong internship component and industrial ties. Specific duties include teaching courses in computational science and related disciplinary areas, advising students, and developing and overseeing student internships. Stockton is a state-supported residential liberal arts and sciences college with over 5,000 full-time students in rural South Jersey. Salary range $38,789–$54,225; may be higher depending on qualifications, experience, and increases in the appropriately established compensation plan. Screening will continue until position is filled. Send résumé, three letters of recommendation, and evidence of completion of the Ph.D. to: Dr. Lynn Stiles, Dean of Natural Sciences and Mathematics, The Richard Stockton College of New Jersey, AA74, P.O. Box 195, Pomona, NJ 08240-0195. Stockton is an AA/EOE. Women and minorities are encouraged to apply.

PENNSYLVANIA

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Mellon College of Science
Dean Search

The Mellon College of Science of Carnegie Mellon University invites nominations for dean. The college has four academic departments: Biological Sciences, Chemistry, Mathematical Sciences, and Physics. It is also home to the National Science Foundation Science and Technology Center for Light Microscope Imaging and Biotechnology, the Pittsburgh NMR Center for Biomedical Research, the Pittsburgh Supercomputing Center, the Center for Nonlinear Analysis, the Center for Macromolecular Engineering, the Center for Computational Finance, and is a participant in the Center for the Neural Basis of Cognition. The college has 144 tenure-track faculty, 93 special faculty, 167 graduate students, and 545 undergraduate majors.

To be assured full consideration, nominations and applications should be submitted by **February 28, 2001**. More details about the position, including the nomination procedure, may be found at http://www.cmu.edu/mcs/deanSearchAd.html.

UNIVERSITY OF PITTSBURGH AT BRADFORD
Department of Mathematics

Tenure-track assistant professor of mathematics position to begin Fall 2001. Ph.D. in math earned or near completion. A strong commitment to undergraduate education on a small rural campus and a potential in scholarly work are essential. Applicants with information technology background will be given favorable consideration. Send application letter, vita, official transcripts, and three letters of reference to: Dr. Yong-Zhuo Chen, Math Search Committee, University of Pittsburgh at Bradford, 300 Campus Drive, Bradford, PA 16701-2898. Selection process will start on February 15, 2001, and will continue until the positions are filled. Women and minorities are encouraged to apply. AA/EOE.

UNIVERSITY OF SCRANTON
Department of Mathematics

The University of Scranton anticipates a tenure-track opening in the academic year 2001-02 for an assistant professor of mathematics. Applications are invited from candidates seeking a teaching environment where research is part of faculty responsibilities. Applicants should possess the doctorate in mathematics by June 2001. The department offers undergraduate programs in mathematics and biomathematics and is particularly interested in candidates with background in applied mathematics, but will consider strong applicants from all fields. Visit us on the Web at http://academic.uofs.edu/department/math/. The University of Scranton is a Jesuit Catholic institution which welcomes applicants from all backgrounds who can contribute to our unique educational mission (see the Institutional Statement of Mission at http://www.uofs.edu/admin/mission.html). Submit a vita, three letters of recommendation, and a statement on teaching and research interests to: Mathematics Search Committee, University of Scranton, Scranton, PA 18510-4666. The University of Scranton is an Equal Opportunity/Affirmative Action Employer and encourages applications from women and minorities.

TENNESSEE

VANDERBILT UNIVERSITY
Department of Mathematics
1326 Stevenson Center
Nashville, TN 37240

We invite applications for a position in approximation theory or related areas, either at the tenure-track (assistant professor) or tenured (associate or full professor) level. Candidates for a tenure-track appointment should have held the Ph.D. for at least two years and show evidence of outstanding research ability. Candidates for a senior appointment should have a record of exceptional scientific achievement. Evidence of effective teaching is essential. To apply, send the following materials in a single mailing to the attention of Geneva Shilliday at the address above: letter of application (including e-mail address and fax number), the AMS Standard Cover Sheet fully completed, curriculum vitae, and research summary. Do not send additional information (including letters of recommendation) unless requested to do so after our initial screening. Evaluation of the applications will commence immediately and will continue until the position is filled.

Vanderbilt University is an Affirmative Action/Equal Opportunity Employer.

TEXAS

UNIVERSITY OF HOUSTON-CLEAR LAKE
Assistant Professor for Mathematics

The Department of Mathematical Sciences of the University of Houston-Clear Lake invites applications for a tenure-track opening for an assistant professor or higher to begin August 2001. The department seeks candidates whose mathematical interests complement those of current faculty. Preference will be given to candidates in the fields of algebra, number theory, or complex analysis. A Ph.D. in mathematics by August 2001 is expected. The successful candidate will be expected to teach undergraduate and graduate courses in mathematics, to conduct mathematical research, and to perform university service.

The University of Houston-Clear Lake is an upper-level institution with an enrollment of 7,000 located adjacent to the Johnson Space Center. It offers degree programs at the bachelor's and master's levels. The mathematical sciences area offers bachelor's and master's degrees in mathematics, master's degrees in statistics, courses supporting the natural and applied sciences, and courses in support of the certification of elementary and secondary school teachers.

Please send a letter of application, vita, and AMS cover sheet to: Chair of Mathematical Sciences Search Committee, University of Houston-Clear Lake, 2700 Bay Area Blvd. MC-167, Houston, TX 77058. Also required are three letters of recommendation sent directly to the above address by the references. Preliminary interviews will be held at the Joint Winter Meetings in New Orleans (January 2001) but applications will be accepted until the position is filled.

The University of Houston-Clear Lake is an Affirmative Action/Equal Opportunity Employer supporting workplace diversity. The university hires only individuals authorized to work in the United States.

CANADA

UNIVERSITY OF ALBERTA
Department of Mathematical Sciences
Mathematical Biology (MB 2001)

The Department of Mathematical Sciences, University of Alberta, invites applications for an assistant professor tenure-track position in mathematical biology. We are looking for a person with a superb research record in complex biological systems involving partial differential equation models or related nonlinear spatial models. The successful applicant will interact with related groups in mathematical sciences (including an expanding mathematical biology group), as well as with other mathematical biology researchers outside the department. We are looking for a highly motivated person with excellent communication and teaching skills and a commitment to undergraduate and graduate education. Current research strengths in mathematical biology include ecology, epidemiology, and physiology. Applicants must have a Ph.D. in an area of mathematical biology. In accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada. If suitable Canadian citizens and permanent residents cannot be found, other individuals will be considered.

Applications should include a curriculum vitae, a research plan, and a teaching dossier. Candidates should arrange for at least three confidential letters of reference to be sent to: A. H. Rhemtulla, Chair, Department of Mathematical Sciences, University of Alberta, Edmonton, Alberta, T6G 2G1, Canada. The closing date for applications is Friday, March 16, 2001, or until a suitable candidate is found. Early applications are encouraged. For more information about the department and our university, please see our Web page, `http://www.math.ualberta.ca/`. The records arising from this competition will be managed in accordance with provisions of the Alberta Freedom of Information and Protection of Privacy Act (FOIPP).

The University of Alberta hires on the basis of merit. We are committed to the principle of equity in employment. We welcome diversity and encourage applications from all qualified women and men, including persons with disabilities, members of visible minorities, and aboriginal persons.

UNIVERSITY OF ALBERTA
Department of Mathematical Sciences
Mathematical Finance (MF-01)

The Department of Mathematical Sciences, University of Alberta, invites applications for a tenure-track position in mathematical finance. We are looking for a person with a strong record/outstanding potential for research, excellent communication and teaching skills, and leadership potential. The successful candidate must have a commitment to graduate and undergraduate education. Preference will be given to an individual whose research interests promote contact with other university researchers and/or industry. Current research strengths in the department include stochastic analysis and finance. The position requires a Ph.D. in a mathematical discipline and expertise in the areas of probability theory, stochastic analysis or stochastic differential equations, and mathematical finance.

Applications should include curriculum vitae, research plan, and a teaching dossier. Candidates should arrange for at least three confidential letters of reference to be sent to: A. H. Rhemtulla, Chair, Department of Mathematical Sciences, University of Alberta, Edmonton, Alberta, T6G 2G1, Canada. The closing date for applications is March 15, 2001, or until a suitable candidate is found. Early applications are encouraged. For more information about the department and our university, please see our Web page, `http://www.math.ualberta.ca/`. The records arising from this competition will be managed in accordance with provisions of the Alberta Freedom of Information and Protection of Privacy Act (FOIPP).

The University of Alberta hires on the basis of merit. We are committed to the principle of equity in employment. We welcome diversity and encourage applications from all qualified women and men, including persons with disabilities, members of visible minorities, and aboriginal persons.

UNIVERSITY OF TORONTO AT MISSISSAUGA
Department of Mathematics

Tenure-stream appointment in mathematics at Erindale. The University of Toronto solicits applications for a tenure-stream appointment in any area of pure or applied mathematics, with preference given to the areas of algebra and geometry.

The appointment is at the University of Toronto at Mississauga, Erindale College, at open rank, to begin July 1, 2001. Salary commensurate with experience. Candidates are expected to have demonstrated excellence in both teaching and research after the Ph.D.; in particular, a candidate's research record should show clearly the ability to make significant original and independent contributions to mathematics.

Applicants should send their complete C.V., including a list of publications, a short statement describing their research program, and all appropriate material about their teaching. They should also arrange to have at least four letters of reference sent directly to:

Search Committee
Department of Mathematics
University of Toronto
100 St. George Street, Room 4072
Toronto, Canada M5S 3G3

At least one letter should be primarily concerned with the candidate's teaching. In addition, it is recommended that applicants submit the electronic application form at http://www.math.toronto.edu/jobs/. The position code is ERIN.

To ensure full consideration, this information should be received by February 28, 2001.

The University of Toronto is strongly committed to diversity within its community. The university especially welcomes applications from visible minority group members, women, aboriginal persons, persons with disabilities, and others who may add to the diversity of ideas.

Any inquiries about the application should be sent to ida@math.toronto.edu.

HONG KONG

THE CHINESE UNIVERSITY OF HONG KONG
Department of Mathematics

Applications are invited for Department of Mathematics lecturer (carrying the academic title of assistant professor or associate professor, as appropriate) (Ref. 00/122(047)/2) (closing date: February 28, 2001).

Applicants should have an outstanding profile in both research and teaching, preferably with some experience in computer teaching. The department's research pursuits cover applied mathematics, algebra, analysis, and geometry. Appointment will initially be made on a fixed-term contract basis for one or two years. Starting salary will be commensurate with qualifications and experience.

Benefits include leave with full pay; medical/dental care; hospitalization benefits; where applicable, housing benefit for eligible appointee (subject to the rules for the prevention of double housing benefits); and a contract-end gratuity and/or university contribution to retirement scheme (totalling up to 15% of basic salary).

Further information about the university and the general terms of service for teaching appointees is available on our home page, http://www.cuhk.edu.hk/.

Application Procedure: Please send full résumé, copies of academic credentials, a publication list and/or abstracts of selected published papers, together with names and addresses (fax numbers/e-mail addresses as well, if available) of three referees to: Personnel Office, The Chinese University of Hong Kong, Shatin, New Territories, Hong Kong (fax: 852 2603 6852) on or before February 28, 2001. Please quote the reference number and mark "Application" on cover.

ITALY

INTERNATIONAL SCHOOL FOR ADVANCED STUDIES
Postdoctoral Positions

The International School for Advanced Studies (SISSA) in Trieste offers three postdoctoral positions in nonlinear differential equations and calculus of variations and one position in mathematical control theory, available in fall 2001 for one year, renewable for a second. Those interested can find the official announcement and the application form on SISSA's home page, http://www.sissa.it/. Deadline for receipt of applications: 30 March 2001.

SOUTH AFRICA

UNIVERSITY OF PRETORIA
Department of Mathematics and Applied Mathematics

The Department of Mathematics and Applied Mathematics at the University of Pretoria, South Africa, invites applications for one position as either lecturer, senior lecturer, associate professor, or full professor, rank depending on qualifications. The department will consider only applicants whose research interests fall in one of the following research areas: abstract analysis on operator algebras, stochastic processes and evolution operators; combinatorics and convex and discrete geometry; partial differential equations and financial mathematics. For a position at the associate professor or full professor level, the candidate should specialize in one of these areas: discrete geometry, stochastic analysis, or financial mathematics.

Deadline: Review of applications will begin on April 1, 2001, and will continue until the position is filled. For details regarding application requirements, consult: http://www.math.up.ac.za/; e-mail: astroh@math.up.ac.za.

PUBLICATIONS WANTED

MATHEMATICS BOOKS PURCHASED

Pure & appl. adv. & research level, any age, usable cond. Reprints OK. One box to whole libraries sought. Contact: Collier Brown or Ryan Thomas @ **Powell's Technical Bks.**, Portland, OR. Call 800-225-6911, fax 503-228-0505, or e-mail ryan.thomas@powells.com.

THE UNIVERSITY OF HONG KONG

香 港 大 學

The University of Hong Kong is one of the leading international comprehensive research universities in the Asia-Pacific region, with more than 100 departments and sub-divisions of studies and learning. There is currently an enrolment of more than 15,000 students (6,000 at postgraduate level). Research students come from more than 40 countries. The medium of instruction is English. The University is committed to its vision of globalisation, together with excellence in scholarship and research.

Associate Professor/ Assistant Professors in Mathematics

Applications are invited for appointments as (1) Associate Professor/Assistant Professor and (2) Assistant Professor in the Department of Mathematics (RF: 2000/2001-178), tenable from 1 September 2001. The appointments will initially be made on a three-year fixed-term basis, with a possibility of renewal, subject to availability of funding.

The Department of Mathematics provides a good solid general undergraduate education in mathematics, offers supervision in graduate study for students with a strong interest in and a capacity for mathematics and engages in research aiming at a high international standing.

Applicants should have a PhD degree and a good record of teaching and research in a main area of mathematics.

Annual salaries [attracting 15% (taxable) terminal gratuity] are on the following scales, with starting salary depending on qualifications and experience: **Associate Professor (in the grade of Senior Lecturer)** (9 points) HK$861,180 - HK$1,156,860 (approx. US$110,490 - US$148,425; US dollar equivalents as at 16 November 2000), **Assistant Professor (in the grade of Lecturer)** (11 points) HK$554,280 - HK$925,980* (approx. US$71,114 - US$118,803). *An appointee with an annual salary at HK$740,640 (approx. US$95,024) or above may be considered for the award of the title of Associate Professor on the basis of academic merits and achievements.

At current rates, salaries tax will not exceed 15% of gross income. The appointments carry leave, medical and dental benefits, an allowance for children's education in Hong Kong, and, where appropriate, a financial subsidy under the Home Financing Scheme for reimbursing either the actual rental payment or the mortgage repayment up to the relevant maximum entitlement may be provided.

Further particulars and application forms can be obtained at http://www.hku.hk/apptunit/; or from the Appointments Unit (Senior), Registry, The University of Hong Kong, Hong Kong (Fax (852) 2540 6735 or 2559 2058; e-mail: apptunit@reg.hku.hk). **Closes 28 February 2001.**

The University is an equal opportunity employer and enjoys a smoke-free environment

MATHEMATICS *from* HINDAWI

Abstract and Applied Analysis

Editor-in-Chief: A. G. Kartsatos (University of South Florida)

Aims & Scope: AAA is devoted exclusively to the publication of original research papers in the fields of abstract and applied analysis. Emphasis is placed on important developments in classical analysis, linear and nonlinear functional analysis, ordinary and partial differential equations, optimization theory, and control theory.

Subscription Information (ISSN 1085-3375, 2001, volume 6, 8 issues): $295 (print and electronic), $195 (electronic only), $195 (personal print and electronic), $95 (personal electronic only). Journal's web site: http://aaa.hindawi.com.

International Journal of Mathematics and Mathematical Sciences

Founding Managing Editor: L. Debnath (University of Central Florida)

Aims & Scope: IJMMS is devoted to the publication of original research papers, research notes, and research expository and survey articles with emphasis on unsolved problems and open questions in mathematics and mathematical sciences. All areas listed on the cover of Mathematical Reviews are included within the scope of the journal.

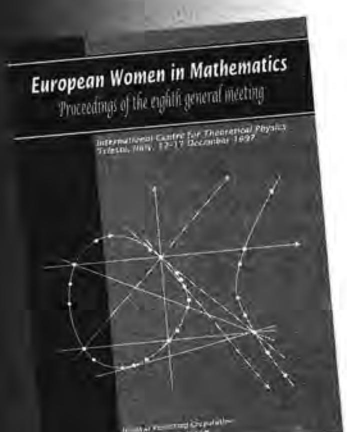
Subscription Information (ISSN 0161-1712, 2001, volumes 25-28, 48 issues): $495 (print and electronic), $395 (electronic only), $395 (personal print and electronic), $95 (personal electronic only). Journal's web site: http://ijmms.hindawi.com.

Journal of Applied Mathematics

Editors-in-Chief: C. Brezinski (Université des Sciences et Technologies de Lille), L. Debnath (University of Central Florida), H. Nijmeijer (Eindhoven University of Technology)

Aims & Scope: JAM is devoted to the publication of original research papers and review articles in all areas of applied, computational, and industrial mathematics.

Subscription Information (ISSN 1110-757X, 2001, volume 1, irregular): $295 (print and electronic), $195 (electronic only), $195 (personal print and electronic), $95 (personal electronic only). Journal's web site: http://jam.hindawi.com.



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Electronic Submission: Submit manuscripts to IJMMS at submit@ijmms.hindawi.com and to JAM at submit@jam.hindawi.com.

Books online: Symmetry in Nonlinear Mathematical Physics. Proceedings of EWM 8th and 9th general meetings. EWM Workshop on Moduli Spaces in Mathematics and Physics. Visit http://www.hindawi.com for more mathematics publications.

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AMS APPLICATION FOR MEMBERSHIP 2001

AMERICAN MATHEMATICAL SOCIETY

JANUARY—DECEMBER

WWW.AMS.ORG/MEMBERSHIP/

Please read the "Membership Categories" section of this form to determine the membership category for which you are eligible. Then fill out this application and return it as soon as possible.

Date _____________ **20** ___

____

Family Name First Middle

Place of Birth: ____

City State Country

Date of Birth: ____

Day Month Year

If formerly a member of AMS, please indicate dates ________________

Check here if you are now a member of either ☐ MAA or ☐ SIAM

Degrees, with institutions and dates ________________________________

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Present position ____

Firm or institution ____

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City State Zip/Country

Primary Fields of Interest (choose five from the list at right)

_______ _______ _______ _______ _______

Secondary Fields of Interest (choose from the list at right)

_______ _______ _______ _______ _______

_______ _______ _______ _______ _______

Address for all mail

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Telephone: home: (____)__________ office: (____)__________

Fax: (____)______________

E-mail: ____

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Signature

☐ ***Check here to receive free quarterly*** **PUBLICATIONS UPDATE** ***by mail.***

Fields of Interest

If you wish to be on the mailing lists to receive information about publications in fields of mathematics in which you have an interest, please consult the list of major headings below. These categories will be added to your computer record so that you will be informed of new publications or special sales in the fields you have indicated.

00 General
01 History and biography
03 Mathematical logic and foundations
05 Combinatorics
06 Order, lattices, ordered algebraic structures
08 General algebraic systems
11 Number theory
12 Field theory and polynomials
13 Commutative rings and algebras
14 Algebraic geometry
15 Linear and multilinear algebra; matrix theory
16 Associative rings and algebras
17 Nonassociative rings and algebras
18 Category theory, homological algebra
19 *K*-theory
20 Group theory and generalizations
22 Topological groups, Lie groups
26 Real functions
28 Measure and integration
30 Functions of a complex variable
31 Potential theory
32 Several complex variables and analytic spaces
33 Special functions
34 Ordinary differential equations
35 Partial differential equations
37 Dynamical systems and ergodic theory
39 Difference and functional equations
40 Sequences, series, summability
41 Approximations and expansions
42 Fourier analysis
43 Abstract harmonic analysis
44 Integral transforms, operational calculus
45 Integral equations
46 Functional analysis
47 Operator theory
49 Calculus of variations and optimal control; optimization
51 Geometry
52 Convex and discrete geometry
53 Differential geometry
54 General topology
55 Algebraic topology
57 Manifolds and cell complexes
58 Global analysis, analysis on manifolds
60 Probability theory and stochastic processes
62 Statistics
65 Numerical analysis
68 Computer science
70 Mechanics of particles and systems
74 Mechanics of deformable solids
76 Fluid mechanics
78 Optics, electromagnetic theory
80 Classical thermodynamics, heat transfer
81 Quantum theory
82 Statistical mechanics, structure of matter
83 Relativity and gravitational theory
85 Astronomy and astrophysics
86 Geophysics
90 Operations research, mathematical programming,
91 Game theory, economics, social and behavioral sciences
92 Biology and other natural sciences
93 Systems theory; control
94 Information and communication, circuits
97 Mathematics Education

Prepayment Methods and Mailing Addresses

All prices quoted in U.S. dollars.
Payment by check must be drawn on U.S. bank if paid in U.S. dollars.

Send checks, money orders, UNESCO coupons to American Mathematical Society, P.O. Box 845904, Boston, MA 02284-5904.

To use credit cards, fill in information requested and mail to American Mathematical Society, P.O. Box 6248, Providence, RI 02940-6248 or call (401) 455-4000 or 1-800-321-4AMS.

For Foreign Bank Transfers: Citizens Bank, 1 Citizens Drive, Riverside, RI 02915, ABA #011-500-120, for American Mathematical Society, Acct #1107802021.

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Account number **Expiration date**

M00NO

Membership Categories

Please read the following to determine what membership category you are eligible for, and then indicate below the category for which you are applying.

Introductory ordinary member rate applies to the first five ***consecutive*** years of ordinary membership. Eligibility begins with the first year of membership in any category other than student and nominee. Dues are $51.

For ***ordinary members*** whose annual professional income is below $75,000, the dues are $102; for those whose annual professional income is $75,000 or more, the dues are $136.

For a ***joint family membership,*** one member pays ordinary dues, based on his or her income; the other pays ordinary dues based on his or her income, less $20. (Only the member paying full dues will receive the *Notices* and the *Bulletin* as a privilege of membership, but both members will be accorded all other privileges of membership.)

Minimum dues for ***contributing members*** are $204. The amount paid which exceeds the higher ordinary dues level and is purely voluntary may be treated as a charitable contribution.

For either ***students*** or ***unemployed individuals,*** dues are $34, and annual verification is required.

The annual dues for ***reciprocity members*** who reside outside the U.S. are $68. To be eligible for this classification, members must belong to one of those foreign societies with which the AMS has established a reciprocity agreement, and annual verification is required. Reciprocity members who reside in the U.S. must pay ordinary member dues ($102 or $136).

The annual dues for ***category-S members,*** those who reside in developing countries, are $16. Members can chose only one privilege journal. Please indicate your choice below.

Members can purchase a ***multi-year membership*** by prepaying their current dues rate for either two, three, four or five years. This option is not available to category-S, unemployed, or student members.

2001 Dues Schedule (January through December)

Ordinary member, introductory rate			☐$51
Ordinary member		☐$102	☐$136
Joint family member (full rate)		☐$102	☐$136
Joint family member (reduced rate)		☐$82	☐$116
Contributing member (minimum $204)			☐
Student member (please verify)[1]			☐$34
Unemployed member (please verify)[2]			☐$34
Reciprocity member (please verify)[3]	☐$68	☐$102	☐$136
Category-S member[4]			☐$16
Multi-year membership	$........	for........	years

[1] ***Student Verification*** (sign below)
I am a full-time student at ______________________________

______________________________ currently working toward a degree.

[2] ***Unemployed Verification*** (sign below) I am currently unemployed and actively seeking employment.

[3] ***Reciprocity Membership Verification*** (sign below) I am currently a member of the society indicated on the right and am therefore eligible for reciprocity membership.

____
Signature

[4] ☐ ***send*** **NOTICES** ☐ ***send*** **BULLETIN**

Reciprocating Societies

- ☐ Allahabad Mathematical Society
- ☐ Australian Mathematical Society
- ☐ Azerbaijan Mathematical Society
- ☐ Balkan Society of Geometers
- ☐ Berliner Mathematische Gessellschaft
- ☐ Calcutta Mathematical Society
- ☐ Canadian Mathematical Society
- ☐ Croatian Mathematical Society
- ☐ Cyprus Mathematical Society
- ☐ Dansk Matematisk Forening
- ☐ Deutsche Mathematiker-Vereinigung
- ☐ Edinburgh Mathematical Society
- ☐ Egyptian Mathematical Society
- ☐ European Mathematical Society
- ☐ Gesellschaft für Angewandte Mathematik und Mechanik
- ☐ Glasgow Mathematical Association
- ☐ Hellenic Mathematical Society
- ☐ Icelandic Mathematical Society
- ☐ Indian Mathematical Society
- ☐ Iranian Mathematical Society
- ☐ Irish Mathematical Society
- ☐ Israel Mathematical Union
- ☐ János Bolyai Mathematical Society
- ☐ The Korean Mathematical Society
- ☐ London Mathematical Society
- ☐ Malaysian Mathematical Society
- ☐ Mathematical Society of Japan
- ☐ Mathematical Society of Serbia
- ☐ Mathematical Society of the Philippines
- ☐ Mathematical Society of the Republic of China
- ☐ Mongolian Mathematical Society
- ☐ Nepal Mathematical Society
- ☐ New Zealand Mathematical Society
- ☐ Nigerian Mathematical Society
- ☐ Norsk Matematisk Forening
- ☐ Österreichische Mathematische Gesellschaft
- ☐ Palestine Society for Mathematical Sciences
- ☐ Polskie Towarzystwo Matematyczne
- ☐ Punjab Mathematical Society
- ☐ Ramanujan Mathematical Society
- ☐ Real Sociedad Matemática Española
- ☐ Saudi Association for Mathematical Sciences
- ☐ Singapore Mathematical Society
- ☐ Sociedad Colombiana de Matemáticas
- ☐ Sociedad Española de Matemática Aplicada
- ☐ Sociedad de Matemática de Chile
- ☐ Sociedad Matemática de la Republica Dominicana
- ☐ Sociedad Matemática Mexicana
- ☐ Sociedad Uruguaya de Matemática y Estadística
- ☐ Sociedade Brasileira Matemática
- ☐ Sociedade Brasileira de Matemática Aplicada e Computacional
- ☐ Sociedade Paranaense de Matemática
- ☐ Sociedade Portuguesa de Matemática
- ☐ Societat Catalana de Matemàtiques
- ☐ Societatea de Ştiinţe Matematice din România
- ☐ Societatea Matematicienilor din Romania
- ☐ Société Mathématique de Belgique
- ☐ Société Mathématique de France
- ☐ Société Mathématique du Luxembourg
- ☐ Société Mathématique Suisse
- ☐ Société Mathématiques Appliquées et Industrielles
- ☐ Society of Associations of Mathematicians & Computer Science of Macedonia
- ☐ Society of Mathematicians, Physicists, and Astronomers of Slovenia
- ☐ South African Mathematical Society
- ☐ Southeast Asian Mathematical Society
- ☐ Suomen Matemaattinen Yhdistys
- ☐ Svenska Matematikersamfundet
- ☐ Ukrainian Mathematical Society
- ☐ Union Mathemática Argentina
- ☐ Union of Bulgarian Mathematicians
- ☐ Union of Czech Mathematicians and Physicists
- ☐ Union of Slovak Mathematicians and Physicists
- ☐ Unione Matematica Italiana
- ☐ Vijnana Parishad of India
- ☐ Wiskundig Genootschap

Meetings & Conferences of the AMS

IMPORTANT INFORMATION REGARDING MEETINGS PROGRAMS: AMS Sectional Meeting programs do not appear in the print version of the *Notices*. However, comprehensive and continually updated meeting and program information with links to the abstract for each talk can be found on e-MATH. See `http://www.ams.org/meetings/`. Programs and abstracts will continue to be displayed on e-MATH in the Meetings and Conferences section until about three weeks after the meeting is over. Final programs for Sectional Meetings will be archived on e-MATH in an electronic issue of the *Notices* as noted below for each meeting.

Columbia, South Carolina

University of South Carolina

March 16-18, 2001

Meeting #963

Southeastern Section
Associate secretary: John L. Bryant
Announcement issue of *Notices*: January 2001
Program first available on e-MATH: February 1, 2001
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: Volume 22, Issue 2

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: January 23, 2001

Invited Addresses

David C. Brydges, University of Virginia, *Title to be announced.*

Albert A. Cohen, University of Paris VI, *Harmonic analysis and image processing.*

Herbert Edelsbrunner, Duke University, *Title to be announced.*

Daniel J. Kleitman, Massachusetts Institute of Technology, *Title to be announced.*

Carl Pomerance, Bell Laboratories - Lucent Technologies, *Title to be announced* (Erdős Memorial Lecture).

Special Sessions

Algebraic Structures Associated with Lie Theory (Code: AMS SS B1), **Ben L. Cox**, **Elizabeth Jurisich**, and **Oleg Smirnov**, College of Charleston.

Algebras, Lattices, Varieties (Code: AMS SS K1), **George F. McNulty**, University of South Carolina, and **Ralph S. Freese** and **James B. Nation**, University of Hawaii.

Analytic Number Theory (Code: AMS SS H1), **Michael A. Filaseta** and **Ognian Trifonov**, University of South Carolina, Columbia.

Approximation and Wavelets (Code: AMS SS D1), **Konstantin Oskolkov**, **Pencho Petrushev**, and **Vladimir Temlyakov**, University of South Carolina, Columbia.

Banach Spaces (Code: AMS SS E1), **George Androulakis**, **Stephen Dilworth**, and **Maria K. Girardi**, University of South Carolina, Columbia.

Combinatorics and Graph Theory (Code: AMS SS C1), **Jerrold R. Griggs**, University of South Carolina, Columbia.

Discrete and Computational Geometry and Graph Drawing (Code: AMS SS A1), **Farhad Shahrokhi**, University of North Texas, and **Laszlo A. Szekely**, University of South Carolina, Columbia.

Geometry of Curves and Surfaces (Code: AMS SS F1), **Mohammad Ghomi** and **Ralph E. Howard**, University of South Carolina, Columbia.

Mathematical Biology (Code: AMS SS J1), **Douglas B. Meade**, **Matthew Miller**, and **David Wethey**, University of South Carolina, Columbia.

Semigroups and Evolution Equations (Code: AMS SS G1), **Anton R. Schep**, University of South Carolina, Columbia.

Lawrence, Kansas

University of Kansas

March 30–31, 2001

Meeting #964

Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: February 2001
Program first available on e-MATH: February 15, 2001
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: Volume 22, Issue 2

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: February 6, 2001

Invited Addresses

S. Dale Cutkosky, University of Missouri, *Monomialization of morphisms.*

Alexandre Eremenko, Purdue University, *Rational functions with real critical points.*

Ken Ono, University of Wisconsin-Madison, *Title to be announced.*

Yongbin Ruan, University of Wisconsin-Madison, *Stringy geometry and topology of orbifolds.*

Special Sessions

Algebraic Geometry (Code: AMS SS C1), **Christopher Peterson**, Colorado State University, and **B. P. Purnaprajna**, University of Kansas.

C-Algebras and Crossed Products* (Code: AMS SS G1), **Steve Kaliszewski**, Arizona State University, and **May Nilsen**, Texas A&M University.

Commutative Algebra (Code: AMS SS A1), **Craig Huneke** and **Daniel Katz**, University of Kansas.

Complex Variables (Code: AMS SS M1), **Pietro Poggi-Corradini**, Kansas State University.

Deformation Theory (Code: AMS SS N1), **Yan Soibelman** and **David Yetter**, Kansas State University.

Harmonic Analysis and Applications (Code: AMS SS K1), **Rodolfo Torres**, University of Kansas.

Number Theory (Code: AMS SS D1), **Ken Ono**, University of Wisconsin-Madison, **Cristian Popescu**, University of Texas at Austin, and **Tonghai Yang**, Harvard University.

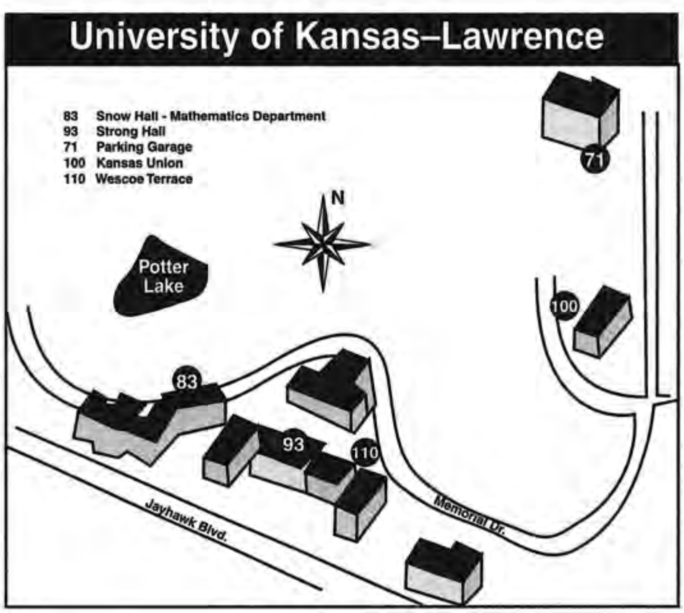
Optimal Control, Calculus of Variations, and Nonsmooth Analysis (Code: AMS SS J1), **Michael Malisoff**, Texas A&M University, Corpus Christi, and **Peter R. Wolenski**, Louisiana State University.

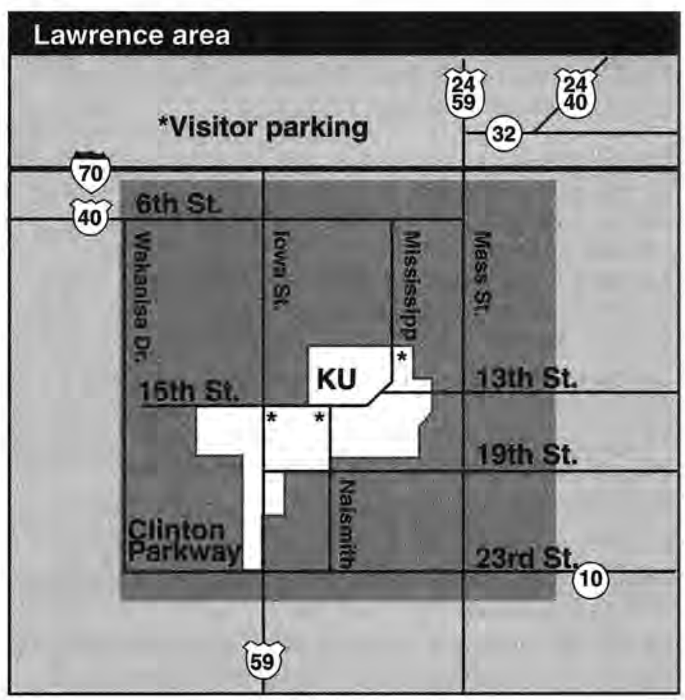
PDEs and Geometry (Code: AMS SS F1), **Marianne Korten** and **Lev Kapitanski**, Kansas State University.

Polytopes (Code: AMS SS H1), **Margaret Bayer** and **Carl Lee**, University of Kansas.

Progress in Numerical Linear Algebra (Code: AMS SS E1), **Ralph Byers**, University of Kansas.

Quantization and Operator Algebras (Code: AMS SS L1), **Albert Sheu**, University of Kansas.





Set Theoretic Topology and Boolean Algebra (Code: AMS SS B1), **William Fleissner**, University of Kansas.

Accommodations

Participants should make their own arrangements directly with the hotel of their choice and request the AMS Sectional Meeting or Mathematics Department-UK discount. The AMS is not responsible for rate changes or for the quality of the accommodations. The Mathematics Department will provide a limited shuttle service from the hotels to the meeting site at the start and end of each day.

Best Western Hallmark Inn, 730 Iowa Street, Lawrence, KS 66044; 785-841-6500 or fax 785-841-6612; $40/single, $45/double, plus taxes. Deadline for reservations is February 28, 2001.

Eldridge Hotel, 701 Massachusetts St., Lawrence, KS 66044; 785-749-5011, 800-527-0909, or fax 785-749-4512; $88/single suite, $147/double or king, plus taxes. Deadline for reservations is February 28, 2001.

Hampton Inn, 2300 West Sixth Street, Lawrence, KS 66049; 785-841-4994 or fax 785-841-7997; $58/single or double, plus taxes. Deadline for reservations is February 13, 2001.

Holiday Inn-Holidome, 200 McDonald Drive, Lawrence, KS 66044; 785-841-7077 or fax 785-841-2799; $72/single or double, plus taxes. Deadline for reservations is February 28, 2001.

Travelodge Motel, 801 Iowa St., Lawrence, KS 66044; 785-5100; $45/single or double, plus taxes. Deadline for reservations is February 28, 2001.

Victorian Veranda Country Inn, 1431 N. 1900 Road (two miles north of town; will need car); 785-841-1265; $110/queen or king, includes breakfast plus taxes. Deadline for reservations is February 28, 2001.

Westminster Inn & Suites, 2525 W. Sixth Street, Lawrence, KS 66049; 785-841-8410 or fax 785-841-1901; $54/single, $65/double, $74/suite, plus taxes. Deadline for reservations is February 28, 2001.

Food Service

Food service is available on campus at Wescoe Terrace Snack Bar and the Kansas Union. Wescoe Terrace is open on Monday through Friday from 7:30 a.m. to 4:00 p.m. and offers a deli bar, salad bar, pizza, and hot dogs. The Kansas Union food services are available on Level 3. The Union Square is open on Friday from 8:00 a.m. to 2:30 p.m. and offers a variety from salad and sandwich bars to Mexican, hamburgers, and hot entrées. The Hawk's Nest is open Friday from 7:00 a.m. to 5:30 p.m. and Saturday from 10:00 a.m. to 3:00 p.m. and offers deli sandwiches. The Prairie Room is open Friday 11:00 a.m.-2:00 p.m. and has waiter service and daily specials. There is a sandwich shop and vegetarian restaurant located near campus. There are numerous restaurants located downtown on Massachusetts Street and west of campus on Iowa Street.

Local Information

The University of Kansas home page is at `http://www.ukans.edu/`, the mathematics department home page is at `http://www.math.ukans.edu/`, a complete map of the campus is at `http://www.math.ukans.edu/maps/index.html`, a visitor's guide of the Lawrence area and attractions is at `http://www.ukans.edu/especially/visitors.html`. The mathematics department home page has links to all these addresses and more.

Other Activities

AMS Book Sale: Examine the newest titles from the AMS! Most books will be available at a special 50% discount offered only at meetings. Complimentary coffee will be served, courtesy of AMS Membership Services.

Social event: The mathematics department invites all participants to a reception on Friday from 6:00 p.m. to 8:00 p.m. at the UK Alumni Center, across from the Kansas Union. Appetizers will be provided. Cash bar. The Society thanks the UK mathematics department for its gracious hospitality.

Parking

Parking is restricted on Friday. Most lots require a permit. There is a garage located next to the Kansas Union at a cost of $1.00 per hour, which must be prepaid. On Saturday parking is open and free. If you are ticketed in a restricted lot, forward the ticket to the UK mathematics department.

Registration and Meeting Information

The registration desk will be located in the third floor lobby in Snow Hall and will be open from 7:30 a.m. to 4:30 p.m. on Friday, and from 8:00 a.m. to noon on Saturday. Talks will take place in Snow and Strong Halls, located on the UK campus on Jayhawk Boulevard.

Registration fees: (payable on-site only) $40/AMS members; $60/nonmembers; $5/emeritus members, students, or unemployed mathematicians. Fees are payable by cash, check, VISA, MasterCard, Discover, or American Express.

Travel

Lawrence is conveniently located just 45 minutes west of Kansas City and 30 minutes east of Topeka (state capital). Easily accessible through Kansas City International Airport (KCI), Greyhound, Amtrak and Interstate 70.

By air: The following specially negotiated rates on USAirways are available exclusively to mathematicians and their families for the period March 27–April 3, 2001. Discounts apply only to travel within the continental U.S. Other restrictions may apply, and seats are limited. Receive a 5% discount off First or Envoy Class and any published USAirways promotional round-trip fare. By purchasing your ticket 60 days or more prior to departure, you can receive an additional bonus discount. Or you may receive a 10% discount off unrestricted coach fares with seven-day advance purchase. For reservations call (or have your travel agent call) USAirways Group and Meeting Reservation Office toll-free at 877-874-7687 between 8:00 a.m. and 9:30 p.m. Eastern Time. Refer to **Gold File number 8811579**.

Kansas City International Airport (KCI), 45 miles northeast, is served by most national airline carriers. Airport limousine and shuttle service is available between Lawrence and KCI via: KCI Roadrunner, 785-842-2432 (picks up and drops off from the Lawrence Holidome); Affordable Limo and Shuttle Service, 841-0463/841-3670 (holiday service only); Superior Shuttle, 1-888-795-3914/785-838-4500.

Driving: From the east (KCI): Take I-29N, which becomes I-29N/I-435W to I-435S (a short distance), Exit 17, towards Topeka. Take I-435S to I-70W/Kansas Turnpike, Exit 12. I-70 takes you to Lawrence, approx. 25 miles. Take the East Lawrence exit, turn left onto North Second Street. Go across the Kansas River Bridge and turn right onto Sixth Street. Take Sixth Street to Mississippi, turn left. (The Kansas Union and parking garage are at 12th and Mississippi. Parking at the football stadium is across the street.) Continue on Mississippi to get to the meeting site. Turn right before reaching the parking booth. This will take you behind Snow Hall. The hotels can be easily reached by taking the West Lawrence exit to Iowa Street (59HWY).

From the west: If you are coming on the Kansas Turnpike, exit at the East Lawrence exit and proceed as "From the east".

Car rental: Special rates have been negotiated with Avis Rent A Car for the period March 23–April 7, 2001. All rates include unlimited free mileage; the weekend rates quoted are available from noon Thursday until Monday at 11:59 p.m. Rates do not include state or local surcharges, taxes, optional coverages, or gas refueling charges. Renter must meet Avis's age, driver, and credit requirements. Make reservations by calling 800-331-1600 or online at `http://www.avis.com/`. Nonweekend and weekly rates are also available. Please quote **Avis Discount Number J098887** when making reservations.

Daily weekend rates are: Subcompact, $22.99; Compact, $23.99; Intermediate, $24.99; Full-size (2-door), $25.99, Full-size (4-door), $26.99; Premium, $29.99; Luxury, $70.99; Minivan, $70.99; and Sport Utility, $70.99.

Weather

The weather should be mild, with temperatures ranging from 50° to 70°. In the spring there is a chance of rain.

Las Vegas, Nevada

University of Nevada

April 21–22, 2001

Meeting #965

Western Section
Associate secretary: Bernard Russo
Announcement issue of *Notices*: February 2001
Program first available on e-MATH: March 8, 2001
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: Volume 22, Issue 2

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: February 27, 2001

Invited Addresses

Panagiota Daskalopoulos, University of California Irvine, *Title to be announced.*

Randall J. LeVeque, University of Washington, *Title to be announced.*

Vera Serganova, University of California Berkeley, *Title to be announced.*

Lynne Walling, University of Colorado, *Title to be announced.*

Special Sessions

Analysis and Applications of Nonlinear PDEs (Code: AMS SS G1), **David G. Costa**, **Zhonghai Ding**, and **Hossein Tehrani**, University of Nevada, Las Vegas.

Finite Element Analysis and Applications (Code: AMS SS B1), **Jichun Li**, **Michael Marcozzi**, **George Miel**, and **Darrell W. Pepper**, University of Nevada.

Geometric and Computational Group Theory (Code: AMS SS A1), **Eric M. Freden**, Southern Utah University, and **Eric L. Swenson**, Brigham Young University.

Graphs and Digraphs (Code: AMS SS C1), **Michael Jacobson**, University of Louisville, and **K. Brooks Reid**, California State University, San Marcos.

History of Mathematics (Code: AMS SS J1), **Shawnee L. McMurran**, California State University, San Bernadino, **Adrian Rice**, Randolph-Macon College, and **James Tattersall**, Providence College.

Number Theory with a Geometric Flavor (Code: AMS SS K1), **Arthur Baragar**, University of Nevada, Las Vegas.

PDEs from Fluid Mechanics: Applied Analysis and Numerical Methods (Code: AMS SS H1), **L. Steven Hou**, York University and Iowa University, and **Xiaoming Wang**, Iowa State University.

Physical Knotting and Unknotting (Code: AMS SS D1), **Jorge Alberto Calvo**, North Dakota State University, **Kenneth C. Millett**, University of California Santa Barbara, and **Eric J. Rawdon**, Chatham College.

Set Theory (Code: AMS SS E1), **Douglas Burke** and **Derrick Dubose**, University of Nevada, Las Vegas.

Topology of Links (Code: AMS SS F1), **Jeff Johannes**, University of Nevada, Las Vegas, and **Swatee Naik**, University of Nevada, Reno.

Waves in Heterogeneous Media (Code: AMS SS L1), **Randall J. LeVeque**, University of Washington, and **Knut Solna**, University of California Irvine.

Accommodations

Participants should make their own arrangements directly with the hotel of their choice and request the American Mathematical Society discount. The AMS is not responsible for rate changes or for the quality of the accommodations.

Howard Johnson Inn, 5100 Paradise Road, Las Vegas, NV (1/2 mile to CBC); 702-798-2777 or toll-free 800-634-6439; $49 single or double. Deadline for reservations is

March 20, 2001. N.B. Cancellations must be made 14 days prior to date of arrival in order to receive a refund.

Wellesley Inn & Suites, 1550 East Flamingo Road, Las Vegas, NV; 702-731-3111; $129 for a suite. Deadline for reservations is March 19, 2001. N.B. Cancellations must be made by March 19 in order to receive a refund.

Key Largo Casino & Hotel, 377 East Flamingo Road, Las Vegas, NV: 702-733-7777 or toll-free 800-634-6617; all rates are single or double as follows: $39.99 Sunday through Thursday, $59.99 Friday and Saturday. A two-night minimum stay is required for Saturday arrivals. Deadline for reservations is March 19, 2001. N.B. Cancellations must be made up to 48 hours prior to arrival in order to receive a refund.

Food Service

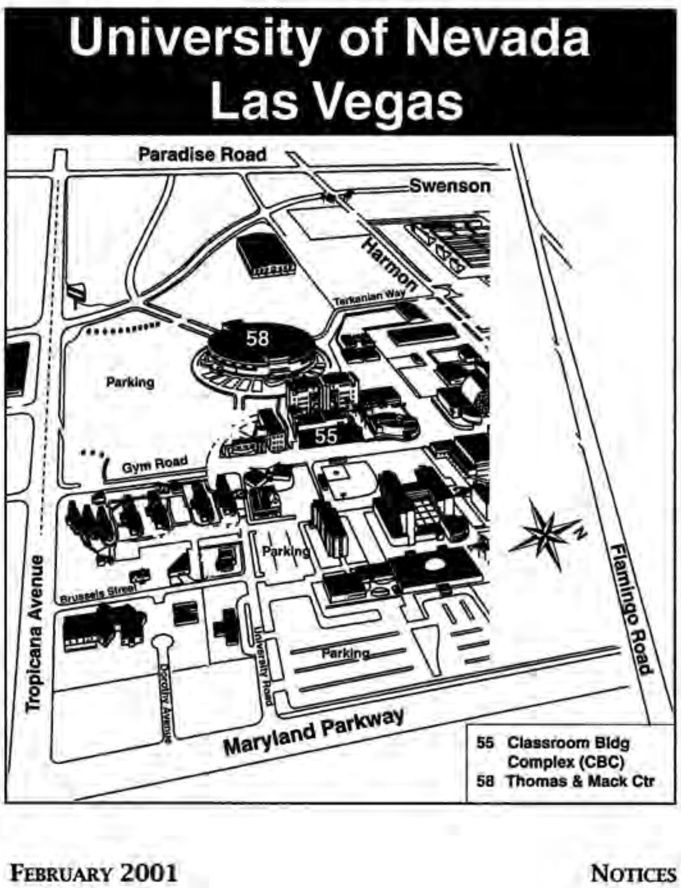
There are a number of restaurants adjacent to the campus. A list of restaurants will be available at the registration desk.

Local Information

Please visit the Web site maintained by the Department of Mathematics at `http://www.unlv.edu/Colleges/Sciences/Mathematics/` and the University of Nevada Web site, `http://www.unlv.edu/`. A campus map can be found at `http://www.unlv.edu/Campus_Map/`.

Other Activities

AMS Book Sale: Examine the newest titles from the AMS! Most books will be available at a special 50% discount offered only at meetings. Complimentary coffee will be served, courtesy of AMS Membership Services.



Parking

Participants should park in the Thomas & Mack parking area and may use any meter, student, or staff area. There is no charge for weekend parking.

Registration and Meeting Information

The registration desk will be located in the second floor lobby of Classroom Building Complex-C (CBC-C) and will be open from 7:30 a.m. to 4:30 p.m. on Saturday and from 8:00 a.m. to noon on Sunday. The four invited talks will be in Building A of the Classroom Building Complex (CBC-A). All other talks are in Building C of the Classroom Building Complex (CBC-C).

Registration fees: (payable on-site only) $40/AMS members; $60/nonmembers; $5/emeritus members, students, or unemployed mathematicians. Fees are payable by cash, check, VISA, MasterCard, Discover, or American Express.

Travel

The following specially negotiated rates on USAirways are available exclusively to mathematicians and their families for the period April 18-25, 2001. Discounts apply only to travel within the continental U.S. Other restrictions may apply, and seats are limited. Receive a 5% discount off First or Envoy Class and any published USAirways promotional round-trip fare. By purchasing your ticket 60 days or more prior to departure, you can receive an additional bonus discount. Or you may receive a 10% discount off unrestricted coach fares with seven-day advance purchase. For reservations call (or have your travel agent call) USAirways Group and Meeting Reservation Office toll-free at 877-874-7687 between 8:00 a.m. and 9:30 p.m. Eastern Time. Refer to **Gold File number 8811579**.

By air: McCarren International Airport is located approximately two miles from the UNLV campus. Taxi, shuttle, limo, and car rental services are readily available at the airport.

Driving: UNLV is located north of the Tropicana Avenue and Maryland Parkway intersection. The airport exits by way of Swenson Avenue to Tropicana Avenue. From Swenson go right onto Tropicana, then left onto Thomas & Mack Drive.

Car rental: Special rates have been negotiated with Avis Rent A Car for the period April 14-29, 2001. All rates include unlimited free mileage; the weekend rates quoted are available from noon Thursday until Monday at 11:59 p.m. Rates do not include state or local surcharges, taxes, optional coverages, or gas refueling charges. Renter must meet Avis's age, driver, and credit requirements. Make reservations by calling 800-331-1600 or online at `http://www.avis.com/`. Nonweekend and weekly rates are also available. Please quote **Avis Discount Number J098887** when making reservations.

Daily weekend rates are: Subcompact, $22.99; Compact, $23.99; Intermediate, $24.99; Full-size (2-door), $25.99, Full-size (4-door), $26.99; Premium, $29.99; Luxury, $70.99; Minivan, $70.99; and Sport Utility, $70.99.

Weather

The average high and low temperatures in April are 78°F and 50°F. The climate is typically dry, with an average of .17 inches of rainfall in April.

Hoboken, New Jersey

Stevens Institute of Technology

April 28–29, 2001

Meeting #966

Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: February 2001
Program first available on e-MATH: March 15, 2001
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: Volume 22, Issue 2

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: March 6, 2001

Invited Addresses

Alexander Barvinok, University of Michigan, Ann Arbor, *Title to be announced.*

Robert Calderbank, AT&T Laboratories Research, *Title to be announced.*

Alexei Miasnikov, City College, New York, *Title to be announced.*

Frank Sottile, University of Massachusetts at Amherst, *Title to be announced.*

Special Sessions

Analytic Number Theory (Code: AMS SS A1), **Milos A. Dostal**, Stevens Institute of Technology, and **Werner G. Nowak**, Vienna, Austria.

Computational Algebraic Geometry and Its Applications (Code: AMS SS B1), **Serkan Hosten**, San Francisco State University, and **Frank Sottile**, University of Massachusetts at Amherst.

Computational Group Theory (Code: AMS SS C1), **Robert Gilman**, Stevens Institute of Technology; and **Alexei Myasnikov**, **Vladimir Shpilrain**, and **Sean Cleary**, City College, New York.

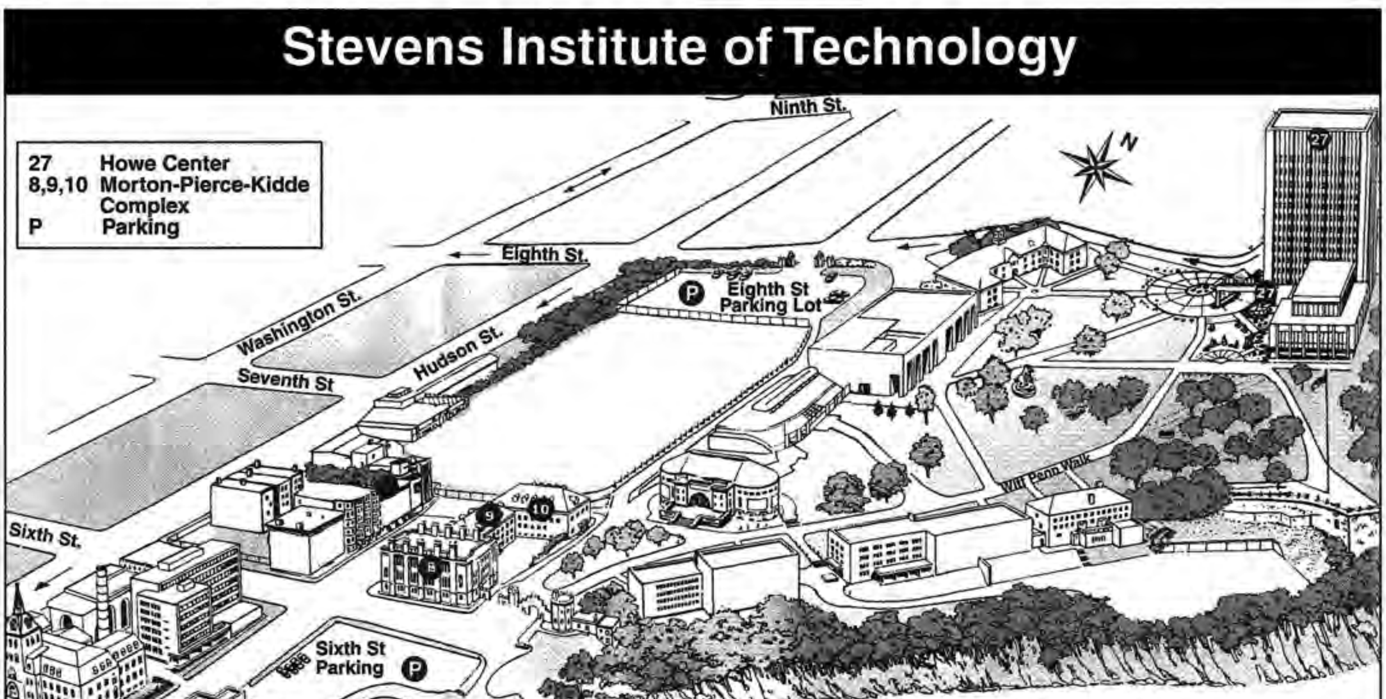
Deformation Quantization and Its Applications (Code: AMS SS K1), **Siddhartha Sahi**, Rutgers University, and **Martin J. Andler**, University of Versailles.

Graph Theory (Dedicated to Frank Harary on His 80th Birthday) (Code: AMS SS M1), **Michael L. Gargano** and **Louis V. Quintas**, Pace University, and **Charles Suffel**, Stevens Institute of Technology.

History of Mathematics (Code: AMS SS E1), **Patricia R. Allaire**, Queensborough Community College, CUNY, and **Robert E. Bradley**, Adelphi University.

Matchings in Graphs and Hypergraphs (Code: AMS SS F1), **Alexander Barvinok**, University of Michigan, and **Alex Samorodnitsky**, Institute for Advanced Study.

Quantum Error Correction and Related Aspects of Coding Theory (Code: AMS SS J1), **Harriet S. Pollatsek**, Mount Holyoke College, and **M. Beth Ruskai**, University of Massachusetts at Lowell.



Ricci Curvature and Related Topics (Code: AMS SS G1), **George I. Kamberov**, Stevens Institute of Technology, **Christina Sormani**, Lehman College, CUNY, and **Megan M. Kerr**, Wellesley College.

Singular and Degenerate Nonlinear Elliptic Boundary Value Problems (Code: AMS SS D1), **Joe McKenna**, **Changfeng Gui**, and **Yung Sze Choi**, University of Connecticut.

Stability of Nonlinear Dispersive Waves (Code: AMS SS H1), **Yi Li**, Stevens Institute of Technology, and **Keith S. Promislow**, Simon Fraser University.

Surface Geometry and Shape Perception (Code: AMS SS L1), **Gary R. Jensen**, Washington University, and **George I. Kamberov**, Stevens Institute of Technology.

Wavelets, Multiscale Analysis, and Applications (Code: AMS SS N1), **Ivan Selesnick**, Polytechnic University.

Accommodations

Participants should make their own arrangements directly with a hotel of their choice. Special rates have been negotiated at the hotel listed below. Rates quoted do not include sales tax of 12%. The AMS is not responsible for rate changes or for the quality of the accommodations. When making a reservation, participants should state that they are with the American Mathematical Society meeting at Stevens.

Double Tree Club Suites, 455 Washington Blvd., Jersey City, NJ 07310; 201-499-2400; fax 201-499-2406. $109/night for 4/27, 4/28, and 4/29; $149/night for 4/25, 4/26, 4/30, and 5/1. This is a comfortable facility with many amenities, including a bar and restaurant serving light meals. Check-in time is 3:00 p.m. It is about three miles from the hotel to the campus. Participants may choose to take the PATH transit system, about one block from the hotel. The ride takes a few minutes and will drop you off six streets from the campus. **The deadline for reservations is March 25, 2001**.

Food Service and Local Information

Colonel Johns and the cafeteria on campus are available for breakfast, lunch, and dinner. Both are located in the Howe Center. An extensive list of restaurants will be included in the program. For information about the Stevens campus see `http://www.stevens-tech.edu/`. The Department of Mathematical Sciences site is at `http://attila.stevens-tech.edu/math/`. A full campus map is at `http://www.stevenstech.edu/eci/about/map.html`.

Other Activities

AMS Book Sale: Examine the newest titles from the AMS. Most books will be available at a special 50% discount offered only at meetings. Complimentary coffee will be served courtesy of AMS Membership Services.

Reception

On Saturday, April 28, a reception hosted by the Department of Mathematical Sciences will be held in the magnificent Great Hall of the Samuel Williams Library on campus. All participants are invited. The Society thanks the department for its gracious hospitality.

Registration and Meeting Information

Registration and exhibits will be in the Howe Center, Bissinger Room, 4th floor, on Saturday from 7:30 a.m. to 4:30 p.m. and on Sunday from 8:00 a.m. to noon. All sessions will take place in the Morton-Pierce-Kidde complex.

Registration fees: (payable on site only) $40/AMS or CMS members; $60/nonmembers; $5/emeritus members, students, or unemployed mathematicians. Fees are payable by cash, check, VISA, MasterCard, Discover, or American Express.

Parking

There will be limited complimentary parking in the Eighth and Sixth St. lots on Saturday and Sunday. Street parking is also allowed, but be mindful of signs. If you plan to park in the campus lots, please send e-mail to Katherine Connors at Stevens, `kconnors@stevens-tech.edu`, so that appropriate space can be secured. There is a public parking lot located two blocks south of campus at a cost of $2.00 per hour.

Travel

The closest airport is Newark Airport, located about ten miles from the Stevens campus.

The following specially negotiated rates on USAirways are available exclusively to mathematicians and their families for the period April 25–May 2, 2001. Discounts apply only to travel within the continental U.S. Other restrictions may apply, and seats are limited. Receive a 5% discount off First or Envoy Class and any published USAirways promotional round-trip fare. By purchasing your ticket 60 days or more prior to departure, you can receive an additional 5% bonus discount. Or you may receive a 10% discount off unrestricted coach fares with seven-day advance purchase. For reservations call (or have your travel agent call) USAirways Group and Meeting Reservation Office toll-free at 877-874-7687 between 8:00 a.m. and 9:30 p.m. Eastern Time. Refer to **Gold File number 88111579**.

Taxi fare is approximately $35, and the trip takes about 20–30 minutes. You may also take New Jersey Transit's bus service (800-772-3606) to Penn Station, Newark. Take the PATH train for $1 to Exchange Place and switch to the train for Hoboken (HOB).

Driving directions: From the north: I-95 South to the New Jersey Turnpike South, Exit 17-Lincoln Tunnel. Or the Garden State Parkway South, Exit 153-Route 3 East will turn into Route 495 East going toward the Lincoln Tunnel. Exit at "Weehawken/Hoboken-Last Exit in NJ". Get in the right lane, go to the bottom of the hill, and turn right. Proceed straight to 14th Street, following the signs for Hoboken.

From all points south and west: Take the Garden State Parkway or the New Jersey Turnpike North, Exit 16E (if coming from the south) or Exit 17 (if coming from the west) to Route 3 East to Route 495-Lincoln Tunnel, and follow as above.

From Long Island and New York City: Take the Midtown Tunnel to the Lincoln Tunnel. Bear to extreme right at the end of the tunnel. Exit immediately at "Hoboken-Local Streets" and proceed straight to 14th Street in Hoboken.

Once at 14th Street in Hoboken, turn left at the traffic light onto 14th St. Proceed to the end and turn right onto Hudson St. Go through several traffic lights, staying right at the fork. Turn left onto 9th St., then two blocks to Castle Point Terrace, and turn right onto the 8th St. parking lot one block ahead. There is also a parking lot on 6th St. When in doubt, just follow the red "Stevens" signs located at entrances to and throughout Hoboken.

By train: New Jersey Transit trains stop at the Hoboken station. All other trains stop at Penn Station, Newark, or Penn Station, New York City. From Newark take a cab to campus for about $30 or the PATH train for $1 to Exchange Place and switch trains to Hoboken (HOB). From New York City walk one block to 33rd St. and take the PATH train for $1 to Hoboken. From the Hoboken station, Stevens is a 10-minute walk up River St. Taxi fare is about $3.

Weather

Typical spring weather in the New York area is about 60°F with cooler evenings.

Morelia, Mexico

May 23–26, 2001

Meeting #967

Fifth International Joint Meeting of the AMS and the Sociedad Matemática Mexicana (SMM).
Associate secretary: John L. Bryant
Announcement issue of *Notices*: To be announced
Program first available on e-MATH: Not applicable
Program issue of electronic *Notices*: Not applicable
Issue of *Abstracts*: Not applicable

Deadlines

For organizers: To be announced
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Invited Addresses

Víctor Pérez Abreu, CIMAT, *Title to be announced.*

Eric M. Friedlander, Northwestern University, *Title to be announced.*

Helmut H. W. Hofer, Courant Institute, New York University, *Title to be announced.*

Ernesto A. Lacomba, UAM-I, *Title to be announced.*

Claude R. LeBrun, SUNY at Stony Brook, *Title to be announced.*

Antonmaría Minzoni, IIMAS-UNAM, *Title to be announced.*

Special Sessions

Algebraic Geometry, **Pedro Luis del Angel**, CIMAT, and **Javier Elizondo**, IMATE-UNAM.

Algebraic Topology and K-Theory, **Miguel Xicoténcatl**, CINVESTAV.

Biomathematics, **Jorge Velasco**, UAM-I.

Combinatorics and Graph Theory, **Ernesto Vallejo**, IMATE-UNAM.

Complex Analysis, **Enrique Ramírez de Arellano**, CINVESTAV.

Differential Geometry, **Adolfo Sánchez Valenzuela**, CIMAT, and **Raúl Quiroga**, CINVESTAV.

Dynamical Systems with Emphasis on Holomorphic Dynamics, Hamiltonian Systems and Variational Systems, **Joaquín Delgado-Fernandez**, UAM-I, and **Héctor Sánchez-Morgado**, IMATE-UNAM.

Functional and Harmonic Analysis, **Lourdes Palacios**, UAM-I, and **Salvador Pérez-Esteva**, IMATE-UNAM.

General Topology, **Alejandro Illanez**, IMATE-UNAM.

Nonlinear Analysis, **Gustavo Cruz**, IIMAS-UNAM, and **Mónica Clapp**, IMATE-UNAM.

Numerical Methods in Differential Equations, **Pablo Barrera**, UNAM, and **Francisco Solís**, IIMAS-UNAM.

Representation Theory of Algebras and Related Topics, **Raymundo Bautista**, IMATE-UNAM.

Ring Theory, **Francisco Raggi**, IMATE-UNAM.

Stochastical Analysis, **Mogens Blatt**, IIMAS-UNAM, and **María E. Caballero**, IAMTE-UNAM.

Lyon, France

July 17–20, 2001

Meeting #968

First Joint International Meeting between the AMS and the Société Mathématique de France.
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: To be announced
Program first available on e-MATH: To be announced
Program issue of electronic *Notices*: Not applicable
Issue of *Abstracts*: Not applicable

Deadlines

For organizers: To be announced
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Invited Addresses

Sun-Yung Alice Chang, Princeton University, *Title to be announced.*

Jean-Pierre Demailly, Université de Grenoble, *Title to be announced.*

Persi Diaconis, Stanford University, *Title to be announced.*

Robert Gardner, University of Massachusetts at Amherst, *Title to be announced.*

Claude Le Bris, Université de Paris IX-Dauphine, *Title to be announced.*

Yves Meyer, École Normale Supérieure de Cachan, *Title to be announced.*

Michèle Vergne, École Polytechnique, *Title to be announced.*

Special Sessions

Additive Number Theory, **Melvyn B. Nathanson**, Herbert H. Lehman College (CUNY), and **Jean-Marc Deshouillers**, University of Bordeaux II.

Commutative Algebra and Its Interactions with Algebraic Geometry, **Marc F. Chardin**, and **Claudia Polini**, University of Oregon.

Differential Geometric Methods in Mathematical Physics, **Johannes Huebschmann**, University of Lille 1, **Yvette Kosmann-Schwarzbach**, École Polytechnique Palaiseau, and **Richard W. Montgomery**, University of California Santa Cruz.

Dynamics of Nonlinear Waves, **Christopher K. R. T. Jones**, Brown University, and **Jean-Michel Roquejoffre**.

Fractal Geometry, Number Theory, and Dynamical Systems, **Michel Lapidus**, University of California Riverside, **Michel Mendes-France**, University of Bordeaux, and **Machiel van Frankenhuysen**, University of California Riverside.

Gauge Theory, **Jean-Claude Sikorav**, École Normale Superieure de Lyon, and **Ronald Fintushel**, Michigan State University.

Geometric Group Theory, **Gilbert Levitt**, University Paul Sabatier, and **Karen Vogtmann**, Cornell University.

Geometric Methods in Low Dimensional Topology, **Hamish Short**, and **Daryl Cooper**, University of California Santa Barbara.

Geometric Structures in Dynamics, **M. Lyubich**, SUNY at Stony Brook, **Etienne Ghys**, École Normale Superieure de Lyon, and **Xavier Buff**.

Geometry and Representation Theory of Algebraic Groups, **Michel Brion**, University of Grenoble I, and **Andrei Zelevinsky**, Northeastern University.

History of Mathematics, **Thomas W. Archibald**, Acadia University, **Christian Gilain**, and **James J. Tattersall**, Providence College.

Logic and Interaction: From the Rules of Logic and the Logic of Rules, **Jean-Yves Girard**, University of Marseilles, and **Philip Scott**, University of Ottawa.

Mathematical Fluid Dynamics, **Susan J. Friedlander**, University of Illinois at Chicago, **Emmanuel Grenier**, École Normale Superieure de Lyon, and **Yann Brenier**, University of Paris VI.

Mathematical Methods in Financial Modelling, **Marco Avellaneda**, Courant Institute, New York University, and **Rama Cont**.

Model Theory, **Gregory L. Cherlin**, Rutgers University, and **Frank Wagner**, Université Claude Bernard.

Partial Differential Equations and Geometry, **Fabrice Bethuel** and **Paul C. Yang**.

Probability, **Gerard Benarous**, École Normale Superieure, and **George C. Papanicolaou**, Stanford University.

Columbus, Ohio

Ohio State University

September 21–23, 2001

Meeting #969

Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: To be announced
Program first available on e-MATH: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: February 21, 2001
For consideration of contributed papers in Special Sessions: June 5, 2001
For abstracts: July 31, 2001

Invited Addresses

Alex Eskin, University of Chicago, *Title to be announced.*

Dennis Gaitsgory, Harvard University, *Title to be announced.*

Yakov B. Pesin, Pennsylvania State University, *Title to be announced.*

Thaleia Zariphopoulou, University of Texas at Austin, *Title to be announced.*

Special Sessions

Algebraic Cycles, Algebraic Geometry (Code: AMS SS A1), **Roy Joshua**, Ohio State University.

Coding Theory (Code: AMS SS B1), **Tom Dowling**, Ohio State University, and **Dijen Ray-Chaudhuri**.

Commutative Algebra (Code: AMS SS C1), **Evan Houston**, University of North Carolina, Charlotte, and **Alan Loper**, Ohio State University.

Fractals (Code: AMS SS P1), **Gerald Edgar**, Ohio State University.

Group Theory (Code: AMS SS F1), **Koichiro Harada**, **Surinder Seghal**, and **Ronald Solomon**, Ohio State University.

L^2 Methods in Algebraic and Geometric Topology (Code: AMS SS G1), **Dan Burghelea** and **Michael Davis**, Ohio State University.

Multivariate Generating Functions and Automatic Computation (Code: AMS SS H1), **Robin Pemantle**, Ohio State University.

Number Theory (Code: AMS SS J1), **David Goss**, Ohio State University.

Proof Theory and the Foundations of Mathematics (Code: AMS SS K1), **Timothy Carlson**, Ohio State University.

Quantum Topology (Code: AMS SS L1), **Thomas Kerler**, Ohio State University.

Rings and Modules (Code: AMS SS M1), **S. K. Jain**, Ohio University, and **Tariq Rizvi**, Ohio State University.

Spectral Theory of Schrödinger Operators (Code: AMS SS N1), **Boris Mityagin**, Ohio State University, and **Sergei Novikov**, University of Maryland.

Chattanooga, Tennessee

University of Tennessee, Chattanooga

October 5–6, 2001

Meeting #970

Southeastern Section
Associate secretary: John L. Bryant
Announcement issue of *Notices*: To be announced
Program first available on e-MATH: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: March 5, 2001
For consideration of contributed papers in Special Sessions: June 19, 2001
For abstracts: August 14, 2001

Special Sessions

Asymptotic Behavior of Solutions of Differential and Difference Equations (Code: AMS SS B1), **John R. Graef**, University of Tennessee at Chattanooga, and **Chuanxi Qian**, Mississippi State University.

Commutative Ring Theory (Code: AMS SS A1), **David F. Anderson** and **David E. Dobbs**, University of Tennessee at Knoxville.

New Directions in Combinatorics and Graph Theory (Code: AMS SS C1), **Teresa Haynes** and **Debra J. Knisley**, East Tennessee State University.

Real Analysis (Code: AMS SS D1), **Paul D. Humke**, Saint Olaf College, and **Harry I. Miller**, University of Tennessee at Chattanooga.

Topics in Geometric Function Theory (Code: AMS SS E1), **Lelia Miller-Van Wieren**, Penn State Berks Campus, and **Bruce P. Palka**, University of Texas at Austin.

Williamstown, Massachusetts

Williams College

October 13–14, 2001

Meeting #971

Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: To be announced
Program first available on e-MATH: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: March 13, 2001
For consideration of contributed papers in Special Sessions: June 26, 2001
For abstracts: August 21, 2001

Invited Addresses

Hubert Bray, Massachusetts Institute of Technology, *Title to be announced.*

Robin Forman, Rice University, *Title to be announced.*

Emma Previato, Boston University, *Title to be announced.*

Yisong Yang, Polytechnic University, *Title to be announced.*

Special Sessions

Algebraic and Topological Combinatorics (Code: AMS SS D1), **Eva Maria Feichtner**, ETH, Zürich, Switzerland, and **Dmitry N. Kozlov**, KTH, Stockholm, Sweden.

Commutative Algebra (Code: AMS SS C1), **Susan R. Loepp**, Williams College, and **Graham J. Leuschke**, University of Kansas.

Diophantine Problems (Code: AMS SS F1), **Edward B. Burger**, Williams College, and **Jeffrey D. Vaaler**, University of Texas at Austin.

Ergodic Theory (Code: AMS SS H1), **Cesar Silva**, Williams College.

Geometry and Topology of the Universe (Code: AMS SS E1), **Colin C. Adams**, Williams College, **Glenn Starkmann**, Case Western Reserve University, and **Jeffrey R. Weeks**, Canton, New York.

Harmonic Analysis Since the Williamstown Conference of 1978 (Code: AMS SS G1), **Janine E. Wittwer**, Williams College, and **David Cruz-Uribe**, Trinity College.

History of Mathematics (Code: AMS SS A1), **Glen R. Van Brummelen**, Bennington College, **Della D. Fenster**, Richmond University, and **James J. Tattersall**, Providence College.

Number Theory, Holomorphic Dynamics, and Algebraic Dynamics (Code: AMS SS B1), **Robert L. Benedetto**, University of Rochester, **John W. Milnor**, IMS and SUNY Stony Brook, and **Kevin M. Pilgrim**, University of Missouri at Rolla.

Irvine, California

University of California Irvine

November 10–11, 2001

Meeting #972

Western Section
Associate secretary: Bernard Russo
Announcement issue of *Notices*: To be announced

Program first available on e-MATH: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: April 10, 2001
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

San Diego, California

San Diego Convention Center

January 6–9, 2002

Joint Mathematics Meetings, including the 108th Annual Meeting of the AMS, 85th Meeting of the Mathematical Association of America (MAA), annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic (ASL).
Associate secretary: John L. Bryant
Announcement issue of *Notices*: To be announced
Program first available on e-MATH: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: April 4, 2001
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced
For summaries of papers to MAA organizers: To be announced

Ann Arbor, Michigan

University of Michigan

March 1–3, 2002

Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: To be announced
Program first available on e-MATH: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: August 3, 2001
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Atlanta, Georgia

Georgia Institute of Technology

March 8–10, 2002

Joint Meeting with the Mathematical Association of America.
Southeastern Section
Associate secretary: John L. Bryant
Announcement issue of *Notices*: To be announced
Program first available on e-MATH: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: October 8, 2001
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced
For summaries of papers to MAA organizers: To be announced

Montréal, Quebec, Canada

Centre de Recherches Mathématiques, Université de Montréal

May 3–5, 2002

Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: To be announced
Program first available on e-MATH: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: October 3, 2001
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Pisa, Italy

June 12–16, 2002

First Joint International Meeting between the AMS and the Unione Matematica Italiana.
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: To be announced
Program first available on e-MATH: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: To be announced

For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Portland, Oregon

Portland State University

June 20-22, 2002

Western Section
Associate secretary: Bernard Russo
Announcement issue of *Notices*: To be announced
Program first available on e-MATH: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: November 20, 2001
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Boston, Massachusetts

Northeastern University

October 5-6, 2002

Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: To be announced
Program first available on e-MATH: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: March 6, 2002
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Madison, Wisconsin

University of Wisconsin-Madison

October 12-13, 2002

Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: To be announced
Program first available on e-MATH: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: March 12, 2002
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Baltimore, Maryland

Baltimore Convention Center

January 15-18, 2003

Joint Mathematics Meetings, including the 109th Annual Meeting of the AMS, 86th Annual Meeting of the Mathematical Association of America (MAA), annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic (ASL).
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: To be announced
Program first available on e-MATH: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: April 15, 2002
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced
For summaries of papers to MAA organizers: To be announced

Phoenix, Arizona

Phoenix Civic Plaza

January 7-10, 2004

Associate secretary: Bernard Russo
Announcement issue of *Notices*: To be announced
Program first available on e-MATH: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: April 2, 2003
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced
For summaries of papers to MAA organizers: To be announced

Meetings and Conferences of the AMS

Associate Secretaries of the AMS

Western Section: Bernard Russo, Department of Mathematics, University of California Irvine, CA 92697; e-mail: brusso@math.uci.edu; telephone: 949-824-5505.

Central Section: Susan J. Friedlander, Department of Mathematics, University of Illinois at Chicago, 851 S. Morgan (M/C 249), Chicago, IL 60607-7045; e-mail: susan@math.nwu.edu; telephone: 312-996-3041.

Eastern Section: Lesley M. Sibner, Department of Mathematics, Polytechnic University, Brooklyn, NY 11201-2990; e-mail: lsibner@magnus.poly.edu; telephone: 718-260-3505.

Southeastern Section: John L. Bryant, Department of Mathematics, Florida State University, Tallahassee, FL 32306-4510; e-mail: bryant@math.fsu.edu; telephone: 850-644-5805.

The Meetings and Conferences section of the *Notices* gives information on all AMS meetings and conferences approved by press time for this issue. Please refer to the page numbers cited in the table of contents on this page for more detailed information on each event. Invited Speakers and Special Sessions are listed as soon as they are approved by the cognizant program committee; the codes listed are needed for electronic abstract submission. For some meetings the list may be incomplete. **Information in this issue may be dated. Up-to-date meeting and conference information is available on the World Wide Web at** www.ams.org/meetings/.

Meetings:

Important Information regarding AMS Meetings

Potential organizers, speakers, and hosts should refer to page 87 in the January 2001 issue of the *Notices* for general information regarding participation in AMS meetings and conferences.

Abstracts

Several options are available for speakers submitting abstracts, including an easy-to-use interactive Web form. No knowledge of LaTeX is necessary to submit an electronic form, although those who use LaTeX or AMS-LaTeX may submit abstracts with such coding. To see descriptions of the forms available, visit http://www.ams.org/abstracts/instructions.html, or send mail to abs-submit@ams.org, typing help as the subject line; descriptions and instructions on how to get the template of your choice will be e-mailed to you.

Completed abstracts should be sent to abs-submit@ams.org, typing submission as the subject line. Questions about abstracts may be sent to abs-info@ams.org.

Paper abstract forms may be sent to Meetings & Conferences Department, AMS, P.O. Box 6887, Providence, RI 02940. There is a $20 processing fee for each paper abstract. There is no charge for electronic abstracts. Note that all abstract deadlines are strictly enforced. Close attention should be paid to specified deadlines in this issue. Unfortunately, late abstracts cannot be accommodated.

Conferences: (See http://www.ams.org/meetings/ for the most up-to-date information on these conferences.)

June 10–August 9, 2001: Joint Summer Research Conferences in the Mathematical Sciences, Mount Holyoke College, South Hadley, MA. See pages 1327-1331, November 2000 issue, for details.

Cosponsored Conferences:

February 15–20, 2001: AAAS Annual Meeting, San Francisco, CA. See page 1477, December 2000 issue, for details.

May 28–30, 2001: 2001 International Conference on Computational Science, Hilton San Francisco and Towers Hotel, San Francisco, CA

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