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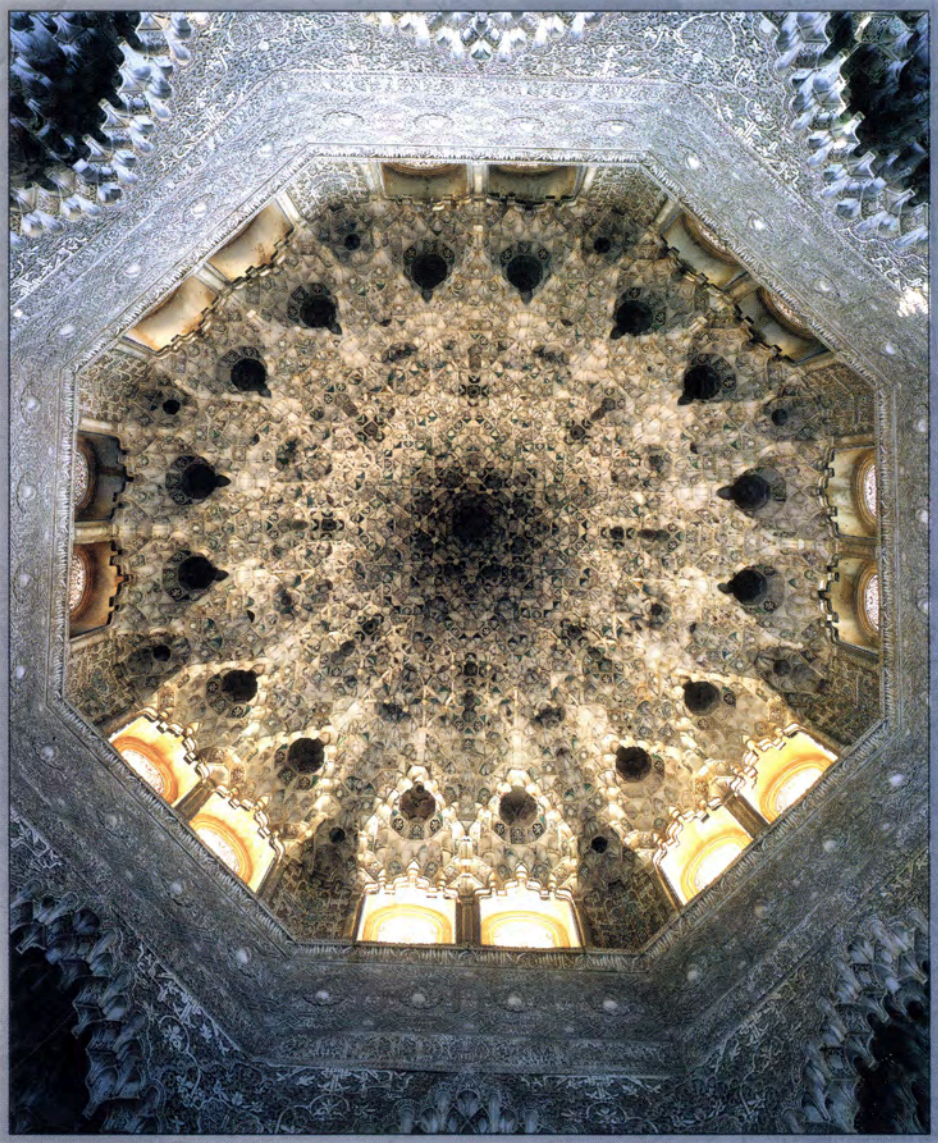

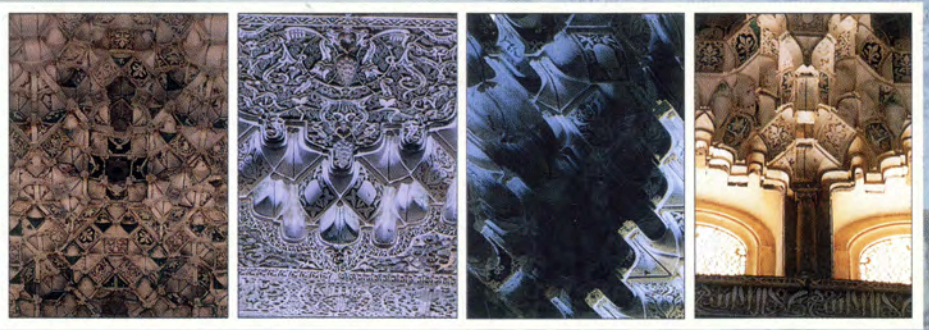

INTERNATIONAL CONGRESS OF MATHEMATICIANS MADRID 2006

ICM Madrid 2006
(see page 213)

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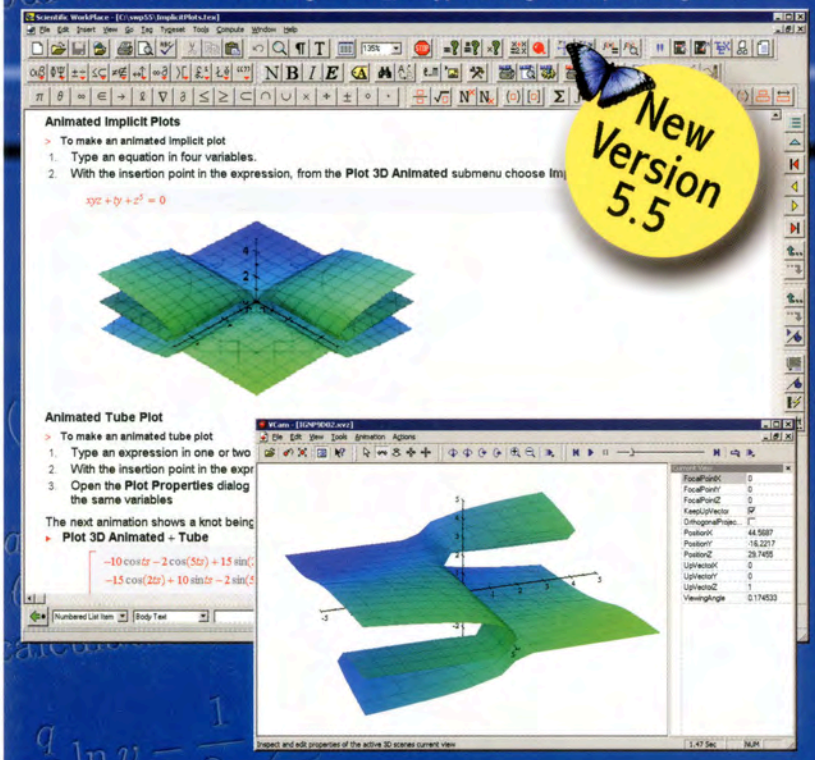

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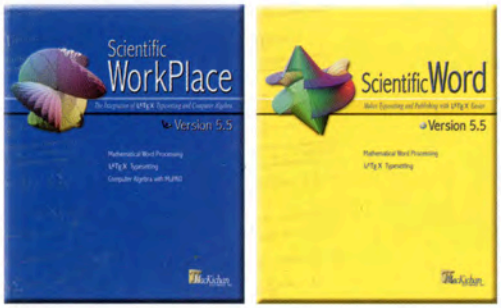

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- Graded Multiplicities in the Macdonald Kernel. Part I, *John R. Stembridge*
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GABRIEL DANIEL VILLA SALVADOR, *CINVESTAV del IPN, Mexico City, Mexico*

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The book can serve as a text for a graduate course in number theory or an advanced graduate topics course. Alternatively, chapters 1-4 can serve as the base of an introductory undergraduate course for mathematics majors, while chapters 5-10 can support a second course for advanced undergraduates. Researchers interested in number theory, field theory, and their interactions will also find the work an excellent reference.

2006/APPROX. 685 PP., 20 ILLUS./HARDCOVER
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Vortices in the Magnetic Ginzburg–Landau Model

ETIENNE SANDIER, *Université Paris-12 Val-de-Marne, Créteil, France;* **SYLVIA SERFATY,** *CMLA, École Normale Supérieure de Cachan, France*

The Ginzburg–Landau (G–L) functional has become an important phenomenological model since its confirmation both theoretically and experimentally. It describes the phase transition occurring in certain metals from a normal conducting state to a superconducting state. This text describes the critical points of the G–L functional of superconductivity in two dimensions in terms of vortices, introducing tools for analyzing certain complex situations. The material presented requires basic knowledge of Sobolev spaces and linear elliptic theory. The book is aimed at mathematicians, physicists, and graduate students interested in this very active field of research.

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AMANDINE AFTALION, *CNRS, Laboratoire Jacques-Louis Lions, Paris, France*

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PIERRE ANGLES, *Université Paul Sabatier, Toulouse, France*

Conformal groups play a key role in geometry and spin structures. This book provides a self-contained overview of this important area of mathematical physics, beginning with its origins in the works of Cartan and Chevalley and progressing to recent research in spinors and conformal geometry. All the major aspects of the field are introduced, followed by detailed descriptions and definitions. Rich in exercises—accompanied by full proofs and hints—the book will provide further directions for study and research.

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VOLKER SCHEIDEMANN, *Marburg, Germany*

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2005/180 PP./SOFTCOVER
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Introduction to Plane Algebraic Curves

ERNST KUNZ, *University of Regensburg, Germany*
RICHARD G. BELSHOFF, *Southwest Missouri State University, Springfield, MO (Translator)*

This work treats an introduction to commutative ring theory and algebraic plane curves, requiring of the student only a basic knowledge of algebra, with all of the algebraic facts collected into several appendices that can be easily referred to, as needed. Kunz's proven conception of teaching topics in commutative algebra together with their applications to algebraic geometry makes this book significantly different from others on plane algebraic curves.

From a review of the German edition: *"The reader is invited to learn some topics from commutative ring theory by mainly studying their illustrations and applications in plane curve theory. . . . The whole text is a real masterpiece of clarity, rigor, comprehension, methodical skill, algebraic and geometric motivation. . . highly enlightening, motivating and entertaining at the same time. . . One simply cannot do better in writing such a textbook."* —**ZENTRALBLATT MATH**

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Compactifications of Symmetric and Locally Symmetric Spaces

A. BOREL; LIZHEN JI, *University of Michigan, Ann Arbor, MI*

Noncompact symmetric and locally symmetric spaces naturally appear in many mathematical theories, including analysis (representation theory, nonabelian harmonic analysis), number theory (automorphic forms), algebraic geometry (modulae) and algebraic topology (cohomology of discrete groups). In most applications it is necessary to form an appropriate compactification of the space. The literature dealing with such compactifications is vast. The main purpose of this book is to introduce uniform constructions of most of the known compactifications with emphasis on their geometric and topological structures.

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Notices

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of the American Mathematical Society

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Departments

From the AMS Secretary

Welcome to Madrid for ICM2006: The Spanish Mathematical Fiesta

The International Congress of Mathematicians will be held for the first time in Madrid, Spain, August 22–30, 2006. The Spanish mathematics community is delighted to be hosting this event and wishes to extend its warmest welcome to mathematicians from all over the world. It will be without doubt not only the most important mathematical event ever held in Spain but probably the greatest in any scientific discipline in this country. The ICM2006 in Madrid follows the International Congress on Mathematical Education held in Seville in 1996 and the Third European Congress of Mathematics held in Barcelona in 2000.

Although the venue for the ICM2006 will be Madrid, the Spanish Mathematical Committee regards it as a collective project embracing the whole country, a fact that is borne out in the following two ways: the broad cross-section of members making up the Organizing Committee and the financial support provided by all the mathematics departments in Spanish universities.

The preparations for the congress have received invaluable support, not only from the city of Madrid, but also from government bodies at the regional and national levels. From the very beginning of our candidacy, the head of state, His Majesty D. Juan Carlos I, king of Spain, gave his backing to the event, and the Organizing Committee has requested the honor of his presence at the opening ceremony as well as at the award presentations of the Fields, Nevanlinna, and Gauss Medals. Furthermore, the committee has received vital funding from the community of Madrid, from the Madrid City Council, and from the Ministeries of Education and Foreign Affairs.

Given Spain's geopolitical location, the Organizing Committee has outlined three main axes for the ICM2006: the European axis, symbolized by the holding of the General Assembly, which will take place prior to the ICM, in the city of Santiago de Compostela, renowned for the Road to Santiago or Pilgrim's Way, an artery of European science and culture in the Middle Ages; the Latin American axis, an integral part of Spanish history and culture; and the Mediterranean axis, celebrating the Spain of the "three cultures", a universal example of tolerance and cohabitation. In support of this structure, the Organizing Committee aims to make many more grants available to both young and senior mathematicians coming from these last two areas.

Mathematics in Spain has a relatively short history, and if we look for mathematicians born in our country in the Middle Ages, we find names of Spanish Arabs and Jews. The need for naval pilots, architects, and engineers led King Philip II to found the Madrid Academy of Mathematics in 1572. Unfortunately, the venture was short-lived, but during the first third of the twentieth century, Spanish science, and mathematics in particular, experienced a period of development known as the Edad de Plata, or "Age of Silver", of which the Junta de Ampliación de Estudios, or Council for the Extension of Studies, formed the cornerstone. Spanish progress in science is also very recent, but in the case of mathematics it has been nothing short of spectacular. If we consider that in 1980 the contribution of Spanish mathematicians accounted for a mere 0.3 percent of all articles and papers published in ISI (Institute of Scientific Information) journals and compare this with the figure for the five-year period 2000–2004, which rose to 4.83 percent, we have an idea of the progress achieved in Spanish mathematical research.

Furthermore, the complex social organization of Spanish mathematics is a highly articulated structure. The pioneering mathematical body in this field is the Royal Spanish Mathematical Society, whose founding in 1911 culminated a process started in 1903. In 1931 the Catalan Society for Physics, Chemistry, and Mathematics was founded within the Institute of Catalan Studies; the Catalan Mathematical Society, as an independent body, was created in 1986. More recently, other societies have appeared on the scene, such as the Society of Statistics and Operations Research (1961), the Spanish Society of the History of Techniques and Sciences (1974), the Spanish Federation of Teachers of Mathematics (1989), the Spanish Society of Applied Mathematics (1991), and the Spanish Society for Research in Mathematical Education (1996). They all participate in the Spanish Mathematical Committee (CeMAT, `http://www.ce-mat.org`), which represents Spain in the International Mathematical Union (IMU) and whose structure is based on that of the IMU itself, providing a point of encounter for secondary and university education as well as for research. Some 8,500 mathematicians are represented in CeMAT.

The venue for the Madrid ICM is the Palacio Municipal de Congresos, a spectacular marble building designed by the Spanish architect Ricardo Bofill, an example of the modern, open Spain that has been forged since the transition to democratic rule. Organized around the congress will be over fifty satellite conferences, the highest number in the history of the ICM, many of them held in different parts of Spain and constituting an example of the experience and organizing ability of Spanish mathematicians. These achievements make us feel highly optimistic about the attendance at the ICM itself.

We cordially invite you to visit our website at `http://www.icm2006.org`, which contains up-to-date information about the congress.

—Manuel de León, President
Spanish Committee of Mathematics
Chairman, Local Organizing Committee of ICM2006
`mdeleon@imaff.cfmac.csic.es`

Letters to the Editor

Winter Meeting Sites

Years ago the AMS had its January meeting in Chicago, and the participants experienced a couple of days with maximum temperatures below zero; all interest in meeting again in Chicago during January vanished. Since then we have had extreme winter experiences in St. Louis and Cincinnati, and ice and cold in Washington. A number of meetings in warmer climates have followed, but it seems the lessons of the past have not been learned, as the AMS will meet in Washington in 2009 and Boston in 2012. Prepare for the worst again.

—*Jon Alperin*
University of Chicago
alperin@math.uchicago.edu

(Received October 19, 2005)

Pure and Applied

Regarding the Letter from the Editor, November 2005 ("Graduate Students and Applications"): At Brown we have a Division of Applied Mathematics and a mathematics department, physically separated by about a block's distance but fortunately not so distantly separated in our associations. People at Brown outside the two sections would usually ask me, "Are you in the applied math department or the pure math department?" and I decided to reply, "No, I'm in the unmodified math department."

—*Jonathan Lubin*
Professor of Mathematics, Emeritus
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(Received October 24, 2005)

Pure and Applied Mathematics

Regarding the brief discussion of "pure" vs. "applied" mathematics in the November *Notices* (Letter from the Editor):

I've always thought that "applied mathematics" simply meant mathematics motivated by questions in other, nonmathematical, fields, whereas "pure mathematics" meant questions motivated mainly by mathematical considerations. This is, on the face of it, an a priori dichotomy and does not depend on the uses one finds for a mathematical theory after it has been developed, so I don't agree that the area to which a problem or a result belongs can't be predicted in advance. (And, of course, I certainly don't agree with some people that one area is in any way superior to the other.)

—*Jacob E. Goodman*
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(Received November 4, 2005)

Another Textbook Policy

We have the following reply to the letter titled "A Textbook Editions Policy" that originally appeared in the Sept. 2005 *Notices of the AMS*, Vol. 52, No. 8, p. 830:

We see some problems with the new textbook editions policy adopted by the UCLA math department (as appeared in the Sept. 2005 *Notices*, Vol. 52, No. 8, p. 830), in which they automatically search for a replacement text whenever a new edition of a textbook appears beyond the third unless it is pedagogically justified.

The stated goal, with which we agree, is to reduce the number of editions of textbooks and increase the shelf life of each edition. The current practice serves no purpose other than enriching publishers at the expense of students. Yet the suggested policy is likely to cause the department to search for new textbooks much more frequently for all courses. For every new textbook, instructors have to make substantial changes in the course outlines, and students will be unable to buy used copies of the new text on campus, since they are unlikely to be available. Moreover, the policy is unlikely to achieve its goals in the long run. Even if most departments adopt it, the net effect might simply be a regular reshuffling of the textbooks used by various math departments, thus actually increasing the number of new textbooks students have to buy. Since the publishers' main interest is in the overall number of new textbooks sold, they might embrace this policy and produce new editions even more frequently.

What should we do instead? It seems to us that the important goal should be to ease the financial burden on our students. Thus our policy should help them buy significantly cheaper (i.e., used) copies of textbooks. As soon as we realize this, we can see that the solution is simple: allow the students to use previous editions of the textbook, not necessarily the latest one, with the obvious caveat that we are discussing here the typical "new edition" that offers no significant advantage over the previous one. In the case of a fundamentally new edition, we may decide to require it, or, alternatively, we may decide to consider an entirely new text, since a radically different edition may not suit our course anymore. In a way, we are then falling back on the UCLA policy.

The big advantage of this approach is that we need no cooperation from the publishers or other math departments. As long as used copies of old editions are available, students can buy those cheaply even if (or especially if) a new edition comes out. The only disadvantage is that instructors can't assume that every student has the same edition of the textbook; thus assignments have to be given explicitly instead of by problem number only. This minor inconvenience is a small price to pay for the immediate gain by the students. Moreover, some gain can be realized by adopting the policy even for just one course! Thus each of us can adopt this policy without waiting for department discussions and approval.

To get the most benefits, it is necessary that the department officially adopts a variant of this policy so bookstores will buy back used textbooks of the old editions. In the meantime, students can use the Internet to find used copies if our syllabi clearly state which editions of the text are acceptable.

If adopted by most departments, will this policy decrease the frequency of new editions coming out? Our guess is yes, but it really doesn't matter. The important goal is achieved anyway.

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(Received October 24, 2005)

Math Circles and Olympiads

MSRI Asks: Is the U.S. Coming of Age?

James Tanton

The list of outreach programs aimed at providing rich mathematical experiences for middle- and high-school students is growing. Programs such as the Berkeley Math Circle [6], the San Jose Math Circle [8], and the Boston Math Circle [7] are thriving; a plethora of summer math camps exist across the nation; and student participation in regional, national, and international mathematics competitions is significant. Clearly there is some important issue being addressed by these programs. It's exciting and intriguing, even if the "it" cannot be easily articulated.

On December 16–18, 2004, the Mathematical Sciences Research Institute (MSRI) took the bold step to bring together over one hundred dedicated folk, all with strong interests in these programs and all clearly committed to the larger goal of sharing the joy of pure mathematics. Organized by Hugo Rossi, Deputy Director of MSRI; Tatiana Shubin of San Jose State University, CA; Zvezdelina Stankova of Mills College, CA; and Paul Zeitz of the University of San Francisco, the *Conference on Math Circles and Olympiads* united educators and researchers from the pre-college and college worlds, brought focus to the questions of "what are we doing?" and "where are we going?," and offered concrete steps towards fostering discussion and sharing resources. From it, MSRI plans to establish a permanent national educator/researcher network. "One of the central purposes of this conference was to bring these communities together to begin an interaction," writes Hugo Rossi. And it seems that the math circle concept provided a key intersection point of discussion. What route—alternative to math competitions and math camps—do circles provide for the discovery of young talent? Is the use of the word "talent" appropriate? Can circles contribute to the general secondary curriculum? Are math circles self-sustaining? What makes them work? Hugo Rossi comments:

> I am convinced that the idea of math circles has come of age in the U.S., and it can become a movement which develops fast so as to be something like what exists in Eastern Europe. The people at our conference are the resource for this development; we have to make that resource widely available.

MSRI recognizes that the time is right to draw upon the collective experiences of our colleagues—here and abroad—and examine the opportunities that lie before us. I am personally intrigued by the broader challenge of possibly incorporating math circle ideals into the fixed secondary curriculum. (I have had the pleasure of working with Bob and Ellen Kaplan of the Boston Math Circle for a number of years before leaving the college world to tackle life as a high-school teacher.) I have no real answers, but I was delighted to learn from this conference that I am far from alone in exploring issues like these. Serious discussion about the "it" that math circles and other extracurricular activities provide is now under way.

The Math Circle Experience

Extracurricular circles in a variety of subjects began in Hungary in the 1800s, all with the goal of providing young students opportunities to pursue personal interests to the fullest. Today they are considered a standard part of the Eastern-European

James Tanton is professor of mathematics at St. Mark's Institute of Mathematics. His email address is jamestanton@stmarksschool.org.

student experience, and participation in them is regarded as just as natural as participation in sports activities is viewed in the U.S. Although there is no set protocol to a math circle experience, all circles have the same goal of sharing the intellectual appeal and beauty of mathematics with as large an audience as possible. They engage faculty from both secondary and post-secondary institutions in their operation and successfully welcome students of all backgrounds to the mathematical experience. Circles now exist in many countries, including the U.S. (see also [1], for instance), and follow multiple styles and approaches. Given the success of the Eastern European model it is natural to ask then whether some version(s) of the math circle experience could be incorporated into the U.S. cultural norm. Could even more be accomplished? Tatiana Shubin notes:

> We're in a wonderful and unique situation ... where we have the widest source of practices and traditions from all over the world to draw upon. And there exist new tools, like the Internet and TV ... If real circle meetings could be aired on TV, lots of people would see how kids interact with it—and it might make a profound impact on the public's perception of our beloved discipline.

Indeed, imagine the impact! As a beginning step, participants at the conference were treated to two demonstration classes—one from each of the Boston and Berkeley Math Circle programs— and it was clear each time that indeed something remarkable was taking place.

Two U.S. Models

The Boston Math Circle was founded by Bob and Ellen Kaplan and Tomas Guillermo in 1994 and currently has over 120 participants. In this circle, the lecture format is completely set aside and mathematics is discovered and developed through exploration, intellectual play, and the give-and-take of conversation (see [4]). The questions discussed are attractive and mathematically rich and offer multiple pathways for exploration, generalization, and variation. Students work on the same fundamental question and the ideas generated from it for ten consecutive weeks. As examples, young students, K–3, have explored the vague question "Are there numbers between numbers?" to discover, by the end of the semester, the density and the countability of the rationals. Middle schoolers, in exploring the issue of whether or not a power of two ever begins with a seven, created their own versions of logarithms, developed basic results in ergodic theory, and proved density results on infinite sets. Slightly older students have found their own means to compute i^i, to prove the fundamental theorem of algebra, and to conduct original research [5]. The Boston Math Circle works hard to remove any sense of competition and completely disregards labels of "talented" and "gifted". It relies solely on the "intellectual seduction of attractive questions," as Ellen puts it, to engage and excite. The role of an instructor is not to teach, but to guide, nudge, offer suggestions, and, more often than not, to step out of the way.

The Berkeley Math Circle, founded in 1998 and run by Zvezdelina Stankova, works with over 50 San Francisco Bay Area middle- and high-school students. It openly recognizes that there are many different routes for the enjoyment of mathematics and actively works to offer a variety of experiences. Meetings tend to vary in style, organization, and topic from week to week, and competition and competition preparation play an important role in the circle experience. (The Berkeley circle has had tremendous success helping students prepare for national and international competitions.) Stankova also recognizes that great joy and beauty can be found in advanced mathematics and may preface a session with a lecture on a sophisticated topic. For example, the following is a Berkeley Math Circle favorite:

> Four planar circles are pair-wise externally tangent. Three of the circles are also tangent to a line L. If the radius of the fourth circle is one unit, what is the distance of its center from L?

Participants tackle this problem after attending a lecture on circle inversion. The power and beauty of this advanced topic is made astoundingly clear when one discovers that this problem has a tractable, unique solution based on a single application of the Pythagorean Theorem! During the MSRI demonstration, Stankova led young participants through a series of interactive challenges on the principles of Eulerian circuits and on winning strategies in some innovative checker-move games.

One thing was clear from the demonstrations: both programs have hit upon ways not only to excite young students with mathematics, but also to help young folk develop the tenacity to tackle sustained challenges via consistent—and joyful—hard work. In each circle the creative and organic mathematical process is clearly laid bare and students are placed in command of their own learning. What an accomplishment! Rick Umiker of St. Mark's School, an independent high school in Southborough, MA, comments: "Math circles demonstrate very good teaching ... Are they rediscovering the power of small classes and an intimate environment?" Is it precisely the personal, intimate nature of the experience that leads to a circle's success? Is it perhaps the human experience that is being laid bare?

On this issue Shubin writes "Circles might be harmful if taught without caution and discretion, or without life and spark. And I don't know what is worse. ... As every delicate, subtle and complex organism, they [circles] require very specific and diligent care in order to thrive." Stankova comments:

> [Math circle] sessions must be masterfully designed so as to do an array of things: invite the students, intrigue them, engage them, teach them, challenge them, and leave them with more questions to think about than when they entered the session. The format of the session is less relevant, as long as the above goals are achieved. How can a session leader keep the students' attention on harder or more intricate concepts: that's what distinguishes a truly gifted teacher.

One could naively say that it is not difficult to start a circle: simply gather a few young students and add a handful of exciting problems. The amount of organization and finance needed is minimal. But Paul Zeitz expresses concern that it all seems to ultimately rely on personality—and overloaded schedules. "[These] programs work because of one or two people with incredible charisma making sacrifices. There is no evidence of a program that is truly self-sustaining." Is the only feasible math circle model a local one, run by the passion and dedication of an energetic individual or two? It seems to be the only model that currently exists in the U.S. Is this the one we should encourage and support? And if so, how do we find math circle leaders with just the right touch? How do we cultivate and support them? And can we share resources?

The Role of Competitions

Melanie Wood, a graduate student at Princeton and former Putnam fellow and International Mathematical Olympiad (IMO) silver medalist, expressed an alarming concern at the conference. She said she felt a negative bias from the research community for having succeeded so well in the competition world. "Some people reason that since problem solving isn't 'real math', then students who did well in competitions must not be good at research and, in particular, decide those students don't have the patience it takes to do research." Melanie expressed a sentiment that her IMO colleagues also present at the conference supported, that the competition route brought her great joy and success in mathematical exploration, that she was exposed to and learned a considerable bulk of new mathematics outside the typical school curriculum, and that she developed thinking skills and maturity of mind that can only be described as an incredible asset and advantage as she now embarks on a path of original inquiry.

Joe Gallian of the University of Minnesota, Duluth, recent second vice president of the Mathematical Association of America, remarked that in his observation students who had participated in and were good at competitions are generally doing better in Research Experiences for Undergraduate programs than the typical participant. Inna Zakharevich, a winner of the USA and the Bay Area Mathematical Olympiads, and now at Harvard University, also added that students do not feel bad if they lose a competition. She stated that the general attitude is one of struggling against problems rather than competing against colleagues and that everyone appreciates and admires a good solution even if it is not one's own.

The primary role of competitions is often perceived as a means for identifying and culling bright potential in mathematics and consequently as fundamentally elitist. Is it possible to turn this perception around and foster, articulate, and communicate instead the sentiments expressed by the young scholars? Rossi comments:

> Just look at what's going on and observe that competition is an essential motivator for some people, and irrelevant or even detrimental to others. Is it bad to have problems drive education and good to drive education with content? Or the other way around? ... Both approaches work well, especially together.

Some suggested at the conference that high-school teachers might not know what the ultimate mission of the competition experience is for their students, nor know how to prepare students for them. Can we help? Individuals, such as Richard Rusczyk, with his site `http://www.artofproblemsolving.com`, are attempting to do so. How can we support and aid such attempts? And what about those for whom the culture of competitions might be deemed "detrimental"? Are we adequately conveying multiple definitions of success in mathematics? Are we clear ourselves about the image we wish to promote?

The Typical Secondary Curriculum: Do We Have Something to Offer?

Many secondary-school teachers feel that the nature of the teenage mind is different from the mind of a young adult in college, requiring special attention and care and special approaches when it comes to education in mathematics. They are, of course, right, and the U.S. secondary educational system has, over the decades, homed in on a by and large successful, and certainly valuable, approach to mathematics education. The question is not, what is wrong with how mathematics is taught in

the secondary scene, but what more can we offer? The existence of extracurricular mathematics programs is not a statement of dissatisfaction, only the recognition that there is certainly room and opportunity for discussion and connection between the pre-college and college worlds.

"We need math circles for teachers," comments Umiker, "so that they will value that kind of freedom for their students. [We need to see] the things that can be done around the edges. Not all of us are aware of what can be done."

A typical example that comes to mind is the introduction of the trigonometric functions in the ninth-grade curriculum. It comes at a time when many—but certainly not all—young teenagers are starting to learn not to memorize formulae. Yet many texts first introduce the subject as a list of three (perhaps six) ratios to be committed to memory ("SOHCAHTOA").

A math circle-type approach (as I have done with young students in a math circle) would be to introduce "circle-ometry" and define the sine and cosine (properly!) as the "height" and "overness" functions of a point rotating about the simplest circle possible in mathematics, the unit circle centered about the origin. Just to play with (and cement?) the ideas, one can then explore "square-ometry" and look at, and graph, the squine and cosquine functions, as my young students dubbed them, described by a point moving about a square with vertices $(\pm 1, \pm 1)$. What do these graphs look like? Could this also be done in typical ninth-grade classrooms? It would be interesting to find out. "The research community," adds Umiker, "should note that we need people who can challenge us to explore mathematics beyond a prescribed end."

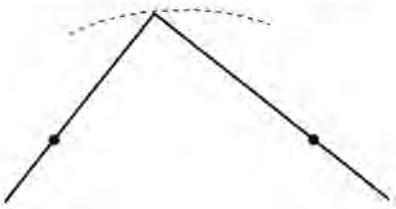
Of course, secondary educators are faced with the absolute necessity to cover a fixed bulk of content. (The pressure I personally experience in the secondary world is far greater than anything I ever felt teaching at the college level.) Math circles do not have to contend with this. Nor do secondary teachers have the luxury of working with a self-selected group of math-excited students. But these are not insurmountable issues. Tatiana Shubin is delighted to say that she is having some success in her college calculus classes moving away from center stage, and I, in my ninth-grade and AP calculus teaching, have not at all given up my math circle tendencies. Multiple approaches can successfully work together. The issue is to explore how to communicate ideas, share resources between educators of all levels, and find the forum to discuss observations and results.

Another issue to consider is the role of high-school textbooks. They are designed to be intellectually safe and are usually written so as to provide the young scholar structure, processes composed of small steps, routine, and rote practice. They also aim to provide good psychological impact—it feels good to young students to be right, and it feels good to have success quickly. Problems in textbooks are often carefully designed to offer hand-holds, pats on the back, and indicators of success. (If, for example, you find yourself working with the familiar quantity $\sin(30^0)$ chances are you must be on the right path.)

But one could note that research mathematicians and students taking competitions often look for the same indicators of success. Complicated problems are usually attacked in very small steps, and in studying them one is always looking for familiarity and connection to techniques previously practiced. If progress on a problem is leading to a certain sense of elegance, or if a formula obtained possesses symmetry of some kind, then one tends to feel good and feel confident about the path one is following. (A key difference here, of course, is that success is usually not garnered quickly. Nor are solution manuals available.)

Is it possible to view the experience offered through the typical mathematics text as intimately connected to the research mathematical experience? Is this too radical a point of view? Is there a way to highlight a connection between the typical school curriculum and the creative research experience? Is this what math circles, math camps, and math competitions are ultimately trying to offer?

I was personally confronted with this issue some months ago when I came to theorem 5.15 of my class's geometry text: *The midpoint of the hypotenuse of a right triangle is equidistant from the three vertices of the triangle.* One could, of course, present this as a known result to be proved and follow up the discussion with a variety of practice problems to be completed. I decided to turn matters around and offered instead a mystery:



Place two tacks in a wall. Insert a sheet of paper between them at some angle and mark where the corner of the paper lies. Move the paper to a different angle between the tacks and again mark the location of the corner. Repeat multiple times. What curve is produced?

In the lively discussion that ensued students discovered theorem 5.15 for themselves, proved it, and then began to wonder about other mysteries: *What if the corner of the paper is not a ninety*

degree angle: do we still obtain the arc of a circle? Is the converse true: Given a circle first, does this mean that all angles from the diameter are ninety degrees in measure? (Note that the answer to this latter question provides a nifty means for finding the diameter of a given circle using nothing more than the corner of a piece of paper.)

I was particularly delighted that one of my students took hold of these problems and managed to prove, completely in his own way, that all points subtending the same angle from a fixed chord do indeed trace the arc of a circle—a remarkable achievement. I witnessed the math circle experience come alive within my classroom.

It was apparent at the conference that many extracurricular activities—math circle topics, competition problems—favor graph theory, combinatorics, and number theory as sources of content. (Admittedly, geometry too.) These topics are immediately accessible and offer multiple routes of exploration and discovery. Surprisingly, none of these topics appear in any depth in the typical secondary curriculum, if at all. Is it worth asking why? Are there ways to make all topics—pre-calculus? algebra II?—equally appealing and accessible, and to present them with multiple paths of discovery and exploration? Is this appropriate? How much of this is content-dependent? How much is dependent on individual teacher style? How do we connect with and support teachers who may already be asking these questions and experimenting? Is this the wrong track?

What Can We Do to Support Educators on All Levels?

Elevating mathematics through education is a noble pursuit. The work being done by those organizing and running math competitions, math camps, and math circles is often unrecognized by their supporting institutions and is done as an overload to their professional activities. Secondary-school teachers have demands placed upon them above and well beyond the requirements of simply teaching mathematics, often leading to fragmented and ridiculously lengthy work days. There is often very little freedom of mind (and freedom of practice) to pause, reflect, and experiment. Yet the determination and passion of a growing number of educators to look for and provide more is astounding. What can be done to offer support?

For me, discovering that I am not alone in this pursuit was a great comfort. Establishing connections between like-minded educators is proving to be immensely fruitful and rewarding. Discussions about the issues raised carry on through email and local discussions, and ideas and approaches are actively being explored. I am delighted that this was the *first* of a series of conferences on the topic of Math Circles and Olympiads that MSRI intends to offer. The number of attendees surely will grow.

Fundamental questions remained unanswered. Some participants wonder, for example, whether the math circle model is destined to remain localized and extracurricular. Others are trying to incorporate math circle ideals directly into the classroom experience. Work is under way to create a general website, supported by MSRI, offering advice, plans, and resource materials as a means to reach out to those who may be interested in exploring these ideas. We should consider how to help teachers pursue this work. Would the formation of a special interest group on math circles and competitions through the mathematics professional societies be of help?

Mary Fay-Zenk, mathematics resource teacher for the Cupertino Union School District, CA, having experienced great pedagogical success with the use of math competitions as motivators, suggested the idea of starting a math circle for middle- and high-school teachers. A number of people are picking up on this idea. Matthias Beck of San Francisco State University and Paul Zeitz of the University of San Francisco, for instance, with the support of MSRI and funded by the McKesson Foundation, are starting a new math circle for young students in the Bay Area, accompanied with math-circle type courses for their teachers. St. Mark's Institute of Mathematics in Southborough, MA, in collaboration with the Northeastern University School of Education, began a similar program for teachers. Not only will programs like these disseminate the ideas and principles of math circle teaching, they will also help establish a network of support and communication.

MSRI is organizing a number of special workshops to explore and address directly some of the questions raised at its December 2004 conference. For example, the "Mathematical Knowledge for Teaching" workshop, May 25–28, 2005, brought together K–12 educators, educational researchers, mathematicians, and policy makers to examine what is known about the knowledge needed for teaching mathematics.

Is this enough to get the big ideas "out there"? Perhaps the only route for success along these lines is to consistently offer forums for discussion and to rely on local dissemination of ideas. (Such a route certainly works for the Boston Math Circle, for instance. Relying solely on word-of-mouth, the program is consistently over 120 students strong.)

Some programs are reluctant to write down any form of "curriculum" to share, not because of a reluctance to disseminate ideas—far from it—but rather because the very nature of creative exploration is organic and nonlinear and cannot be prescribed. On the other hand, one can argue that it is certainly better to have something written to share, even if it ends up not being used as intended. (And thankfully the Kaplans have decided on this too. Their book, *Out of the Labyrinth: Mathematics Set Free* will be released by Oxford University Press later this year.) I have to say that Dmitri Fomin, Sergey Genkin, and Ilia Itenberg's book *Mathematical Circles (Russian Experience)* (AMS, Providence, 1996) significantly guided my own ideas about how to conduct a math circle. (For the more structured experience, one may consult [7] for a collation of over seven years' worth of Berkeley Math Circle lecture notes and [3] for an impressive collection of guest lectures given at the Bay Area Mathematical Adventures series, a program intimately connected with the San Francisco Bay Area math circles.)

Maybe the key is to articulate and clarify the notion that mathematics is ultimately a creative human endeavor, and maybe we should strive to offer means for it to be experienced as such by teacher and student alike. Can we communicate (teach?) educators of all levels not to fear pursuing, or at least exploring, the creative process—to let go of the perception of needing to be the master of the subject at all times? Can we encourage folks to trust the mathematical experience even if one cannot identify where a class is heading with it at a particular moment (day? week?)? Can we encourage educators to be comfortable and confident with the process even if time is running out, there is a common exam next week, and the Dean of Faculty wants evidence of demonstrable success? Should we?

References

[1] R. CAVALIERI and D. HARTENSTINE, Math circle: An outreach program at the University of Utah, *FOCUS*, **25**(1) (2005), 6–8.

[2] D. HAYES and T. SHUBIN, Eds., *Mathematical Adventures for Students and Amateurs*, Mathematical Association of America, Washington DC, 2004.

[3] R. KAPLAN, The math circle, *Notices of the American Mathematical Society*, **42**(9) (1995), 976–978.

[4] S. KENNEDY, The math circle, *Math Horizons*, April (2003), 9–10, 27–28.

[5] J. TANTON, Young students approach integer triangles, *FOCUS*, **22**(5) (2002), 4–6.

[6] The Berkeley Math Circle: `http://mathcircle.berkeley.edu`.

[7] The Boston Math Circle: `http://www.themathcircle.org`.

[8] The San Jose Math Circle: `http://www.mathcircles.org`.

A System of Axioms of Set Theory for the Rationalists

Jan Mycielski

Introduction

This paper proposes and discusses a list of axioms for set theory based on the principle: *Accept as much regularity or specificity as possible without weakening the theory.*

The philosophy of mathematics has little or no influence upon 99% of mathematics. But there is that 1% where it matters, namely the choice of axioms of set theory, and this is the theme of this paper.

There are two extreme ontologies of mathematics: (a) Platonism, which tells us that *pure* mathematics is a description of an ideal structure that exists independently of humanity, and (b) Formalism, which says that *pure* mathematics is just a game with symbols. (Both views acknowledge the seminal role of applications, e.g., both agree that Greek geometry is an abstract approximate description of the physical space-time.) We think that neither (a) nor (b) is convincing; (a) assumes too much, it violates Ockham's principle *entia non sunt multiplicanda praeter necessitatem*, and (b) ignores that *logic and set theory constitute a framework and a tool for describing reality which was given to us by natural evolution.* We believe the latter since people of all cultures agree that mathematical arguments are convincing, and those who study the rules of logic and the axioms of set theory (ZFC with urelements allowed) think that they are evident. [Some postmodernists try to refute this observation by quoting various psychological experiments. We cannot take here the time and space to criticize them, but we believe that the evidence in favor of our opinion is overwhelming.] (Note: In this article, I will use parentheses to indicate additional information that is necessary but outside the main flow of ideas, square brackets for additions that are more remote from the main flow, and curly braces for digressions.)

Thus we accept a view which is intermediate between (a) and (b) and which says that not only applications but (in a great measure) human nature itself defines and causes pure mathematics. The ideal actually infinite sets of the Platonists are replaced by physical phenomena in human brains, that is, thoughts of things like boxes whose content is not fully imagined (see [H_1]). The meaning of quantifiers is explained as follows (see [SK] and [H_2]): If we claim in *pure* mathematics that $\forall x \exists y \varphi(x, y)$, where x and y range over a universe U, we assert only that we have a mental operation such that given any a in U we can imagine a b in U satisfying $\varphi(a, b)$. Hence the infinite sets and universes of pure mathematics are not actually but only potentially infinite. (For a fuller explanation see remark 3 at the end of this paper.) Thus pure mathematics is a finite human construction in a state of growth dealing with imaginary objects. It makes no sense to call it true or false since truth can appear only in applications (this does not contradict the fact that there exists a mathematical theory of the relation of truth). And yet logic and set theory are not arbitrary since human intelligence is made to describe reality in this framework (i.e., to classify using sets, sets of sets. etc.).

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{Although we have explained pure mathematics without introducing actual infinity, it seems that actual infinity does exist in physical reality, e.g., the space-time continuum appears to be infinite (see e.g., [P]). But some objects or structures of mathematics are purely *imaginary*, for example, a well-ordering of the real line, while others have potential interpretations as physical objects or processes, and we call them *real*. In mathematical practice many real objects are constructed or explained by means of imaginary ones. This is the natural way to do mathematics, such are the necessities of human intelligence. Constructivism, which tries to avoid imaginary objects, is unwieldy, but the distinction between imaginary and real objects is interesting, see [DM] and [M_5].}

Although the concept of truth does not apply to pure mathematics, we can ask *does such and such a set-theoretic proposition P constitute a natural law of thought*? Of course if the answer is *yes* we accept P as an axiom. If it is *no*, but P is consistent with the natural laws, then we are free to accept or to reject P. After Gödel and Cohen it is known that many simple set-theoretic propositions P are in that last category. And yet some of them can be desirable axioms if they have any of the following properties: (1) They simplify set theory, inducing regularities without excluding any interesting objects. (2) They strengthen set theory and enrich its universe with interesting objects.

For these reasons it is rational to add new axioms, when we think they satisfy (1) or (2). But I feel that, for a long time, set theorists have not taken advantage of this freedom; that is, they accept in practice the view of Platonists who worry that the prospective axioms could be false. (The only axioms extending ZFC which set theorists accept rather freely are the large cardinal axioms, see [Ka] and Axiom SC below.) For example, my paper [M_3] was written under the spell of that restrictive tradition. On the other hand, such new axioms cannot be written in stone. Since the future developments of mathematics may require their rejection, they can reflect only the actual state of mathematics.

The purpose of this paper is to propose and to discuss briefly a system ST of axioms for set theory which appear at present to be the natural choices of a rationalist. ST will be much stronger than the traditional theory ZFC, since several "conjectures" will be accepted as axioms. I will argue that the acceptance of these "conjectures" (they are known to be consistent with the original axioms if the latter are consistent) is well motivated.

The Axioms of ST

We propose a set theory ST based on ten axioms:

The Axiom of Extensionality:

$$(1) \qquad \forall x y[\forall z[z \in x \longleftrightarrow z \in y] \rightarrow x = y].$$

This axiom defines the concept of a set in terms of the membership relation $\in$. Since x and y are unrestricted variables, (1) also precludes the existence of objects that are not sets. This may appear too restrictive since in real life we imagine many objects which we do not treat as sets. Therefore in some older books the universe of set theory is divided into sets and non-sets (called *urelements*), and in the Axiom of Extensionality the range of x and y is restricted to sets; see e.g., [KM] and [Su]. However, experience has shown that in mathematics urelements are not essential (they can be constructed in terms of sets and a modification of the relation $\in$). Therefore, in view of its simplifying role, we accept the Axiom of Extensionality.

The Axiom of Union:

$$(2) \qquad \forall x \exists y \forall z[z \in y \longleftrightarrow \exists s[z \in s \,\&\, s \in x]].$$

Of course we often need to construct a set y in terms of a set x in the above way. Thus we accept the Axioms of Union. (We write $y = \bigcup(x)$.)

The Axiom of the Powerset:

$$(3) \qquad \forall x \exists y \forall z[z \in y \longleftrightarrow \forall s[z \in s \rightarrow s \in x]].$$

Once again, we often need to construct y in terms of x in the above way. Thus we accept the Axiom of the Powerset. (We write $y = P(x)$.)

The Axiom of Replacement:

$$(4) \qquad \begin{aligned} &\forall \bar{u}[\forall x y \exists z[\varphi(x, y, \bar{u}) \rightarrow y = z] \rightarrow \\ &\forall d \exists r \forall y[y \in r \longleftrightarrow \exists x[x \in d \,\&\, \varphi(x, y, \bar{u})]]]. \end{aligned}$$

Here $\bar{u}$ denotes a finite string of variables, and φ is any formula written in terms of $\neg$ (negation), $\rightarrow$ (implication), $\forall$ and $\exists$ (universal and existential quantifiers), the symbols $=$ and $\in$, and variables, and such that the variables x, y, z, d, r do not appear in $\bar{u}$. This axiom is really a rule of proof since we can put for φ any formula we wish. It tells us that if we pick any string of sets $\bar{u}$, and a formula $\varphi(x, y, \bar{u})$ such that for all x there is at most one y which satisfies it, then for every set d (the domain) there exists a set r (the range) which is the image of d under φ. Again we often use this rule to construct r from d (and $\bar{u}$), and hence we accept the Axiom of Replacement.

[For example, if we choose φ to be the formula $x = y \,\&\, \psi(x, \bar{u})$, then r is the subset of d consisting of these x that satisfy $\psi(x, \bar{u})$. If we choose a φ that is always false then r is the empty set $\varnothing$. Then using the Powerset Axiom we can construct the set $d = PP(\varnothing) = \{\varnothing, \{\varnothing\}\}$. And, using this d and an appropriate $\varphi(x, y, a, b)$, (4) yields the unordered pair $\{a, b\}$. Then we can build the singleton $\{a\}$ and the ordered pair $\{\{a\}, \{a, b\}\}$, etc.]

The Axiom of Regularity:

$$(5) \quad \forall x[x \neq \varnothing \rightarrow \exists y[y \in x \,\&\, \forall s[s \in y - s \notin x]]].$$

The only role of this axiom is to simplify the universe of sets. It precludes the existence of infinite sets $\{a_1, a_2, \dots\}$ such that $a_1 \ni a_2 \ni a_3, \dots$. Indeed if x was such a set it would violate (5). It also precludes sets a such that $a \in a$. Indeed, for such an a, the set $x = \{a\}$ would violate (5). Of course any urelements would also violate (5). Set theories without the axiom of regularity have been considered, but they do not appear to lead to any sufficiently interesting mathematics. Therefore, in view of its simplifying role, we accept the Axiom of Regularity.

However, we will introduce below an axiom (7) which implies (5); thus (5) is superfluous in ST, but it will appear in some later remarks.

The Axiom of Infinity:

(6) $\quad \exists x[x \neq \varnothing \ \& \ \forall y[y \in x \to y \cup \{y\} \in x]],$

where $y \cup \{y\} = \bigcup\{y, \{y\}\}$. This axiom is essential for the construction of infinite sets, for example, of the set $\mathbb{N}$ of positive integers. The former axioms (1)–(5) of set theory constitute a system definitionally equivalent to Peano's Arithmetic (PA), and this system is not strong enough to develop mathematics in a natural way. For example, (6) is necessary for the development of analysis.

[A very artificial finitistic way of doing set theory is possible. It is based on the Completeness Theorem of Gödel. Namely, we can develop mathematics within the theory PA + Con(S), where PA is Peano's Arithmetic and Con(S) expresses in the language of PA (by means of Gödel numbers) the consistency of a set theory S. In this theory we can define a model of S. But this is not natural since it is only a translation of the idea of S into the language of PA.]

The Axiom V = OD:

From now on we depart from the beaten track since V = OD and the remaining axioms have not yet been accepted by other set theorists. To explain this axiom, recall first that the class of ordinal numbers Ord is defined to be the smallest class of sets that contains $\varnothing$ and that is closed under unions of its subsets and closed under the function $x \mapsto x \cup \{x\}$. (One shows that $\alpha \in Ord$ if and only if $\forall xy[x \subseteq y \subseteq \alpha \to x \in y \in \alpha]$.) The former axioms (1)–(6) yield a proof that each ordinal α is well-ordered by the relation $\in$. As usual, $\in$ restricted to ordinals is denoted by $<$, and ω denotes the least infinite ordinal. For every ordinal α, we define $\alpha + 1 = \alpha \cup \{\alpha\}$. Then we define recursively the sets V_α ($\alpha \in Ord$):

$$V_\alpha = \bigcup_{\xi<\alpha} P(V_\xi).$$

Thus $V_0 = \varnothing$, $V_1 = \{\varnothing\}$, $V_2 = \{\varnothing, \{\varnothing\}\}, \dots, V_{\alpha+1} = P(V_\alpha), \dots$. The former axioms (1)–(6) yield the theorem:

$$\forall x \exists \alpha[x \in V_\alpha],$$

and we write

$$(*) \qquad V = \bigcup_{\alpha \in Ord} V_\alpha.$$

Thus V denotes the universe of all sets. Unlike the V_α's, V is not a set, and hence $(*)$ is not a formal definition in the language of set theory.

Now we form the models $\langle V_\alpha, \in\rangle$, and we denote by D_α the set of elements of V_α which can be defined by unary formulas in the model $\langle V_\alpha, \in\rangle$. Then OD is a class informally defined as follows:

$$\text{OD} = \bigcup_{\alpha \in Ord} D_\alpha.$$

Again OD is not a set. But our seventh axiom, V = OD, can be formally expressed as follows:

$$(7) \qquad \forall x \exists \alpha[x \in D_\alpha].$$

Notice that each D_α is finite or countable. Still the union $\bigcup_{\xi<\alpha} D_\alpha$ builds up relentlessly, so we never need in mathematics any set that has to be outside of OD. [Of course we could assume that there exist such sets, but heretofore this assumption has not led to any interesting mathematics.]

We mention three consequences of V = OD: (a) it implies the Axiom of Choice, and moreover it yields a certain binary formula $\varphi(x, y)$ that well orders all of V; (b) it implies the Axiom of Regularity (5); (c) the set theory S based on the axioms (1)–(7) has the elegant property that the definable elements of any model M of S constitute an elementary submodel of M. Peano's arithmetic also has this property, but the traditional system of axioms ZFC does not have it. I believe that, in view of these consequences and for sake of definiteness, it is rational to accept V = OD.

Of course this may be a temporary situation. For example, some interesting theory involving real numbers that are not in OD could arise in the future. But we have no reason to predict that such a thing will happen.

[It appears natural to add a refinement (7*) of (7), which, in the presence of (5), implies (7):

$$(7^*) \qquad V_\alpha \subseteq \bigcup_{\xi<|V_\alpha|} D_\xi,$$

where $|V_\alpha|$ is the ordinal of the least well-ordering of V_α. But I do not know any interesting consequences of (7*). Every set x has the structure of a tree $\langle Tr(x), \in\rangle$, where

$$Tr(x) = \{x\} \cup x \cup \bigcup(x) \cup \bigcup(\bigcup(x)) \cup \dots$$

Perhaps one can postulate some more detailed relation between the definitions of definable sets and their trees?]

The Axiom GCH:

The cardinal number of a set a, in symbols $|a|$, is the smallest ordinal number which has a bijection

to a. Thus the least infinite cardinal number is ω, also denoted $\aleph_0$. The next one is denoted ω_1 or $\aleph_1$, etc. For every cardinal number α we define $2^\alpha = |P(\alpha)|$ and $\alpha^+ =$ (the least cardinal larger than α). The Axiom GCH is:

(8) *For every infinite cardinal α we have $2^\alpha = \alpha^+$.*

This axiom greatly simplifies the theory of infinite cardinal numbers, and it adds many interesting theorems to the combinatorics of infinite sets. These well known advantages are so significant that it is rational to accept GCH as an axiom of set theory. (Even CH, that is $2^{\aleph_0} = \aleph_1$, has many interesting consequences.)

Set theorists often say that probably GCH restricts too much the sets $PP(\alpha)$. But one can also surmise the opposite. Indeed $2^\alpha > \alpha^+$ precludes the existence of any subset of $P(\alpha)$ which codes a function $f : P(\alpha) \to P(\alpha)$ such that whenever $x, y \in P(\alpha)$ and $x \neq y$, then $f(x)$ and $f(y)$ code different well-orderings of α. Since, as we explained in the first section, $PP(\alpha)$ is only potentially infinite, we are free to accept GCH. [It is often said that the Axiom of Choice (AC) and CH have consequences that contradict probabilistic intuition that is based on physical experience. However, a closer look shows that those paradoxical consequences do not pertain to any mathematical objects that have a potential for direct physical interpretations (for a detailed discussion see [DM] and [M_5]). On the other hand AC and GCH have similar organizing or simplifying roles, which motivate their presence in ST. (As mentioned earlier AC is a consequence of $V =$ OD.)]

The acceptance of GCH leads us to the following considerations. If we have a nontrivial proof of a theorem T which does not use GCH, such that T becomes trivial if GCH is assumed, then that proof ought to give a stronger theorem T* that is still nontrivial even in the presence of GCH. I will give two examples where I do not know the correct statement of T*.

The first is a theorem of R. McKenzie and S. Shelah [MS]. To state it we need the following concepts. An algebra **A** of countable type is a system $\langle A, f_1, f_2, \dots \rangle$, where A is a nonempty set and each f_n is a function of finitely many variables running over A and with values in A. Let Σ be an infinite system of equations written in terms of the f_n's and any (possibly infinite) number of unknowns. **A** is said to be *equationally compact* if every Σ has the property that if all its finite subsystems can be solved in **A** then the entire system Σ can be also solved in **A**. And, **A** will be called *folded* if for every proper homomorphic image **B** of **A** there exists a finite system Σ which can be solved in **B** but not in **A**. It was known (W. Taylor [T]), that if **A** is of countable type, equationally compact, and folded then $|A| \leq 2^{\aleph_0}$. McKenzie and Shelah proved without using CH that $\aleph_0 < |A| < 2^{\aleph_0}$ is impossible. According to the idea expressed earlier, the proof should yield a stronger theorem T* which remains nontrivial even if we assume the theorem of Taylor and CH. I do not know such a theorem.

Another example of this situation is the following. A well known conjecture of R. L. Vaught says that if T is a countable theory, then the number α of isomorphism types of countable models of T cannot satisfy $\aleph_0 < \alpha < 2^{\aleph_0}$. Morley [Mo] has shown a little less, namely that $\aleph_1 < \alpha < 2^{\aleph_0}$ is impossible. Again I think that a stronger conjuncture and a theorem that do not follow immediately from CH should exist.

The above ideas should not be construed as a criticism of a branch of foundations called Reverse Mathematics. In this branch one proves theorems of the form T $\to$ A, where T is some interesting theorem and A is an axiom (of course A is not assumed in the proof of T $\to$ A). Some examples of such theorems are the following. *Tarski's theorem*: (For all infinite sets X there exists a bijection of X to $X \times X$) $\to$ (Axiom of Choice). Or *Sierpiński's theorem*: (The space $\mathbb{R}^3$ with a Cartesian coordinate system X, Y, Z, is a union of three sets A, B, and C such that every linear section of A parallel to X is finite, every linear section of B parallel to Y is finite, and every linear section of C parallel to Z is finite) $\to$ CH. There are many interesting theorems of Reverse Mathematics, but some critics do not care for such results. [Tarski told me the following story. He tried to publish his theorem (stated above) in the *Comptes Rendus Acad. Sci. Paris* but Fréchet and Lebesgue refused to present it. Fréchet wrote that an implication between two well known propositions is not a new result. Lebesgue wrote that an implication between two false propositions is of no interest. And Tarski said that after this misadventure he never tried to publish in the *Comptes Rendus*.]

The Axiom SH:

(9) *If A is a linearly ordered set such that every set of disjoint open intervals of A is countable then A has a countable subset which intersects every non-empty open interval of A.*

This axiom, called Suslin's Hypothesis, has been extensively studied (see [Ku]). Once again, we do not meet in mathematics any linear orders violating (9). So we accept (9) since it simplifies set theory in a natural way.

It may be of some interest to recall a statement equivalent to (9) (see e.g., [Ku]). By a tree we mean a partially ordered set T such that the set of predecessors of any element of T is fully well-ordered. A subset of T is called a chain if and only if it is

well-ordered; it is called an antichain if no two of its elements are comparable. Then (9) can be expressed equivalently as follows:

(9′) *If every chain and every antichain of a tree T is countable then T is countable.*

(Perhaps the simplifying nature of (9′) is more salient than that of (9). SH or (9′) may suggest similar axioms for higher cardinal numbers.)

The Axiom $AD^{L(\mathbb{R})}$:

To explain this axiom we need the following concepts. For every set A, we form the relational structure $\langle A, \in\rangle$, where $\in$ is restricted to A. Then a set $X \subseteq A$ is called *A-constructible* if there exists a formula of set theory $\varphi(x, \bar{y})$ and a finite string $\bar{a}$ of elements of A such that

$$x \in X \longleftrightarrow (\varphi(x, \bar{a}) \text{ is true in } \langle A, \in\rangle).$$

Let $C(A)$ denote the set of A-constructible subsets of A.

Then we define

$$L_\alpha = \bigcup_{\xi<\alpha} C(L_\xi)$$

and

$$L = \bigcup_{\alpha\in Ord} L_\alpha.$$

We define also

$$L_0(\mathbb{R}) = V_{\omega+1},$$

and, for all $\alpha > 0$,

$$L_\alpha(\mathbb{R}) = \bigcup_{\xi<\alpha} C(L_\xi(\mathbb{R})),$$

and finally

$$L(\mathbb{R}) = \bigcup_{\alpha\in Ord} L_\alpha(\mathbb{R}).$$

(The notation $L(\mathbb{R})$ derives from the existence of natural bijections from $V_{\omega+1}$ to the set $\mathbb{R}$ of real numbers.) The structures $\langle L, \in\rangle$ and $\langle L(\mathbb{R}), \in\rangle$ are of special interest. The first satisfies all the axioms (1)–(8) (but not (9)), and the second satisfies (1)–(6). In fact $\langle L(\mathbb{R}), \in\rangle$ is the smallest structure which contains $\mathbb{R}$ and all the ordinal numbers and which satisfies (1)–(6).

Although $L(\mathbb{R})$ is minimal in the above sense it is large enough for mathematical analysis. For example, it contains not only all the real numbers but also the projective sets of all ranks $< \omega_1$, and presumably all sets that are of true significance for analysis over Polish spaces. On the other hand, it does not contain sets that appear pathological in a probabilistic sense. But these claims depend on the axiom $AD^{L(\mathbb{R})}$ which we will explain presently.

Consider the following infinite binary game of perfect information. Let $\{0,1\}^\omega$ be the set of all infinite sequences $(\varepsilon_0, \varepsilon_1, \ldots)$ where $\varepsilon_n \in \{0,1\}$, and let a set $X \subseteq \{0,1\}^\omega$ be given. Player I chooses ε_0, then player II chooses ε_1, then again I chooses ε_2, and II chooses ε_3, etc. The set X and the sequence $(\varepsilon_0, \ldots, \varepsilon_{n-1})$ are known to the player choosing ε_n. I wins if the sequence $(\varepsilon_0, \varepsilon_1, \ldots)$ belongs to X and II wins otherwise.

The Axiom of Determinacy AD is the statement *for every X one of the players has a winning strategy.* It is easy to prove using the Axiom of Choice that AD is false. But the Axiom $AD^{L(\mathbb{R})}$ [which was suggested in [M$_6$S] and in [M$_4$] footnote ([1])] is the following restriction of AD:

(10) AD *is true provided* $X \in L(\mathbb{R})$.

This axiom has many interesting consequences. Assuming $AD^{L(\mathbb{R})}$ the class $L(\mathbb{R})$ becomes the natural universe of sets for mathematical analysis in Polish spaces. Indeed, AD implies that: *all uncountable sets of reals have perfect subsets, all sets of reals are Lebesgue-measurable, and all have the property of Baire* (see [M$_2$]). Also the theory of projective sets gets a very regular form (see e.g., [M]).

Therefore it is rational to accept the axiom $AD^{L(\mathbb{R})}$.

The Axiom SC:

To explain this axiom we need the following concepts. For every infinite cardinal α, a Hausdorff space S is called *α-compact* if every covering of S with open sets has a subcovering with less than α sets. (Thus ω-compact means compact in the usual sense.) A cardinal α is called *strongly compact* if every topological Cartesian product of any number of α-compact spaces is α-compact. By the Tychonoff product theorem, ω is a strongly compact cardinal. (There exist other definitions of strongly compact cardinals. They were introduced in [KT] and the above definition was shown in [M$_1$].) The axiom SC is the following:

(11) *For every cardinal κ there exists a strongly compact cardinal larger than κ.*

It is natural to replace the product topology in the definition of a strongly compact cardinal α by a larger topology whose basis is the set of all cylinders over products of less than α open sets. But the corresponding concept of strong compactness is equivalent to the former.

Thus SC postulates the existence of many cardinal numbers similar to ω. One can prove many large cardinal properties of α-compact cardinals, for example they are strongly inaccessible and even measurable (see [D] and [Ka]).

The axiom SC is also interesting for other reasons. One of them is a theorem of R. M. Solovay [So], which says that all cardinals α, which are larger than the least uncountable strongly compact cardinal and are singular and strong limit[1], satisfy $2^\alpha = \alpha^+$.

[1] *α is strong limit if $\kappa < \alpha \to 2^\kappa < \alpha$.*

{Again we believe that the proof in [So] should yield a property of α stronger than $2^\alpha = \alpha^+$, which does not become obvious under the assumption of GCH.}

To state an interesting consequence of SC let us generalize the infinite game defined in the previous section. We replace the set $\{0, 1\}$ by an arbitrary set P, and the set X by any $X \subseteq P^\omega$. (Thus the players I and II choose their ε_n in P.) Let N be a countable set, and consider the product topology in $P^\omega \times N^\omega$, where both P and N are given the discrete topology. A set $X \subseteq P^\omega$ is called *analytic* if it is a projection of a closed subset of $P^\omega \times N^\omega$. It is a consequence of SC that *if X is analytic then the game is determined, i.e., one of the players has a winning strategy.* (In fact a large cardinal axiom significantly weaker than SC suffices to prove this theorem, viz. $(\exists \kappa > |P|)\ [\kappa \to (\omega_1)^{<\omega}_2]$, see [$M_2$]. This result for $P = \omega$ is due to D. A. Martin; in [M_2] his proof is generalized to all sets P.)

Large cardinal axioms much stronger than SC have been proposed and studied. Some of them imply the axiom $AD^{L(\mathbb{R})}$ (this is a difficult theorem of Martin, Steel, and Woodin, see [N_1], [N_2] and [Ka]), but I stated SC rather than those stronger axioms since the latter are more complicated and, as far as I know, unlike SC, they are not suggested by any properties of ω.

Conclusion

This concludes my definition of a set theory ST which I believe to be reasonable, that is, as strong and simple as possible and unrestricted by any Platonic beliefs. Thus

$$\mathrm{ST} = [\mathrm{ZF} + (\mathrm{V} = \mathrm{OD}) + \mathrm{GCH} + \mathrm{SH} + \mathrm{AD}^{L(\mathbb{R})} + \mathrm{SC}],$$

where, as usual, ZF denotes the system (1)–(6). But, as explained in the introduction, ST is an attempt at a good synthesis of the *current* state of mathematics. It will have to be strengthened or modified if mathematics calls for more sets.

However, much of the current work in set theory consists of difficult and ingenious proofs in theories weaker than ST (see e.g., [Ka], [KL], and [S]), and of constructions of very artificial models that yield independence and consistency results. Of course this is interesting to the specialists, but I think that it is difficult to justify such work to mathematicians at large. Indeed they can object: We are not very interested in methodology; if you have the freedom to assume strong and simplifying axioms why don't you assume them?

Recently W. H. Woodin and others have proposed set theories that are inconsistent with ST, but I think that the motivation of ST is better (see remark 2 below).

[It is known that in very strong set theories, e.g., ZFC + (there exists a supercompact cardinal), one can prove that ST is consistent. But the definitions of supercompact cardinals or any cardinals sufficient for that proof (see [N_1, N_2]), are so complicated that the claim that ST is consistent is more convincing to me than the claim that these very strong theories are consistent.]

Additional Remarks

Let ZFC denote (as usual) the system of axioms (1)–(6) plus the Axiom of Choice. Let me reiterate the motivation of ST. As we mentioned in the Introduction, ZFC is natural in the sense that almost every mathematician who reads its axioms feels that he accepts them. However, as explained in our discussion of axioms (1) and (5), ZFC departs from the natural way of thinking by accepting some simplifications which eliminate certain sets that are not important for mathematics (urelements and sets that are not well founded). So it is natural to follow this path and accept the other axioms of ST that simplify the theory, namely $V = \mathrm{OD}$, GCH, SH, and $\mathrm{AD}^{L(\mathbb{R})}$. (Of course SC enriches rather than simplifies.)

This suggests the question why these well known propositions are not yet generally accepted by most set theorists. I see three reasons: (a) the tradition of treating them as open problems; (b) the thought that they oversimplify set theory; (c) the belief of Platonists that they could be false. In the next three sections I will argue contra (a), (b), and (c).

1. *Ad (a).* Of course (a) should be dismissed since it is known that none of the axioms (7)–(11) is a consequence of the other ones.

2. *Ad (b).* If we agree that ST does not appear to impose any bounds on the consistency strength of its possible extensions, then the fear that it oversimplifies set theory has no motivation. Thus I feel that (b) is not true (at least at the present time).

However, alternative theories were proposed recently in [W_1, W_2]. These theories yield certain descriptions of the model

$$\langle P(\omega_1), \omega_1, +, \cdot, \in \rangle,$$

where + and $\cdot$ are ordinal addition and multiplication restricted to countable ordinals, and they happen to disprove the Continuum Hypothesis; they prove $2^{\aleph_0} = \aleph_2$. This looks odd, and it is a big complication of the theory of cardinal numbers or of the combinatorics of infinite sets. Moreover, all uncountable subsets of ω_1 (and of $\mathbb{R}$) are imaginary objects without the potential for any direct physical interpretations (see [DM] and [M_5]). Hence any additions to ZFC describing these objects can be motivated only by human preference. Therefore the only objective criteria which can guide our choice among these theories are precisely the simplicity of the axioms and the regularity of their consequences. Are the theories proposed in [W_1, W_2] so attractive from this point of view that we

should give up GCH?

[Some philosophers have tried to dismiss the concept of simplicity of a theory, claiming that it is vague or language-dependent or irrelevant. Yet the simpler theories are easier to communicate and easier to to remember, and in our descriptions of reality (that appear to be true) the simplest are the most convincing. Moreover, all generalizations or inductive inferences can be viewed as simplifications of lists of special cases. Therefore it is natural to apply also the criterion of simplicity or elegance in our choice of set-theoretic axioms and their consequences.]

3. *Ad (c)*. Let me amplify some remarks made in the Introduction. Hilbert's view [H_1] of the structure of sets of pure mathematics as a finite array of potentially infinite sets can be compared to the interpretation of complex numbers as points of the Cartesian plane (by Wessel, Argand, and Gauss). Like the latter it gives a physical significance to some formal concepts. I think that the idea of Hilbert is deep since it simplifies in a dramatic way the ontology of pure mathematics. [It may have been anticipated by Poincaré, by Skolem (in some papers related to [Sk]), and even by Aristotle.] And yet this idea is not yet a part of the general mathematical culture (perhaps because it has little relevance outside of set theory or because of a weakness of the current philosophical culture). Now, a full understanding of this interpretation also requires an explanation of quantifiers that does not use actual infinity. None of the books that I know presents this development in modern terms, although this is very easy:

Let $\bar{x}$ and $\bar{y}$ be finite strings of variables, and $|\bar{s}|$ denotes the length of the string $\bar{s}$. Let ε be an operator which attaches to every formula $\varphi(\bar{x}, \bar{y})$ *without quantifiers*, where $\bar{x}$ and $\bar{y}$ are disjoint strings, a string of $|\bar{y}|$ new function symbols of $|\bar{x}|$ variables each. Denoting by $\varepsilon_{\varphi,\bar{y}}$ this string of new function symbols (if $\bar{x}$ is of length 0 they are constants) we have the axiom

$$\text{(H)} \qquad \varphi(\bar{x}, \bar{y}) \to \varphi(\bar{x}, \varepsilon_{\varphi,\bar{y}}(\bar{x}))$$

essentially due to Hilbert [H_2]. Granted this axiom, quantifiers can be defined as abbreviations

$$\exists \bar{y}\varphi(\bar{x}, \bar{y}) = \varphi(\bar{x}, \varepsilon_{\varphi,\bar{y}}(\bar{x}))$$

and

$$\forall \bar{y}\varphi(\bar{x}, \bar{y}) = \varphi(\bar{x}, \varepsilon_{\neg\varphi,\bar{y}}(\bar{x})).$$

Then the usual rules of logic concerning quantifiers can be derived from (H). Also using these formulas and working from inside out, variables (and quantifiers) can be eliminated from every sentence; and (H) can be viewed as an axiom-schema or a rule, where $\bar{x}$ and $\bar{y}$ are arbitrary strings of names of constants.

{In the presence of $V = \mathrm{OD}$ we have a definable well-ordering of the universe, and then the operator ε can be also defined: $\varepsilon_{\varphi,\bar{y}}(\bar{x})$ is the least $|\bar{y}|$-tuple such that $\varphi(\bar{x}, \varepsilon_{\varphi,\bar{y}}(\bar{x}))$ holds, and, if no such $|\bar{y}|$-tuple exists, then $\varepsilon_{\varphi,\bar{y}}(\bar{x})$ can be any $\bar{y}$-tuple, say $(\emptyset, \ldots, \emptyset)$.

Logicians who want to interpret symbols in models (within set theory) can interpret the sequence $\varepsilon_{\varphi,\bar{y}}$ as a variable $|\bar{y}|$-tuple ranging over the relation (depending on $\bar{x}$) denoted by φ when the latter is nonempty, and unrestricted when it is empty.}

We conclude that the feeling of concreteness and reproducibility of mathematical objects is based on the fact that, no matter what language we use to describe them, they constitute finite structures in our thoughts and memories of very definite kinds. And the feeling of consistency of ZFC arises from the simplicity of these constructions. Thus we are able to explain these feelings without the assumption that mathematics describes some Platonic ideas independent of humankind.

References

[D] F. R. Drake, *Set Theory, An Introduction to Large Cardinals*, North-Holland, 1974.

[DM] R. Dougherty and J. Mycielski, Canonical universes and intuitions about probabilities, (to appear).

[H_1] D. Hilbert, On the foundations of logic and arithmetic (1904), *From Frege to Gödel, A Source Book in Mathematical Logic, 1879–1931*, (J. van Heijenoort, ed.), Harvard Univ. Press, Cambridge, 1976, pp. 129–138.

[H_2] _____, Die Logischen Grundlagen der Mathematik, *Math. Annalen* **88** (1923), 191–165.

[Ka] A. Kanamori, *The Higher Infinite*, Springer-Verlag, Berlin, Heidelberg, 2003 (second edition).

[Ku] K. Kunen, *Set Theory, An Introduction to Independence Proofs*, North-Holland, 1992.

[KL] V. G. Kanovei and V. A. Lyubetskii, On some classical problems of descriptive set theory, *Russian Math. Surveys* **48**:5 (2003), 839–927.

[KM] K. Kuratowski and A. Mostowski, *Set Theory*, North-Holland, 1968.

[KT] H. J. Keisler and A. Tarski, From accessible to inaccessible cardinals, *Fund. Math.* **53** (1964), 225–308.

[M] D. A. Martin, Descriptive set theory, *Mathematical Logic* (J. Barwise, ed.), North-Holland, 1991, pp. 783–815.

[MS] R. McKenzie and S. Shelah, The cardinals of simple models for universal theories, *Proc. Symp. Pure Math., vol XXV, Proceedings of the Tarski Symposium*, Amer. Math. Soc., Providence, RI, 1974, pp. 53–74.

[Mo] M. Morley, The number of countable models, *J. Symbolic Logic* **35** (1970), 14–18.

[M_1] J. Mycielski, Two remarks on Tychonoff's Product Theorem, *Bull. Acad. Polon. Sci., Series Math. Astr. Phys.* **12** (1964), 439–441.

[M_2] _____, Games with perfect information, *Handbook of Game Theory with Economic Applications* (R. J. Aumann and S. Hart, eds.), North-Holland, 1992, pp. 41–69.

[M_3] _____, Axioms which imply GCH, *Fund. Math.* **176** (2003), 193–207.

[M_4] _____, On the axiom of determinateness, *Fund. Math.* **53** (1964), 205–224.

[M5] _____, Pure mathematics and physical reality, to appear in *Fundamental and Applied Mathematics* (*Fundamentalnaya i prikladnaya matematika*) **11**(5), 2005.
[M6S] J. MYCIELSKI and H. STEINHAUS, A mathematical axiom contradicting the axiom of choice, *Bull. Acad. Polon. Sci., Series Math. Astr. Phys.* **10** (1962), 1–3.
[N1] I. NEEMAN, Optimal proofs of determinacy, *Bull. Symbolic Logic* **1** (1995), 327–339.
[N2] _____, Optimal proofs of determinacy (II), *J. Math. Logic* **2** (2002), 227–258.
[P] R. PENROSE, *The Road to Reality*, A. A. Knopf, New York, 2005.
[S] S. SHELAH, Logical dreams, *Bull. Amer. Math. Soc.* **40** (2003), 203–228.
[Sk] T. SKOLEM, Logico-combinatorial investigations in the satisfiability or provability of mathematical propositions (1920), in *From Frege to Gödel, A Source Book in Mathematical Logic, 1879–1931*, (J. van Heijenoort, ed.), Harvard Univ. Press, Cambridge, 1976, pp. 252–263.
[So] R. M. SOLOVAY, Strongly compact cardinals and the GCH, *Proc. Symp. Pure Math., vol XXV, Proceedings of the Tarski Symposium*, Amer. Math. Soc., Providence, RI, 1974, pp. 365–372.
[Su] P. SUPPES, *Axiomatic Set Theory*, Dover Publ. Inc., New York, 1972.
[T] W. TAYLOR, Some constructions of compact algebras, *Annals of Math. Logic* **3** (1971), 395–436.
[W1] W. H. WOODIN, The Continuum Hypothesis, *Notices Amer. Math. Soc.* **48** (2001), Part I, 567–576; Part II, 681–690; correction to Part II, ibidem **49** (2002), 46.
[W2] W. H. WOODIN, Set theory after Russell: The journey back to Eden, *One Hundred Years of Russell's Paradox*, (G. Link, ed.), de Gruyter, Amsterdam, New York, 2004, pp. 29–47.

About the Cover

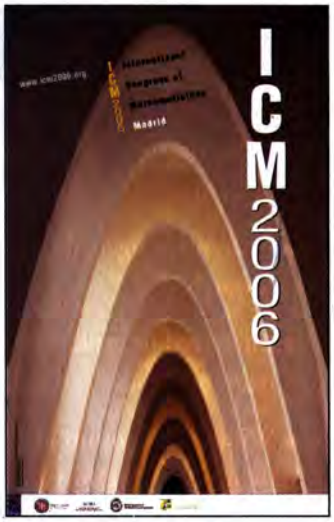
ICM Madrid 2006

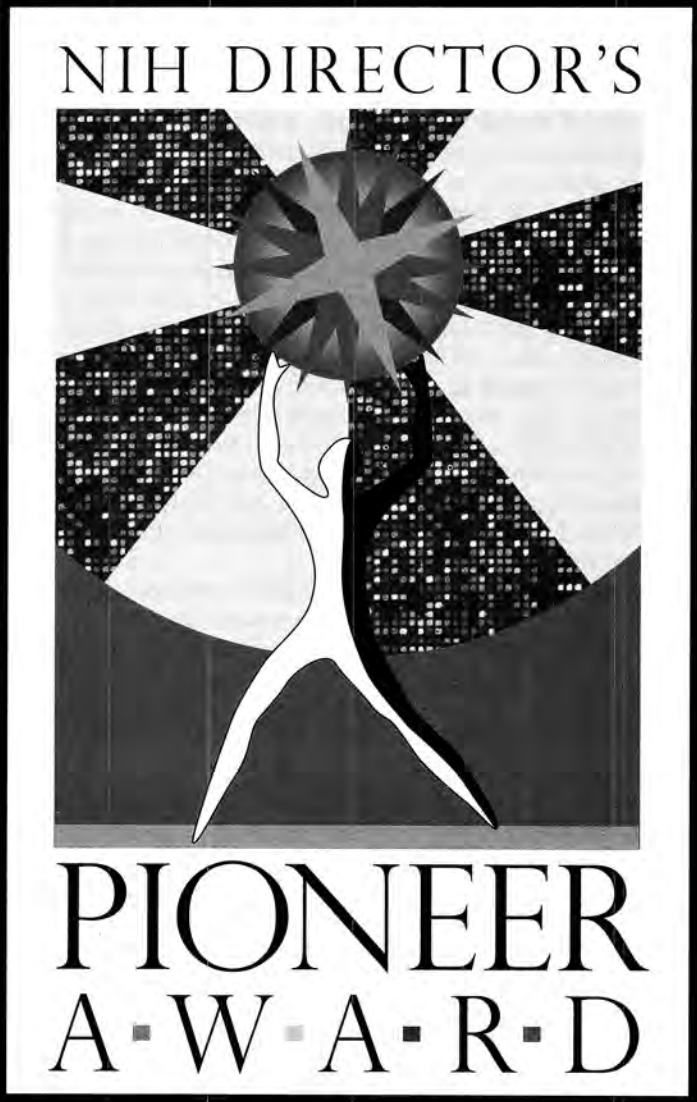
As Manuel de León and Allyn Jackson explain elsewhere in this issue, the next International Congress of Mathematicians will be held in the summer of 2006 in Madrid. As many mathematicians already know, a number of extremely handsome posters have been distributed to advertise the event. The image on this issue's cover, which shows the cupola of the *Sala de las dos Hermanas* in the Alhambra, is taken from one of them. Two of the posters are shown in the article by Allyn Jackson, and the other two are reproduced below. The verses by Ibn Zamrak, mentioned in a caption in Jackson's article, are just visible on the cover. One of the posters below exhibits a view of the Colegio de las Teresianas, designed by the Barcelonian architect Gaudí, and the other the cupola of the imperial Escorial Palace just outside Madrid. The graphics designer for all of the posters associated with the ICM 2006 was Maria Casassas of Barcelona. The photographer was Marc Llimargas, who specializes in architectural photography. In particular, he did the photography for a recent book on Gaudí.

The geometric nature of Islamic design, incorporating complex symmetries, has been well-explored from a mathematical point of view. A fairly sophisticated discussion, referring specifically to the Alhambra, can be found in the book *Classical Tessellations and Three-manifolds* by José María Montesinos. One good introduction to the Alhambra, with a short discussion of the mathematics in context, is the book *The Alhambra* by Oleg Grabar. A mathematical treatise much respected by nonmathematicians is the University of Zürich Ph.D. thesis of Edith Müller, *Gruppentheoretische und Strukturanalytische Untersuchungen der Maurischen Ornamente aus der Alhambra in Granada.*

Our thanks to Manuel de León for his help in obtaining the images we used.

—Bill Casselman, Graphics Editor
(notices-covers@ams.org)





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PopCo

Reviewed by Alex Kasman

PopCo
Scarlett Thomas
Harvest Books, 2005
512 pages, US$14.00
ISBN 015603137X

The novel *PopCo* by Scarlett Thomas is many different things at once. It is a psychological study of the social pressures on a teenage girl in a new school. It presents a sort of "conspiracy theory" about the manipulation of consumers by advertisers and manufacturers (and a "counter-conspiracy" by an underground movement). It parodies the events at a corporate retreat, where workers are forced to participate in morale building exercises. It also tells an adventurous story of pirates and the modern rediscovery of long hidden treasure. Surprisingly, *PopCo* is also a particularly good example of "mathematical fiction".

The protagonist in this book is Alice Butler, a young British woman working as an inventor of products for introverted teenagers at the multinational toy corporation, PopCo. Her product line includes toys involving code-breaking, spying, and puzzle-solving. In fact, Alice has a very good background for this sort of job because of her grandparents. After her mother died and her father left, she was raised by her grandparents who were both mathematicians. Her grandmother, who was a code-breaker at Bletchley Park during World War II, spent

all of her spare time attempting to prove the Riemann Hypothesis. Her grandfather, Peter Butler, who was not allowed to help Britain with the war effort due to his early antiwar activism, writes a column on mathematical puzzles for a science magazine. (At one point the book mentions Martin Gardner and his column in *Scientific American*, calling it an "American version" of Butler's "Mind Mangle" column.) However, because he was not allowed to work at Bletchley Park, Peter Butler still feels that he has something to prove to the world. So, Alice's grandfather spends his time trying to decode famous mysterious documents like the Voynich Manuscript and the Stevenson/Heath manuscript.

While the Voynich manuscript is a real document whose original purpose remains unknown (see, for instance, mathematician John Baez's page on it at `http://math.ucr.edu/home/baez/voynich.html`), the Stevenson/Heath manuscript is supposedly known to be the key to a pirate's hidden treasure and was invented for this book. When Alice was still very young, Peter Butler broke the code of the Stevenson/Heath manuscript and

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discovered the location of the treasure. However, for reasons both personal and environmental, he decides not to retrieve it or tell anyone else where it is. (It was this decision that prompted her father to leave.) Instead, he encodes a secret message in a locket that he gives to young Alice which will serve as proof that he was indeed the first to break the code and discover the location of the treasure.

The locket has in it the expression "2.14488156Ex48" and the Hebrew letter "aleph" with a subscript zero, Georg Cantor's notation for the cardinality of a countably infinite set. Alice learns the mathematical significance of the aleph early on in her childhood, entertaining her grandparents by answering questions such as "How many biscuits would you like, Alice?" with "Aleph-null, please". However, the significance of the other clue on the necklace eludes her and becomes the main focus of her own hunt for the pirate's treasure.

Mathematics is everywhere in Alice's world, not only in those portions connected to her mathematical grandparents. In those scenes that take place when she is in school, mathematics gets mentioned frequently. In part, this is because she has an interest in mathematics, but most of the focus is on her sexist teacher who refuses to allow girls to excel in his math class. Later, a speaker at the PopCo retreat talks to the workers about networks and asks if anyone there has heard of Paul Erdős. Alice is able to say that she has—her grandmother had an Erdős number of 2—but she is not alone. A coworker who has aleph-one (the next "size" of infinity) tattooed on his hand demonstrates detailed familiarity with Erdős and also with networks. And, when the workers are divided into teams for a sailing competition, Alice is elected as her boat's navigator because of her mathematical skills. Clearly, mathematics is something one needs to know about in the fictional world of *PopCo*.

The list of mathematical topics discussed in the book, some addressed in depth and others just casually, is quite broad. Among them are: Cantor's transfinite cardinals, prime numbers, public key encryption, the Monty Hall problem, the Riemann Hypothesis, Pythagoras' numerical analysis of pleasing musical tones, Gödel's incompleteness theorem, the Continuum Hypothesis, logical paradoxes, Conway's "Game of Life", and the Fibonacci sequence. The novel even includes as an appendix a table of the first 1,000 prime numbers and relates anecdotes about mathematicians such as Turing, Erdős, and Hardy.

Thomas' ability to include mathematics in her fiction is impressive on several counts. She avoids two of the most common problems of mathematical fiction: awkwardly including technical prose that seems out of place, and relying too heavily on stereotypes. The common stereotypes of mathematicians in fiction (as male, as schizophrenic, as antisocial, as unfeeling, etc.) are all avoided here. And her ability to fit mathematical ideas into a story without the result seeming forced is quite amazing. In the world of *PopCo*, sophisticated mathematics can arise in a casual conversation and not seem at all out of place. Of course, I am a mathematician, and so I might not be reacting to the mathematics the way a non-mathematically inclined reader might. However, that I could comfortably read through Alice's frequent discussions of homeopathy testifies to Thomas' literary skill. Because of my own skeptical inclinations, I would not normally choose to read about someone trying to decide which homeopathic remedy one should take when one "feels like glass". Though reading this book has not changed my mind about homeopathy, it has given me a better understanding of those who feel differently. And I would like to think that the same might be true of readers who would not normally want to read about someone discussing math.

Thomas also comes very close to avoiding one of the other pitfalls of mathematical fiction. Often authors have such a poor understanding of the mathematical objects they choose to include in their fiction that the result is unreadable by mathematicians. Although her writing is not entirely mathematically correct, Scarlett Thomas does basically understand the main ideas and conveys them well. For instance, without getting into any details about modular arithmetic, she really gets across the significance of public key encryption in the form of an analogy about locked boxes. Since Alice has been factoring numbers in an attempt to help her grandfather with the Voynich manuscript, she appreciates the difficulty presented by factoring very large numbers, which also helps the reader appreciate modern number theoretic methods in cryptography. Thomas also does an excellent job discussing Gödel's method for encoding mathematical expressions as numbers. However, she becomes a bit confused in her explanation of the proof of his incompleteness theorem, leaving out the key point of its meta-mathematical recursiveness. In her version, Gödel writes logical statements only about arithmetic properties (she suggests that "If $1 + 1 = 2$ then $1 + 1 = 3$" is akin to the key step in the proof), and so she seems to conclude that mathematics is inconsistent. Fortunately, this is not true or we might all be out of a job! If she had explained that it was also possible to encode statements about whether something was provable, she could have more correctly used "This statement cannot be proved" as her simplified example of Gödel's key step, since the ability to make such a statement in arithmetic terms leads either to the conclusion that arithmetic is inconsistent (because proving this statement would contradict the statement itself) or that it is

incomplete (since if it could not be proved then this would be an example of a true but unprovable statement). Her poetic description of the Riemann Hypothesis also borders on being mathematically incorrect, and one of the substitution ciphers in the book had two letters accidentally interchanged. However, I do not want to dwell too much on these small problems when the book is so successful and appealing otherwise.

Of course, whether one likes a novel or not is largely a matter of taste. *PopCo* has a subversive and lively style that appealed to me. One aspect of my personal taste in fiction is that I like to see an ending in which all of the mysteries and dilemmas are resolved, especially if it is able to achieve that "Aha!" feeling that one gets after solving a difficult problem or proving a mathematical result. Others may prefer an ambiguous ending, such as the ending of David Auburn's play *Proof*, which leaves everything to the audience's imagination. An ending that is conclusive and satisfying is very difficult to achieve, and *PopCo* succeeds here as well. In the end, there is a resolution ("Aha!") that ties together all of the loose threads. Mathematically inclined readers may also appreciate the self-referential implications towards the end of the book, when Alice begins talking about how she would like to write a book about her experiences.

PopCo is an entertaining and satisfying novel that embeds real mathematical ideas into a story about toys, trends, and fashions. That this improbable sounding combination is so successful may explain why Scarlett Thomas was the winner of a 2002 style award from *Elle* magazine.

For more information, visit Scarlett Thomas' homepage at `http://www.bookgirl.org` *(where you can find two very mathematical chapters that were cut from the book) and* `http://math.cofc.edu/kasman/MATHFICT/` *where you can read more about* PopCo *and other works of mathematical fiction.*

In High Gear: Spanish Mathematics Looks to the Future—and to ICM2006

Allyn Jackson

The International Congress of Mathematicians will be held in Madrid, Spain, August 22–30, 2006. The Second Announcement of the Congress appeared in the December 2005 issue of the *Notices*, pages 1407–1432, and contains information about the scientific program, the social program, registration, and accommodations. Updated information may be found on the ICM2006 website, `http://www.icm2006.org`.

Today, mathematics in Spain is in high gear. Many Spanish mathematicians are working at the top international echelons of research, speaking at important conferences, and publishing papers in the best journals. But this high level of mathematical activity is a relatively recent phenomenon in Spain. Even as Spanish mathematicians applaud the growth in their field, they see challenges ahead and know that sustaining the newfound momentum will take plenty of effort. Their successful bid to bring the International Congress of Mathematicians (ICM) to Madrid in August 2006 is emblematic of their efforts to highlight Spanish mathematics and keep it thriving.

Scientifically, A Developing Country

When it comes to scientific and mathematical research, Spain is in many ways a developing country. "We don't have a tradition of research in Spain," said Manuel de León, a permanent researcher at the Consejo Superior de Investigaciones Cientificas (CSIC, High Council for Scientific Research) and president of the Executive Committee for ICM2006. During the Middle Ages there were very good Arabic and Jewish mathematicians in Spain, and in 1572 King Phillipe II founded the Academia de Matemáticas de Madrid. Nevertheless, Spain has traditionally been known more for its arts and literature than for science and mathematics. In the early part of the twentieth century, some mathematical activity began to develop. The Real Sociedad Matemática Española (Royal Spanish Mathematical Society, RSME) was founded in 1911 and a mathematics research laboratory was established in Madrid in 1915. But the laboratory disappeared during the Spanish Civil War, and the RSME began a slow decline that was reversed only with its refounding in 1997.

During much of the twentieth century, when many other countries were building up the infrastructure and traditions that support research, Spain was under the dictatorship of Francisco Franco, which lasted from the 1930s until Franco's death in 1975 and kept Spain rather isolated from research at the international level. The Franco regime did make some efforts to support research within Spain and in particular founded the CSIC, which remains today one of the country's most important organizations for research. The CSIC consists mainly of a collection of institutes with permanent research staffs. In 1939, the Instituto Jorge Juan de Matemáticas was created in the CSIC. Although this institute was run more on the basis of influence and connections than on mathematical accomplishment, it nevertheless played an important role in keeping mathematics alive in Spain. So it was a setback for the Spanish mathematical community when the Jorge Juan Institute was shut down in 1984. Today mathematicians who work within CSIC are employed by institutes in other areas. For example, de León works in a Madrid-based CSIC institute focused on theoretical and fundamental physics, which is the only CSIC institute that has a mathematics department. This department has seven permanent members, eight postdoctoral researchers, and eight doctoral students.

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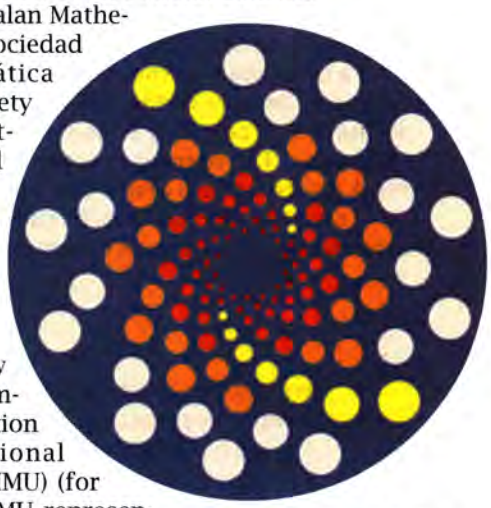
The improvement over the last couple of decades of Spain's economic condition led to increased investment in research and education, which in turn improved the climate for mathematics. During this time, and particularly in the last ten years, mathematics in Spain has undergone a revival. There are many more Spanish mathematicians working at the top levels of mathematics research than before. According to data collected by the Institute of Scientific Information (ISI), the percentage of mathematics research papers written by Spanish authors has grown from 0.3 percent in 1980 to close to 5 percent today. "Now when you open international journals, it is common to see Spanish authors," commented Carlos Andradas of the Universidad Complutense de Madrid, who is the current president of the RSME and vice president general of the ICM2006 Executive Committee. "This was not the case several years ago." One also sees more Spanish mathematicians on editorial boards of journals, as winners of international prizes, and as participants in research programs such as the international networks funded by the European Union.

The ISI also publishes a list of the world's most highly cited scientists. Among the fifteen Spaniards on this list, mathematics has the largest showing, with four mathematicians. The four are: David Nualart of the Universitat de Barcelona and the University of Kansas, Jesús María Sanz Serna of the Universidad de Valladolid, and Juan Luis Vázquez and Enrique Zuazua, both of whom are at the Universidad Autónoma de Madrid. Vázquez will deliver a plenary lecture at ICM2006, while Nualart and Zuazua will present section lectures. Indeed, de León pointed to the strong showing of Spanish mathematicians among ICM2006 speakers—nine in all—as yet another indication of the burgeoning of mathematics in Spain.

Rising Investment in Mathematics

Mathematics research in Spain is concentrated mainly in the country's universities. Judging by percentage of mathematics papers written, the primary centers are in Andalusia (19 percent), Barcelona (21 percent), and Madrid (24 percent). There are also strong groups in Granada, Santiago, Sevilla, and other places. There is one mathematics research institute that operates at the international level, the Centre de Recerca Matematica (CRM), based at the Universitat Autónoma de Barcelona. The CRM is supported by the Institut d'Estudis Catalans, a scholarly academy devoted to the promotion of Catalan culture. de León estimates that there are about 3,000 permanent positions for Spain's approximately 6,000 mathematicians and that about one-quarter of these individuals are actively doing research. Among the main areas of strength are algebraic topology, algebraic and differential geometry, partial differential equations, probability theory, and Fourier, complex, and functional analysis. Some branches of mathematics, such as number theory and logic, have little representation in Spain. Most of the research, even in such areas as PDEs and numerical analysis, tends toward the theoretical end of the spectrum.

Aside from the RSME, Spain has three other major mathematical societies: the Societat Catalana de Matemàtiques (Catalan Mathematical Society), the Sociedad Española de Matemática Aplicada (Spanish Society of Applied Mathematics), and the Sociedad de Estadística e Investigación Operativa (Society for Statistics and Operations Research). In 1998 these four organizations banded together to create a new Spanish National Committee for representation within the International Mathematical Union (IMU) (for many years, Spain's IMU representation was handled directly by the Ministry of Education and Science, which is the official adhering organization to the IMU).



Logo of ICM2006. The logo is an idealized image of a sunflower. The number of spirals to the right and left in a sunflower are consecutive numbers of the Fibonacci sequence. The logo also symbolizes the idea of Spain as a Mediterranean country. The colors of the logo are used to identify different fields of ICM2006 activity. For example, orange represents scientific activity.

These four organizations also collaborated to prepare the bid to the IMU to hold the 2006 ICM in Madrid. Carles Casacuberta of the Universitat de Barcelona, who is the current president of the Catalan Mathematical Society and a vice president of the ICM2006 Executive Committee, stated in an email message: "The bid's success testifies to the progress and unity of the Spanish mathematical community, in spite of its rich thematic and geographical diversity. Now Spain is willing and prepared to host this ICM. I doubt it would have been possible twenty years ago, or perhaps even ten years ago. Nowadays we have strong teams in almost every mathematical subject, linked by growing research structures, and the whole community is ready to support the ICM." The four mathematical societies—together with two other societies in education and history, plus a federation of teachers' associations—have formed the Comité Español de Matemáticas (Spanish Committee for Mathematics, CeMAT), which aims to coordinate Spanish activities connected with the IMU.

Right now Spain devotes just over 1 percent of its gross domestic product to research, while the

The ICM2006 Alhambra Poster. The Hall of the Two Sisters (Sala de las dos Hermanas) derives its name from the twin marble flagstones forming part of the floor. This hall was in the center of a series of chambers where the Sultana and her family lived. The hall was built by order of Mohammed V. It is square, has interlacing ceilings and bedchambers connected with the Emperor's Chambers (Habitaciones de Carlos V) and, through a balcony, with the Gardens of the Partal (Jardines del Partal). Visitors may access the hall through a semicircular festooned arch, where the original wooden doors are still preserved. A passageway leads to the high chambers, with ceilings carved in the 16th century. Three little arches, with Mozarabs on the lateral arches and arch scallops on the central arch, lead to the chamber of the mirador. You can see the Patio of the Lions (Patio de los Leones) from there. The hall's paving is made of marble and has a small fountain with a jet and a little channel that carries the water to the Patio of the Lions. The most impressive feature of the hall is the beautiful and perfect Mozarabic dome. Its lighting was carefully considered and it receives the light from small lateral windows. The dome is therefore a beautiful and exquisitely rich flower. Ibn Zamrak wrote a poem about this dome, and some of his verses are reproduced on a tile skirting board that has metallic iridescence. The hall's walls are covered with extremely fine plasterwork with different themes, among which we find the classical Nasrid motto "Only God is victorious" and also, for example, a pair of clasped hands.

average for countries in the European Union is about 2 percent; the benchmark set by the EU is 3 percent. The current Spanish government has set a target to reach 2 percent by 2010, so it seems likely that funding for research in Spain will continue to grow. The government supports research primarily through the Ministry of Education and Science, which in particular provides funding for the CSIC. Employing about 2,500 scientists in 120 institutes across Spain, the CSIC is the country's main research organization. Very few mathematicians have positions in the CSIC, and there is no single CSIC institute devoted to mathematics. But in another sign of the progress of mathematics in Spain, plans are now being laid to launch a CSIC mathematics institute, possibly in 2006, in cooperation with the three major universities in Madrid (the Autónoma, the Complutense, and the Carlos III).

For the past twenty years or so, the Ministry of Education and Science has also supported research through grant programs. Mathematics did not have its own funding program but was funded through a general program for basic research overseen by a committee that also dealt with physics grants. This changed in 2001, when the government stepped up its support for research and decided to launch a separate mathematics program. Enrique Zuazua was appointed to get the new program off the ground, and after a transition period, the National Program in Mathematics was formally established in 2004. (In spring 2005 a new manager of the program was appointed, Enrique Fernández-Cara of Sevilla University.) The last five years have seen large growth in government funding for mathematics, from just under 2 million Euros (approximately US$2.5 million) in 2000 to 5.5 million Euros in 2004. The grants are usually given to teams of researchers and function much like grants from the U.S. National Science Foundation, although the Spanish government does not provide any salary for principal investigators. The increase in funding has had a large impact, improving the research conditions for mathematicians and making it easier to support students. "Every single active mathematician felt the effect" of the National Program in Mathematics, commented Casacuberta.

Zuazua and others said that the National Program in Mathematics has reached a plateau and now provides sufficient support for small teams of researchers. They argue that what is needed now is a more ambitious endeavor, such as establishing a major national center for mathematics in Spain. And indeed the Spanish government that was in power before the elections in spring 2004 agreed in principle to establish a National Research Center for Mathematics. But exactly what form this center will take and exactly when it will come into being are open questions. At least at first, it will most likely be a "distributed institute" consisting of a network of university-based groups, CSIC institutes, and the CRM. Deciding whether and where to erect a building that would serve as a permanent home for the center is, according to Zuazua, fraught with political difficulties that the government is not yet prepared to face. There are vague hopes that an announcement about the center's establishment will be made at the ICM in August 2006, but nothing is certain yet. Zuazua believes the government will eventually fund the center, but he sees some urgency in getting the project going soon. "We are losing important years," he noted. "There is a great generation of mathematicians in Spain right now.

The ICM2006 Calatrava poster.
This is a photograph of the City of Arts and Sciences in Valencia, Spain, designed by the Spanish architect Santiago Calatrava. The photograph depicts an example of the new Spain, a dynamic country open to science and technology.

"As the site is close to the sea, and Valencia is so dry, I decided to make water a major element for the whole site using it as a mirror for the architecture."
—Santiago Calatrava

Thanks to Manuel de Léon for providing text describing the subjects of the two ICM posters.

These people are getting older, and they cannot wait forever to have the right tools for their research."

Challenges Ahead

The many positive developments in mathematics in Spain seem to presage a bright future, but the mathematical community there nevertheless faces some substantial challenges. One is the declining number of students pursuing mathematics—a phenomenon that is not particular to Spain but in fact seems to be worldwide in scope. When he first came to Madrid in 1990, Zuazua would have perhaps fifteen students in his graduate classes. "Today, if I have three students, I am very happy," he said. In Spain, ties between mathematics and industry have traditionally been weak, so Spanish companies generally do not seek mathematically trained employees. As a result, the career path for those with advanced mathematical training points inevitably to academia—where in recent years jobs have been few and far between. But this situation is poised to change. Recently Andradas helped to prepare a study that concluded that about half of all professorial positions in Spain will open up in the coming decade. "For young people starting now, the perspectives are much better than for people who started ten years ago," he noted. Nevertheless, it remains difficult right now to convince students to pursue and remain in mathematics. de León noted that Spanish mathematicians have begun several initiatives to spark the interest of young people in mathematics, such as the "Divulgamat" website of the RSME that contains virtual exhibitions, popularizations, mathematical poetry, biographies of mathematicians, and other resources.

A second challenge, according to Zuazua, is related to the lack of connection to industry. Such connections are not easy to cultivate, so, as Zuazua put it, "you continue to work on your inequality." As a result, Spanish mathematicians have developed a propensity for deep but somewhat narrow research, and the infusion of new ideas that can come from interactions with other disciplines is missing. At the same time, there is little recognition for interdisciplinary work. But this too seems to be changing. "Ten years ago there was a big explosion of mathematics on Wall Street," Zuazua observed. "Now it is happening here in Spain." Spanish companies are slowly waking up to the value of mathematics, and industrial laboratories have gradually begun hiring mathematicians. However, the effect has not yet been large enough to lure more students into the field.

A third challenge for Spanish mathematics is the inbred nature of the academic hiring system. It is not only rare to find a foreigner in a Spanish mathematics department, it is even unusual to find someone from outside the local area. Zuazua recalled that, when he took a position at the Universidad Complutense in Madrid, there was grumbling that his job should have gone to a local; Zuazua is originally from Bilbao in the Basque country. Many mathematics departments are filled with people who received their Ph.D.'s there or at nearby universities. While a case can be made that such a strategy helps to build cohesive research groups, over the long term the result can be mediocrity. Andradas noted that Spain has made some efforts to try to improve the hiring system, but change has been exceedingly difficult. "Spain is a country where mobility is still not very common," especially when one is over thirty-five and has one's own family, he noted. "People try to work in the neighborhood where they grew up and where their family is living. Family still has a strong influence here."

Intense local loyalties have developed hand in hand with this hiring system, and big centers like Madrid are sometimes eyed with suspicion by mathematicians in other places. de León and the ICM2006 co-organizers seem determined to use

the occasion of the Congress to bring the Spanish mathematical community together. "We are trying to get every university, every mathematician, to feel that he or she is a part of the ICM organization," he said. "It is not a separate thing—it's an ICM by the full Spanish mathematical community." To this end, the ICM executive committee has held its meetings in various cities around Spain, so that they could discuss the plans with local mathematicians. It would have been easier to have had all of the meetings in Madrid, de León noted. But the ICM organizers wanted to make the point that "this is the ICM for Spain, not just for Madrid."

Reaching Out

In fact, the organizers are reaching out far beyond the borders of Spain. Because this is the first ICM to be held in a Spanish-speaking country, special efforts are being made to bring in participants from Latin America, through a program of travel grants. Because of Spain's geographical and cultural proximity to north Africa, the ICM organizers are working to foster participation by mathematicians from that area. Also in the works is a special conference called "Mathematics for Peace and Development", to be held in Córdoba in conjunction with the ICM. Spain has a unique cultural identity formed through an unusual combination of Jewish, Islamic, and Christian influences. The idea, said de León, is to capitalize on this heritage and "use mathematics as an instrument for peace." The conference would bring together mathematics students from Latin America, north Africa, Israel, and the Middle East.

The Congress itself will be held at the Palacio Municipal de Congresos, a convention center in the northeast of Madrid. The format is the traditional one of plenary and parallel "section" lectures. While the breakdown of areas into sections is largely the same as for previous ICMs, some tweaking has been done. Also, rather than nineteen sections, as there were at ICM2002, there are now twenty: A section devoted to "Control Theory and Optimization" has been added. The cultural attractions of Madrid will be on full display, and there will be special events aimed at communicating mathematics to the wider Spanish public. At the previous ICM in 2002 in Beijing, the president of China, Jiang Zemin, presented the Fields Medals. That's a tough act to follow, but the ICM organizers have received assurances from the King of Spain that he will attend the opening ceremonies.

Mathematics in Spain seems poised to grow and prosper, and many mathematicians there speak with great ambition about their aspirations for the future. At the same time, they are not resting on their laurels. They see challenges ahead, and they are working to meet them. Zuazua likened the development of mathematics in Spain to an orange tree—it is not enough for the tree to flower, it must also bear fruit. "ICM06 is the flower, but we have to be extremely hard workers, clever and coordinated, and able to convince politicians if we want that to persist and to give the fruit of putting Spain in the first division of mathematics," he said. "ICM06 is a proof of our success, but also the right time to be extremely, but positively, critical of ourselves."

Interview with Peter D. Lax

Martin Raussen and Christian Skau

Peter D. Lax is the recipient of the 2005 Abel Prize of the Norwegian Academy of Science and Letters. On May 24, 2005, prior to the Abel Prize celebrations in Oslo, Lax was interviewed by Martin Raussen of Aalborg University and Christian Skau of the Norwegian University of Science and Technology. This interview originally appeared in the *European Mathematical Society Newsletter*, September 2005, pages 24–31.

Raussen & Skau: *On behalf of the Norwegian and Danish Mathematical Societies we would like to congratulate you on winning the Abel Prize for 2005.*

You came to the U.S. in 1941 as a fifteen-year-old kid from Hungary. Only three years later, in 1944, you were drafted into the U.S Army. Instead of being shipped overseas to the war front, you were sent to Los Alamos in 1945 to participate in the Manhattan Project, building the first atomic bomb. It must have been awesome as a young man to come to Los Alamos to take part in such a momentous endeavor and to meet so many legendary famous scientists: Fermi, Bethe, Szilard, Wigner, Teller, Feynman, to name some of the physicists, and von Neumann and Ulam, to name some of the mathematicians. How did this experience shape your view of mathematics and influence your choice of a research field within mathematics?

Lax: In fact, I returned for a year's stay at Los Alamos after I got my Ph.D. in 1949 and then spent many summers as a consultant. The first time I spent in Los Alamos, and especially the later exposure, shaped my mathematical thinking. First of all, it was the experience of being part of a scientific team—not just of mathematicians, but people with different outlooks—with the aim being not a theorem, but a product. One cannot learn that from books, one must be a participant, and for that reason I urge my students to spend at least a summer as a visitor at Los Alamos. Los Alamos has a very active visitor's program. Secondly, it was there—that was in the 1950s—that I became imbued with the utter importance of computing for science and mathematics. Los Alamos, under the influence of von Neumann, was for a while in the 1950s and the early 1960s the undisputed leader in computational science.

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Research Contributions

R & S: *May we come back to computers later? First some questions about some of your main research contributions to mathematics: You have made outstanding contributions to the theory of nonlinear partial differential equations. For the theory and numerical solutions of hyperbolic systems of conservation laws your contribution has been decisive, not to mention your contribution to the understanding of the propagation of discontinuities, so-called shocks. Could you describe in a few words how you were able to overcome the formidable obstacles and difficulties this area of mathematics presented?*

Lax: Well, when I started to work on it I was very much influenced by two papers. One was Eberhard Hopf's on the viscous limit of Burgers' equation, and the other was the von Neumann-Richtmyer paper on artificial viscosity. And looking at these examples I was able to see what the general theory might look like.

R & S: *The astonishing discovery by Kruskal and Zabusky in the 1960s of the role of solitons for solutions of the Korteweg-deVries (KdV) equation, and the no less astonishing subsequent explanation given by several people that the KdV equation is completely integrable, represented a revolutionary development within the theory of nonlinear partial differential equations. You entered this field with an ingenious original point of view, introducing the so-called Lax-pair, which gave an understanding of how the inverse scattering transform applies to equations like the KdV, and also to other nonlinear equations which are central in mathematical physics,*

(Photo: Knut Falch/Scanpix) Copyright: Det Norske Videnskaps-Akademi/Abelprisen.

Peter D. Lax was interviewed by Martin Raussen and Christian Skau at the Hotel Continental in Oslo.

like the sine-Gordon and the nonlinear Schrödinger equation. Could you give us some thoughts on how important you think this theory is for mathematical physics and for applications, and how do you view the future of this field?

Lax: Perhaps I should start by pointing out that the astonishing phenomenon of the interaction of solitons was discovered by numerical calculations, as was predicted by von Neumann some years before, namely that calculations will reveal extremely interesting phenomena. Since I was a good friend of Kruskal, I learned early about his discoveries, and that started me thinking. It was quite clear that there are infinitely many conserved quantities, and so I asked myself: How can you generate all at once an infinity of conserved quantities? I thought if you had a transformation that preserved the spectrum of an operator then that would be such a transformation, and that turned out to be a very fruitful idea, applicable quite widely.

Now you ask how important is it? I think it is pretty important. After all, from the point of view of technology for the transmission of signals, signalling by solitons is very important and a promising future technology in trans-oceanic transmission. This was developed by Linn Mollenauer, a brilliant engineer at Bell Labs. It has not yet been put into practice, but it will be some day. The interesting thing about it is that classical signal theory is entirely linear, and the main point of soliton signal transmission is that the equations are nonlinear. That's one aspect of the practical importance of it.

As for the theoretic importance: the KdV equation is completely integrable, and then an astonishing number of other completely integrable systems were discovered. Completely integrable systems can really be solved in the sense that the general population uses the word solved. When a mathematician says he has solved the problem he means he knows the solution exists, that it's unique, but very often not much more.

Now the question is: Are completely integrable systems exceptions to the behavior of solutions of non-integrable systems, or is it that other systems have similar behavior, only we are unable to analyze it? And here our guide might well be the Kolmogorov-Arnold-Moser theorem which says that a system near a completely integrable system behaves as if it were completely integrable. Now, what near means is one thing when you prove theorems, another when you do experiments. It's another aspect of numerical experimentation revealing things. So I do think that studying completely integrable systems will give a clue to the behavior of more general systems as well.

Who could have guessed in 1965 that completely integrable systems would become so important?

R & S: *The next question is about your seminal paper "Asymptotic solutions of oscillating initial value problems" from 1957. This paper is considered by many people to be the genesis of Fourier Integral Operators. What was the new viewpoint in the paper that proved to be so fruitful?*

Lax: It is a micro-local description of what is going on. It combines looking at the problem in the large and in the small. It combines both aspects, and that gives it its strengths. The numerical implementation of the micro-local point of view is by wavelets and similar approaches, which are very powerful numerically.

R & S: *May we touch upon your collaboration with Ralph Phillips—on and off over a span of more than thirty years—on scattering theory, applying it in a number of settings. Could you comment on this collaboration, and what do you consider to be the most important results you obtained?*

Lax: That was one of the great pleasures of my life! Ralph Phillips is one of the great analysts of our time and we formed a very close friendship. We had a new way of viewing the scattering process with incoming and outgoing subspaces. We were, so to say, carving a semi-group out of the unitary group, whose infinitesimal generator contained almost all the information about the scattering process. So we applied that to classical scattering of sound waves and electromagnetic waves by potentials and obstacles. Following a very interesting discovery of Faddeev and Pavlov, we studied the spectral theory of automorphic functions. We elaborated it further, and we had a brand new approach to Eisenstein series for instance, getting at spectral representation via translation representation. And we were even able to contemplate—following Faddeev and Pavlov—the Riemann hypothesis peeking around the corner.

R & S: *That must have been exciting!*

Lax: Yes! Whether this approach will lead to the proof of the Riemann hypothesis, stating it, as one can, purely in terms of decaying signals by cutting out all standing waves, is unlikely. The Riemann

hypothesis is a very elusive thing. You may remember in Peer Gynt there is a mystical character, the Boyg, which bars Peer Gynt's way wherever he goes. The Riemann hypothesis resembles the Boyg!

R & S: *Which particular areas or questions are you most interested in today?*

Lax: I have some ideas about the zero dispersion limit.

Pure and Applied Mathematics

R & S: *May we raise a perhaps contentious issue with you: pure mathematics versus applied mathematics. Occasionally one can hear within the mathematical community statements that the theory of nonlinear partial differential equations, though profound and often very important for applications, is fraught with ugly theorems and awkward arguments. In pure mathematics, on the other hand, beauty and aesthetics rule. The English mathematician G.H. Hardy is an extreme example of such an attitude, but it can be encountered also today. How do you respond to this? Does it make you angry?*

Lax: I don't get angry very easily. I got angry once at a dean we had, terrible son of a bitch, destructive liar, and I got very angry at the mob that occupied the Courant Institute and tried to burn down our computer. Scientific disagreements do not arouse my anger. But I think this opinion is definitely wrong. I think Paul Halmos once claimed that applied mathematics was, if not bad mathematics, at least ugly mathematics, but I think I can point to those citations of the Abel Committee dwelling on the elegance of my works!

Now about Hardy: When Hardy wrote *A Mathematician's Apology* he was at the end of his life, he was old, I think he had suffered a debilitating heart attack, he was very depressed. So that should be taken into account. About the book itself: There was a very harsh criticism by the chemist Frederick Soddy, who was one of the co-discoverers of the isotopes—he shared the Nobel Prize with Rutherford. He looked at the pride that Hardy took in the uselessness of his mathematics and wrote: "From such cloistral clowning the world sickens." It was very harsh because Hardy was a very nice person.

My friend Joe Keller, a most distinguished applied mathematician, was once asked to define applied mathematics and he came up with this: "Pure mathematics is a branch of applied mathematics." Which is true if you think a bit about it. Mathematics originally, say after Newton, was designed to solve very concrete problems that arose in physics. Later on, these subjects developed on their own and became branches of pure mathematics, but they all came from applied background. As von Neumann pointed out, after a while these pure branches that develop on their own need invigoration by new empirical material, like some scientific questions, experimental facts, and, in particular, some numerical evidence.

R & S: *In the history of mathematics, Abel and Galois may have been the first great mathematicians that one may describe as "pure mathematicians", not being interested in any "applied" mathematics as such. However, Abel did solve an integral equation, later called "Abel's integral equation", and Abel gave an explicit solution, which incidentally may have been the first time in the history of mathematics that an integral equation had been formulated and solved. Interestingly, by a simple reformulation one can show that the Abel integral equation and its solution are equivalent to the Radon Transform, the mathematical foundation on which modern medical tomography is based.*

Examples of such totally unexpected practical applications of pure mathematical results and theorems abound in the history of mathematics—group theory that evolved from Galois' work is another striking example. What are your thoughts on this phenomenon? Is it true that deep and important theories and theorems in mathematics will eventually find practical applications, for example in the physical sciences?

Lax: Well, as you pointed out, this has very often happened: Take for example Eugene Wigner's use of group theory in quantum mechanics. And this has happened too often to be just a coincidence. Although, one might perhaps say that other theories and theorems which did not find applications were forgotten. It might be interesting for a historian of mathematics to look into that phenomenon. But I do believe that mathematics has a mysterious unity which really connects seemingly distinct parts, which is one of the glories of mathematics.

R & S: *You have said that Los Alamos was the birthplace of computational dynamics, and I guess it is safe to say that the U.S. war effort in the 1940s advanced and accelerated this development. In what way has the emergence of the high-speed computer altered the way mathematics is done? Which role will high-speed computers play within mathematics in the future?*

Lax: It has played several roles. One is what we saw in Kruskal's and Zabusky's discovery of solitons, which would not have been discovered without computational evidence. Likewise the Fermi-Pasta-Ulam phenomenon of recurrence was also a very striking thing which may or may not have been discovered without the computer. That is one aspect.

But another is this: in the old days, to get numerical results you had to make enormously drastic simplifications if your computations were done by hand, or by simple computing machines. And the talent of what drastic simplifications to make was a special talent that did not appeal to most mathematicians. Today you are in an entirely different

situation. You don't have to put the problem on a Procrustean bed and mutilate it before you attack it numerically. And I think that has attracted a much larger group of people to numerical problems of applications—you could really use the full theory. It invigorated the subject of linear algebra, which as a research subject died in the 1920s. Suddenly the actual algorithms for carrying out these operations became important. It was full of surprises, like fast matrix multiplication. In the new edition of my linear algebra book I will add a chapter on the numerical calculation of the eigenvalues of symmetric matrices.

You know it's a truism that due to increased speed of computers, a problem that took a month forty years ago can be done in minutes, if not seconds today. Most of the speed-up is attributed, at least by the general public, to increased speed of computers. But if you look at it, actually only half of the speed-up is due to this increased speed. The other half is due to clever algorithms, and it takes mathematicians to invent clever algorithms. So it is very important to get mathematicians involved, and they are involved now.

R & S: *Could you give us personal examples of how questions and methods from applied points of view have triggered "pure" mathematical research and results? And conversely, are there examples where your theory of nonlinear partial differential equations, especially your explanation of how discontinuities propagate, have had commercial interests? In particular, concerning oil exploration, so important for Norway!*

Lax: Yes, oil exploration uses signals generated by detonations that are propagated through the earth and through the oil reservoir and are recorded at distant stations. It's a so-called inverse problem. If you know the distribution of the densities of materials and the associated waves' speeds, then you can calculate how signals propagate. The inverse problem is that if you know how signals propagate, then you want to deduce from it the distribution of the materials. Since the signals are discontinuities, you need the theory of propagation of discontinuities. Otherwise it's somewhat similar to the medical imaging problem, also an inverse problem. Here the signals do not go through the earth but through the human body, but there is a similarity in the problems. But there is no doubt that you have to understand the direct problem very well before you can tackle the inverse problem.

Hungarian Mathematics

R & S: *Now to some questions related to your personal history. The first one is about your interest in, and great aptitude for, solving problems of a type that you call "Mathematics Light" yourself. To mention just a few, already as a seventeen-year-old boy you gave an elegant solution to a problem that was posed by Erdős and is related to a certain inequality for polynomials, which was earlier proved by Bernstein. Much later in your career you studied the so-called Pólya function which maps the unit interval continuously onto a right-angled triangle, and you discovered its amazing differentiability properties. Was problem solving specifically encouraged in your early mathematical education in your native Hungary, and what effect has this had on your career later on?*

Lax: Yes, problem solving was regarded as a royal road to stimulate talented youngsters, and I was very pleased to learn that here in Norway they have a successful high-school contest, where the winners were honored this morning. But after a while one shouldn't stick to problem solving, one should broaden out. I return to it every once in a while, though.

Back to the differentiability of the Pólya function: I knew Pólya quite well having taken a summer course with him in 1946. The differentiability question came about this way: I was teaching a course on real variables, and I presented Pólya's example of an area-filling curve, and I gave as homework to the students the problem of proving that it's nowhere differentiable. Nobody did the homework, so then I sat down and I found out that the situation was more complicated.

There was a tradition in Hungary to look for the simplest proof. You may be familiar with Erdős' concept of The Book. That's The Book kept by the Lord of all theorems and the best proofs. The highest praise that Erdős had for a proof was that it was out of The Book. One can overdo that, but shortly after I had gotten my Ph.D., I learned about the Hahn-Banach theorem, and I thought that it could be used to prove the existence of Green's function. It's a very simple argument—I believe it's the simplest—so it's out of The Book. And I think I have a proof of Brouwer's Fixed Point Theorem, using calculus and just change of variables. It is probably the simplest proof and is again out of The Book. I think all this is part of the Hungarian tradition. But one must not overdo it.

R & S: *There is an impressive list of great Hungarian physicists and mathematicians of Jewish background that had to flee to the U.S. after the rise of fascism, Nazism and anti-Semitism in Europe. How do you explain this extraordinary culture of excellence in Hungary that produced people like de Hevesy, Szilard, Wigner, Teller, von Neumann, von Karman, Erdős, Szegő, Pólya, yourself, to name some of the most prominent ones?*

Lax: There is a very interesting book written by John Lukacs with the title "Budapest 1900: A Historical Portrait of a City and its Culture", and it chronicles the rise of the middle class, rise of commerce, rise of industry, rise of science, rise of literature. It was fueled by many things: a long period

of peace, the influx of mostly Jewish population from the East eager to rise, and intellectual tradition. You know in mathematics, Bolyai was a cultural hero to Hungarians, and that's why mathematics was particularly looked upon as a glorious profession.

R & S: *But who nurtured this fantastic flourishing of talent, which is so remarkable?*

Lax: Perhaps much credit should be given to Julius Kőnig, whose name is probably not known to you. He was a student of Kronecker, I believe, but he also learned Cantor's set theory and made some basic contribution to it. I think he was influential in nurturing mathematics. His son was a very distinguished mathematician, Denes Kőnig, really the father of modern graph theory. And then there arose extraordinary people. Leopold Fejér, for instance, had enormous influence. There were too many to fill positions in a small country like Hungary, so that's why they had to go abroad. Part of it was also anti-Semitism.

There is a charming story about the appointment of Leopold Fejér, who was the first Jew proposed for a professorship at Budapest University. There was opposition to it. At that time there was a very distinguished theologian, Ignatius Fejér, in the Faculty of Theology. Fejér's original name was Weiss. So one of the opponents, who knew full well that Fejér's original name had been Weiss, said pointedly: This professor Leopold Fejér that you are proposing, is he related to our distinguished colleague Father Ignatius Fejér? And Eőtvős, the great physicist who was pushing the appointment, replied without batting an eyelash: "Illegitimate son." That put an end to it.

R & S: *And he got the job?*

Lax: He got the job.

Scribbles That Changed the Course of Human Affairs

R & S: *The mathematician Stanislaw Ulam was involved with the Manhattan Project and is considered to be one of the fathers of the hydrogen bomb. He wrote in his autobiography Adventures of a Mathematician: "It is still an unending source of surprise for me to see how a few scribbles on a blackboard, or on a sheet of paper, could change the course of human affairs." Do you share this feeling? And what are your feelings about what happened to Hiroshima and Nagasaki, to the victims of the explosions of the atomic bombs that brought an end to World War II?*

Lax: Well, let me answer the last question first. I was in the army, and all of us in the army expected to be sent to the Pacific to participate in the invasion of Japan. You remember the tremendous slaughter that the invasion of Normandy brought about. That would have been nothing compared to the invasion of the Japanese mainland. You remember the tremendous slaughter on Okinawa and Iwo Jima. The Japanese would have resisted to the last man. The atomic bomb put an end to all this and made an invasion unnecessary. I don't believe reversionary historians who say: "Oh, Japan was already beaten, they would have surrendered anyway." I don't see any evidence for that.

There is another point which I raised once with someone who had been involved with the atomic bomb project. Would the world have had the horror of nuclear war if it had not seen what one bomb could do? The world was inoculated against using nuclear weaponry by its use. I am not saying that alone justifies it, and it certainly was not the justification for its use. But I think that is a historical fact.

Now about scribbles changing history: Sure, the special theory of relativity, or quantum mechanics, would be unimaginable today without scribbles. Incidentally, Ulam was a very interesting mathematician. He was an idea man. Most mathematicians like to push their ideas through. He preferred throwing out ideas. His good friend Rota even suggested that he did not have the technical ability or patience to work them out. But if so, then it's an instance of Ulam turning a disability to tremendous advantage. I learned a lot from him.

R & S: *It is amazing for us to learn that an eighteen-year-old immigrant was allowed to participate in a top-secret and decisive weapon development during WWII.*

Lax: The war created an emergency. Many of the leaders of the Manhattan Project were foreigners, so being a foreigner was no bar.

Collaboration. Work Style

R & S: *Your main workplace has been the Courant Institute of Mathematical Sciences in New York, which is part of New York University. You served as its director for an eight-year period in the 1970s. Can you describe what made this institute, which was created by the German refugee Richard Courant in the 1930s, a very special place from the early days on, with a particular spirit and atmosphere? And is the Courant Institute today still a special place that differs from others?*

Lax: To answer your first question, certainly the personality of Courant was decisive. Courant saw mathematics very broadly, he was suspicious of specialization. He wanted it drawn as broadly as possible, and that's how it came about that applied topics and pure mathematics were pursued side by side, often by the same people. This made the Courant Institute unique at the time of its founding, as well as in the 1940s, 1950s, and 1960s. Since then there are other centers where applied mathematics is respected and pursued. I am happy to say that this original spirit is still present at the Courant Institute. We still have large areas of

applied interest, meteorology and climatology under Andy Majda, solid state and material science under Robert Kohn and others, and fluid dynamics. But we also have differential geometry as well as some pure aspects of partial differential equations, even some algebra.

I am very pleased how the Courant Institute is presently run. It's now the third generation that's running it, and the spirit that Courant instilled in it—kind of a family feeling—still prevails. I am happy to note that many Norwegian mathematicians received their training at the Courant Institute and later rose to become leaders in their field.

R & S: *You told us already about your collaboration with Ralph Phillips. Generally speaking, looking through your publication list and the theorems and methods you and your collaborators have given name to, it is apparent that you have had a vast collaboration with a lot of mathematicians. Is this sharing of ideas a particularly successful, and maybe also joyful, way of advancing for you?*

Lax: Sure, sure. Mathematics is a social phenomenon after all. Collaboration is a psychological and interesting phenomenon. A friend of mine, Vera John-Steiner, has written a book (*Creative Collaboration*) about it. Two halves of a solution are supplied by two different people, and something quite wonderful comes out of it.

R & S: *Many mathematicians have a very particular work style when they work hard on certain problems. How would you characterize your own particular way of thinking, working, and writing? Is it rather playful or rather industrious? Or both?*

Lax: Phillips thought I was lazy. He was a product of the Depression, which imposed a certain strict discipline on people. He thought I did not work hard enough, but I think I did!

R & S: *Sometimes mathematical insights seem to rely on a sudden unexpected inspiration. Do you have examples of this sort from your own career? And what is the background for such sudden inspiration in your opinion?*

Lax: The question reminds me of a story about a German mathematician, Schottky, when he reached the age of seventy or eighty. There was a celebration of the event, and in an interview like we are having, he was asked: "To what do you attribute your creativity and productivity?" The question threw him into great confusion. Finally he said: "But gentlemen, if one thinks of mathematics for fifty years, one must think of something!" It was different with Hilbert. This is a story I heard from Courant. It was a similar occasion. At his seventieth birthday he was asked what he attributed his great creativity and originality to. He had the answer immediately: "I attribute it to my very bad memory." He really had to reconstruct everything, and then it became something else, something better. So maybe that is all I should say. I am between these two extremes. Incidentally, I have a very good memory.

Teaching

R & S: *You have also been engaged in the teaching of calculus. For instance, you have written a calculus textbook with your wife Anneli as one of the coauthors. In this connection you have expressed strong opinions about how calculus should be exposed to beginning students. Could you elaborate on this?*

Lax: Our calculus book was enormously unsuccessful, in spite of containing many excellent ideas. Part of the reason was that certain materials were not presented in a fashion that students could absorb. A calculus book has to be fine-tuned, and I didn't have the patience for it. Anneli would have had it, but I bullied her too much, I am afraid. Sometimes I dream of redoing it because the ideas that were in there, and that I have had since, are still valid.

Of course, there has been a calculus reform movement and some good books have come out of it, but I don't think they are the answer. First of all, the books are too thick, often more than 1,000 pages. It's unfair to put such a book into the hands of an unsuspecting student who can barely carry it. And the reaction to it would be: "Oh, my God, I have to learn all that is in it?" Well, all that is not in it! Secondly, if you compare it to the old standards, Thomas, say, it's not so different—the order of the topics and concepts, perhaps.

In my calculus book, for instance, instead of continuity at a point, I advocated uniform continuity. This you can explain much more easily than defining continuity at a point and then say the function is continuous at every point. You lose the students; there are too many quantifiers in that. But the mathematical communities are enormously conservative: "Continuity has been defined pointwise, and so it should be!"

Other things that I would emphasize: To be sure there are applications in these new books. But the applications should all stand out. In my book there were chapters devoted to the applications, that's how it should be—they should be featured prominently. I have many other ideas as well. I still dream of redoing my calculus book, and I am looking for a good collaborator. I recently met someone who expressed admiration for the original book, so perhaps it could be realized, if I have the energy. I have other things to do as well, like the second edition of my linear algebra book, and revising some old lecture notes on hyperbolic equations. But even if I could find a collaborator on a calculus book, would it be accepted? Not clear. In 1873, Dedekind posed the important question: "What are, and what should be, the real numbers?" Unfortunately, he gave the wrong answer as far as calculus students

are concerned. The right answer is: infinidecimals. I don't know how such a joke will go down.

Heading Large Institutions

R & S: *You were several times the head of large organizations: director of the Courant Institute in 1972–1980, president of the American Mathematical Society in 1977–1980, leader of what was called the Lax Panel on the National Science Board in 1980–1986. Can you tell us about some of the most important decisions that had to be taken in these periods?*

Lax: The president of the American Mathematical Society is a figurehead. His influence lies in appointing members of committees. Having a wide friendship and reasonable judgement are helpful. I was very much helped by the secretary of the American Mathematical Society, Everett Pitcher.

As for being the director of the Courant Institute, I started my directorship at the worst possible time for New York University. They had just closed down their School of Engineering, and that meant that mathematicians from the engineering school were transferred to the Courant Institute. This was the time when the Computer Science Department was founded at Courant by Jack Schwartz. There was a group of engineers that wanted to start activity in informatics, which is the engineers' word for the same thing. As a director I fought very hard to stop that. I think it would have been very bad for the university to have had two computing departments—it certainly would have been very bad for our Computer Science Department. Other things: Well, I was instrumental in hiring Charlie Peskin at the recommendation of Alexander Chorin. I was very pleased with that. Likewise, hiring Sylvain Cappell at the recommendation of Bob Kohn. Both were enormous successes.

What were my failures? Well, maybe when the Computer Science Department was founded I should have insisted on having a very high standard of hiring. We needed people to teach courses, but in hindsight I think we should have exercised more restraint in our hiring. We might have become the number one computer science department. Right now the quality has improved very much—we have a wonderful chairwoman, Margaret Wright.

Being on the National Science Board was my most pleasant administrative experience. It's a policy-making body for the National Science Foundation (NSF), so I found out what making policy means. Most of the time it just means nodding "yes", and a few times saying "no". But then there are sometimes windows of opportunity, and the Lax Panel was a response to such a thing. You see, I noticed through my own experience and that of my friends who are interested in large scale computing (in particular, Paul Garabedian, who complained about it), that university computational scientists had no access to the supercomputers. At a certain point the government, which alone had enough money to purchase these supercomputers, stopped placing them at universities. Instead they went to national labs and industrial labs. Unless you happened to have a friend there with whom you collaborated, you had no access. That was very bad from the point of view of the advancement of computational science, because the most talented people were at the universities. At that time accessing and computing at remote sites became possible thanks to ARPANET, which then became a model for the Internet. So the panel that I established made strong recommendation that the NSF establish computing centers, and that was followed up. My quote on our achievement was a paraphrase of Emerson: "Nothing can resist the force of an idea that is ten years overdue."

R & S: *A lot of mathematical research in the U.S. has been funded by contracts from DOD (Department of Defense), DOE (Department of Energy), the Atomic Energy Commission, the NSA (National Security Agency). Is this dependence of mutual benefit? Are there pitfalls?*

Lax: I am afraid that our leaders are no longer aware of the subtle but close connection between scientific vigor and technological sophistication.

Personal Interests

R & S: *Would you tell us a bit about your interests and hobbies that are not directly related to mathematics?*

Lax: I love poetry. Hungarian poetry is particularly beautiful, but English poetry is perhaps even more beautiful. I love to play tennis. Now my knees are a bit wobbly, and I can't run anymore, but perhaps these can be replaced—I'm not there yet. My son and three grandsons are tennis enthusiasts so I can play doubles with them. I like to read. I have a knack for writing. Alas, these days I write obituaries—it's better to write them than being written about.

R & S: *You have also written Japanese haikus?*

Lax: You're right. I got this idea from a nice article by Marshall Stone—I forget exactly where it was—where he wrote that the mathematical language is enormously concentrated, it is like haikus. And I thought I would take it one step further and actually express a mathematical idea by a haiku. (See Peter Lax's haiku below.)

R & S: *Professor Lax, thank you very much for this interview on behalf of the Norwegian, the Danish, and the European Mathematical Societies!*

Lax: I thank you.

Speed depends on size
Balanced by dispersion
Oh, solitary splendor.

2005 Annual Survey of the Mathematical Sciences

(First Report)

Report on the 2004–2005 New Doctoral Recipients Faculty Salary Survey

Ellen E. Kirkman, James W. Maxwell, and Colleen Rose

The First Report of the 2005 Annual Survey gives a broad picture of 2004–05 new doctoral recipients from U.S. departments in the mathematical sciences, including their employment status in fall 2005. The First Report also presents salary data for faculty members in U.S. departments of mathematical sciences in four-year colleges and universities. This report is based on information collected from two questionnaires distributed to departments in May 2005. A follow-up questionnaire was distributed to the individual new doctoral recipients in October 2005. 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 the Second Report of the 2005 Annual Survey in the August 2006 issue of the *Notices of the AMS*. Another questionnaire concerned with data on fall 2005 course enrollments, majors, graduate students, and departmental faculty was distributed to departments in September 2005. Results from this questionnaire will appear in the Third Report of the 2005 Annual Survey in the September 2006 issue of the *Notices of the AMS*.

The 2005 Annual Survey represents the forty-ninth in an annual series begun in 1957 by the American Mathematical Society. The 2005 Survey is conducted by staff at the American Mathematical Society with guidance from the 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 Amy Cohen-Corwin, Donald M. Davis, Nicholas M. Ercolani, J. Douglas Faires, Naresh Jain, Donald R. King, Ellen E. Kirkman (chair), David J. Lutzer, James W. Maxwell (ex officio), Polly Phipps, David E. Rohrlich, and Henry Schenck. The committee is assisted by AMS survey analyst Colleen Rose. Comments or suggestions regarding this Survey Report may be directed to the members of the Data Committee.

Ellen E. Kirkman is professor of mathematics at Wake Forest University. James W. Maxwell is AMS associate executive director for Membership, Meetings, and Programs. Colleen Rose is AMS survey analyst.

Report on the 2004–2005 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, 2004, through June 30, 2005. It includes a preliminary analysis of the fall 2005 employment plans of 2004–05 doctoral recipients and a demographic profile summarizing characteristics of citizenship status, sex, and racial/ethnic group. All information came from the departments that awarded the degrees.

Table 1: Doctorates Granted Response Rates

Group I (Pu)	23 of 25 including	0 with 0 degrees
Group I (Pr)	18 of 23 including	0 with 0 degrees
Group II	51 of 56 including	3 with 0 degrees
Group III	68 of 73 including	19 with 0 degrees
Group IV	63 of 87 including	1 with 0 degrees
Group Va	17 of 23 including	2 with 0 degrees

See "Definitions of the Groups" on page 245.

Table 1 provides the departmental response rates for the 2005 Survey of New Doctoral Recipients. See page 245 for a description of the groups. No adjustments were made in this report for nonresponding departments.

This preliminary report will be updated in the Second Report of the 2005 Annual Survey using information gathered from the new doctoral recipients. The Second Report will appear in the August 2006 issue of the *Notices of the AMS*.

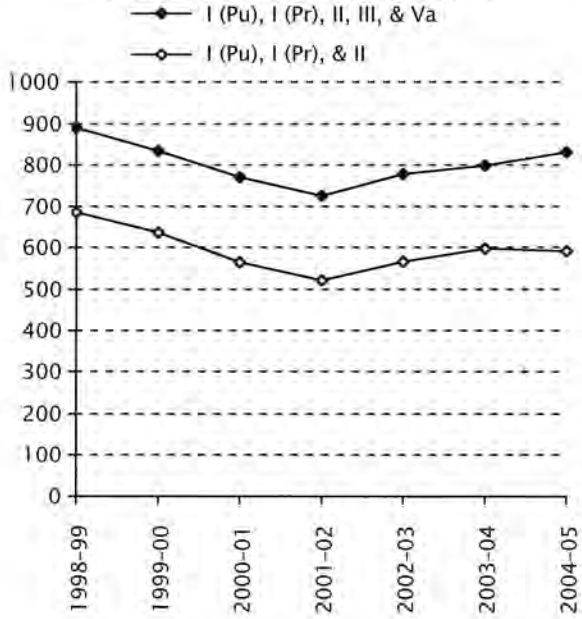
Changes in the Annual Survey occur over time, and these changes need to be considered when comparing results in this report to those in prior years. Information about changes that occurred in 1997 or later can be found in the First Report for the 2000 Annual Survey in the February 2001 issue of the *Notices of the AMS*.

In this First Report's tables referring to new doctoral recipients, "Fall" refers to results based on information about new doctoral recipients received from departments granting their degrees. This information is gathered in the first fall following the academic year in which the degrees were granted. "Final" refers to results based on supplemental information received from the new doctoral recipients themselves as well as additional new doctoral recipients not reported by departments in time for publication in the First Report. These results are published each August in the Second Report.

Table 2: New Doctoral Degrees Awarded by Group, Fall Count

Group	I (Pu)	I (Pr)	II	III	IV	Va	TOTAL
1998-99	292	152	241	136	243	69	**1133**
1999-00	256	157	223	132	284	67	**1119**
2000-01	233	129	203	125	237	81	**1008**
2001-02	218	139	164	124	222	81	**948**
2002-03	258	138	170	121	239	91	**1017**
2003-04	195	187	215	111	243	90	**1041**
2004-05	243	146	203	153	285	86	**1116**

Figure 1: New Doctoral Degrees Awarded by Combined Groups, Fall Count



Highlights

- There were 1,116 new doctoral recipients reported for 2004-05 by departments responding in time for the 2005 First Report. This is the highest number reported since 1999-2000.
- Groups I (Pu) reported the largest increase (48) in new doctoral recipients, but the number of new doctoral recipients last year was a 10-year low. This year Groups III and IV reached seven-year highs of 153 and 285, respectively.
- Only 433 (39%) of the new doctoral recipients for 2004-05 are U.S. citizens. The percentage of new doctoral recipients who are U.S. citizens is the lowest percentage observed in the past ten years.
- Based on responses from departments alone, the fall 2005 unemployment rate for the 950 new doctoral recipients whose employment status is known is 7.3%, up from 5.7% for fall 2004.
- Fifty-seven new doctoral recipients hold positions at the institution that granted their degree, although not necessarily in the same department. This is 8% of the new doctoral recipients who are currently known to have jobs and 9% of those who have academic positions in the U.S. Twenty-three new doctoral recipients have part-time positions.
- The number of new doctoral recipients employed in the U.S. is 751, up 12 from last year. The number of new doctoral recipients employed in academic positions in the U.S. decreased slightly to 602 from 614 last year (a 2% decrease from a nine-year high).
- Of the 751 new doctoral recipients taking positions in the U.S., 115 (15%) have jobs in business and industry; the number of new doctoral recipients taking jobs in business and industry, after oscillating in the late 1990s, declined three consecutive years (2001, 2002, and 2003), and now shows a slight increase for the second consecutive year, up 16 (16%) from last year. The number of new doctoral recipients taking jobs in government is up 8 (31%) over fall 2004.
- Among the 751 new doctoral recipients having employment in the U.S., 325 (43%) are U.S. citizens (down from 338 (46%) last year). The number of non-U.S. citizens having employment in the U.S. is 426, up 6% from 401 last year.
- Among the 288 new doctoral recipients hired by U.S. doctoral-granting departments, 38% are U.S. citizens (same as last year). Among the 314 having other academic positions in the U.S., 51% are U.S. citizens.
- Of the 1,116 new doctoral recipients, 330 (30%) are females, up just 15 from fall 2004. Of the 433 U.S. citizen new doctoral recipients, 120 (28%) are females, down 15 from fall 2004.
- Among the 433 U.S. citizen new doctoral recipients, 1 is American Indian or Alaska Native, 21 are Asian, 14 are Black or African American, 12 are Hispanic or Latino, 380 are White, 3 are Native Hawaiian or Other Pacific Islander, and 3 are Other.
- Group IV produced 285 new doctorates, of which 126 (44%) are females, compared to all other groups combined, where 204 (25%) are females. In Group IV, 79 (28%) of the new doctoral recipients are U.S. citizens (while in the other groups 43% are U.S. citizens).
- Three hundred seventy-four new doctorates had a dissertation in statistics/ biostatistics (345) or probability (29), an 18% increase over last year. The next highest number was in algebra and number theory with 161. Those with dissertations in statistics/biostatistics and probability accounted for 31% of the new doctorates in 2004-05.

Table 3: Full-Time Graduate Students in Groups I, II, III, & Va, Fall 1995 to Fall 2004

GRADUATE STUDENTS	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total full-time	9761	9476	9003	8791	8838	9637	9361	9972	10444	10707
First-year full-time	2601	2443	2386	2458	2664	2839	2875	2996	2711	3004
U.S. citizen full-time	5623	5445	4947	4831	4668	5085	4631	5055	5590	5877
First-year U.S. citizen full-time	1551	1465	1316	1349	1401	1527	1517	1630	1527	1803

(Data Reprinted from Table 6B in Third Report, 2004 Annual Survey)

Doctoral Degrees Granted in 2004–05

Table 2 shows the number of new doctoral degrees granted by the different doctoral groups surveyed in the Annual Survey for the past seven years. The 1,116 new doctorates granted by these departments in 2004–05 is an increase of 75 from the fall count for 2003–04. Figure 1 presents the trends in doctorates granted for Groups I (Pu), I (Pr), II, III, and Va combined and Groups I (Pu), I (Pr), and II combined.

The response rates were above 90% for all groups except Groups I (Pr), IV and Va. Response rates decreased in all groups, except Group II which remained the same. Overall, thirteen fewer departments responded in time for the First Report this year than responded last year.

The 1,116 new doctoral recipients is a preliminary count. A final count will appear in the Second Report in the August 2006 issue of the *Notices of the AMS*. Efforts continue to obtain data from as many of the nonresponding departments as possible.

From Table 2 we see that Group I (Pu) showed the largest increase (48) in the number of doctoral recipients from the previous year (which was the lowest number for Group I (Pu) in the last 10 years), while Groups III and IV also had increases that put them at their highest numbers in the last seven years. Groups I (Pr), II, and Va showed decreases of 41, 12, and 4 respectively.

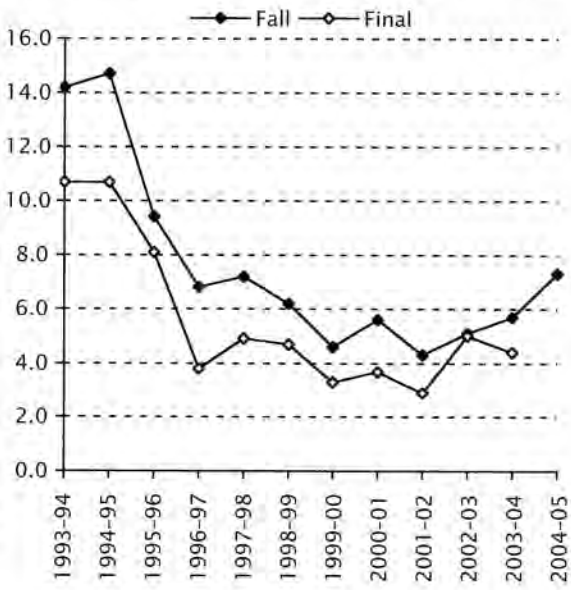
Table 3 gives historical information about various types of full-time graduate students in Groups I, II, III, and Va combined. These data, gathered in the 2004 Departmental Profile survey, are reprinted from Table 6B of the Third Report of the 2004 Annual Survey (*Notices of the AMS*, September 2005). It sheds some light on the upward trend in number of new doctorates as shown in Table 2 and Figure 1. First-year graduate enrollment has been generally increasing since 1997, with relatively large increases in 1999 and 2000; these increases in first-year graduate enrollment are likely to be related to this year's increase in new Ph.D.'s. The continuing increase in graduate enrollment shown in Table 3 suggests that numbers of new Ph.D.'s will continue a generally upward trend over the next few years.

The 2004–05 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 1,116 new doctoral recipients are found on pages 258–276 of this issue of the *Notices*.

Figure 2: Percentage of New Doctoral Recipients Unemployed (as reported in the respective Annual Survey Reports 1993–2005)

Report	Fall	Final
1993–94	14.0	11.0
1994–95	15.0	11.0
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	3.3
2000–01	5.6	3.7
2001–02	4.3	2.9
2002–03	5.1	5.0
2003–04	5.7	4.4
2004–05	7.3	*

*To appear in the Second Report.
Note: Prior to 1998–99, the percentages include new doctoral recipients from Group Vb.



Employment Status of 2004–05 New Doctoral Recipients

Tables 4A, 4B, and 4C each provide a different cross-tabulation of the 1,116 new doctoral recipients in the mathematical sciences. These tables contain a wealth of information about these new doctoral recipients, some of which will be discussed in this report. Note that these tables give a breakdown by sex for type of employer, type of degree-granting department, and field of thesis. Keep in mind that 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 will appear

Table 4A: Employment Status of 2004–05 U.S. New Doctoral Recipients in the Mathematical Sciences by Field of Thesis

TYPE OF EMPLOYER		FIELD OF THESIS												TOTAL
		Algebra/ Number Theory	Real, Comp., Funct., & Harmonic Analysis	Geometry/ Topology	Discr. Math./ Combin./ Logic/ Comp. Sci.	Probability	Statistics/ Biostat.	Applied Math.	Numerical Analysis/ Approxi-mations	Linear Nonlinear Optim./ Control	Differential, Integral, & Difference Equations	Math. Educ.	Other/ Unknown	
Group I (Public)		17	8	11	8	1	0	5	5	2	16	0	0	**73**
Group I (Private)		12	5	14	7	0	1	4	0	1	6	0	0	**50**
Group II		17	7	9	4	5	3	7	4	1	9	0	0	**66**
Group III		3	8	2	6	1	11	2	3	1	3	1	1	**42**
Group IV		0	1	1	0	2	40	1	0	0	0	0	0	**45**
Group Va		1	0	0	0	0	0	4	3	2	2	0	0	**12**
Master's		12	2	5	6	3	16	5	3	3	13	1	0	**69**
Bachelor's		26	14	12	19	1	15	7	7	6	8	4	0	**119**
Two-Year College		1	0	2	2	1	1	0	0	0	0	0	0	**7**
Other Academic Dept.		7	1	2	5	2	53	10	8	0	6	3	0	**97**
Research Institute/ Other Nonprofit		3	1	0	0	0	12	2	0	1	3	0	0	**22**
Government		1	1	2	1	0	14	6	5	3	1	0	0	**34**
Business and Industry		2	3	4	3	7	75	13	3	0	5	0	0	**115**
Non-U.S. Academic		21	6	18	14	5	17	13	5	3	10	1	0	**113**
Non-U.S. Nonacademic		3	0	0	0	0	7	0	0	0	0	0	0	**10**
Not Seeking Employment		1	1	0	1	0	3	1	0	0	0	0	0	**7**
Still Seeking Employment		10	4	4	11	1	16	11	3	0	8	1	0	**69**
Unknown (U.S.)		9	7	6	2	0	25	17	2	1	6	1	0	**76**
Unknown (non-U.S.)*		15	4	5	5	0	36	8	4	3	9	1	0	**90**
TOTAL		**161**	**73**	**97**	**94**	**29**	**345**	**116**	**55**	**27**	**105**	**13**	**1**	**1116**
Column Subtotals	Male	132	57	77	75	24	192	86	41	17	80	4	1	**786**
	Female	29	16	20	19	5	153	30	14	10	25	9	0	**330**

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

Table 4B: Employment Status of 2004–05 U.S. New Doctoral Recipients in the Mathematical Sciences by Type of Degree-Granting Department

TYPE OF EMPLOYER		TYPE OF DOCTORAL DEGREE-GRANTING DEPARTMENT						TOTAL	Row Subtotals	
		Group I (Public) Math.	Group I (Private) Math.	Group II Math.	Group III Math.	Group IV Statistics	Group Va Applied Math.		Male	Female
Group I (Public)		36	19	9	4	0	5	**73**	58	15
Group I (Private)		20	27	2	0	0	1	**50**	40	10
Group II		18	14	25	3	3	3	**66**	54	12
Group III		6	1	8	17	10	0	**42**	29	13
Group IV		0	3	2	2	37	1	**45**	26	19
Group Va		0	1	3	1	0	7	**12**	8	4
Master's		12	6	22	15	8	6	**69**	38	31
Bachelor's		27	10	41	27	12	2	**119**	90	29
Two-Year College		3	0	3	0	0	1	**7**	6	1
Other Academic Dept.		5	4	11	14	50	13	**97**	60	37
Research Institute/ Other Nonprofit		4	3	4	0	11	0	**22**	14	8
Government		6	2	6	3	11	6	**34**	20	14
Business and Industry		5	9	14	15	64	8	**115**	82	33
Non-U.S. Academic		42	23	14	11	17	6	**133**	87	26
Non-U.S. Nonacademic		2	1	0	0	7	0	**10**	7	3
Not Seeking Employment		1	1	1	0	3	1	**7**	5	2
Still Seeking Employment		13	12	13	10	11	10	**69**	44	25
Unknown (U.S.)		24	2	12	15	16	7	**76**	51	25
Unknown (non-U.S.)*		19	8	13	16	25	9	**90**	67	23
TOTAL		**243**	**146**	**203**	**153**	**285**	**86**	**1116**	**786**	**330**
Column Subtotals	Male	192	120	158	97	159	60	**786**		
	Female	51	26	45	56	126	26	**330**		

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

Table 4C: Field of Thesis of 2004-05 New Doctoral Recipients 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/ Biostat.	Applied Math.	Numerical Analysis/ Approxi-mations	Linear Nonlinear Optim./ Control	Differential, Integral, & Difference Equations	Math. Educ.	Other/ Unknown	
Group I (Public)	68	20	40	25	6	12	20	8	8	35	1	0	**243**
Group I (Private)	42	9	32	19	5	2	13	8	2	14	0	0	**146**
Group II	42	21	19	23	10	6	24	16	9	33	0	0	**203**
Group III	9	23	4	20	2	33	23	9	3	15	12	0	**153**
Group IV	0	0	0	0	3	280	1	0	0	0	0	1	**285**
Group Va	0	0	2	7	3	12	35	14	5	8	0	0	**86**
Column Total	**161**	**73**	**97**	**94**	**29**	**345**	**116**	**55**	**27**	**105**	**13**	**1**	**1116**

Table 5A: U.S. Employed 2004-05 New Doctoral Recipients by Type of Degree-Granting Department

U.S. EMPLOYER	I (Pu)	I (Pr)	II	III	IV	Va	TOTAL
Groups I, II, III, IV, and Va	80	65	49	27	50	17	**288**
Master's, Bachelor's, and 2-Year Colleges	42	16	66	42	20	9	**195**
Other Academic and Research Institutes	9	7	15	14	61	13	**119**
Government	6	2	6	3	11	6	**34**
Business and Industry	5	9	14	15	64	8	**115**
TOTAL	**142**	**99**	**150**	**101**	**206**	**53**	**751**

in the 2005 Second Report in the August 2006 issue of the *Notices of the AMS*.

The last column (Total) in Table 4A 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 7.3%. This figure will be updated later with information gathered from the individual new doctoral recipients. The figure for fall 2004 was 5.7%. Figure 2 shows how this unemployment rate compares with other years over the past decade. The unemployment rates, calculated using Table 4B, vary from group to group, with a high of 14.3% for Group Va and lows of 4.5% and 6.5% for Groups IV and I (Pu) respectively.

There are 751 new doctoral recipients employed in the U.S. Table 5A gives a breakdown of type of employer by type of degree-granting department for these 751 new doctoral recipients. Of these, 602 (80%) hold academic positions, 34 (5%) are employed by government, and 115 (15%) hold positions in business and industry.

In the First Report for 2003-04, there were 739 new doctoral recipients employed in the U.S., of which 614 (83%) held academic positions, 26 (4%) were in

Table 5B: Number of New Doctoral Recipients Taking Positions in Business and Industry in the U.S. by Type of Degree-Granting Department, Fall 2001 to Fall 2005

Group	I (Pu)	I (Pr)	II	III	IV	Va	TOTAL
Fall 2001	24	15	25	21	59	24	**168**
Fall 2002	15	12	19	6	56	15	**123**
Fall 2003	19	13	5	8	45	7	**97**
Fall 2004	9	13	9	9	50	9	**99**
Fall 2005	5	9	14	15	64	8	**115**

Table 5C: Number of New Doctoral Recipients Taking U.S. Academic Positions by Type of Degree-Granting Department, Fall 2001 to Fall 2005

Group	I (Pu)	I (Pr)	II	III	IV	Va	TOTAL
Fall 2001	146	70	109	74	84	27	**510**
Fall 2002	120	83	91	86	92	31	**503**
Fall 2003	123	76	117	60	118	40	**534**
Fall 2004	110	113	130	70	142	49	**614**
Fall 2005	131	88	130	83	131	39	**602**

Table 5D: U.S. Academic Positions Filled by New Doctoral Recipients by Type of Hiring Department, Fall 2001 to Fall 2005

Group	I-III	IV	Va	M&B	Other	TOTAL
Fall 2001	199	41	12	161	97	**510**
Fall 2002	213	46	7	138	99	**503**
Fall 2003	203	39	9	156	127	**534**
Fall 2004	222	63	17	154	158	**614**
Fall 2005	231	45	12	188	126	**602**

Table 5E: Females as a Percentage of 2004-05 New Doctoral Recipients Produced by and Hired by Doctoral-Granting Groups

Percent	I (Pu)	I (Pr)	II	III	IV	Va	TOTAL
Produced	21	18	22	37	44	30	**30**
Hired	21	20	18	31	42	33	**25**

government, and 99 (13%) were in business and industry. The number of new doctoral recipients employed in the U.S. decreased in all categories of Table 5A except "Master's, Bachelor's and Two-Year Colleges", "Government", and "Business and Industry"; "Other Academic and Research Institutes" is down 17% this year over last year, and "Master's, Bachelor's and Two-Year Colleges" is up 16% this year over last year.

Table 5B shows the number of new doctoral recipients who took positions in business and industry by the type of department granting their degree for fall 2001 to fall 2005. The number of new doctoral recipients taking jobs in business and industry oscillated in the late 1990s, declined three consecutive years (2001, 2002, and 2003), and the past two years shows a slight increase (up 16% from fall 2004). The fall 2005 number is down 32% from the fall 2001 number. The number of new doctoral recipients taking jobs in government is up 8 (31%) over fall 2004.

Among the 751 new doctoral recipients known to have employment in the U.S. in fall 2005, Group I (Pu) has the smallest percentage taking jobs in business and industry at 4% and Group IV the highest at 31%.

Table 5C shows the number of new doctoral recipients who took academic positions in the U.S. by type of department granting their degree for fall 2001 to fall 2005. After reaching a nine-year high of 614 last year, the number of new doctoral recipients taking academic employment in fall 2005 has dropped 2%. Among the 751 new doctoral recipients employed in the U.S. in fall 2005, 80% have academic positions. This percentage is highest for Group I (Pu) at 92% and lowest for Groups IV at 64%.

Table 5D shows the number of positions filled with new doctoral recipients for each type of academic employer. Increases in positions filled by new doctoral recipients were realized by all groups except Groups IV, Va, and Other.

In fall 2005, 57 new doctoral recipients held positions in the institution that granted their degree, although not necessarily in the same department. This represents 6.5% of new doctoral recipients who are currently employed and 9% of the U.S. academic positions held by new doctoral recipients. In fall 2004 there were 58 such individuals making up 7% of the new doctoral recipients who were employed at the time of the First Report. Twenty-three new doctoral recipients have taken part-time positions in fall 2005 compared with 19 in fall 2004.

Information about 2004–05 Female New Doctoral Recipients

Tables 4A and 4B give male and female breakdowns of the new doctoral recipients in 2004–05 by Field of Thesis, by Type of Degree-Granting Department, and by Type of Employer.

Table 5G: 2004–05 New Doctoral Recipients Having Employment in the U.S. by Type of Employer and Citizenship

	CITIZENSHIP		
U.S. EMPLOYER	U.S.	Non-U.S.	TOTAL
Academic, Groups I–Va	108	180	**288**
Academic, Other	160	154	**314**
Nonacademic	57	92	**149**
TOTAL	**325**	**426**	**751**

Table 5F: Employment Status of 2004–05 U.S. New Doctoral Recipients by Citizenship Status

	CITIZENSHIP				
		NON-U.S. CITIZENS			
TYPE OF EMPLOYER	U.S. CITIZENS	Permanent Visa	Temporary Visa	Unknown Visa	TOTAL
U.S. Employer	325	61	352	13	**751**
U.S. Academic	268	43	280	11	**602**
Groups I, II, III, and Va	100	18	116	9	**243**
Group IV	8	1	36	0	**45**
Non-Ph.D. Department	155	21	114	2	**292**
Research Institute/Other Nonprofit	5	3	14	0	**22**
U.S. Nonacademic	57	18	72	2	**149**
Non-U.S. Employer	23	2	96	2	**123**
Non-U.S. Academic	21	2	89	1	**113**
Non-U.S. Nonacademic	2	0	7	1	**10**
Not Seeking Employment	6	0	1	0	**7**
Still Seeking Employment	20	9	40	0	**69**
SUBTOTAL	374	72	489	15	**950**
Unknown (U.S.)	53	9	14	0	**76**
Unknown (non-U.S.)*	6	1	74	9	**90**
TOTAL	**433**	**82**	**577**	**24**	**1116**

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

Table 6: Sex, Race/Ethnicity, and Citizenship of 2004-05 U.S. New Doctoral Recipients

	MALE					FEMALE					
		NON-U.S. CITIZENS					NON-U.S. CITIZENS				
RACIAL/ETHNIC GROUP	U.S. CITIZENS	Permanent Visa	Temporary Visa	Unknown Visa	Total Male	U.S. CITIZENS	Permanent Visa	Temporary Visa	Unknown Visa	Total Female	TOTAL
American Indian or Alaska Native	1	0	0	0	1	0	0	0	0	0	1
Asian	14	18	205	6	243	7	15	115	4	141	384
Black or African American	6	1	19	0	26	8	0	1	0	9	35
Hispanic or Latino	8	3	24	1	36	4	3	5	0	12	48
Native Hawaiian or Other Pacific Islander	1	0	0	0	1	2	0	1	0	3	4
White	277	22	162	8	469	103	15	46	1	165	634
Unknown	3	1	3	0	7	0	1	2	0	3	10
TOTAL	**310**	**45**	**413**	**15**	**783**	**124**	**34**	**170**	**5**	**333**	**1116**

Overall, 330 (30%) of the 1,116 new doctoral recipients in 2004-05 are female. In 2003-04, 315 (30%) of the new doctoral recipients were female. This percentage varies over the different groups, and these percentages are given in the first row of Table 5E. This year the percentage of females produced is highest again for Group IV at 44%, compared with 40% last year. While the lowest percentage last year was for Group I (Pu) at 23%, this year it is for Group I (Pr) at 18%.

The second row of Table 5E 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, 45% of the new doctoral recipients hired in Group M, master's departments, are female; 24% of the new doctoral recipients hired in Group B, bachelor's departments, are female; and 29% of new doctoral recipients hired in business and industry are female.

The unemployment rate for female new doctoral recipients is 9% compared to 7% for males and 7.3% overall.

The percentage of female new doctoral recipients within fields of thesis ranged from 17% in probabilty, to 44% in statistics, and 69% in mathematics education.

Later sections in this First Report give more information about the female new doctoral recipients by citizenship and the female new doctoral recipients in Group IV.

Employment Information about 2004-05 New Doctoral Recipients by Citizenship and Type of Employer

Table 5F shows the pattern of employment within employer categories broken down by citizenship status of the new doctoral recipients.

The unemployment rate for the 433 U.S. citizens is 5.3% compared to 6.1% in fall 2004. The unemployment rate for non-U.S. citizens is 8.5%. This varies by type of visa. The unemployment rate for non-U.S. citizens with a permanent visa is 12.5%, while that for non-U.S. citizens with a temporary visa is 8.2%. Among U.S. citizens whose employment status is known, 87% are employed in the U.S. Among non-U.S. citizens with a permanent visa whose employment status is known, 85% have jobs in the U.S. (same as last year), while the percentage for non-U.S. citizens with a temporary visa is 72% (last year the percentage was 75%). The number of non-U.S. citizens having employment in the U.S. is 426, up 6% from 401 last year.

Table 5G is a cross-tabulation of the 751 new doctoral recipients who have employment in the U.S. by citizenship and broad employment categories, using numbers from Table 5F. Of the 751 new doctoral recipients having jobs in the U.S., 43% are U.S. citizens. Of the 288 new doctoral recipients who took jobs in U.S. doctoral-granting departments, 38% are U.S. citizens (same as last year). Of the 314 who took other academic positions, 51% are U.S. citizens. Of the 149 who took nonacademic positions, 38% are U.S. citizens. Of the 325 U.S. citizens employed in the U.S., 33% have jobs in a doctoral-granting department, 49% are in other academic positions, and 18% are in nonacademic positions. For the 426 non-U.S. citizens employed in the U.S., the analogous percentages are 42%, 36%, and 22% respectively.

Sex, Race/Ethnicity, and Citizenship Status of 2004-05 New Doctoral Recipients

Table 6 presents a breakdown of new doctoral recipients according to sex, racial/ethnic group, and citizenship status. The information reported in this table was obtained in summary form from the departments granting the degrees.

There were 433 (39%) U.S. citizens among the 1,116 new doctoral recipients in 2004-05. Among

Table 7: U.S. Citizen Doctoral Recipients

Year	Total Doctorates Granted by U.S. Institutions	Total U.S. Citizen Doctoral Recipients	%
1980-81	839	567	68%
1985-86	755	386	51%
1990-91	1061	461	43%
1995-96	1150	493	43%
1998-99*	1133	554	49%
1999-00	1119	537	48%
2000-01	1008	494	49%
2001-02	948	418	44%
2002-03	1017	489	48%
2003-04	1041	441	42%
2004-05	1116	433	39%

*Prior to 1998-99, the counts include new doctoral recipients from Group Vb. In addition, prior to 1982-83, the counts include recipients from computer science departments.

U.S. citizens, 1 is American Indian or Alaska Native (male), 21 are Asian (14 males and 7 females), 14 are Black or African American (6 males and 8 females), 12 are Hispanic or Latino (8 males and 4 females), 3 are Native Hawaiian or Other Pacific Islander (1 male and 2 females), 380 are White (277 males and 103 females), and 3 are Other (males). Among non-U.S. citizens, there are 363 Asians, 21 Blacks or African Americans, 36 Hispanics or Latinos, 1 Native Hawaiian or Other Pacific Islander, 254 Whites, and 7 Other.

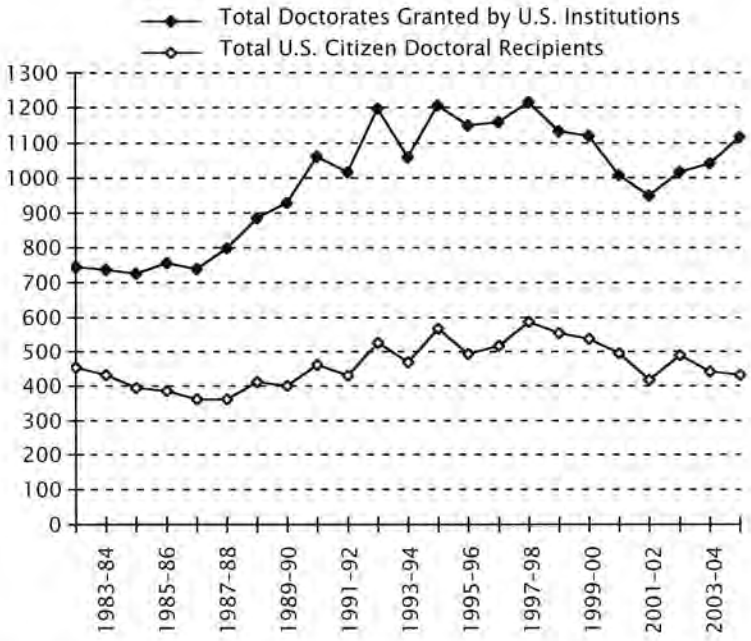
Table 7 (and Figure 3) gives the number of new U.S. doctoral recipients and the number of U.S. citizens back to 1980-81. The 433 U.S. citizen new doctoral recipients is down by 121 (22%) since 1998-99. The percentage of U.S. citizen new doctoral recipients has decreased for the second year to 39% from 42% in fall 2004, while in both years the total number of doctorates granted increased.

Table 8: U.S. Citizen Doctoral Recipients by Sex

Year	Total U.S. Citizen Doctoral Recipients	Male	Female	% Female
1980-81	567	465	102	18%
1985-86	386	304	82	21%
1990-91	461	349	112	24%
1995-96	493	377	116	24%
1998-99*	554	367	187	34%
1999-00	537	379	158	29%
2000-01	494	343	151	31%
2001-02	418	291	127	30%
2002-03	489	332	157	32%
2003-04	441	297	144	33%
2004-05	433	313	120	28%

*Prior to 1998-99, the counts include new doctoral recipients from Group Vb. In addition, prior to 1982-83, the counts include recipients from computer science departments.

Figure 3: U.S. Citizen Doctoral Recipients



Females make up 28% of the 433 U.S. citizens receiving doctoral degrees in the mathematical sciences in 2004-05. This is the lowest percentage of females among U.S. citizen new doctoral recipients reported since 1997-98, when it was also 28%. Last year this percentage was 33%, and the percentage of women among U.S. citizens receiving doctoral degrees had been increasing the previous three years. Among the 683 non-U.S. citizen new doctoral recipients, 31% (209) are female, up from last year's 29%.

Figure 4: Females as a Percentage of U.S. Citizen New Doctoral Recipients

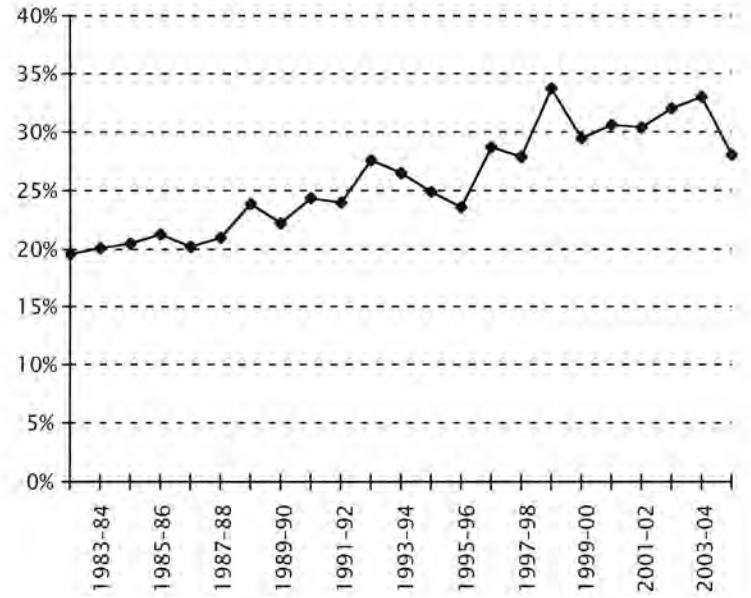


Table 9: Sex and Citizenship of 2004-05 New Doctoral Recipients by Granting Department

	GROUP												TOTAL	
	I (Pu)		I (Pr)		II		III		IV		Va			
CITIZENSHIP	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
U.S.	93	15	45	11	67	24	37	27	44	34	27	9	**313**	**120**
Non-U.S.	99	36	75	15	91	21	60	29	115	92	33	17	**473**	**210**
TOTAL	**192**	**51**	**120**	**26**	**158**	**45**	**97**	**56**	**159**	**126**	**60**	**26**	**786**	**330**

Table 8 (and Figure 4) gives the historical record of U.S. citizen new doctoral recipients, broken down by male and female for past years, going back to 1980-81. The number of female U.S. citizen new doctoral recipients is down 67 (36%) from an all-time high of 187 in 1998-99.

Table 9 gives a sex and citizenship breakdown of the new doctorates within each of the six groups of doctoral-granting departments. Among all 1,116 new doctoral recipients, 40% of the males and 36% of the females are U.S. citizens. Within the groups the percentage of the new doctoral recipients who are U.S. citizens is lowest in Group IV at 27% and highest in Group II at 45%. The number of U.S. citizen new doctoral recipients is lower than the number of non-U.S. citizen new doctoral recipients in all doctoral granting groups for 2004-05.

2004-05 New Doctoral Recipients with Dissertations in Statistics/Biostatistics and Probability

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 addition, other groups in the Annual Survey produce new doctoral recipients with dissertations in statistics/biostatistics and probability. The other groups produced 91 new doctoral recipients with dissertations in statistics/biostatistics and probability in 2004-05 and have averaged 82 per year over the past ten years. Information about these 91 new doctoral recipients and the 285 new doctoral recipients in Group IV is found in this section of the report.

Table 10 contains information about new doctoral recipients in Group IV as well as those with dissertations in statistics/biostatistics and probability in other groups for the past seven years. The last two rows of Table 10 give a split of the 2004-05 results between the 58 statistics departments and the 29 biostatistics and biometrics departments in Group IV. This year 374 new doctorates had a dissertation in statistics/biostatistics (345) or probability (29), an 18% increase over last year's number. Those with dissertations in statistics/biostatistics and probability accounted for 31% of new doctorates in 2004-05. Quite a bit of the variation in numbers from year to year in Table 10 is due to the changes made in the departments in Group IV over the ten years and to the relatively low response rate for this group. At the time of the Second Report last year, 78 of 87 (90%) of Group IV departments had responded, which is the largest percentage ever.

Group IV has 87 departments for 2004-05, 14 more than the next largest doctoral group. It

Table 10: New Doctoral Recipients with Dissertations in Statistics/Biostatistics and Probability

			New Doctoral Recipients in Group IV				New Doctoral Recipients in Statistics/Biostatistics and Probability				New Doctoral Recipients Hired by Group IV	
Year	Depts Surveyed	Depts Responding (percent)	Total	Female (percent)	Jobs in Bus & Ind	Percentage Unemployed	Total	Group IV	Other Groups	Percentage Unemployed	Male	Female
1995-96	80	54 (68%)	172	46 (27%)	55	3.9%	266	171	95	4.8%	24	6
1996-97	81	60 (74%)	197	74 (38%)	70	4.2%	292	187	105	5.1%	24	9
1997-98	82	59 (72%)	213	73 (34%)	70	3.2%	294	199	95	3.7%	25	10
1998-99	91	72 (79%)	243	87 (36%)	57	4.9%	320	240	80	5.8%	29	20
1999-00	89	75 (84%)	284	110 (39%)	79	2.4%	351	278	73	2.0%	24	22
2000-01	86	70 (81%)	237	98 (41%)	59	5.1%	289	221	68	5.3%	27	14
2001-02	86	72 (84%)	222	92 (41%)	56	6.0%	288	221	67	5.4%	31	15
2002-03	86	74 (86%)	239	98 (41%)	45	2.1%	302	234	68	3.3%	20	19
2003-04	87	65 (75%)	243	97 (40%)	50	3.0%	318	241	77	4.0%	48	15
2004-05	87	63 (72%)	285	126 (44%)	64	5.0%	374	283*	91**	5.0%	26	19
Statistics	58	43 (74%)	192	79 (41%)	43	3.0%					13	14
Biostatistics	29	20 (62%)	93	47 (51%)	21	9.0%					13	5

* Of 283, there were 280 in statistics/biostatistics and 3 in probability. For complete details, see Table 4C.

** Of 91, there were 65 in statistics/biostatistics and 26 in probability. For complete details, see Table 4C.

contains 33% of all doctoral departments surveyed, and the 63 Group IV departments responding to the Annual Survey reported 285 new doctoral recipients, 26% of all new doctoral recipients in 2004–05. While this is the second lowest percentage of responding Group IV departments since 1995–96 when it was 68%, it's the largest number of new doctoral recipients reported since 1999–00 when it was 284. The number of new doctoral recipients in Group IV is up 42 from the number reported at this time last year, while the number of departments responding is down 2 from the number responding by this time last year.

Because of its size, the data from Group IV have a large effect on the 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. Group IV results can mask important changes in the other doctoral groups. In the following paragraphs some of these differences are presented. The trends noted below have also been observed in past reports.

Table 9 shows that for the Group IV new doctoral recipients, 126 of 285 (44%) are female, while 204 of 831 (25%) are female in the other doctoral groups. Among U.S. citizens, females accounted for 34 of the 79 (43%) Group IV new doctoral recipients, while for the other groups 86 of 354 (24%) were female. Overall, 120 of 433 (28%) U.S. citizen new doctoral recipients were female.

In Group IV, 79 of 285 (28%) new doctoral recipients are U.S. citizens, while in other groups 354 of 831 (43%) are U.S. citizens.

Of the 206 new doctoral recipients from Group IV who found employment in the U.S., 64 (31%) took jobs in business or industry. From the other groups, 545 new doctoral recipients found employment in the U.S., of which 51 (9%) took jobs in business or industry.

The employment status for 244 Group IV new doctoral recipients is known, and 11 (4.5%) are unemployed. For the other groups, the employment status of 706 is known, and 58 (8.2%) are unemployed. Nineteen of 45 (42%) new doctoral recipients hired by Group IV departments were female, up from last year's 24%, the lowest percentage of female hires reported since 1999–2000. The other doctoral groups reported that 54 of 243 (22%) new doctoral recipients hired were female, down from last year's 27%.

Group IV had 283 new doctoral recipients with fields of thesis in statistics/biostatistics (280) and probability (3), and the other doctoral departments had 91 with fields of thesis in statistics/biostatistics (65) and probability (26). The distribution of these 65 degrees among the various groups can be found in Table 4C. The number of new doctoral recipients with theses in statistics/biostatistics and probability (374) is substantially larger than any other field, with algebra and number theory next with 161.

Faculty Salary Survey

The charts on the following pages display faculty salary data for Groups I (Pu), I (Pr), II, III, IV (Statistics), IV (Biostatistics), 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. This is the third year that salary information has been reported separately for statistics departments and biostatistics and biometrics departments in Group IV.

Table 11 provides the departmental response rates for the 2005 Faculty Salary Survey. Departments were asked to report for each rank the number of tenured and tenure-track faculty whose 2005–06 academic-year salaries fell within given salary intervals. Reporting salary data in this fashion eliminates some of the concerns about confidentiality but does not permit determination of actual quartiles. Although the actual quartiles cannot be determined from the data gathered, these quartiles have been estimated assuming that the density over each interval is uniform.

Table 11: Faculty Salary Response Rates

Department	Number	Percent
Group I (Public)	23 of 25	92
Group I (Private)	11 of 23	48
Group II	45 of 56	80
Group III	66 of 75	88
Group IV (Statistics)	42 of 55	76
Group IV (Biostatistics)	17 of 31	55
Group Va	11 of 21*	52
Group M	80 of 189	42
Group B	320 of 1010	32

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

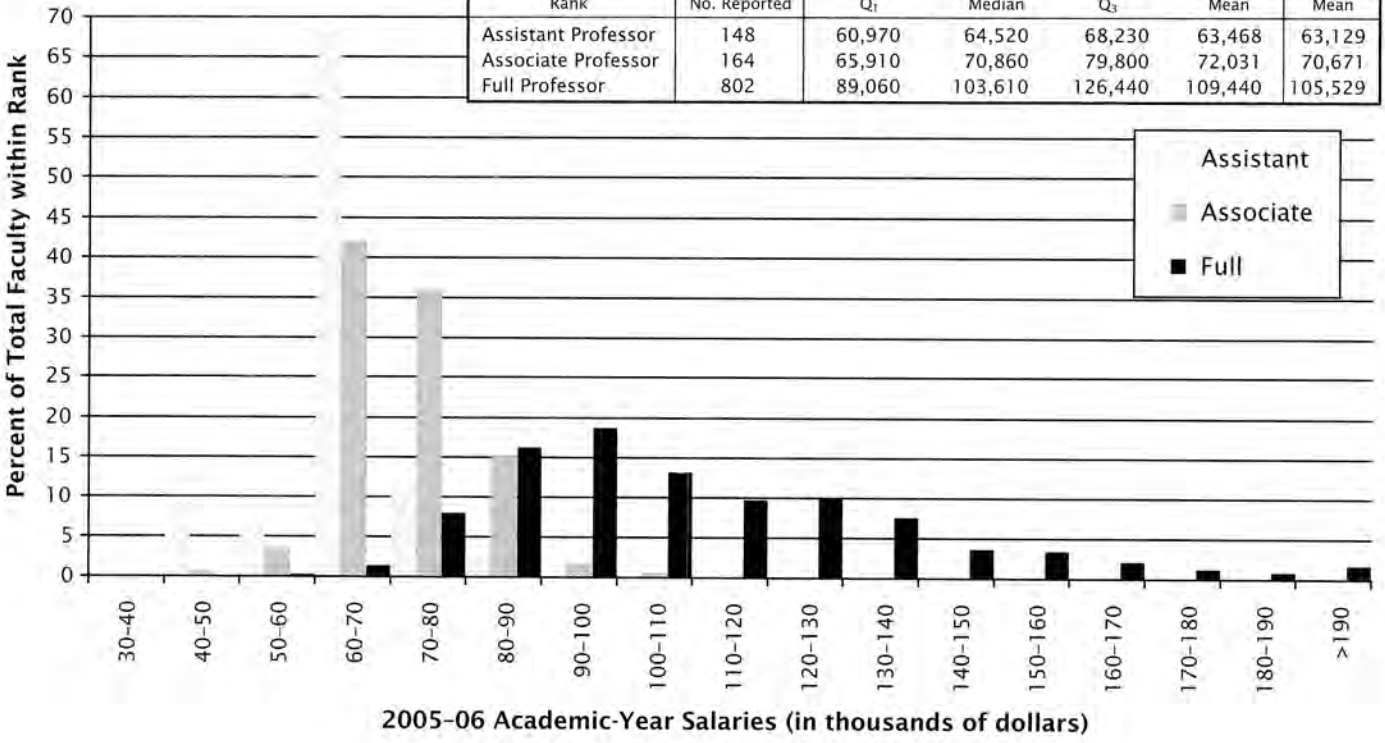
Since departments in Groups I, II, and III were changed in 1995–96 (see definitions of the groups on page 245), comparisons are possible only to the last eight years' data. In addition, prior to the 1998 survey Groups Va and Vb were reported together as Group V. When comparing current and prior year figures, one should keep in mind that differences in the set of responding departments

Group I (Public) Faculty Salaries

Doctoral degree-granting departments of mathematics (25)

23 responses (92%)

Rank	2005-06 No. Reported	Q_1	Median	Q_3	Mean	2004-05 Mean
Assistant Professor	148	60,970	64,520	68,230	63,468	63,129
Associate Professor	164	65,910	70,860	79,800	72,031	70,671
Full Professor	802	89,060	103,610	126,440	109,440	105,529

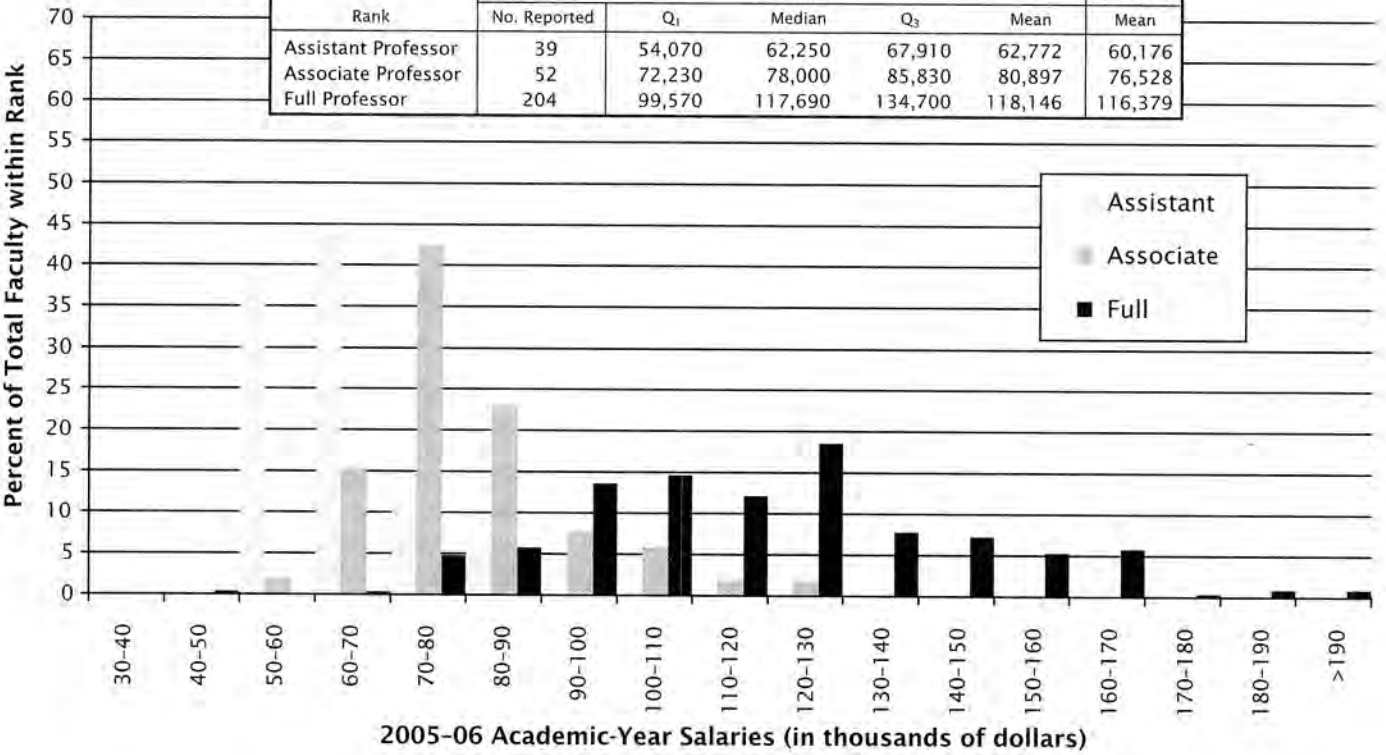


Group I (Private) Faculty Salaries

Doctoral degree-granting departments of mathematics (23)

11 responses (48%)

Rank	2005-06 No. Reported	Q_1	Median	Q_3	Mean	2004-05 Mean
Assistant Professor	39	54,070	62,250	67,910	62,772	60,176
Associate Professor	52	72,230	78,000	85,830	80,897	76,528
Full Professor	204	99,570	117,690	134,700	118,146	116,379

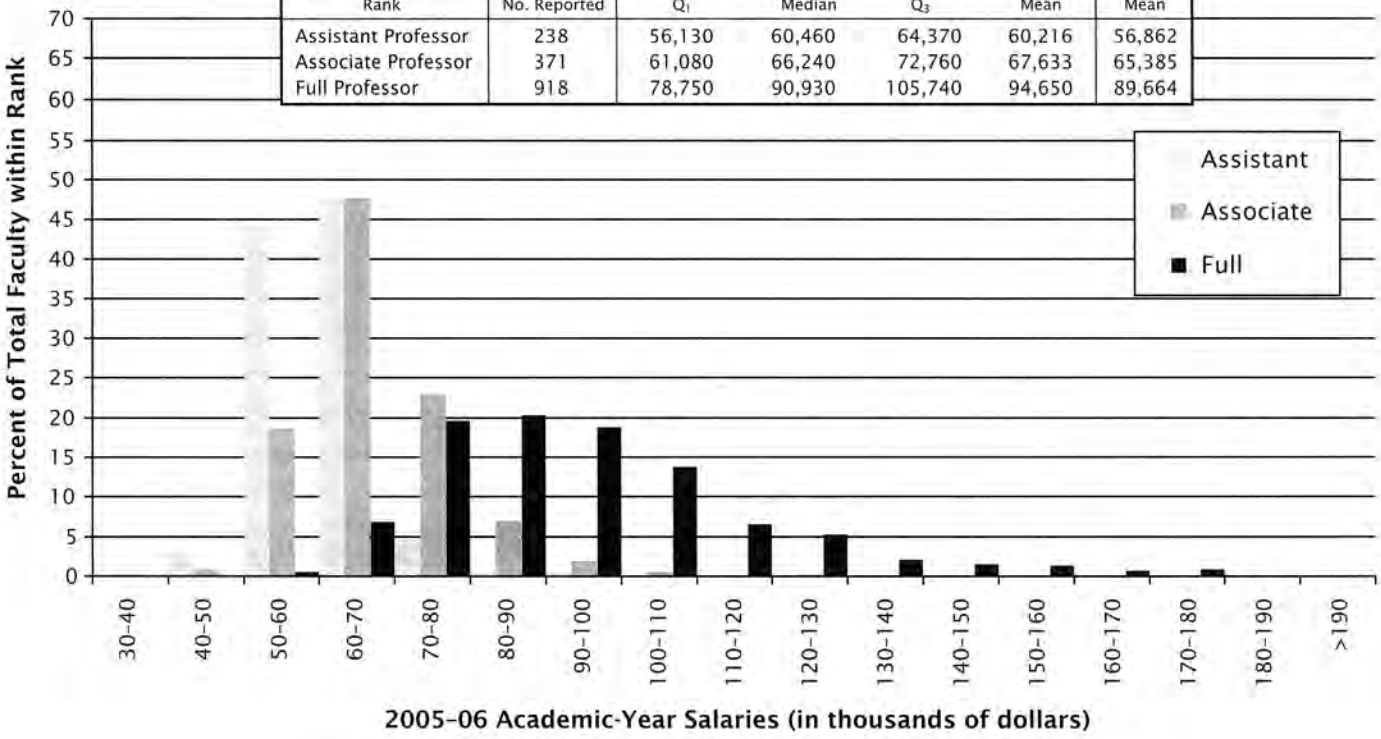


Group II Faculty Salaries

Doctoral degree-granting departments of mathematics (56)

45 responses (80%)

Rank	2005-06 No. Reported	Q_1	Median	Q_3	Mean	2004-05 Mean
Assistant Professor	238	56,130	60,460	64,370	60,216	56,862
Associate Professor	371	61,080	66,240	72,760	67,633	65,385
Full Professor	918	78,750	90,930	105,740	94,650	89,664

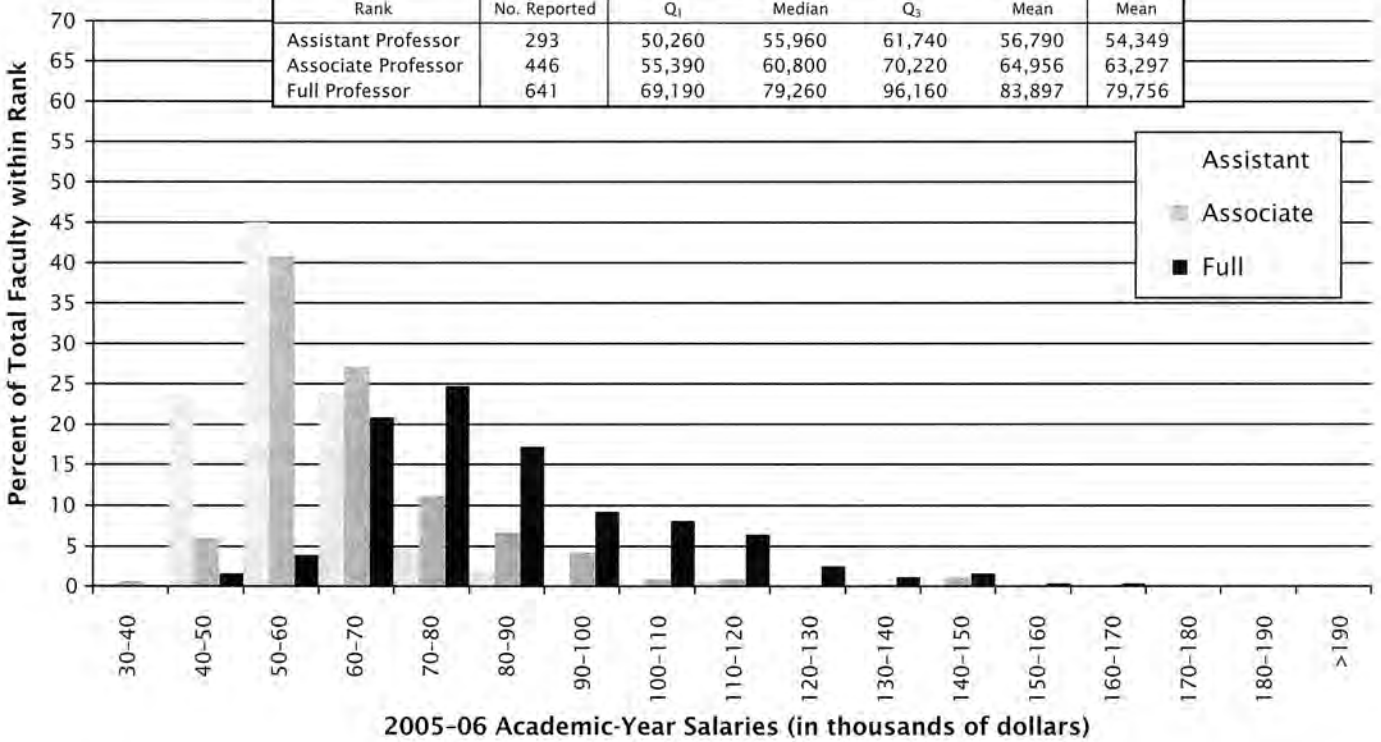


Group III Faculty Salaries

Doctoral degree-granting departments of mathematics (75)

66 responses (88%)

Rank	2005-06 No. Reported	Q_1	Median	Q_3	Mean	2004-05 Mean
Assistant Professor	293	50,260	55,960	61,740	56,790	54,349
Associate Professor	446	55,390	60,800	70,220	64,956	63,297
Full Professor	641	69,190	79,260	96,160	83,897	79,756

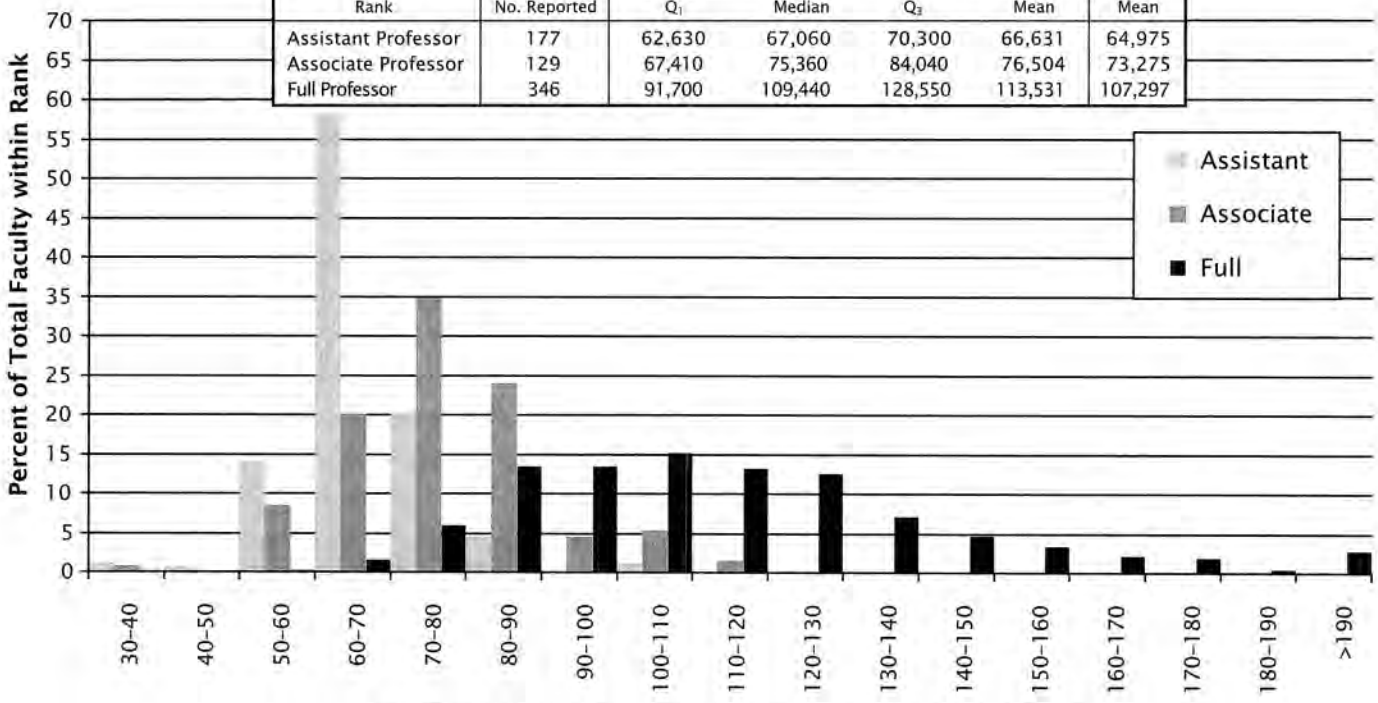


Group IV (Statistics) Faculty Salaries

Doctoral degree-granting departments of statistics (55)

42 responses (76%)

Rank	2005-06 No. Reported	Q_1	Median	Q_3	Mean	2004-05 Mean
Assistant Professor	177	62,630	67,060	70,300	66,631	64,975
Associate Professor	129	67,410	75,360	84,040	76,504	73,275
Full Professor	346	91,700	109,440	128,550	113,531	107,297

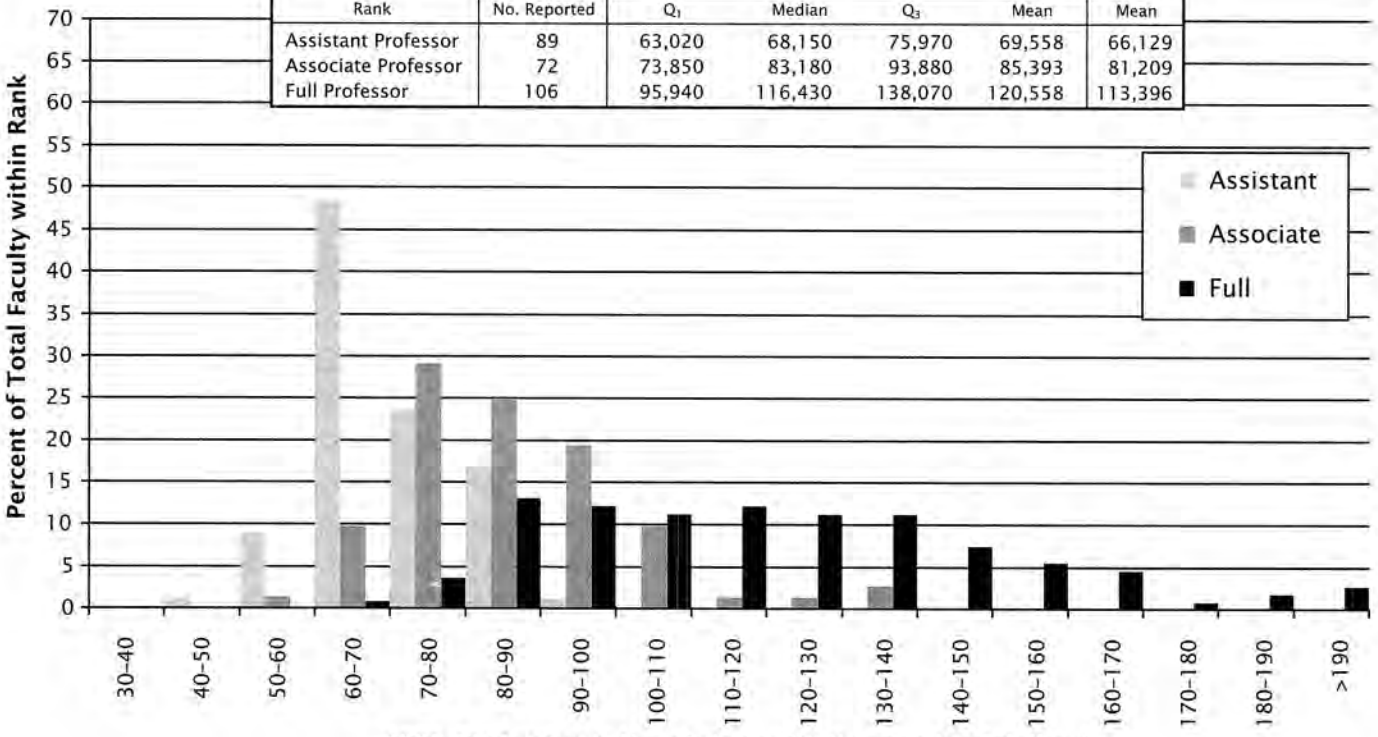


Group IV (Biostatistics) Faculty Salaries

Doctoral degree-granting departments of biostatistics and biometrics (31)

17 responses (55%)

Rank	2005-06 No. Reported	Q_1	Median	Q_3	Mean	2004-05 Mean
Assistant Professor	89	63,020	68,150	75,970	69,558	66,129
Associate Professor	72	73,850	83,180	93,880	85,393	81,209
Full Professor	106	95,940	116,430	138,070	120,558	113,396

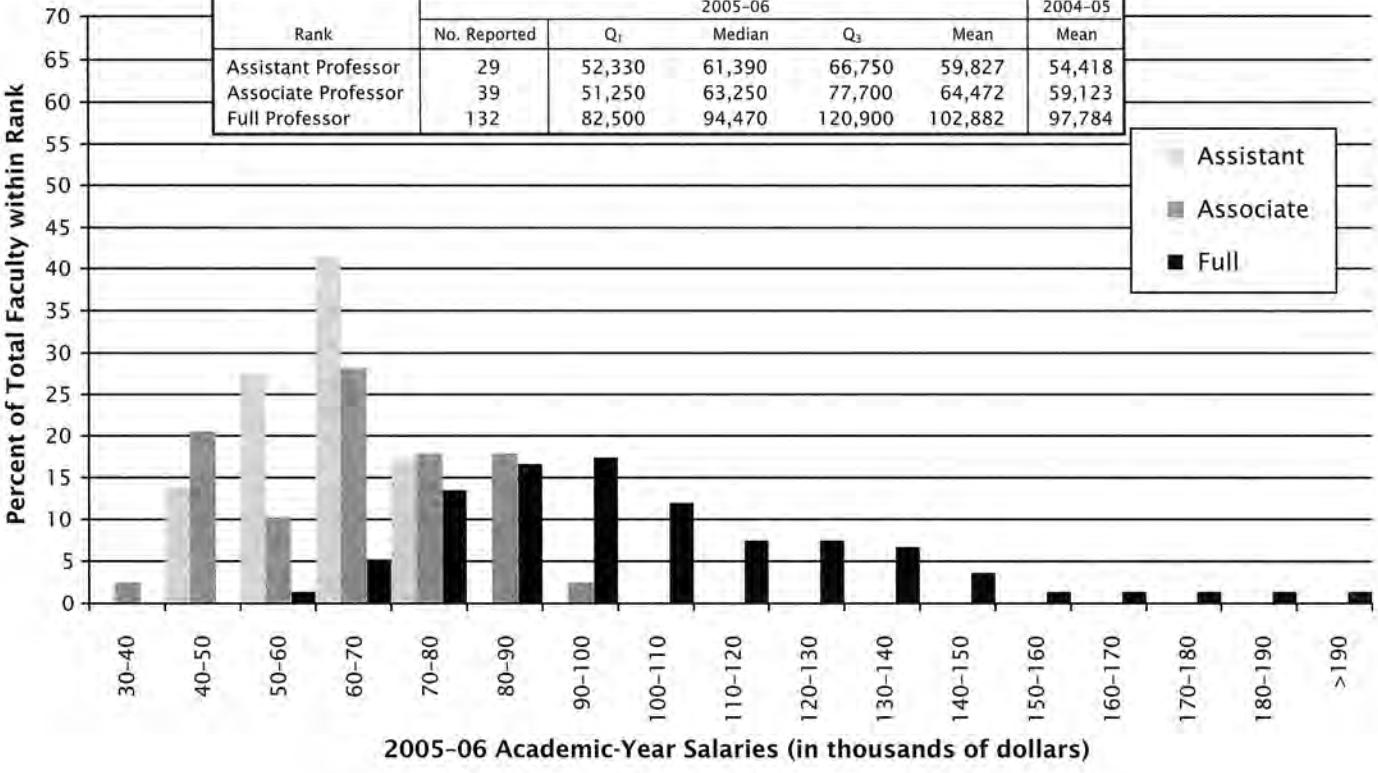


Group Va Faculty Salaries

Doctoral degree-granting departments of applied mathematics (18)

11 responses (61%)

Rank	2005-06 No. Reported	Q_1	Median	Q_3	Mean	2004-05 Mean
Assistant Professor	29	52,330	61,390	66,750	59,827	54,418
Associate Professor	39	51,250	63,250	77,700	64,472	59,123
Full Professor	132	82,500	94,470	120,900	102,882	97,784

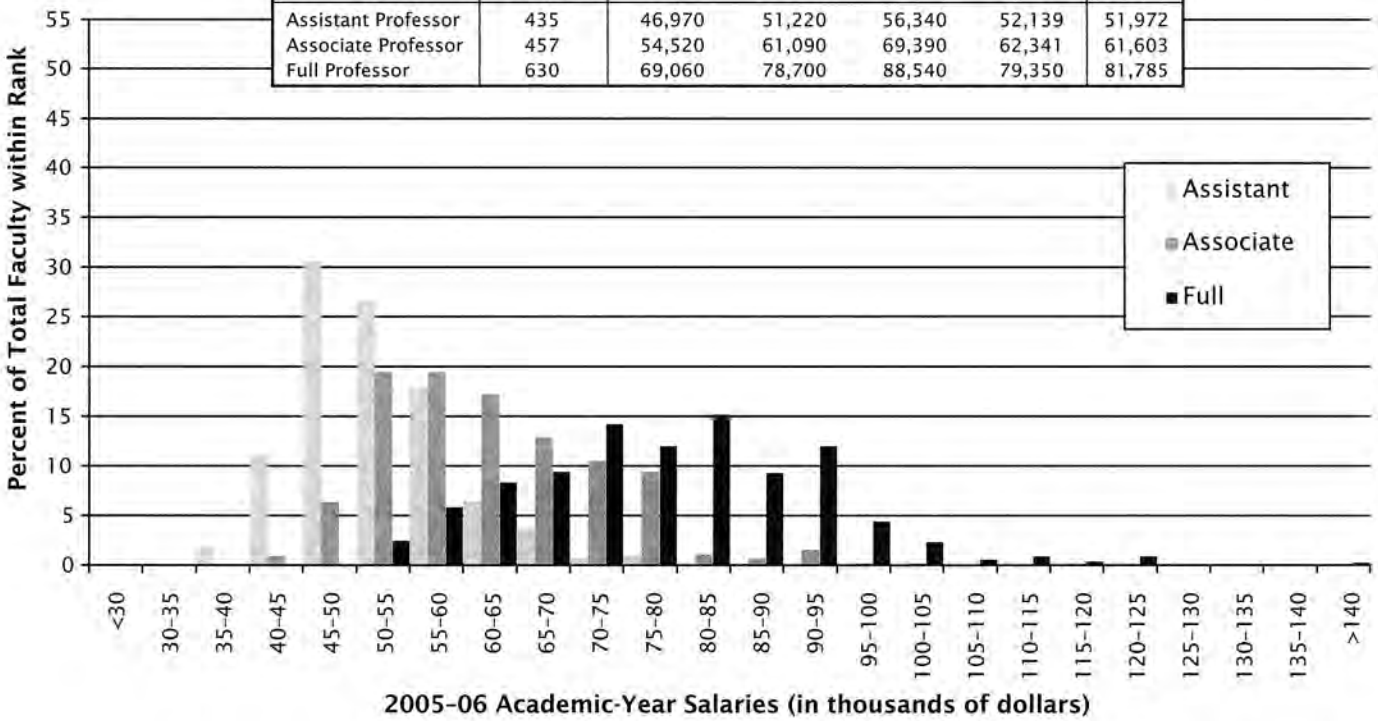


Group M Faculty Salaries

Master's degree-granting departments of mathematics (189)

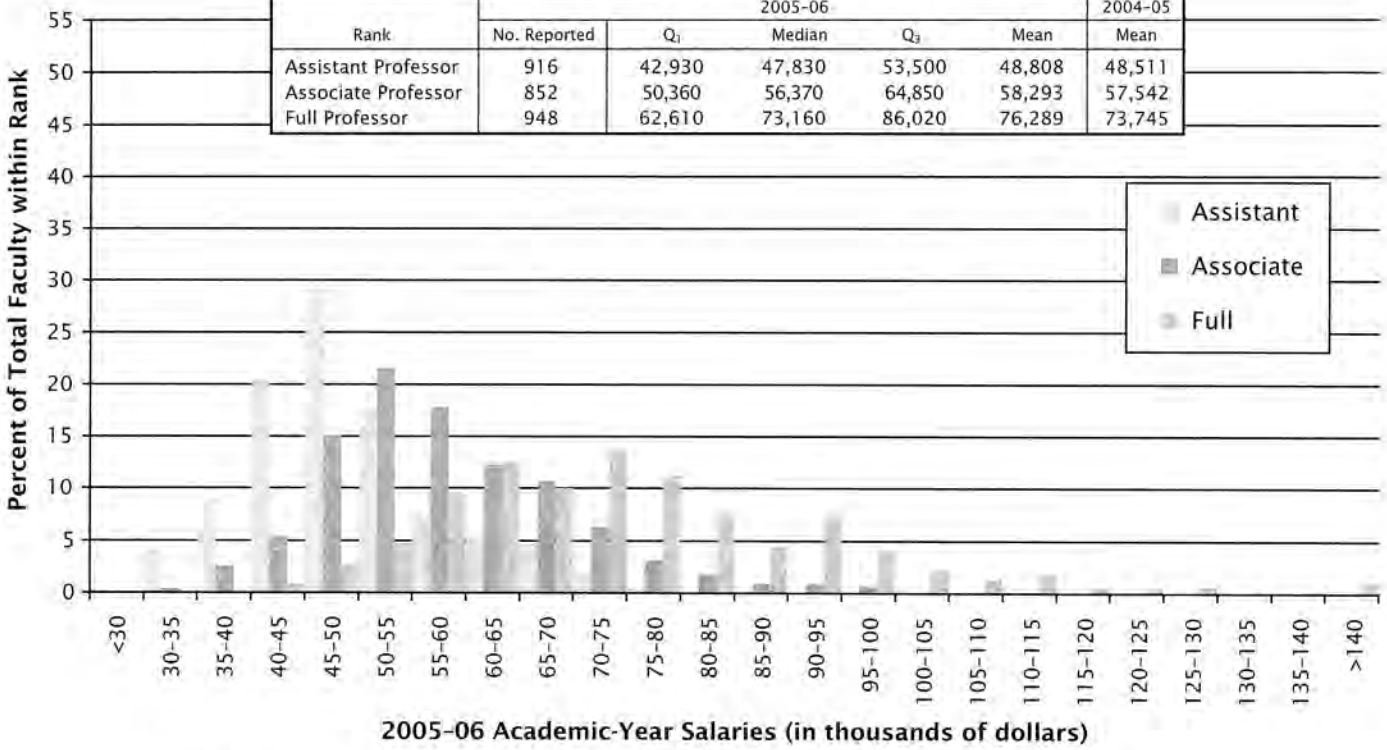
80 responses (42%)

Rank	2005-06 No. Reported	Q_1	Median	Q_3	Mean	2004-05 Mean
Assistant Professor	435	46,970	51,220	56,340	52,139	51,972
Associate Professor	457	54,520	61,090	69,390	62,341	61,603
Full Professor	630	69,060	78,700	88,540	79,350	81,785



Group B Faculty Salaries
Bachelor's degree-granting departments of mathematics (1010)
320 responses (32%)

Rank	2005-06 No. Reported	Q_1	Median	Q_3	Mean	2004-05 Mean
Assistant Professor	916	42,930	47,830	53,500	48,808	48,511
Associate Professor	852	50,360	56,370	64,850	58,293	57,542
Full Professor	948	62,610	73,160	86,020	76,289	73,745



may be a significant factor in the change in the reported mean salaries.

Previous Annual Survey Reports

The 2004 First, Second, and Third Annual Survey Reports were published in the *Notices of the AMS* in the February, August, and September 2005 issues respectively. These reports and earlier reports, as well as a wealth of other information from these surveys, are available on the AMS website at `www.ams.org/employment/surveyreports.html`.

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 2004-2005*, Academe: Bull. AAUP (April 2005), Washington, DC.

American Statistical Association, *Business, Industry, and Government 2005 Salary Survey*. [`http://www.amstat.org/publications/amsn/2005/highlights10-1.pdf`] Revised November 2005. (Published in *AMSTATNEWS*, October 2005, Issue #340.)

——, *2004-2005 Salary Report of Academic Statisticians*. [`http://www.amstat.org/profession/salaryreport_acad2004-5.pdf`] (Published in *AMSTATNEWS*, December 2004, Issue #330.)

Commission on Professionals in Science and Technology, *Professional Women and Minorities*, 15th ed., CPST, Washington, DC, 2004.

——, *Salaries of Scientists, Engineers, and Technicians: A Summary of Salary Surveys*, 21st ed., CPST, Washington, DC, 2004.

——, *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.

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

Conference Board of the Mathematical Sciences, *Statistical Abstract of Undergraduate Programs in the Mathematical Sciences in the United States: Fall 2000 CBMS Survey*, American Mathematical Society, Providence, RI, 2002.

——, *Statistical Abstract of Undergraduate Programs in the Mathematical Sciences in the United States: Fall 1995 CBMS Survey*, MAA Reports No. 2, 1997.

National Opinion Research Center, *Doctorate Recipients from United States Universities: Summary Report 2003*, Survey of Earned Doctorates, Chicago, IL, 2004.

National Research Council, *Strengthening the Linkages 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.

National Science Board, *Science and Engineering Indicators—2004* (NSB 04-01), National Science Foundation, Arlington, VA, 2004.

National Science Foundation, *Characteristics of Doctoral Scientists and Engineers in the United States: 2001* (NSF 03-310), Detailed Statistical Tables, Arlington, VA, 2003.

——, *Emigration of U.S.-Born S&E Doctorate Recipients* (NSF 04-327), Arlington, VA, June 2004.

——, *Graduate Students and Postdoctorates in Science and Engineering: Fall 2002* (NSF 05-310), Arlington, VA, 2004.

——, *Gender Differences in the Careers of Academic Scientist and Engineers* (NSF 04-323), Arlington, VA, 2004.

——, *Plans for Postdoctoral Research Appointments Among Recent U.S. Doctorate Recipients* (NSF 04-308), Arlington, VA, 2004.

——, *Science and Engineering Degrees: 1966–2000* (NSF 02-327), Detailed Statistical Tables, Arlington, VA, 2002.

——, *Science and Engineering Degrees, by Race/Ethnicity of Recipient: 1992–2001* (NSF 04-318), Detailed Statistical Tables, Arlington, VA, 2004.

——, *Science and Engineering Doctorate Awards: 2003* (NSF 05-300), Detailed Statistical Tables, Arlington, VA, 2004.

——, *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2004* (NSF 004-317), Arlington, VA, 2004.

——, *Statistical Profiles of Foreign Doctoral Recipients in Science and Engineering: Plans to Stay in the United States* (NSF 99-304), Arlington, VA, 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 compose 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 was 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 compose these groups are available on the AMS website 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 of the AMS, *pages 257–67, and an analysis of the classifications was given in the June 1983* Notices of the AMS, *pages 392–3.*

Mathematics People

Colmez and Le Gall Awarded Fermat Prize

The 2005 Fermat Prize for Mathematics Research has been awarded jointly to PIERRE COLMEZ, Institut de Mathématiques de Jussieu, and JEAN-FRANÇOIS LE GALL, Université Paris VI and École Normale Supérieure. Colmez was honored for his contributions to the study of L-functions and p-adic Galois representations. Le Gall was chosen for his contributions to the fine analysis of planar Brownian motion and his invention of the Brownian snake and its applications to the study of nonlinear partial differential equations.

The Fermat Prize is presented every two years and carries a monetary award of 20,000 euros (approximately US$23,500). The prize rewards the research work of one or more mathematicians in fields in which the contributions of Pierre de Fermat have been decisive: calculus of variations, foundations of probability and analytic geometry, and number theory. The award is given by the Université Paul Sabatier, Toulouse.

Previous recipients of the Fermat Prize are: Abbas Bahri and Kenneth A. Ribet (1989), Jean-Louis Colliot-Thélène (1991), Jean-Michel Coron (1993), Andrew J. Wiles (1995), Michel Talagrand (1997), F. Bethuel and F. Helein (1999), Richard Taylor and Wendelin Werner (2001), and Luigi Ambrosio (2003).

—Elaine Kehoe

AAAS Fellows Elected

Five individuals whose work involves the mathematical sciences have been elected as fellows of the American Association for the Advancement of Science (AAAS). The new fellows are JENNIFER TOUR CHAYES, Microsoft Research; ROBERT M. MIURA, New Jersey Institute of Technology; LINDA R. PETZOLD, University of California, Santa Barbara; T. CHRISTINE STEVENS, St. Louis University; and ROBERT WILLIAMS, University of Texas, Austin.

—From an AAAS announcement

NSF Graduate Fellowships Awarded

The National Science Foundation (NSF) has awarded its Graduate Fellowships for fiscal year 2005. This program supports students pursuing doctoral study in all areas of science and engineering and provides a stipend of US$18,000 per year for three years of full-time graduate study. Following are the names of the awardees in the mathematical sciences for 2005, followed by their undergraduate institutions (in parentheses) and the institutions at which they plan to pursue graduate work.

JEFFREY M. ARISTOFF (Massachusetts Institute of Technology), Massachusetts Institute of Technology; ETHAN P. ATKINS (Rensselaer Polytechnic Institute), New York University; REID W. BARTON (Massachusetts Institute of Technology), Massachusetts Institute of Technology; JONAH BLASIAK (Princeton University), University of California, Berkeley; JEREMY S. BRANDMAN (Yale University), University of California, Los Angeles; MOOREA L. BREGA (University of Colorado at Boulder), Courant Institute of Mathematical Sciences, New York University; DAVID M. BROWN (University of Arizona), University of California, Berkeley; ALEJANDRO L. CANTARERO (University of Colorado at Boulder), University of California, Los Angeles; MARGARET I. DOIG (University of Notre Dame), University of California, Berkeley; DAMIR D. DZHAFAROV (Purdue University), University of California, Berkeley; JOHN N. FRANCIS (Harvard University), Massachusetts Institute of Technology; ELENA D. FUCHS (University of California, Berkeley) Princeton University; ANTON I. GERASCHENKO (Brandeis University), University of California, Berkeley; JANA L. GEVERTZ (Rutgers University), Princeton University; STACY L. HOEHN (Xavier University), University of Notre Dame; JEFFREY N. HOOD (Reed College), University of British Columbia; KENNETH N. KAMRIN (University of California, Berkeley), Massachusetts Institute of Technology; ADAM W. MARCUS (Georgia Institute of Technology), Georgia Institute of Technology; CARL S. MCTAGUE (University of Cincinnati), Courant Institute of Mathematical Sciences, New York University; AARON C. NABER (Pennsylvania State University), Pennsylvania State University; SARAH A. NOWAK (Massachusetts Institute of Technology), University of California, Los Angeles; MARIBETH B. OSCAMOU (Santa Clara

University), University of Colorado at Boulder; VICTOR M. PANARETOS (Athens University of Economics and Business), University of California, Berkeley; ROBERT C. RHOADES (Bucknell University), Massachusetts Institute of Technology; ERIC M. SCHOENFELD (Williams College), Stanford University; ALEXEY N. SPIRIDONOV (Princeton University), Massachusetts Institute of Technology; KARTIK VENKATRAM (Harvard University), Princeton University; RACHEL A. WARD (University of Texas at Austin), Princeton University; WILLIE W. WONG (Princeton University), Stanford University; CARL R. YERGER (Harvey Mudd College), University of California, San Diego; YEVGENY K. ZAYTMAN (Massachusetts Institute of Technology), Princeton University.

—From an NSF announcement

2006 AMS Sectional Meetings

April 1-2, 2006
Florida International University, Miami, FL

April 8-9, 2006
University of Notre Dame, Notre Dame, IN
(features the Erdős Memorial Lecture by Béla Bollobás)

April 22-23, 2006
University of New Hampshire, Durham, NH

April 29-30, 2006
San Francisco State University, San Francisco, CA
(features the Einstein Public Lecture in Mathematics by Benoît Mandelbrot)

October 7-8, 2006
University of Utah, Salt Lake City, UT

October 21-22, 2006
University of Cincinnati, Cincinnati, OH

October 28-29, 2006
University of Connecticut, Storrs, CT

November 3-4, 2006
University of Arkansas, Fayetteville, AR

For more information, see
http://www.ams.org/amsmtgs/sectional.html

Mathematics Opportunities

NSF-CBMS Regional Conferences, 2006

With funding from the National Science Foundation (NSF), the Conference Board of the Mathematical Sciences (CBMS) will hold four NSF-CBMS Regional Research Conferences during the summer of 2006.

These conferences are intended to stimulate interest and activity in mathematical research. Each five-day conference features a distinguished lecturer who will deliver ten lectures on a topic of important current research in one sharply focused area of the mathematical sciences. The lecturer subsequently prepares an expository monograph based on these lectures. Depending on the conference topic, the monograph will be published by the American Mathematical Society, by the Society for Industrial and Applied Mathematics, or jointly by the American Statistical Association and the Institute of Mathematical Statistics.

Support for about thirty participants will be provided for each conference. Established researchers and interested newcomers, including postdoctoral fellows and graduate students, are invited to attend.

Information about an individual conference may be obtained by contacting the conference organizer. The four conferences to be held in 2006 are as follows.

Mathematical and Numerical Treatment of Fluid Flow and Transport in Porous Media, Zhangxin (John) Chen, lecturer. May 22–26, 2006; University of Nevada, Las Vegas. Organizers: Jichun Li, telephone: 702-895-0365, email: jichun@unlv.nevada.edu; and Yi-Tung Chen, telephone: 702-895-1202, email: uuchen@nscee.edu; website: http://www.ncacm.unlv.edu/cbms/.

Cluster Algebras and Applications, Andrei Zelevinsky, lecturer. June 13–17, 2006; North Carolina State University. Organizer: Naihuan Jing, telephone: 919-513-3584, email: jing@unity.ncsu.edu; website: http://www.math.ncsu.edu/~jing/conf/CBMS/cbms06.html.

The Interplay between Convex Geometry and Harmonic Analysis, Alexander Koldobsky, lecturer. July 29–August 2, 2006; Kansas State University. Organizers: Dmitry Ryabogin, telephone: 785-532-6750, email: ryabs@math.ksu.edu; and David Auckly, telephone: 785-532-6750, email: dav@math.ksu.edu; website: http://www.math.ksu.edu/main/events/convex-geom.

Probabilistic and Combinatorial Approach in Analysis, Mark Rudelson, lecturer. August 6–12, 2006; Kent State University. Organizers: Artem Zvavitch, telephone: 330-672-3316, email: zvavitch@math.kent.edu; Per Enflo, telephone 330-672-9095, email: enflo@math.kent.edu; and Andrew Tonge, telephone: 330-672-9046, email: tonge@math.kent.edu; website: http://www.math.kent.edu/math/CBMS.cfm.

—From a CBMS announcement

Call for Proposals for 2007 NSF-CBMS Regional Conferences

To stimulate interest and activity in mathematical research, the National Science Foundation (NSF) intends to support up to seven NSF-CBMS Regional Research Conferences in 2007. A panel chosen by the Conference Board of the Mathematical Sciences will make the selections from among the submitted proposals.

Each five-day conference features a distinguished lecturer who delivers ten lectures on a topic of important current research in one sharply focused area of the mathematical sciences. The lecturer subsequently prepares an expository monograph based on these lectures, which is normally published as a part of a regional conference series. Depending on the conference topic, the monograph will be published by the American Mathematical Society, by the Society for Industrial and Applied Mathematics, or jointly by the American Statistical Association and the Institute of Mathematical Statistics. Support is provided for about thirty participants at each conference, and the conference organizer invites both established researchers and interested newcomers, including postdoctoral fellows and graduate students, to attend.

The proposal due date is **April 7, 2006**. For further information on submitting a proposal, consult the CBMS website, http://www.cbmsweb.org/NSF/2007_call.htm, or contact: Conference Board of the Mathematical Sciences, 1529 Eighteenth Street, NW, Washington, DC 20036;

telephone: 202-293-1170; fax: 202-293-3412; email: lkolbe@maa.org or rosier@georgetown.edu.

—From a CBMS announcement

National Academies Research Associateship Programs

The Policy and Global Affairs Division of the National Academies is sponsoring the 2006 Postdoctoral and Senior Research Associateship Programs. The programs are meant to provide opportunities for Ph.D., Sc.D., or M.D. scientists and engineers of unusual promise and ability to perform research at more than one hundred research laboratories throughout the United States and overseas.

Full-time associateships will be awarded for research in the fields of mathematics, chemistry, earth and atmospheric sciences, engineering, applied sciences, life sciences, space sciences, and physics. Most of the laboratories are open to both U.S. and non-U.S. nationals and to both recent doctoral recipients and senior investigators.

Awards are made for one or two years, renewable for a maximum of three years. Annual stipends for recent Ph.D. recipients range from US$30,000 to US$50,000, depending on the sponsoring laboratory; the awards for senior recipients will be higher. Support is also provided for allowable relocation expenses and for limited professional travel during the period of the award.

Awards will be made four times during the year, in February, May, August, and November. The deadline for application materials to be postmarked or for electronic submissions for the February 2006 review is **February 1, 2006.**

For further information and application materials, see the National Academies website at http://www4.nas.edu/pga/rap.nsf/WebDocuments/Home+Page, or contact Research Associateship Programs, Keck Center of the National Academies, 500 Fifth Street, NW, GR322A, Washington, DC 20001; telephone 202-334-2760; fax 202-334-2759; email: rap@nas.edu.

—From an NRC announcement

National Academies Graduate Fellowship Program

The Christine Mirzayan Science and Technology Policy Graduate Fellowship Program of the National Academies is designed to engage graduate science, engineering, medical, veterinary, business, and law students in the analysis and creation of science and technology policy and to familiarize them with the interactions of science, technology, and government. As a result, students develop essential skills different from those attained in academia and make the transition from graduate student to professional. In 2006 programs will be held in the summer, from June 5 through August 11, and in the fall, from September 11 through November 17.

Applications for the fellowships are invited from scholars from graduate through postdoctoral levels in any physical, biological, or social science field or any field of engineering, medicine and health, or veterinary medicine, as well as business, law, education, and other graduate and professional programs. Postdoctoral scholars should have received their Ph.D.'s within the past five years.

The stipend for both ten-week programs is US$4,800. The fellowship stipend is intended to cover all living expenses for the period. In addition, a travel stipend of up to US$500 will be provided.

Deadlines for receipt of materials for the summer program is **March 1, 2006**, and for the fall program, **June 1, 2006**. More information and application forms and instructions can be found on the website http://www7.nationalacademies.org/policyfellows or by contacting National Academies Christine Mirzayan Science and Technology Policy Graduate Fellowship Program, 500 Fifth Street, NW, Room 508, Washington, DC 20001; telephone: 202-334-2455; fax: 202-334-1667.

—From a National Academies announcement

ONR Young Investigator Program

The Office of Naval Research (ONR) sponsors a Young Investigator Program to support academic scientists and engineers who have recently received Ph.D. or equivalent degrees and who show exceptional promise for doing creative research. The ONR expects to make up to twenty-four new awards in fiscal year 2006. Awards of up to US$100,000 per year for three years are made, and additional funds may be provided based on need.

Proposals are sought that address the following priority research areas in mathematical, computer, and information sciences: inverse problems arising from electromagnetic and acoustic wave propagation and scattering; mathematical foundations for imaging, image analysis, and image processing; mathematical optimization; fundamentals of software and systems; and intelligent systems. The program is open to United States citizens, nationals (native residents of a U.S. possession), and permanent residents who hold tenure-track or permanent faculty positions at U.S. universities and who received their graduate degrees on or after November 1, 2000.

Proposals in mathematical, computer, and information sciences should be sent to: Office of Naval Research (FY06 YIP BAA No. 06-002), Attn: YIP Coordinator, Mathematical, Computer, and Information Sciences Division, ONR Code 311, Room 1106, 875 North Randolph Street, Suite 1425, Arlington, VA 22203-1995; telephone: 703-696-4313. Proposals must be received by 4:00 p.m. Eastern Standard Time on **January 12, 2006**. For further information and instructions for proposal preparation, see the ONR

website, http://www.onr.navy.mil/sci_tech/industrial/363/docs/baa_06_002.doc.

—From an ONR announcement

Clay Mathematics Institute 2006 Summer School

The Clay Mathematics Institute (CMI) Summer School on Arithmetic Geometry will be held at the Mathematisches Institut, Georg-August-Universität Göttingen, Germany, from July 17 to August 11, 2006.

Designed for graduate students and mathematicians within five years of receipt of the Ph.D., the program will introduce the participants to modern techniques and outstanding conjectures at the interface of number theory and algebraic geometry. The main focus is rational points on algebraic varieties over nonalgebraically closed fields. Do they exist? If not, can this be proven efficiently and algorithmically? When rational points do exist, are they finite in number and can they be found effectively? When there are infinitely many rational points, how are they distributed?

For curves, a cohesive theory addressing these questions has emerged in the past few decades. Highlights include Faltings's finiteness theorem and Wiles's proof of Fermat's last theorem. Key techniques are drawn from the theory of elliptic curves, including modular curves and parametrizations, Heegner points, and heights.

The arithmetic of higher dimensional varieties is equally rich, offering a complex interplay of techniques, including Shimura varieties, the minimal model program, moduli spaces of curves and maps, deformation theory, Galois cohomology, harmonic analysis, and automorphic functions. However, many foundational questions about the structure of rational points remain open, and research tends to focus on properties of specific classes of varieties.

This school will offer three core courses (on curves, surfaces, and higher-dimensional varieties), supplemented by seminars on computational and algorithmic aspects of arithmetic geometry and by minicourses on more advanced topics. Lecturers include Dan Abramovich, Fedor Bogomolov, Antoine Chambert-Loir, Ching-Li Chai, Henri Darmon, David Harari, Brendan Hassett, Andrew Kresch, Yuri Manin, Frans Oort, Jason Starr, Yuri Tschinkel, and others. The organizers of the summer school are Jim Carlson, Henri Damon, David Ellwood, Brendan Hassett, and Yuri Tschinkel.

Funding is available to graduate students and postdoctoral fellows who are within five years of receipt of the Ph.D. Standard support amounts will include funds for local expenses and accommodations plus economy travel.

The deadline for application is **February 28, 2006**. For more information and an application form, see http://www.claymath.org/summerschool or contact summerschool@claymath.org; telephone: 617-995-2600.

—CMI announcement

Inside the AMS

AMS Congressional Briefing: How Mathematics Helps Predict Storm Surges

On November 3, 2005, the AMS sponsored its eighth Congressional Briefing, a yearly event that brings together senators, congressional representatives, and their staffs for presentations about using mathematics to address issues of national importance. The title of the latest briefing was "From Katrina Forward: How Mathematics Helps Predict Storm Surges".

The briefing featured two speakers: Clint Dawson, professor of aerospace engineering and engineering mechanics and a member of the Center for Subsurface Modeling in the Institute for Computational Engineering and Sciences at the University of Texas, and Joannes Westerink, associate professor of civil engineering and geological sciences at the University of Notre Dame. The presentations focused on data from Hurricane Katrina and other costly U.S. storms.

Mathematical modeling and computer simulation are essential tools for both forecasting and hindcasting storm surges due to hurricanes and tsunamis. Dawson and Westerink described research that has taken place over the past decade, which allows for predictions of the extent and magnitude of flooding as a storm makes landfall. They also discussed what potential research is still necessary to make these predictions more accurate and timely.

Left to right: Congressman Vernon Ehlers (R-MI), talks with Clint Dawson and Joannes Westerink at the congressional briefing.

Left to right: Congresswoman Eddie Bernice Johnson (D-TX) with Joannes Westerink and Clint Dawson.

For more information on activities of the AMS Washington Office, visit the webpage `http://www.ams.org/government`.

—Anita Benjamin, AMS Washington Office

AMS Email Support for Frequently Asked Questions

The following is an updated list of non-user-specific email addresses for contacting AMS staff. This list is also available on the AMS website at `http://www.ams.org/ams/email.html`.

abs-info@ams.org
for questions regarding a particular abstract.

acquisitions@ams.org
to contact the AMS Acquisitions Department.

ams@ams.org
to contact the Society's headquarters in Providence, Rhode Island.

amsdc@ams.org
to contact the Society's office in Washington, DC.

AMS journal-specific questions should be directed to the following email addresses:

bull-query@ams.org: for questions regarding a paper to appear in *Bulletin of the AMS.*

jams-query@ams.org: for questions regarding a paper to appear in *Journal of the AMS.*

mcom-query@ams.org: for questions regarding a paper to appear in *Mathematics of Computation.*

proc-query@ams.org: for questions regarding a paper to appear in *Proceedings.*

tran-query@ams.org: for questions regarding a paper to appear in *Transactions.*

amsmem@ams.org
to request information about membership in the AMS or about dues payments, or to ask any general membership questions; may also be used to submit address changes.

annualsurvey@ams.org
for information or questions about the AMS-ASA-IMS-MAA *Annual Survey of the Mathematical Sciences* or to request reprints of *Survey* reports.

bookdonations@ams.org
for questions regarding the Society's overseas book donation program.

bookstore@ams.org
for inquiries related to the online AMS Bookstore.

classads@ams.org
to submit classified advertising for the *Notices.*

cust-serv@ams.org
for general information about AMS products (including electronic products); to send address changes, place credit card orders for AMS products, or conduct any general correspondence with the Society's Customer Services Department.

development@ams.org
for information about giving to the AMS, including the Epsilon Fund.

eims-info@ams.org
for general information and questions about *Employment Information in the Mathematical Sciences* (EIMS). For deadlines, rates, and the advertising submission form, go to `http://www.ams.org/eims`.

ejour-submit@ams.org
to submit papers to *Representation Theory* and *Conformal Geometry and Dynamics*, electronic journals of the AMS. Each submission must be accompanied by the journal template. A copy of the template is available by sending email to `ejour-submit@ams.org`. Put the word TEMPLATE in the subject field of the email message. To get additional help, put the word HELP in the subject field in a separate mail message.

emp-info@ams.org
for information on AMS employment and career services.

eprod-support@ams.org
for technical questions regarding AMS electronic products and services.

era-submit@ams.org
for authors to submit research announcements to *Electronic Research Announcements of the AMS.*

mathcal@ams.org
to send information to be included in the "Mathematics Calendar" section of the *Notices.*

mathjobs@ams.org
for user questions about the job application website, `http://www.mathjobs.org`.

mathrev@ams.org
to submit reviews to *Mathematical Reviews* and to send correspondence related to reviews or other editorial questions.

meet@ams.org
to request general information about Society meetings and conferences.

meetreg-request@ams.org
to request email meeting registration forms.

meetreg-submit@ams.org
to submit completed email meeting registration forms.

mmsb@ams.org
for information or questions about registration, housing, and exhibits for the Joint Mathematics Meetings (Mathematics Meetings Service Bureau).

msn-support@ams.org
for technical questions regarding MathSciNet.

notices@ams.org
to send correspondence to the managing editor of the *Notices*, including items for the news columns. The editor (`notices@math.ou.edu`) is the person to whom to send articles. Requests for permission to reprint from the *Notices* should be sent to `reprint-permission@ams.org` (see below).

notices-ads@ams.org
to submit paid display ads electronically for the *Notices.* (Hard copy of the ad should also be faxed or sent via postal mail.)

notices-booklist@ams.org
to submit suggestions for books to be included in the Book List in the *Notices.*

notices-letters@ams.org
to submit letters and opinion pieces to the *Notices.*

notices-whatis@ams.org
to comment on or send suggestions for topics for the WHAT IS...? column to the *Notices.*

paoffice@ams.org
to contact the AMS Public Awareness Office.

president@ams.org
to contact the president of the AMS.

prof-serv@ams.org
to send correspondence about AMS professional programs and services.

pub@ams.org
to send correspondence to the AMS Publication Division.

pub-submit@ams.org
to submit accepted electronic manuscripts to AMS publications (other than *Abstracts*). See `http://www.ams.org/submit-book-journal` to electronically submit accepted manuscripts to the AMS book and journal programs.

reprint-permission@ams.org
to request permission to reprint material from Society publications.

royalties@ams.org
to inquire about royalty statements or payments.

sales@ams.org
to inquire about reselling or distributing AMS publications, or to send correspondence to the AMS sales department.

secretary@ams.org
to contact the secretary of the AMS.

statements@ams.org
to correspond regarding a balance due shown on a monthly statement.

student-serv@ams.org
for questions relating to student programs and services.

tech-support@ams.org
to contact the Society's typesetting Technical Support group.

textbooks@ams.org
to request examination copies or to inquire about using AMS publications as course texts.

webmaster@ams.org
for general information or for assistance in accessing and using the AMS website.

Deaths of AMS Members

MICHAEL E. BRECKENRIDGE, from Solomon, KS, died on February 13, 2005. Born on October 3, 1951, he was a member of the Society for 5 years.

NELSON A. BRIGHAM, retired, from Eugene, OR, died on June 14, 2005. Born on November 6, 1915, he was a member of the Society for 59 years.

KAZIMIERZ GLAZEK, professor, Technical University of Zielona Gora, Poland, died in September 2005. Born on February 20, 1939, he was a member of the Society for 9 years.

JOHN P. HUNEKE, professor, Ohio State University, Columbus, died on October 1, 2004. Born on April 16, 1942, he was a member of the Society for 38 years.

LEE M. SONNEBORN, professor, Michigan State University, East Lansing, died in August 2004. Born on December 27, 1931, he was a member of the Society for 49 years.

CHUNG-TAO YANG, professor emeritus, from Springfield, VA, died on September 15, 2005. Born in May 1923, he was a member of the Society for 34 years.

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.ou.edu in the case of the editor and notices@ams.org in the case of the managing editor. The fax numbers are 405-325-7484 for the editor and 401-331-3842 for the managing editor. Postal addresses may be found in the masthead.

Upcoming Deadlines

January 10, 2006: Applications for AAUW Educational Foundation Fellowships and Grants. See http://www.aauw.org/fga/fellowships_grants/selected.cfm or contact the AAUW Educational Foundation, 1111 Sixteenth St., N.W., Washington, DC 20036; telephone 800-326-2289 (AAUW); fax 202-872-1425; email: info@aauw.org.

January 12, 2006: Proposals for ONR Young Investigator Program. See "Mathematics Opportunities" in this issue.

January 13, 2006: Proposals for NSF Program on Mathematical Sciences: Innovations at the Interface with the Physical and Computer Sciences and Engineering: Chemistry. See the website http://www.nsf.gov/pubs/2005/nsf05622/nsf05622.htm.

January 15, 2006: Applications for AMS-AAAS Mass Media Fellowships. See http://www.aaas.org/programs/education/MassMedia/index.shtml, or contact Stacey Pasco, Manager, Mass Media Program, AAAS Mass Media Science and Engineering Fellows Program, 1200 New York Avenue, NW, Washington, DC 20005; telephone 202-326-6441; fax 202-371-9849. Also see the website http://www.ams.org/government/massmediaann.html or contact the AMS Washington Office, 1527 Eighteenth Street, NW, Washington, DC 20036; telephone 202-588-1100; fax: 202-588-1853; email: amsdc@ams.org.

January 26, 2006: Proposals for NSF Scientific Computing Research Environments for the Mathematical Sciences (SCREMS). See the website http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf05627.

January 27, 2006: Proposals for Partnerships for Adaptation, Implementation, and Dissemination Awards of the NSF ADVANCE Program. See the website http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5383.

January 31, 2006: Applications for postdoctoral fellowships at the Institut Mittag-Leffler. See the website http://www.mittag-leffler.se/grants.

February 1, 2006: Applications for February review for National Academies Postdoctoral and Senior Research Associateship Programs. See

Where to Find It

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

"Mathematics Opportunities" in this issue.

February 1, 2006: Applications for AWM Travel Grants and Mentoring Travel Grants. See http://www.awm-math.org/travelgrants.html; telephone 703-934-0163; email: awm@math.umd.edu; or contact Association for Women in Mathematics, 11240 Waples Mill Road, Suite 200, Fairfax, VA 22030.

February 10, 2006: Applications for Math for America Foundation Newton Fellowships. See the website http://www.mathforamerica.org/.

February 15, 2006: Nominations for Clay Mathematics Institute (CMI) Liftoff Program. See http://claymath.org/fas/liftoff_fellows/; telephone 617-995-2600; email: nominations@claymath.org.

February 28, 2005: Applications for Clay Mathematics Institute (CMI) Summer School. See "Mathematics Opportunities" in this issue.

March 1, 2006: Applications for summer program of the Christine Mirzayan Science and Technology Policy Graduate Fellowship Program of the National Academies. See "Mathematics Opportunities" in this issue.

March 1, 2006: Proposals for NSF Program on Mathematical Sciences: Innovations at the Interface with the Physical and Computer Sciences and Engineering: Computer Science. See the website http://www.nsf.gov/pubs/2005/nsf05622/nsf05622.htm.

March 1, 2006: Applications for EDGE Program. See the website http://www.edgeforwomen.org/ or contact the EDGE Program, Department of Mathematics, Bryn Mawr College, 101 North Merion Avenue, Bryn Mawr, PA 19010; email: edge@edgeforwomen.org; telephone 610-876-3527.

March 31, 2006: Nominations for Third World Academy of Sciences Prizes. See http://www.twas.org/.

April 7, 2006: Proposals for 2007 NSF-CBMS Regional Conferences. See "Mathematics Opportunities" in this issue.

May 1, 2006, October 1, 2006: Applications for AWM Travel Grants. See http://www.awm-math.org/travelgrants.html; telephone 703-934-0163; email: awm@ math.umd.edu; or contact Association for Women in Mathematics, 11240 Waples Mill Road, Suite 200, Fairfax, VA 22030.

June 1, 2006: Applications for fall program of the Christine Mirzayan Science and Technology Policy Graduate Fellowship Program of the National Academies. See "Mathematics Opportunities" in this issue.

MPS Advisory Committee

Following are the names and affiliations of the members of the Advisory Committee for Mathematical and Physical Sciences (MPS) of the National Science Foundation. The date of the expiration of each member's term is given after his or her name. The website for the MPS directorate may be found at http://www.nsf.gov/home/mps/. The postal address is Directorate for the Mathematical and Physical Sciences, National Science Foundation, 4201 Wilson Boulevard, Arlington, VA 22230.

Douglas N. Arnold (10/08)
Institute for Mathematics and its Applications
University of Minnesota

Lars Bildsten (10/07)
KITP
University of California, Santa Barbara

Cynthia J. Burrows (10/08)
Department of Chemistry
University of Utah

Claude R. Canizares (10/08)
Office of the Provost
Massachusetts Institute of Technology

Janet M. Conrad (10/06)
Department of Physics
Columbia University

Susan Coppersmith (10/07)
Department of Physics
University of Wisconsin

Larry R. Dalton (10/08)
Department of Chemistry
University of Washington

Luis Echegoyen (10/06)
Department of Chemistry
Clemson University

Mostafa El-Sayed (10/06)
School of Chemistry and Biochemistry
Georgia Institute of Technology

Lucy Fortson (10/06)
Department of Astronomy
Adler Planetarium

Sol M. Gruner (10/07)
Department of Physics
Cornell University

Frances Hellman (10/06)
Department of Physics
University of California, San Diego

John Huchra (10/06)
Harvard-Smithsonian Center for Astrophysics
Harvard University

Rhonda Hughes (10/08)
Department of Mathematics
Bryn Mawr College

Raymond L. Johnson (10/06)
Department of Mathematics
University of Maryland, College Park

Jon R. Kettenring (10/06)
Charles A. Dana Research Institute
Drew University

Robert V. Kohn (10/07)
Courant Institute
New York University

Steven E. Koonin (10/07)
Chief Scientist
BP, plc

W. Carl Lineberger (chair) (10/06)
Department of Chemistry and Biochemistry
Joint Institute for Laboratory Astrophysics
University of Colorado, Boulder

Venkatesh Narayanamurti (10/06)
Division of Engineering and Applied Sciences
Harvard University

Monica Olvera de la Cruz (10/08)
Department of Materials Science and Engineering
Northwestern University

Jose N. Onuchic (10/08)
Department of Physics
University of California, San Diego

Eve Ostricker (10/07)
Department of Astronomy
University of Maryland, College Park

David W. Oxtoby (10/07)
Office of President
Pomona College

Marcia J. Rieke (10/07)
Steward Observatory 262
University of Arizona

Elizabeth H. Simmons (10/07)
Department of Physics and Astronomy
Michigan State University

Michael Witherell (10/08)
Department of Physics
University of California, Santa Barbara

Book List

The Book List highlights books that have mathematical themes and are aimed at a broad audience potentially including mathematicians, students, and 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* notices-booklist@ams.org.

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

A^3 & His Algebra: How a Boy from Chicago's West Side Became a Force in American Mathematics, by Nancy E. Albert. iUniverse, Inc., January 2005. ISBN 0-595-32817-2. (Reviewed December 2005.)

Action This Day, edited by Michael Smith and Ralph Erskine. Random House of Canada, February 2003. ISBN 0-593-04910-1.

Beyond Reason: Eight Great Problems That Reveal the Limits of Science, by A. K. Dewdney. Wiley, April 2004. ISBN 0-471-01398-6.

The Book of Presidents. London Mathematical Society, 2005. ISBN 0-950-27341-4.

A Brief History of Infinity, by Paolo Zellini. Penguin Books (paperback), March 2005. ISBN 0-141-00762-1.

The Calculus Gallery: Masterpieces from Newton to Lebesgue, by William Dunham. Princeton University Press, December 2004. ISBN 0-691-09565-5.

Chance: A Guide to Gambling, Love, the Stock Market and Just About Everything Else, by Amir D. Aczel. Thunder's Mouth Press, October 2004. ISBN 1-56858-316-8. (Reviewed August 2005.)

**Change Is Possible: Stories of Women and Minorities in Mathematics*, by Pat Kenschaft. AMS, September 2005. ISBN 0-8218-3748-6.

Coincidences, Chaos, and All That Math Jazz: Making Light of Weighty Ideas, by Edward B. Burger and Michael Starbird. W. W. Norton, August 2005. ISBN 0-393-05945-6.

The Colours of Infinity: The Beauty and Power of Fractals, by Michael Barnsley, Nigel Lesmoir-Gordon, Benoît B. Mandelbrot, Ian Stewart, Gary Flake, Robert Prechter, and Arthur C. Clarke. Clear Press, March 2004. ISBN 1-904-55505-5.

Complexities: Women in Mathematics, edited by Bettye Anne Case and Anne M. Leggett. Princeton University Press, January 2005. ISBN 0-691-11462-5.

Converging Realities: Toward a Common Philosophy of Physics and Mathematics, by Roland Omnes. Princeton University Press, November 2004. ISBN 0-691-11530-3.

The Curious Incident of the Dog in the Nighttime, by Mark Haddon. Vintage, May 2004. ISBN 1-400-03271-7.

Dark Hero of the Information Age: In Search of Norbert Wiener, by Flo Conway and Jim Siegelman. Basic Books, December 2004. ISBN 0-738-20368-8.

The Equation That Couldn't Be Solved (How Mathematical Genius Discovered the Language of Symmetry), by Mario Livio. Simon and Schuster, September 2005. ISBN 0-743-25820-7.

**M. C. Escher's Legacy: A Centennial Celebration*, edited by Doris Schattschneider and Michele Emmer. Springer, September 2005 (paperback edition). ISBN 3-540-20100-9.

The Essential Turing, edited by B. Jack Copeland. Oxford University Press, September 2004. ISBN 0-198-25080-0.

Experimentation in Mathematics: Computational Paths to Discovery, by Jonathan Borwein, David Bailey, and Roland Girgensohn. A K Peters, March 2004. ISBN 1-56881-136-5. (Reviewed September 2005.)

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

The Fermat Proof, by C. J. Mozzochi. Trafford Publishing, Inc., February 2004. ISBN 1-412-02203-7.

Geometry and Meaning, by Dominic Widdows. Center for the Study of Language and Information, November 2004. ISBN 1-575-86448-7.

God Created the Integers, by Stephen Hawking. Running Press, October 2005. ISBN 0-762-41922-9.

**Gödel's Theorem: An Incomplete Guide to Its Use and Abuse*, by Torkel Franzen. A K Peters, May 2005. ISBN 1-568-81238-8.

The Golden Ratio: The Story of Phi, the World's Most Astonishing Number, by Mario Livio. Broadway Books, September 2003. ISBN 0-7679-0816-3. (Reviewed March 2005.)

Graphic Discovery: A Trout in the Milk and Other Visual Adventures, by Howard Wainer. Princeton University Press, October 2004. ISBN 0-691-10301-1.

Incompleteness: The Proof and Paradox of Kurt Gödel, by Rebecca Goldstein. W. W. Norton, February 2005. ISBN 0-393-05169-2.

**The Infinite Book: A Short Guide to the Boundless, Timeless and Endless*, by John D. Barrow. Pantheon, August 2005. ISBN 0-375-42227-7.

Introducing Game Theory and Its Applications, by Elliott Mendelson. CRC Press, July 2004. ISBN 1-584-88300-6.

János Bolyai, Euclid, and the Nature of Space, by Jeremy J. Gray. MIT Press, May 2003. ISBN 0-262-57174-9. (Reviewed October 2005.)

John Pell (1611–1685) and His Correspondence with Sir Charles Cavendish: The Mental World of an Early Modern Mathematician, by Noel Malcolm and Jacqueline Stedall. Oxford University Press, second edition, January 2005. ISBN 0-198-56484-8.

The Knot Book: An Elementary Introduction to the Mathematical Theory of Knots, Colin C. Adams. AMS, September 2004. ISBN 0-8218-3678-1. (Reviewed September 2005.)

Knots and Links, by Peter R. Cromwell. Cambridge University Press, October 2004. ISBN 0-691-10301-1.

Luck, Logic, and White Lies: The Mathematics of Games, by Jörg Bewersdorff. Translated by David Kramer. A K Peters, November 2004. ISBN 1-568-81210-8.

Math and the Mona Lisa: The Art and Science of Leonardo da Vinci, by Bulent Atalay. Smithsonian Books, April 2004. ISBN 1-588-34171-2.

The Math Instinct: Why You're a Mathematical Genius (Along with Lobsters, Birds, Cats, and Dogs), by Keith Devlin. Thunder's Mouth Press, March 2005. ISBN 1-560-25672-9.

Mathematical Adventures for Students and Amateurs, David F. Hayes and Tatiana Shubin, editors. Mathematical Association of America, 2004. ISBN 0-88385-548-8.

Mathematical Illustrations: A Manual of Geometry and PostScript, by Bill Casselman. Cambridge University Press, December 2004. ISBN 0-521-54788-1.

A Mathematician at the Ballpark: Odds and Probabilities for Baseball Fans, by Ken Ross. Pi Press, July 2004. ISBN 0-131-47990-3.

Mathematicians under the Nazis, by Sanford L. Segal. Princeton University Press, July 2003. ISBN 0-691-00451-X. (Reviewed April 2005.)

Mathematics by Experiment: Plausible Reasoning in the 21st Century, by Jonathan Borwein and David Bailey. A K Peters, December 2003. ISBN 1-56881-211-6. (Reviewed September 2005.)

Mathematics in Nature: Modeling Patterns in the Natural World, by John A. Adam. Princeton University Press, November 2003. ISBN 0-691-11429-3. (Reviewed June/July 2005.)

Meta Math! The Quest for Omega, by Gregory Chaitin. Pantheon, October 2005. ISBN 0-375-42313-3.

The (Mis)Behavior of Markets: A Fractal View of Risk, Ruin and Reward, by Benoît Mandelbrot and Richard Hudson. Basic Books, August 2004. ISBN 0-465-04355-0.

More Damned Lies and Statistics: How Numbers Confuse Public Issues, by Joel Best. University of California Press, August 2004. ISBN 0-520-23830-3.

More Mathematical Astronomy Morsels, by Jean Meeus. Willmann-Bell, 2002. ISBN 0-943396-743.

Musings of the Masters: An Anthology of Miscellaneous Reflections, edited by Raymond G. Ayoub. Mathematical Association of America, 2004. ISBN 0-88385-549-6.

**New Mexico Mathematics Contest Problem Book*, by Liong-shin Hahn. University of New Mexico Press, November 2005. ISBN 0-8263-3534-9.

The Newtonian Moment: Isaac Newton and the Making of Modern Culture, by Mordechai Feingold. New York Library and Oxford University Press, December 2004. ISBN 0-195-17735-5.

Numbers, the Language of Science, by Tobias Dantzig. Pi Press, fifth edition, March 2005. ISBN 0-131-85627-8.

The Oxford Murders, by Guillermo Martínez. Abacus, January 2005. ISBN 0-349-11721-7. (Reviewed November 2005.)

The Pea and the Sun: A Mathematical Paradox, by Leonard M. Wapner. A K Peters, April 2005. ISBN 1-568-81213-2.

**PopCo*, by Scarlett Thomas. Harvest Books, October 2005. ISBN 0-156-03137-X. (Reviewed in this issue.)

Probability Theory: The Logic of Science, by E. T. Jaynes. Edited by G. Larry Bretthorst. Cambridge University Press, April 2003. ISBN 0-521-59271-2. (Reviewed January 2006.)

R. L. Moore: Mathematician and Teacher, by John Parker. Mathematical Association of America, 2004. ISBN 0-88385-550-X.

Reality Conditions: Short Mathematical Fiction, by Alex Kasman. Mathematical Association of America, May 2005. ISBN 0-88385-552-6.

The Road to Reality: A Complete Guide to the Laws of the Universe, by Roger Penrose. Knopf, February 2005. ISBN 0-679-45443-8.

Saunders Mac Lane: A Mathematical Autobiography, by Saunders Mac Lane. A K Peters, May 2005. ISBN 1-568-81150-0. (Reviewed December 2005.)

Science in the Looking Glass, by E. Brian Davies. Oxford University Press, August 2003. ISBN 0-19-852543-5. (Reviewed December 2005.)

Sneaking a Look at God's Cards: Unraveling the Mysteries of Quantum Mechanics, by Giancarlo Ghirardi, translated by Gerald Malsbary. Princeton University Press, revised edition, January 2005. ISBN 0-691-12139-7.

Spaceland, by Rudy Rucker. Tor Books, June 2002. ISBN 0-765-30366-3. (Reviewed August 2005.)

Stalking the Riemann Hypothesis: The Quest to Find the Hidden Law of Prime Numbers, by Dan Rockmore. Pantheon, April 2005. ISBN 0-375-42136-X.

A Tour through Mathematical Logic, by Robert S. Wolf. Mathematical Association of America, January 2005. ISBN 0-88385-036-2.

The Transformation of Mathematics in the Early Mediterranean World: From Problems to Equations, by Reviel Netz. Cambridge University Press, June 2004. ISBN 0-521-82996-8.

Using the Mathematics Literature, by Kristine K. Fowler. Marcel Dekker, June 2004. ISBN 0-824-75035-7.

The Works of Archimedes: Translation and Commentary. Volume I: The Two Books *On the Sphere* and *The Cylinder*. Edited and translated by Reviel Netz. Cambridge University Press, April 2004. ISBN 0-521-66160-9. (Reviewed May 2005.)

A World without Time: The Forgotten Legacy of Gödel and Einstein, by Palle Yourgrau. Basic Books, January 2005. ISBN 0-465-09293-4.

Doctoral Degrees Conferred

2004–2005

ALABAMA

Auburn University (2)

MATHEMATICS AND STATISTICS

Das, Kumer, Ruin estimates under interest force.

Granado, Michael, On the moving off property and weak additivity of local connectedness and metrizability.

University of Alabama, Birmingham (3)

BIOSTATISTICS

Richman, Joshua S., Sample entropy statistics.

MATHEMATICS

Lee, Young-Ran, Spectral properties of a polyharmonic operator with limit-periodic potential in dimension two.

Lesort, Claire, Statistical efficiency and complexity of curve fitting algorithms.

University of Alabama, Tuscaloosa (10)

INFORMATION SYSTEMS, STATISTICS AND MANAGEMENT SCIENCE

Fan, Guangzhe, Regression and survival tree analysis using TARGET.

Hong, Bo, Multivariate surveillance schemes for infectious diseases on multiple locations.

Howington, Eric, A genetic algorithm for computing the minimum volume ellipsoid estimates.

Yadav, Prashant, Collaborative forecasting and supply chain coordination.

Yu, Jing, Space-time interaction models for mortality data.

MATHEMATICS

Eddins, Melanie, Variation of M/G/1 queues with batch services.

Gong, Minqing, Waiting time in a combined first-come-first-served and shortest-time-first queue.

Kwon, Miyeon, A class of operation on Hardy space in Schatten-von Neumann class and its properties.

Simmons, Carolyn, A comparison of polynomial preconditioners for solving linear systems.

Zhang, Xinjun, A matrix version of corona theorem for algebras of functions on reproducing kernel Hilbert spaces.

ARIZONA

Arizona State University (6)

MATHEMATICS AND STATISTICS

Dueck, Amylou, Robust imputation in multivariate hierarchical data.

Gordillo, Luis, Q-Hausdorff summability.

Lant, Timothy, Transition kernels, integral semigroups on spaces of measures, and perturbation by cumulative outputs.

Li, Jiaxu, The dynamics of glucose-insulin endocrine metabolic regulatory system.

Murakami, Junko, Parameter estimate of a hidden Markov chain.

Rahman, Mohammad Mahbuber, Numerical approximations to stochastic differential equations with applications to mathematical neurosciences.

University of Arizona (11)

MATHEMATICS

Lozano, Guadalupe, Poisson geometry of the Ablowitz-Ladik equations.

Perlis, Alexander, The projective geometry of curves of genus one, and an algorithm for the jacobian of such a curve.

Shipmar, Patrick, Plant patterns.

PROGRAM IN APPLIED MATHEMATICS

Alvarez-Sierra, Oliverio, Acoustic resonance in a cavity under a subsonic flow.

Frey, Sarah, Characterization of instabilities in the problem of elastic planetary tides.

Kim, Sangil, Ensemble filtering methods for nonlinear dynamics.

Kondrashov, Dmitry, Protein control of a ligand: Modeling nitric oxide release in nitrophorin 4.

Lehovich, Andre, List-mode SPECT reconstruction using empirical likelihood.

Lu, Yixia, The integrability of second order nonlinear ordinary differential equations with Painlevé properties and Lie symmetries.

Park, Subok, Signal detection with random backgrounds and random signals.

Sviercoski, Rosangela, Multiscale analytical solutions and homogenization of n-dimensional generalized elliptic equations.

ARKANSAS

University of Arkansas, Fayetteville (3)

MATHEMATICAL SCIENCES

Karber, Kristen, Star-shift invariant subspaces of $H^2(\mathbb{D})$.

Shores, Emily, Regularity theory for weak solutions of systems in Carnot groups.

Singh, Pramod, Decomposition of nonlinear operators on Banach lattices.

CALIFORNIA

California Institute of Technology (13)

APPLIED AND COMPUTATIONAL MATHEMATICS

Stredie, Valentin Gabriel, Mathematical modeling and simulation of aquatic and aerial animal locomotion.

Westhead, Andrew, Upscaling for two-phase flows in porous media.

Yu, Xinwei, Localized non-blowup conditions for 3D incompressible Euler flows and related equations.

The above list contains the names and thesis titles of recipients of doctoral degrees in the mathematical sciences (July 1, 2004, to June 30, 2005) reported in the 2005 Annual Survey of the Mathematical Sciences by 215 departments in 152 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 2006 issue of the *Notices*.

CONTROL AND DYNAMICAL SYSTEMS

Bhat, Harish S., Lagrangian averaging, nonlinear waves, and shock capturing.

Del Vecchio, Domitilla, State estimation in multi-agent decision and control systems.

Gregory, Irene, Design and stability analysis of an integrated controller for highly flexible advanced aircraft utilizing the novel nonlinear dynamic inversion.

Papachristodoulou, Antonis, Scalable analysis of nonlinear systems using convex optimization.

Prajna, Stephen, Optimization-based methods for nonlinear and hybrid systems verification.

MATHEMATICS

Cai, Kaihua, Dispersive property of Schrödinger operators.

Johnson, Jennifer, Artin L-functions for abelian extensions of imaginary quadratic fields.

Katz, Daniel, On p-adic estimates of weights in Abelian codes over Galois rings.

Nenciu, Irina, Lax pairs for the Ablowitz-Ladik system via orthogonal polynomials on the unit circle.

Whitehouse, David, The twisted weighted fundamental lemma for the transfer of automorphic forms from GSp(4) to GL(4).

Claremont Graduate University (1)

SCHOOL OF MATHEMATICAL SCIENCES

Le, Hieu, Delamination detection in composite laminates using genetic algorithm optimization.

Stanford University (14)

STATISTICS

Arias-Castro, Ery, Graphical structures for geometric detection.

Bair, Eric, Methods of predicting patient survival based on DNA microarray data.

Chatterjee, Sourav, Concentration inequalities with exchangeable pairs.

Elkaroui, Noureddine, Extended validity of Tracy-Widom limiting law, with statistical application.

Finkelman, Matthew, Statistical issues in computerized adaptive testing.

Hooker, Giles, Diagnostics and extrapolation in machine learning.

Liu, Ruixue, New findings of functional ANOVA with applications to computational finance and statistics.

Paul, Debashis, Nonparametric estimation of principal components.

Peng, Jie, Score statistics to map genes in humans.

Qing Feng, Zhang, A basis function approach to interest rate derivative valuation.

Stone, Eric, Statistical advances in interspecific data analysis.

Terentyev, Sergiy, Asymmetric counterparty relations in default modeling.

Wang, Pei, Statistical methods for CGH array analysis.

Xiaohu, Zhang, Thin blue noise sampling and its application to antialiasing in computer graphics.

University of California, Berkeley (37)

BIOSTATISTICS

Neugebauer, Romain, Double robust estimation of causal parameters in marginal structural models.

Tai, Yu Chuan, Multivariate empirical Bayes models for replicated microarray time course data.

Xing, Biao, Statistical methods for detecting cis-regulatory motifs and constructing transcriptional regulatory networks.

MATHEMATICS

Bejenaru, Ioan, Quadratic derivative nonlinear Schrödinger equation.

Corn, Patrick, Del Pezzo surfaces and the Braner-Manin obstruction.

Ealy, Clifton, Thorn forking in simple theories and a Manin-Mumford theorem for T-modules.

Esty, Norah, Orbit structures of groups of homeomorphisms on S_1.

Ghioca, Dragos, The arithmetic of Drinfeld modules.

Hall, H. Tracy, Counterexamples in discrete geometry.

Hogan, Apollo, General topology under the axiom of determinacy: The beauty of topology without choice.

Kamnitzer, Joel, Mirkovic-Vilonen cycles and polytopes.

Kirkup, George, Examples of decomposition of ideals.

Levin, Aaron, Generalizations of Siegel's and Picard's theorems.

Levy, Dan, Applications of graph theory to chromosome rearrangements and phylogenetics.

Milanov, Todor, Singularity theory and integrable hierarchies.

Miranian, Luisa, Matrix valued orthogonal polynomials.

Nguyen, Nghi, Whitney theorems and Lefschetz pencils over finite fields.

Pribik, Peter, Integrable soliton hierarchies for $so\&d14, 2n$ via intertwining operators.

Roberts, Lawrence, Heegaard-Floer homology and d-based links in three manifolds.

Shvets, Yelena, Problems of flooding in porous and fissured porous rock.

Siegel, Aaron, Loopy games and computation.

Sinton, Andrew, The spherical transform on projective limits of symmetric spaces.

Speyer, David, Tropical geometry.

Sullivant, Seth, Toric ideals in algebraic statistics.

Tseng, Hsian-Hua, Quantum Riemann-Rock, Lefschetz and Serre theorems for orbifold Gromov-Witten theory.

Van Luijk, Ronald, Rational points on $K3$ surfaces.

Villareal, Oscar, Countable unions of subvarieties of semiabelian varieties.

Voight, John, Quadratic forms and quaternion algebras: Algorithms and arithmetic.

Yu, Yifeng, $L\infty$ variational problems, Aronsson equations and weak KAM theory.

STATISTICS

Chen, Aiyou, Semiparametric inference for independent component analysis.

Collin, Francois, Analysis of oligonucleotide data with a view to data quality assessment.

Hallgrimsdottir, Ingileif, Statistical methods for gene mapping in complex diseases.

Liang, Gang, Statistical inference in network tomography.

Ng, Vivian, Univariate and bivariate variable selection in high dimensional data.

Roginsky, Michael, Modeling of transient processes in Markov chains with an application to the Internet traffic description.

Shi, Tao, Polar cloud detection using satellite data with analysis and applications of kernel learning algorithms.

Zhao, Xiaoyue, Statistical methods for elucidating DNA motifs and modules.

University of California, Davis (9)

MATHEMATICS

Dieng, Momar, Distribution functions for edge eigenvalues in orthogonal and symplectic ensembles: Painlevé representations.

Jerdonek, Christopher, The girth of a Heegaard splitting.

Tamaresis, John, Mathematical modeling of arterial endothelial cell responsiveness to flow.

STATISTICS

Branscum, Adam, Bayesian nonparametric and semiparametric inferences for disease risk and ROC curves.

Gui, Jiang, Regularized estimation in the high-dimension and low-sample size settings with applications to genomic data.

Last, Michael, Detecting abrupt changes in time-varying power spectra.

Tseng, Yi-Kuan, Joint modelling of time-to-event and longitudinal data.

Wai, Newton, Change trees and mutagrams for the visualization of local changes in sequence data.

Zhou, Lei, A new expression index based on the generalized logarithm and differential expression analysis of affymetrix GeneChip arrays.

University of California, Los Angeles (24)

MATHEMATICS

Bene, Alex, Intersections of cycles in the combinatorial moduli space.

Biswas, Kingshook, On the geometry of hedgehogs and log-Riemann surfaces.

Caston, Laurent, Super Lie groups, their actions and applications.

Chung, Tsz Shun Eric, Finite volume and discontinuous Galerkin methods for the numerical approximation of wave propagation problems.

Cotta, Brian, Numerical methods for stiff reaction-diffusion equations with applications to cardiological modeling.

Garibaldi, Julia, Erdös distance problem in other convex metrics.

Jones, Nathan, Almost all elliptic curves are Serre curves.

Kostadinov, Boyan, The Picard-Fuchs equation and its monodromy for a family of Calabi-Yau hypersurfaces in CP^{N-1}.

Lee, Sunmi, Artificial boundary conditions for linear elasticity and atomistic strain models.

Li, Xiaosheng, Inverse scattering problem for system of differential operators.

Mocanasu, Mona, Borel-Moore homology and algebraic oriented theories.

Molnar, Stephanie, Sharp growth estimates for $T(b)$ theorems.

Nguyen, Lan, The Ramanujan conjecture for Hilbert modular forms.

Peng, Pan, Integrality structure in the Gromov-Witten theory.

Soderlund, Christina, Characterizing fixed point sets of maps homotopic to a given map.

Somogyi, Zoltan, Stability of an imploding spherical wave in a van der Waals gas.

Staecker, Peter Christopher, The Reidemeister trace: Computation by nilpotentization and extension to coincidence theory.

Tornquist, Asger, The Borel complexity of orbit equivalence.

Virdol, Cristian, Zeta functions of twisted quaternionic Shimura varieties.

Weisbart, David, Schrödinger operators with matrix potentials and convergence of quantum systems on grids.

Yakes, Christopher, Composition operators on L-domains.

Yip, Andy Ming Ham, Mathematical models for data clustering.

STATISTICS

Tranbarger, Katherine, Point process prototypes and other applications of point processes distance metrics.

Yu, Tianwei, Study of the transcription regulation in Saccharomyces cerevisiae.

University of California, Riverside (5)

MATHEMATICS

Carrion-Alvarez, Miguel, Loop quantization versus Fock quantization of p-form electromagnetism on static spacetimes.

Chung, Jae-Wook, The algebraic structure of n-punctured ball tangles.

Culhan, Dustin, Associated primes and primal decomposition in modules and lattice modules, and their duals.

Overholser, Eric, Boundary behavior of an infinitesimal metric and intrinsic measure on domains and moduli space.

STATISTICS

Chu, Li Ping, Robustness of the respondents-generated interval.

University of California, San Diego (8)

MATHEMATICS

Donohue, Michael, Rank regression and synergy assessment.

Ericksen, Stefan, New settings of the first order Stark conjectures.

Griffin, Joshua D., Interior-point methods for large-scale nonconvex optimization.

Hazel, Graham P., Triangulating Teichmüller spaces using the Ricci flow.

Juhlin, Robert, Normal forms and convergence of formal CR mappings.

Shaheen, Anthony M., Finite planes and finite upper half planes: Their geometry, a trace formula, modular forms, and Eisenstein series.

Suaray, Kagba, On kernel density estimation for censored data.

Yu, Li, Superalgebraic interpretation of quantization maps of Weil algebras.

University of California, Santa Barbara (5)

MATHEMATICS

Delp, Kelly, Almost periodic flows on 3-manifolds.

Lyons, William, Fast algorithms with applications to PDEs.

Miller, Jeffrey, A 3rd order accurate positive scheme for hyperbolic systems of conservation laws in multi-dimensions.

Wills, Michael, Extension of spectral scales to unbounded operators.

STATISTICS AND APPLIED PROBABILITY

Kulkarni, Priya, Bootstrap methods for time series.

University of Southern California (2)

MATHEMATICS

Wan, Xuhu, Dynamic principal-agent problem in continuous time.

Zhang, Yu, Global and local multiple sequence alignment by an Eulerian path approach.

COLORADO

Colorado School of Mines (3)

MATHEMATICS AND COMPUTER SCIENCES

Abushama, Abeer, Modified nodal cubic spline collocation for Poisson's and biharmonic equations in the unit square.

Feng, Yan, Interactive floorplanning in VLSI.

Hayes, Timothy, Multiple choice programming.

Colorado State University (3)

MATHEMATICS

Grande, Beau, Time-stepper based numerical bifurcation analysis: An application to the Taylor-Couette problem.

STATISTICS

Gilleland, Eric, Statistical models for quantifying the spatial distribution of seasonally derived ozone standards.

Hess, Ann, Models and methods for the analysis of microarray data: Before and after the fold change calculation.

University of Colorado, Boulder (15)

APPLIED MATHEMATICS

Burrell, Neil, Merger and alignment of three-dimensional quasigeostrophic vortices.

Carvalho, Marcio, Applying perfect simulation to solve stochastic difference equations that arise from certain time series models.

Hwang, Feng-Nan, Some parallel linear and nonlinear Schwarz methods and applications in computational fluid dynamics.

Maclachlan, Scott, Improving robustness in multiscale methods.

Mullowney, Paul, Lagrangian particle transport/mixing in roll switching systems.

Petersen, Mark, A study of geophysical and astrophysical turbulence using reduced equations.

Roehrle, Oliver, Multilevel first order system least squares for quasi-linear elliptic partial differential equations.

Tearle, Matthew, Optimal perturbation analysis of stratified shear flow.

Thaler, Eric, An evaluation of the operational use of numerical solutions to the quasigeostrophic diagnostic equations by weather forecasters.

Vadlamani, Srinath, An algorithmic unification of particle-in-cell and continuum methods and a wave particle description for the electron temperature gradient (ETG) instability saturation.

Westphal, Chad, First-order system least squares for geometrically-nonlinear elasticity in nonsmooth domains.

MATHEMATICS

Brown, Christopher, Connectedness and reflections in symmetry algebras of differential equations.

Cohen, Robert, Construction of an order theoretic duality for certain groups.

Horne, Jennifer Anne, Cardinal functions on pseudo-tree algebras, and a generalization of homogeneous weak density.

McAlister, Erich, Noncommutative CW-complexes arising from crystallographic groups and their K-theory.

University of Colorado, Denver (2)

MATHEMATICS

Busch, Arthur, III, Arc-traceable tournaments.

Stewart, Dustin, Domination and matrix properties in tournaments and generalized tournaments.

University of Northern Colorado (1)

MATHEMATICAL SCIENCES

Duvall, Sally, Students' concept images of parameters in a multi-representational differential equations course.

CONNECTICUT

University of Connecticut (7)

MATHEMATICS

Lavrentier, Alexander, Uniqueness of the martingale problem for some degenerate elliptic operators.

Nurkhaidarov, Ermek, On automorphisms of models of Peano arithmetic.

STATISTICS

Huang, Lan, Bayesian methods for analyzing missing covariates data.

Majumdar, Anandamayee, Some problems in multivariate spatial and spatio-temporal modeling.

Mallick, Madhuja, Stable random family effects models for multivariate times to effects analysis.

Paliwal, Prashni, Chronological event modeling and computation of conditional rates.

Wu, Shanshan, Statistical model development toward explaining species diversity.

Wesleyan University (5)

MATHEMATICS AND COMPUTER SCIENCE

Coe, Russell, Variational principles for relative d-bar pressure.

Krishnan, Ayalur, Universal quantifiers in logic programming via indexed categories.

Rokicki, Anna, Finiteness results for definite η-regular and almost η-regular Hermitian forms.

Roychowdhury, Mrinal, Finitary orbit equivalence.

Wynne, Brian, Continuous functions on essential P-spaces: A model-theoretic analysis of some non-projectable lattice-ordered groups.

Yale University (6)

BIOSTATISTICS DIVISION

Buenconsejo-Sinfuego, Joan, A Bayesian hierarchical model for estimation of disease incidence using two surveillance datasets.

Duan, Fenghai, Analysis of microarray data.

Feng, Rui, A latent variable model for ordinal traits.

Liu, Nianjun, Statistical methods for haplotype analysis in genetic studies.

Wu, Yu-Te, Detecting rare adverse events in post-marketing studies: Sample size considerations.

STATISTICS

Valaitis, Eduardas, Testing the biomodality of normal mixtures.

DELAWARE

University of Delaware (5)

MATHEMATICAL SCIENCES

Chandler, David, The Smith normal forms of designs with classical parameters.

Dmytrenko, Vasyl, Classes of polynomial graphs.

Muniz, Wagner, A modified linear sampling method valid for all frequencies.

Tourrucoo, Fabricio, Perturbation methods in mathematical finance: Zero coupon bonds and bond options.

Williford, Jason, Constructions in finite geometry with applications to graphs.

DISTRICT OF COLUMBIA

American University (5)

MATHEMATICS AND STATISTICS

Begleri, Valbona, Prediction intervals for the Poisson model with applications to Atlantic storms data.

Jalali, Behzad, An investigation of the relationship between the ability to read and comprehend and mathematical skills.

Makhlouf, Fairouz, Regional scores for localizing genes.

Rishmawi, Shireen, Fitting concentration data with stable distributions.

Safi, Samir, The efficiency of OLS in the presence of auto-correlated disturbances in regression models.

George Washington University (2)

MATHEMATICS

Togha, Ataollah, On automorphisms of structures in logic and orderability of groups in topology.

STATISTICS

George, Barbara Jane, Bayesian regression for circular data.

Howard University (3)

MATHEMATICS

Farrier, Sandra, Fixed point and ergodic theorems for nonexpansive mappings on ultrametric Banach spaces.

Syafrida, An approach to approximation of $(0,q)$ meromorphic forms on a stem manifold.

Tankersley, Barbara, Some algebraic and combinatorial interpretations of lower triangular matrices from the Hankelization of sequences.

FLORIDA

Florida Institute of Technology (1)

MATHEMATICAL SCIENCES

Shaikh, Shoaib, Design optimization using statistical techniques.

Florida State University (4)

MATHEMATICS

Ibrahim Boulis, Caroline, Finite abelian group actions on orientable circle bundles over surfaces.

STATISTICS

Chaimongkol, Saengla, Modeling differential item functioning (DIF) using multilevel logistic regression models: A Bayesian perspective.

Neher, Robert, Jr., A Bayesian MRF framework for labeling terrain using hyperspectral images.

Ye, Gang, Nonparametric estimation for general time-varying covariate effect regression models.

University of Central Florida (4)

MATHEMATICS

Amezziane, Mohamed, Smoothing parameter selection in nonparametric functional estimation.

Edwards, Heather, Measures of concordance of polynomial type.

Masino, Aaron, Wave structure function and temporal frequency in weak to strong optical turbulence.

Salman-Mohamed, Mohamed, Utilization of total mass as a control in diffusion processes.

University of Florida (10)

MATHEMATICS

Huang, Feng, Applications of variational PDE models in medical image processing.

Huang, Shu-Jen, Multiscale discretization of electric-field equations.

Sheu, Yuan-Chyuan, Partition properties and Halpern-Lauchli theorem on the $C_{\min}$ forcing.

Smith, Rebecca, Combinatorial algorithms involving pattern containing and avoiding permutations.

Warren, Daniel, Optimizing the packing behavior of layered permutation patterns.

STATISTICS

Hitchcock, David, Smoothing functional data for cluster analysis.

Klingenberg, Bernhard, Regression models for discrete time series data.

Marchev, Dobrin, Monte Carlo methods for posterior distributions associated with multivariate student's t data.

Sinha, Karabi, Some contributions to small area estimation.

Sinha, Samiran, Bayesian inference for matched case-control studies.

University of South Florida (3)

MATHEMATICS

Chen, Zhao, Bayesian and empirical Bayes on power law process and microarray analysis.

Mahalingam, Kalpana, Involution codes: With application to DNA strand design.

Tookos, Ferenc, Hölder continuity of Green's functions.

GEORGIA

Emory University (7)

BIOSTATISTICS

Chen, Ying, Evaluation of a diagnostic test with partially missing gold standard information based on the test ignorance region.

Guo, Ying, Assessing agreement for survival outcomes.

Yang, Yang, Design and analysis of infectious disease intervention trials.

MATHEMATICS AND COMPUTER SCIENCE

Garten, Heather, Satellite graphs.

Schmitt, John, On potentially P-graphic degree sequences and saturated graphs.

Siggers, Mark, Hypergraph packings and Galois cohomology.

Wilson, Ulrica, Cyclicity of division algebras over an arithmetically nice field.

Georgia Institute of Technology (2)

SCHOOL OF MATHEMATICS

Sammer, Marcus, A transportation approach to the concentration of measure.

Song, Zixia, The extremal function for K_9 minors.

University of Georgia (10)

MATHEMATICS

Almeida, Paulo, Sign changes of error terms related to certain arithmetic functions.

Blair, James, On the embedding of triangles into integer lattices.

Gwena, Tawanda, Degenerations of Prym varieties and cubic threefolds.

Matthews, Graham, Computing generators and relations for matrix algebras.

Nash, Milton, Special values of Hurwitz zeta functions and Dirichlet L-functions.

Pooh, Charles, Capacity theory and algebraic integers.

Shumbusho, Rene-Michel, Elliptic curves with prime conductor and a conjecture of Cremona.

STATISTICS

Jiang, Yan, Semiparametric ANCOVA using shape restrictions.

Yang, Ying, Nonparametric Bayesian inference in biostatistics.

Zhang, Zhengang, Marginal models for zero-inflated clustered data.

HAWAII

University of Hawaii (2)

MATHEMATICS

Seffrood, Jiajia, Non-Desarguesian planes.

Xiong, Jianfei, Some topics on geometry and singularities.

IDAHO

Idaho State University (1)

MATHEMATICS

Moon, Bonnie, Radius of injectivity for a quarter plane.

University of Idaho (2)

MATHEMATICS

Abdo, Zaid, Computationally intensive methods for choosing, assessing and validating statistical models describing polymorphism, with applications in population genetics, phylogenetics and microbial ecology.

Sampson, Koffi, Structured coalescent with nonconservative migration.

ILLINOIS

Illinois State University (5)

MATHEMATICS

Adeyemi, Cheryl, Semiotic chaining: Preservice teacher beliefs and instructional practices.

Carter, John, Effects of lesson study on the beliefs and practices of novice mathematics teachers.

Seidelmann, Antoinette, Students' conceptions of zero.

Tomás Ferreira, Rosa, Portuguese mathematics student teachers' evolving teaching models: A modified teacher development experiment.

Yu, Paul, Prototype development and discourse among middle school students in a dynamic geometry environment.

Northern Illinois University (2)

MATHEMATICAL SCIENCES

Fowler, Kari, Normal functions, the MacLane class and complex differential equations in the unit disc.

Haertzen, Kevin, Geometric aspects of Sturm-Liouville problems.

Northwestern University (9)

ENGINEERING SCIENCE AND APPLIED MATHEMATICS

Comissiong, Donna, A stability analysis of polymerization fronts.

Norman, Catherine, A level set method to numerically determine the dynamics of gas bubbles in inclined channels.

MATHEMATICS

Chen, Jun, Transonic shocks and gas dynamics.

Cheng, Xuezhi, Transferring C_∞-structures.

Clay, Lisa, Some conjectures about the slopes of modular forms.

Kim, Young-Heon, Holomorphic extensions of Laplacians and their determinants.

Saghin, Radu, Generic properties of Lagrangian systems and conservative diffeomorphisms.

Yang, Zaiyong, Laminations and connecting orbits on lattice.

Zhu, Dianwen, Euler equations and steady supersonic flows.

University of Chicago (16)

MATHEMATICS

Barakat, Aliaa, On the moduli space of deformations of bihamiltonian hierarchies of hydrodynamic type.

Cherkashin, Dmitriy, Perception game.

Dani, Pallavi, Statistical properties of elements in infinite groups.

Draganescu, Andrei, Two investigations in numerical analysis: Monotonicity preserving finite element methods and multigrid methods for inverse parabolic problems.

Duchin, Moon, Geodesics track random walks in Teichmüller space.

Fedorov, Roman, Algebraic and Hamiltonian approaches to isostokes deformations.

Leyenson, Maxim, On some questions of the Brill-Noether theory for $K3$ surfaces.

Ogilvie, David, Isomorphisms of Hecke algebras and deformation rings in the function field case.

Pereira, Rochelle, Higher order cohomology operations and minimal atomicity.

Spice, Loren, Supercuspidal characters of SL_l over a p-adic field, l a prime.

Toumpakari, Evelin, On the abelian sandpile model.

Winn, Brandy, Traveling fronts in a reactive Boussinesq system: Bounds and stability.

STATISTICS

Clifford, David, The nature of spatial variation in crop yields.

Min, Wanli, Inferences on time series driven by dependent innovations.

Sen, Rituparna, Modeling the stock price process as a continuous time jump process.

Tong, Liping, Statistical inference for multi-color optical mapping data.

University of Illinois, Chicago (10)

MATHEMATICS, STATISTICS AND COMPUTER SCIENCE

Booton, Barry, Norm inequalities for certain classes of functions and their Fourier transforms.

Chang, Li, Statistical analysis of high frequency intraday security prices.

Chen, Jian, Growth rates with paths, non-commuting loops and Thurston's compactness theorem.

Ding, Junfeng, Efficient association ruling mining among infrequent items.

Radin, Dale, Unidimensional Zariski-type structures and applications to the model theory of compact complex spaces.

Takata, Ken, Listing algorithms for combinatorial objects and related combinatorial problems.

Unlu, Fatih, On explicit representations of the Grothendieck fundamental class.

Wang, Yusong, Computing dynamic output feedback laws with Pieri homotopies on a parallel computer.

Yan, Xu, Optimal designs in stability studies.

Yao, Haishen, Asymptotic analysis of the infinite server shortest queue problems.

University of Illinois, Urbana-Champaign (22)

MATHEMATICS

Chan, Song Heng, On cranks partitions, generalized Lambert series, and basic hypergeometric series.

David, Murphy, Equivariant embeddings of algebraic groups.

Demeter, Ciprian, Qualitative and quantitative analysis of weighted ergodic theorems.

Galway, William Floyd, Analytic computation of the prime-counting function.

Giarlotta, Alfio, Lexiographic products of linear orderings.

Groisman, Pavel, New family of constant mean curvature surfaces with noncoplanar ends.

Hahn, Heekyoung, Einstein series, analogues of the Roger-Ramanujan functions, and partitions identities.

Jegdic, Katarina, Analysis of spacetime discontinuous Galerkin method for systems of conservation laws.

Kang, Jeong Hyun, Coloring of metric spaces and $L(2,1)$-labeling of graphs.

Kulosman, Hamid, Ideals of linear type and c-sequences.

Mileti, Joseph, Partition relations and computability theory.

Nakprasit, Kittikorn, Coloring and packing problems for d-degenerate graph.

Petracovici, Boris, Analysis of a spacetime discontinuous Galerkin method for elastodynamics.

Petrenko, Bogdan, Primitive elements in finite fields.

Sano, Akira, The geometry of finite lattice varieties over Witt vectors.

Selvakumaran, T. V., Morita stable equivalence of certain algebras.

Shebalov, Sergey, Polyhedra study of mixed integer programs with variable upper bounds.

Wong, Kittipat, Intrinsic ultracontractivity and other properties of mixed barrier Brownian motion.

Yesilyurt, Hamza, Contributions to theory of Q-series and mock theta functions.

STATISTICS

Georgescu, Constantin, Finite population quantile estimators.

Wei, Ying, Longitudinal growth charts based on the semiparametric quantile regression.

Xu, Xueli, Computerized adaptive testing and equating methods with nonparametric IRT models.

INDIANA

Indiana University, Bloomington (12)

MATHEMATICS

Carter, Nathan, Logics that prove their own completeness.

Cheskidov, Alexey, The Navier-Stokes-alpha model and boundary-layer turbulence.

Ellett, Andrew, Portfolio management toward optimal consumption and terminal wealth.

Gu, Wentao, Fixed design regression for associated random fields.

Himpel, Benjamin, A splitting formula for spectral flow on closed 3-manifolds.

Im, Bo-Hae, The rank of elliptic curves over large fields.

Kong, Maiying, Nonparametric statistical techniques in bioassay.

Kudzin, Matthew, Cohomogeneity one manifolds of non-negative curvature.

Martinez, Maricarmen, Common sense reasoning via product state spaces.

Mersch, John, Equational logic of recursive program schemes.

Qian, Lei, Message dependence and formal verification of authentication protocols.

Wen, Su-Chi, Hyperbolic extensions of algebras with involution.

Purdue University (20)

MATHEMATICS

Butske, William, Computational aspects of the endomorphism ring of the Jacobian of a curve of genus two.

Enoch, Ruth, Formal power series solutions for Schroeder's equation in several complex variables.

Glotov, Dmitry, Current and vortices in the three-dimensional thin-film Ginzburg-Landau model of superconductivity.

Gower, Jason, Square form factorization.

Mangasuli, Anandateertha, Eigenvalues of the Laplacian for certain Riemannian metrics on S^2 and S^3.

Oh, Byung-Geun, Curvature and hyperbolicity of surfaces.

Rogers, Mark, The index of reducibility of parameter ideals.

Sun, Jianzhong, Long-time limit for the Ginzburg-Landau system with pinning.

Veliche, Oana, Homological dimensions for modules and complexes.

Veliche, Razvan, Some results on fundamental groups of Kähler manifolds.

Ward, Mark, Analysis of an error resilient Lempel-Ziv algorithm via suffix trees.

STATISTICS

Chakrabarti, Arijit, Model selection for high dimensional problems with applications to function estimation.

Collevecchio, Andrea, Limit theorems for reinforced random walks on trees.

Florescu, Ionut, Stochastic volatility stock price-coefficient estimation and option pricing using a recombining tree and sharp estimation of the almost-sure Lyapunov exponent for the Anderson model in continuous space.

Jiang, Hongmei, A two-step procedure for multiple pairwise comparisons in microarray experiments.

Liu, Yali, Incorporating time-dependent covariate in the Cox proportional hazards models: The LVAR approach.

Qin, Yu, A study of random field models in fitting unspecified data generating processes: Theory and applications.

Seo, Jeonggang, Some classical and Bayesian nonparametric regression methods in a longitudinal marginal model.

Stevens, John, Meta-analytic approaches for microarray data.

Vitek, Olga, An inferential approach to protein backbone nuclear magnetic resonance assignment.

University of Notre Dame (7)

MATHEMATICS

Bergner, Julia, Three models for the homotopy theory of homotopy theories.

Calvert, Wesley, Algebraic structure and computable structure.

Heidenreich, Jacob, Stability theory modulo a predicate.

Hubbard, Keith, The notion of vertex operator coalgebra: A construction and geometric characterization.

Jackson, Daniel, Birational maps of surfaces with invariant curves.

Maican, Mario, Vector bundles of finite order on affine manifolds.

Markert, Elke, Connective 1-dimensional euclidean field theories.

IOWA

Iowa State University (14)

MATHEMATICS

Aydinyan, Ruben, Loop transversal codes over finite rings.

Babyonyshev, Sergei, Metatheories of deductive systems.

Bhatt, Ghan, Nonseparable multivariate wavelets.

Campbell, Jessie, Enumeration and symmetry of edit metric spaces.

Kim, Eun-Youn, Analysis of game playing agents with fingerprint.

Kiounge, Benard, Sedenion extension loops and frames of hypercomplex $2n$-ons.

Maxwell, Mandi, Almost perfect nonlinear functions and related combinatorial structures.

Mutungi, Patrick, Simple ternary complex Grassman algebras.

Wangsness, Amy, The matrix completion problem regarding various classes of $P_{0,1}$-matrices.

STATISTICS

Ferraz, Cristiano, Sample design for quality monitoring and measurement error evaluation of large-scale longitudinal surveys.

Furukawa, Kyoji, Development of Markov random field models based on exponential family conditional distributions.

Landes, Reid, Statistical methods for application to calibration problems.

Sun, Shuxia, Bootstrapping the sample quantile based on weakly dependent observations.

Zhang, Zhongqi, Statistical analysis of gene expression profiles.

University of Iowa (13)

APPLIED MATHEMATICAL AND COMPUTATIONAL SCIENCES

Boston, Viorel, A posteriori error analysis and adaptive finite element solution of variational inequalities of the second kind.

Del Valle, Sara, Effects of behavioral changes and mixing patterns in mathematical models for smallpox epidemics.

Han, Xiaoxu, Local Z buffer algorithms in real time rendering of large complex systems.

Zhang, Li, The P-hub center allocation problem and Q-upgrading arc problem.

BIOSTATISTICS

Yang, Xinqun, The posterior probability of linkage allowing for linkage disequilibrium and a new estimate of disequilibrium between a trait and a marker.

MATHEMATICS

Dutkay, Dorin, Wavelet representations.

Farthing, Cynthia, C^*-algebras of higher-rank graphs: Desingularization and groupoid methods.

Hong, Doojin, Spectra of higher spin operators.

Hou, Xiaojie, Traveling wave solutions of the nonlinear diffusion-reaction equation.

Marrero, Alberto, A groupoid approach to ultragraph C^*-algebras.

Stuffelbeam, Ryan, The theta correspondences for $U(1)$ and the quasi-split $U(2)$.

Winders, Michael, Idealization.

STATISTICS AND ACTUARIAL SCIENCE

Kim, Chulmin, Unconstrained models for the covariance structure of multivariate longitudinal data.

KANSAS

Kansas State University (3)

MATHEMATICS

Kim, Sang Hyun, On the structure of finite AW^*-algebras.

STATISTICS

Perrett, Jamis, Using information on the intra-class correlation coefficient for hypothesis testing in unreplicated and under-replicated experiments.

Sy, Oumar, Multilevel mediation analysis: Applications and estimation.

University of Kansas (2)

MATHEMATICS

Caviglia, Giulio, Koszul algebras, Castelnuovo-Mumford regularity and generic initial ideals.

Epstein, Neil, Closure operators in commutative algebra: Tight closure, phantom depth, and $*$-spread.

Wichita State University (2)

MATHEMATICS AND STATISTICS

Bunck, Benjamin, Fast pseudospectral algorithms for boundary value problems for the Laplace equation on a rectangle.

Treinen, Ray, A study of floating drops.

KENTUCKY

University of Kentucky (8)

MATHEMATICS

Dobranski, Michael, Construction of exponentially growing solutions to first-order systems with non-local potentials.

Elliott, Steve, Simple homotopy theory for cell complexes.

Hoffnung, Leonard, Subspace projection methods for the quadratic eigenvalue problem.

Noble, Leigh, Recovery of through-thickness texture profiles in orthorhombic sheets of cubic metals.

Ragland, Matthew, On generalizations of groups in which normality is a transitive position.

Sharrow Pinzon, Kathrine, Absolutely pure modules.

Stepp, Elizabeth, Large Whitney levels and finite antichains.

Wesley, Molly, Torsion free covers of graded and filtered modules.

LOUISIANA

Louisiana State University (7)

MATHEMATICS

Ionita, Costel, Class groups and norms of units.

Johansen, Troels, Orbit structure on the Silov boundary of a tube domain and the Plancherel decomposition of a causally compact symmetric space, with emphasis on the rank one case.

Kovacs, Mihaly, On qualitative properties and convergence of time-discretization methods for semigroups.

Mihai, Claudiu, Asymptotic Laplace transforms.

Mihai, Vochita, The Radon-Gauss transform.

Ortiz, Norma, Dynamical systems with time delay.

Rios, Vinicio, Dissipative Lipschitz dynamics.

Louisiana Technical University (8)

MATHEMATICS AND STATISTICS PROGRAM

Feng, Zongwen, Modeling of solid layer growth at a constant speed in a binary melt crystallization process.

Gao, Wenzhi, Intelligent control of nonlinear systems with actuator saturation using neural networks.

Hughes, Joshua, Obstruction sets for classes of cubic graphs.

Lan, Hong, Integrated modeling and parallel computation of laser-induced axisymmetric rod growth.

Su, Shengjun, Numerical simulation of nanapulse penetration of biological matter using the Z-transform.

Yu, Haofeng, A high-order finite difference method for solving bioheat transfer equations in three dimensional triple-layered skin structure.

Zhang, Le, A numerical method for obtaining an optimal temperature distribution on 3D triple-layered cylindrical skin structure.

Zheng, Bin, Computational approaches to the design and analysis of stability of polypeptide multilayer thin films.

Tulane University (6)

BIOSTATISTICS

Broyles, Stephanie, Addressing missing data in public health: An empirical comparison of strategies.

Diaz, Rafael, Power and bias analyzing the logistic normal likelihood ratio test.

Lin, Hui-Yi, A comparison of goodness-of-fit tests for binomial generalized estimating equations models.

Sabel-Soteres, Allison, Missing data techniques with Likert scales: An imputation study.

Shafer, Leigh Anne, Comparison of methods in regression analysis with longitudinal data: A simulation study.

Xin, Xue, Performance assessment of shrinkage estimators for prediction in multiple regression with future random X.

University of Louisiana at Lafayette (8)

MATHEMATICS

Cai, Yong, Improved inferential methods for some discrete distributions.

Hu, Shuhua, Structured population models: Well-posedness, approximation and parameter estimation.

Jiang, Xiaoou, Single-point and complete quenching for degenerate semilinear parabolic first initial-boundary value problems.

Kim, Mihye, Hybrid interval marching/branch and bound method for parametrized nonlinear systems.

Melton, Tanya, The generalized quasilinearization method and higher order of convergence for nonlinear problems.

West, Ianna, Monotone iterative method for nonlinear problems.

Yang, Jie, Generalized iterative and faster convergence methods for nonlinear dynamical systems.

Yu, JianQi, Inference on the difference between two normal means vectors: Complete and missing data cases.

MARYLAND

Johns Hopkins University (16)

APPLIED MATHEMATICS AND STATISTICS

Castello, Beryl, Semi-obnoxious multifacility location problems: Models and methods.

Ceyhan, Elvan, An investigation of proximity catch digraphs in Delaunay tessellations.

John, Majnu, A data-adaptive methodology for finding the optimal weighted generalized Mann-Whitney-Wilcoxon statistic.

May, William, Computational improvements in the substitution method for bounding percolation thresholds.

Wu, Xiaoling, Some statistical and computational problems in pedigree linkage.

BIOSTATISTICS

Choi, Leena, Modeling biomedical data and the foundations of bioequivalence.

Griswold, Michael, Complex distributions, hmmmm... hierarchical mixtures of marginalized multilevel models.

Liu, Dongmei, Application of hierarchical models in microarray data analysis.

Robinson, John, A hierarchical multivariate two-part model for profiling providers' effects on healthcare charges.

Shardell, Michelle, The analysis of informatively coarsened discrete time-to-event data.

Varadhan, Ravi, The role of the design, analysis, and computation in addressing aetiology in three types of studies in public health.

Wu, Zhijin, Probe level models for DNA microarrays.

Zhou, Hongling, Change point problems in generalized linear models.

MATHEMATICS

Krebs, Michael, Toledo invariants in 2-orbifolds.

Lee, Eun K., On certain cohomological invariants of algebraic number fields.

Tinaglia, Giuseppe, Multi-valued graphs in embedded constant mean curvature disks.

University of Maryland, Baltimore County (8)

MATHEMATICS AND STATISTICS

Hang, Yaming, Statistical analysis of two-dimensional electrophoresis gel images.

Korostyshevskiy, Valeriy, A Hermite spectral approach to homoclinic solutions of ODEs.

Liu, Xing, Interior point methods for sufficient LCPs and their applications in bioinformatics.

Paul, Gitanjali, P-values for testing individual bioequivalence and variance bioequivalence.

Tao, Jiyuan, Some P-properties for linear transformations on the Lorentz cone.

Tymofyeyev, Yevgen, Optimal allocation for multiarmed clinical trials.

Zhang, Jialu, Prediction model selection: Correlated data and CART.

Zhang, Yanqiong, Sequential monitoring for randomization tests.

University of Maryland, College Park (21)

MATHEMATICS

Abbiw-Jackson, Roselyn, Discrete optimization models in data visualization.

Al-Khal, Jawad, New examples of S unimodal maps with a sigma-finite absolutely continuous invariant measure.

Cheng, Yang, Maximum likelihood estimation and computation in a random effect factor model.

Cohen Freue, Gabriela, On robustness in some extended regression models.

Dai, Shibin, Universal bounds on coarsening rates for some models of phase transitions.

Frommer, Ian, Modeling and optimization of transmission networks.

Gagnon, Richard, Certain computational aspects of power efficiency and of state space models.

Gomez, Hector, Binormal motion of curves and surfaces in a manifold.

Jiang, Xiaoping, Nonparametric quasi-likelihood in longitudinal data.

Kalb, Virginia, Low-dimensional models for fluid flow.

Kebo, Andrew, Quantum detection and finite frames.

Lance, Ryan, Network state estimation via passive traffic marketing.

Liu, Kexue, Nonlinear evolutionary PDEs in image processing and computer vision.

Malekpour, Shirin, Predicate product logic and embeddings of ordered abelian group.

Rapatski, Brandy, The non-linear transmission dynamics of HIV/AIDS.

Ren, Huaizhong, Autonomous stochastic perturbations of Hamiltonian systems.

Restrepo, Juan, Synchronization in networks of coupled oscillators.

Schofer, Jarad, Borcherds forms and generalizations of singular moduli.

Trehan, Amit, Lifting of characters and orbital integrals on metaplectic groups.

Yang, Zhihui, Exit problems and stochastic resonance for a class of random perturbations.

Yen, Ju-Yi, Multivariate Levy processes for financial returns.

MASSACHUSETTS

Boston University (8)

MATHEMATICS AND STATISTICS

Kary, Michael, Evenness and its applications.

Look, Daniel, Singular perturbations of complex polynomials and circle inversion maps.

Lozano-Robledo, Alvaro, On elliptic units and p-adic Galois representations attached to elliptic curves.

Mencattini, Igor, The structures of insertion elimination Lie algebra.

Pasol, Vicentiu, p-adic modular symbols attached to C.M. forms.

Shor, Caleb, On towers of function fields and the construction of the corresponding Goppa codes.

Stoev, Stilian, Stable self-similar and locally self-similar random processes: Stochastic properties, parameter estimation and simulation.

Zagaris, Antonios, Analysis of reduction methods for multiscale problems.

Boston University School of Public Health (2)

BIOSTATISTICS

Leip, Eric, Adapting a method for applying the Cox proportional hazards model when the change time of a binary time-varying covariate is interval censored.

Zhang, Fang, Age dependent QTL analysis using Gibbs sampling for random effects models.

Brandeis University (2)

MATHEMATICS

Linshow, Andrew, Vertex algebras and invariant theory.

Paksoy, Vehbi Emrah, The A-series of the tangent bundles of flag manifolds and a generalization of Hori-Vata conjecture.

Harvard University (26)

BIOSTATISTICS

Christensen, Jared, Likelihood methods for clustered discrete and continuous outcomes in developmental toxicology.

Cook, Andrea, Detecting spatial clustering for discrete, censored, or longitudinal outcomes.

Fang, Xuemin, Probe-level microarray analyses: A random effect model to estimate cross-hybridization in expression index computation.

Graham, Dionne, Statistical methods for the analysis of HIV drug-resistance data.

Jemiai, Yannis, Semiparametric methods for inferring treatment effects on outcomes defined only if a post-randomization event occurs.

Kao, Ming-Chih, Computational and statistical approaches to the study of the genetic bases of human diseases.

Kim, Ryung Suk, Microarray analysis: Choice of metric, new clustering algorithm and identification of transcription factors.

Leon, Larry, Robust inference and model checking techniques for censored linear regression models.

Lin, Ming, Statistical methods in SNP-array-based loss-of-heterozygosity studies.

Litman, Heather, Estimation of marginal regression models with multiple source predictors.

Loecke, David, Mixed effects mean score method, optimal design for two-stage longitudinal studies in a GEE framework, and addition of covariates to a Markov model approach for characterizing progression of HIV genetic mutations.

Martin, Emily, Survival analysis under dependent truncation of failure time.

Matthews, Abigail, Analysis of family studies of disease.

Page, John, Doubly robust estimation: Structural nested cumulative failure time models, correction of the diagnostic likelihood ratio for verification bias.

Shubina, Maria, On maximum attainable correlation for the Sarmanov family of bivariate distributions, Bayesian analysis for markers and degradation, and threshold models with markers measured before observed event times.

Wager, Carrie, Mixed-model smoothing for replicated spatial point patterns in brain microscopy.

Wruck, Lisa, Statistical issues in the evaluation of tests for diagnosing disease and monitoring disease progression.

Zhang, Bin, Statistical methods with unrecognized heterogeneity in survival data analysis, identifying family relationships in genetic studies, and response-related incomplete data.

Zheng, Lu (Summer), Contributions to analysis of randomized multi-center clinical trials: The role of conditioning.

Zhong, Sheng (Richard), Computational and statistical approaches to study gene regulation and gene function.

ENGINEERING AND APPLIED SCIENCES

Kirsanov, Danil, Minimal discrete curves and surfaces.

Lauga, Eric, Slip, swim, mix, pack: Fluid mechanics at the micron scale.

Nickerson, Jill, Reference specification in multilingual document production.

Rusnak, John, Jr., The design structure analysis system: A tool to analyze software architecture.

Volpe, Anthony, Modeling flexible supply options for risk-adjusted performance evaluation.

Weber, Griffin, Data representation and algorithms for biomedical informatics applications.

Massachusetts Institute of Technology (30)

MATHEMATICS

Boulet, Cilanne, Partition identity bijections related to sign-balance and rank.

Caines, Ian, New examples of four dimensional AS-regular algebras.

Charbonneau, Benoit, Analytic aspects of periodic instantons.

Ching, Michael, Bar constructions for topological operads and the Goodwillie derivatives of the identity.

Choi, Jaehyuk, Transport-limited aggregation and dense granular flow.

De Silva, Daniela, Existence and regularity of monotone solutions to a free boundary problem.

Dolgushev, Vasilly, A proof of Tsygan's formality conjecture for an arbitrary smooth manifold.

Dong, Yu-An, Statistical analysis of protein interaction network topology.

Douglas, Christopher, Twisted stable homotopy theory.

Francisco, Sandra, Symplectic isotopy for cuspidal curves.

Guth, Lawrence, Area-contracting maps between rectangles.

Hajiaghayi, Mohammad Taghi, The bidimensionality theory and its algorithmic applications.

He, Xuhua, Some subvarieties of the De Concini-Procesi compactification.

Henriques, Andre, Orbispaces.

Honsen, Morten, A compact moduli space for Cohen-Macaulay curves in projective space.

Kleinberg, Robert, Online decision problems with large strategy sets.

Lam, Thomas, Combinatorics of ribbon tableaux.

Mirrokni, Vahab, Approximation algorithms for distributed and selfish agents.

Oblomkov, Alexei, Double affine Hecke algebras and noncommutative geometry.

Oprea, Dragos, The tautological classes of the moduli spaces of stable maps to flag varieties.

Persson, Per-Olof, Mesh generation for implicit geometries.

Robinson, Hugh, Maps and localizations in the category of Segal spaces.

Rochon, Frédéric, Bott periodicity for fibred cusp operators.

Rosenblum, Michael Aaron, Approximating fluid schedules in packet-switched networks.

Sutton, Brian, The stochastic operator approach to random matrix theory.

Testa, Damiano, The Severi problem for rational curves on del Pezzo surfaces.

Vondrak, Jan, Probabilistic methods in combinatorial and stochastic optimization.

Williams, Lauren, Combinatorial aspects of total positivity.

Wu, Damin, Higher canonical asymptotics of Kähler-Einstein metrics on quasi-projective manifolds.

Wu, Hao, Tight contact structures on small Seifert spaces.

Northeastern University (1)

MATHEMATICS

Seven, Ahmet, Combinatorial aspects of double Bruhat cells and cluster algebras.

Tufts University (1)

MATHEMATICS

Beltukov, Aleksei, Sonar transforms.

University of Massachusetts, Amherst (7)

BIOSTATISTICS AND EPIDEMIOLOGY

Sturdivant, Rod, Goodness-of-fit in hierarchical logistic regression models.

MATHEMATICS AND STATISTICS

Cullinan, John, Local global properties of torsion points on three-dimensional Abelian varieties.

Curran, Raymond, Toric ideals and discriminants in codimensions greater than two.

Eisner, Adam, A numerical exploration of the statistical behavior of the discretized nonlinear Schrödinger equation.

Hattaway, Amanda, Modelling tubuloglomerular feedback in coupled nephrons.

Rapti, Zoi, Modular instabilities of perturbed Schrödinger-type equations.

Tzirakis, Nikolaos, Global well-posedness for some dispersive partial differential equations.

MICHIGAN

Central Michigan University (2)

MATHEMATICS

Abu Ghneim, Omar, Nonabelian McFarland and Menon-Hadamard difference sets.

Kong, Lingji, A study of the properties, estimations and applications for the beta-gamma distribution.

Michigan State University (15)

MATHEMATICS

Alpay, Nimet, Global existence of solutions to nonlinear wave equations by weighted Strichartz inequalities.

Buyukbozkirli, Bulent, Modeling dynamics of genetic algorithms for one max and deceptive functions.

Cui, Changjun, Local regularization methods for n-dimensional first-kind integral equations.

Freidovich, Leonid, Logic-based switching control of nonlinear systems using high-gain observers.

Go, Jaegwi, Bucking arch under normal pressure.

Novozhilova, Lydia, Axisymmetric problems in nonlinear elasticity: Existence and global injectivity of energy minimizers and new classes of exact solutions.

Slavin, Leonid, Bellman function and BMO.

Sorto, Maria, Prospective middle school teachers' knowledge about data analysis and its application to teaching.

Vasiliu, Daniel, Constrained lower semicontinuity problems in the calculus of variations.

von Bergmann, Jens, Pseudo-holomorphic maps in folded symplectic manifolds.

Yu, Jui-Ling, A fully explicit optimal two-stage scheme to solve the reaction-diffusion-chemotaxis system.

Yuce, Huseyin, The fundamental frequencies of plates with a core.

STATISTICS AND PROBABILITY

Li, Fang, Testing for the equality of two autoregressive and regression functions.

Sirbu, Corina Mihaela, Assessing medical costs from a longitudinal model.

Sirbu, George, Adaptive designs with covariates.

Michigan Technological University (6)

MATHEMATICAL SCIENCES

Keranen, Melissa, Transverse Steiner quadruple systems.

Kodippli, Asitha, Analysis of intraday dynamics of options trading B.

Milanov, Valentin, Search procedure for identifying gene-gene interaction based on entropy measures.

Senaratne, Maddumage Dona, Development and analysis of a micro-macro simulation.

Sha, Qiuying, Multi-locus association test for detecting complex disease genes.

Yapa, Gaitri, Covariate measurement error in dual systems models.

Oakland University (1)

MATHEMATICS AND STATISTICS

Zhang, Racheal, Some analytical characteristics of the ridge regression trace.

University of Michigan, Ann Arbor (18)

BIOSTATISTICS

An, Hyonggin, Robust model-based analysis of multivariate data with missing values.

Liu, Lei, Modeling recurrent events and medical cost data in the presence of a correlated terminating event.

Luo, Wen-Lin, General linear model for FMRI time series data: Model formulation, covariance estimation, and model selection.

McClure, Leslie, Analysis of clinical trial data where treatments favor different outcomes.

Min, Sung-joon, Group sequential methods for nonlinear models in clinical trials.

Xie, Dawei, Combining information from multiple surveys for small-area estimation: Bayesian approaches.

MATHEMATICS

Chiang, Sylvia Pek-Yin, On vacuum problems for different systems of conservation.

Keen, Benjamin, A kinetic scheme for gas dynamics on arbitrary grids.

Kennedy, Christopher, An exploration of deep matrix algebras.

Kuronya, Alex, Asymptotic cohomological functions on projective varieties.

Lilov, Krastio, Fatou theory in two dimensions.

Mitavskiy, Boris, A mathematical model of evolutionary computation and some consequences.

Nguyen, Quang-Minh, Entropic graphs for image registration.

Tung, Yan-Chun James, Fock spaces.

Woods, Kevin, Rational generating functions and lattice point sets.

STATISTICS

Dyson, Gregory, New techniques in clustering and microarray data analysis.

Vartivarian, Sonya, For the formation of weighting class adjustments for unit nonresponse in sample surveys.

Xi, Bowei, Estimating internal link loss rates using active network tomography.

Wayne State University (7)

MATHEMATICS

Aouina, Mokhtar, The moduli space of thickenings.

Geremew, Wondimagegneau, Metric regularity in variational analysis.

Habte, Aychiluhim, Application of variational analysis to welfare economics.

Ion, Cristina, Recursive estimation algorithms using stochastic approximation methods.

Lin, Runchang, Natural superconvergence in two- and three-dimensional finite element methods.

Liu, Yuanjin, Two-time-scale systems with Markovian regime switching.

Wang, Dong, Optimal control of differential inclusions in infinite dimensional spaces and semilinear evolution inclusions.

MINNESOTA

University of Minnesota, Twin Cities (10)

DIVISION OF BIOSTATISTICS, SCHOOL OF PUBLIC HEALTH

Huang, Xiaohong, Statistical methods for sample classification with microarray gene expression data.

Jin, Xiaoping, Multivariate lattice models for areal data with application to multiple disease mapping.

Zhi, Xin, Likelihood ratio tests for correlated time-to-event data using gamma frailty.

SCHOOL OF STATISTICS

Chen, Chao-Yin, Improving the chemical mass balance model.

de la Vega Gongora, Jorge, A power study of inverse regression methods.

Lazar, Radu, Methods for implementing Bayesian inference for some problems involving linear constraints.

Pontiggia, Laura, Topics in stochastic games.

St. Clair, Katherine, Some objective Bayesian methods for finite population sampling.

Wen, Xuerong (Meggie), Optimal sufficient dimension reduction in regression with categorical predictors.

Yang, Rong, Statistical modeling of multivariate longitudinal binary data.

MISSISSIPPI

University of Mississippi (4)

MATHEMATICS

Kuhl, Jaromy, On completing and avoiding partial Latin squares.

Page, Robert, Jr., On bilinear maps of order bounded variation.

Rayner, Ellen Gibson Johnston, The exchangeable negative binomial distribution and its applications.

Tyler, Benton, Tilings and packings of n-dimensional cubes.

MISSOURI

St. Louis University (1)

MATHEMATICS AND COMPUTER SCIENCE

Ohashi, Ryo, The isometry groups on prism manifolds.

University of Missouri, Columbia (4)

STATISTICS

Nashimoto, Kane, Multiple comparison techniques for order restricted models.

Rabie, Huwaida, Optimal designs for dose-finding in contingent response models.

Zhang, Zhigang, Nonproportional hazards regression models for survival analysis.

Zhao, Qiang, Nonparametric treatment comparisons for interval-censored failure time data.

University of Missouri, Rolla (1)

MATHEMATICS AND STATISTICS

Kytmanov, Alexey, Integral representations and holomorphic extension on toric varieties.

MONTANA

Montana State University (3)

MATHEMATICAL SCIENCES

Graham, Kimberly, An examination of the integration of graphing calculators in formal assessments that accompany high school mathematics textbooks.

Hyde, Scott, Robust methods for multivariate linear models with spectral models for scatter matrices.

Kosiak, Jennifer, Using asynchronous discussions to facilitate collaborative problem solving in college algebra.

University of Montana (2)

MATHEMATICAL SCIENCES

Perkins, David, Investigations of a chip-firing game.

Sloan, Deborah, A conflict in values: The dilemma of equity, diversity, and participation in higher mathematics.

NEBRASKA

University of Nebraska, Lincoln (3)

MATHEMATICS

Baeth, Nicholas, Representation theory of one-dimensional local rings of finite Cohen-Macaulay type.

Duncan, Benton, Universal operator algebras of directed graphs.

Koetz, Matthew, Algebraic constructions of low-density parity check codes.

NEW HAMPSHIRE

Dartmouth College (3)

MATHEMATICS

Cole, Daniel, On minimal surfaces in Martinet-type spaces.

Ryan, Nathan, Satake parameters of Siegel modular forms.

Williams, B. Venus, The mathematics of the coordinated and precise dance that keeps us alive.

University of New Hampshire (4)

MATHEMATICS AND STATISTICS

Alghanem, Maher, Evaluating the middle school mathematics teacher preparation program at Riyadh Teachers' College.

Bannon, Jon, Burnside factors, amenability defects and transitive families of projections in factors in type III.

Gao, Ming Chu, Free products of operator spaces and free Markov processes.

Yousefi, Hassan, Stable invariant subspaces, reflexivity, and BMO.

NEW JERSEY

New Jersey Institute of Technology (7)

MATHEMATICAL SCIENCES

Ambrosio, Christina, The control of frequency of a conditional oscillator simultaneously subjected to multiple oscillating inputs.

Champanerkar, Jyoti, Pitchfork bifurcations of invariant manifolds.

Lukyanov, Valery, Scattering matrix analysis of photonic crystals.

Mileyko, Yuriy, Theory and algorithms for swept manifolds intersections.

Muhammed, Hameed, Influence of surfactant on the breakup of a fluid jet in viscous surrounding.

Tran, Hoa, Numerical simulation of microwave heating of a target with temperature dependent electrical properties in a single mode cavity.

Zhou, Lin, Perturbation analysis on dispersive properties of microstrip.

Princeton University (8)

APPLIED AND COMPUTATIONAL MATHEMATICS

Downs, Oliver B., Learning, adaptive and optimization: The nonnegative Boltzmann machine and the tunneling salesman algorithm.

Oum, Sang-il, Graphs of bounded rank-width.

MATHEMATICS

Alexakis, Spyros, Local and global aspects of conformal geometry.

Asok, Aravind, Geometry of simple G-varieties.

Brumley, Farrell, Distinguishing cusp forms on the general linear group.

Bufetov, Alexander, Decay of correlations for the Rauzy-Veech-Zorich induction map and the central limit theorem for the Teichmüller geodesic flow.

De Sanctis, Luca, Structural approaches to spin glasses and optimization problems.

Gressman, Philip, $L^p - L^q$ estimates for Radon-like operators.

Rutgers University, New Brunswick (14)

MATHEMATICS

Blue, Pieter, Decay estimates and phase space analysis for wave equations on some black hole metrics.

Burdges, Jeffrey, Simple groups of finite Morley rank of odd type: Toward an endgame.

Chelluri, Thyagaraju, Equidistribution of roots of quadratic congruences.

Ciobanu, Laura Ioana, On the complexity of the endomorphism problem in free groups.

Curry, Eva, Characterization of low-pass filters for multivariable wavelets and some related questions.

Dalili, Kia, Cohomological methods for determining numerical invariants of algebras and modules.

Hartke, Stephen, Graph-theoretic models of spread and competition.

Lauve, Aaron, A quasideterminantal approach to quantized flag varieties.

Li, Xiaoqing, The orthogonality of Hecke eigenvalues of automorphic forms.

Medville, Kai, Existence and blow up behavior of planar harmonic functions satisfying certain nonlinear Neumann boundary conditions.

Ponce, Augusto, Some elliptic problems with singularities.

Rios, Alfredo Jose, Some problems on the pointwise convergence of wavelet series and Riesz products.

Sundberg, Eric, Fair and biased positional games.

Xu, Yongzhong, On the Morse index of a functional arising in contact form geometry.

Stevens Institute of Technology (1)

MATHEMATICAL SCIENCES

Kahl, Nathan, Enumerator polynomials and the enumeration of subgraphs of multigraphs.

NEW MEXICO

New Mexico State University, Las Cruces (2)

MATHEMATICAL SCIENCES

Al-Ayyoub, Ibrahim, The Ratliff-Rush closure and a minimal Groebner basis for certain affine monomial curves.

Garcia, Rebecca, On the minors of catalecticant matrices and on the coadunation of generalized crowns.

University of New Mexico (9)

MATHEMATICS AND STATISTICS

Aden, James, Model selection in kernel machine classification with application in bioinformatics.

Andries, Erie, Regularized least square classifiers: Application to leukemia disease classification.

DeCastro, Manuela, Stability of parabolic systems on a half-space and theoretical aspects of radiation.

Degnan, James, Gene tree distributions under the coalescent process.

Dohnal, Tomas, Optical bullets in $(2+1)$ Bragg resonant periodic structures and their interaction.

Doliga, Stanislaw, Real algebraic geometry.

Glubokov, Andrey, Jet spaces of the quantum plane.

Justo, Dagoberto, High order mimetic methods and absorbing boundary conditions.

Nazarov, Igor, A mathematical analysis for sustainable management of ecosystems II. Perfectly matched layers for Euler's linearized equation.

NEW YORK

City University of New York, Graduate Center (8)

PROGRAM IN MATHEMATICS

Diop, Serigne, Non-Gaussian models of financial markets: Paths simulation via series representation.

Kahrobaei, Delaram, Residual solvability, generalized free products, finitely generated nilpotent groups, free groups, and one-relator groups.

La Luz, José, The Bousfield-Kan spectral sequence for Moravalk-theory.

Leibman, George, Consistency strengths of modified maximality principles.

Nouri, Fereydoun, Graph homology.

Pineiro, Jorge, Mahler formula for dynamical systems on p^n.

Ushakov, Alexander, Fundamental search problems in group theory.

Zucker, Marc, Studies in cryptological combinatorics.

Columbia University (20)

BIOSTATISTICS

Cheng, Jianfeng, Evaluating and correcting guess effect in not perfect double-blinded clinical trials.

Li, Huiling, Analysis of incomplete HRQoL data in the REMATCH trial.

Wang, Cuiling, Regression analysis with missing data.

Wong, Kam-Fai, Statistical analysis of current status data.

Wu, Songmei, Nonlinear modeling strategies for metabolism rate data in brain imaging studies.

Wu, Ya-Chi, Linear regression with incomplete dependent variable.

MATHEMATICS

Hedden, Matthew, Knot Floer homology and cabling.

McInroy, Adam, Orbifold mirror symmetry for complex tori.

Moser, Harriet, Proving a manifold to be hyperbolic once it has been approximated to be so.

Niccolai, John, Triple product L-functions.

Qiu, Yannan, Special cycles on Siegel 3-folds.

Sherman, Morgan, The infinitely near Borel-fixed points on the Hilbert scheme.

Van Steirteghem, Bart, A classification of affine smooth spherical varieties.

Wambach, Eric, Integral representations on $U(2) \times U(3)$ and geometric applications.

STATISTICS

Hadjiliadis, Olympia, Change-point direction of two-sided alternatives in the Brownian motion model and its connection to the gambler's ruin problem with relative wealth perception.

Hernandez del-valle, Gerardo, First passage time densities of Brownian motion and applications to credit risk.

Ruiz-Mata, Jesus, Modeling credit and market risk and validation of models.

Wang, Hui, A new approach of detecting influential markers for complex phenotypes with genotype data.

Wang, Yuanjia, Non-parametric estimation of distribution functions from Kin-Cohort data.

Yan, Xin, Discriminant analysis using multi-gene profiles in molecular classification of breast cancer.

Cornell University (18)

APPLIED MATHEMATICS

Grasso, Catherine, Partial order graphs for multiple sequence alignment.

Guzman, Johnny, Pointwise estimates for discontinuous Galerkin methods and for the standard finite method with numerical integration.

He, Changhong, Estimation of volatilities under a Merton's jump-diffusion model and an uncertain volatility model.

Henniger, Jay, Small portfolio selection for benchmark tracking and option hedging under basis risk.

Shontz, Suzanne, Numerical methods for problems with moving meshes.

Singer, Michael, Efficient time splitting methods for reacting flow calculations.

MATHEMATICS

Belk, James, Thompson's group F.

Charalambous, Nelia, On the LP spectrum of the Hodge Laplacian and logarithmic Sobolev inequalities on non-compact manifolds.

Ciubotaru, Dan, Unitary representations of exceptional p-adic groups.

Cortissoz, Jean, On the Ricci flow in rotationally symmetric manifolds with boundary.

Francisco, Christopher, Hilbert functions and graded free resolutions.

Gabay, Yuval, Double jump inversions and strong minimal covers in the Turing degrees.

Greenberg, Noam, The role of true finiteness in the admissible recursively enumerable degrees.

Ku, Ja Eun, Least-squares methods for second-order elliptic partial differential equations.

Leykekhman, Dmitriy, Pointwise weighted error estimates for parabolic finite element equations.

Lin, Yi, Equivariant symplectic Hodge theory and strong Lefschetz manifolds.

Schwartz, Fernando, Scalar curvature problems on manifolds with boundary.

Zhou, Hilibin, Minimax estimation with thresholding and asymptotic equivalence theory for Gaussian variance regression.

Rensselaer Polytechnic Institute (6)

MATHEMATICAL SCIENCES

Ji, Xiaoyun, Clique partition problem with minimum size requirement.

Peng, Jufeng, Multiple robot coordination: A mathematical programming approach.

Scherzer, David, Multi-dimensional cellular chords.

Thorp Kusel, Elizabeth, New parabolic equation solutions for high frequency and elastic media problems.

Xin, Jianguo, Aspects on discontinuous Galerkin solutions of hyperbolic conservation laws.

Xue, Yonggang, Hermite subdivision schemes and jet subdivision surfaces.

State University of New York, Albany (1)

MATHEMATICS AND STATISTICS

Kures, Osman, The Bergman projection and related integral operators on the unit ball in C^n.

State University of New York, Binghamton (4)

MATHEMATICAL SCIENCES

Koban, Lori Jean, Two generations of biased graphs: Circuit signatures and modular triples of matroids and biased expansions of biased graphs.

Palmatier, Joshua, M-zeroids: Structure and categorical equivalences.

Saldarriaga, Omar Daria, Fusion algebras, symmetric polynomials, orbits of N-groups and rank level duality.

Sperber, Ron, A comparison of assembly maps in algebraic K-theory.

State University of New York, Buffalo (9)

MATHEMATICS

Agarwal, Anurag, Some quartic Diophantine equations.

Blanariu, Mihaela, Asymptotic analysis of patterns and islands in strained alloy films.

Cheptea, Dorin, A topological quantum field theory for the Le-Murakami-Ohtsuki invariant of three-dimensional manifolds.

Fan, Jiangnan, Decorated link invariants.

Georgescu, Catalin, The boundary map and the connecting set in Conley index theory.

Huynh, Vu, Reidemeister torsion, twisted Alexander polynomial, the A-polynomial, and the colored Jones polynomial of some classes of knots.

Kuppum, Srikanth, Edge polynomials, Newton and norm polygons of a family of hyperbolic manifolds.

Li, Yuan, Symmetric Boolean functions and their extension to finite fields.

Tekalign, Wondimu, Evolution equation for a thin epitaxial film on a deformable substrate.

State University of New York, Stony Brook (20)

APPLIED MATHEMATICS AND STATISTICS

Curry, Michael, Applications of stochastic methods for periodic scheduling.

Greene, Nataniel, Reconstructing piecewise smooth functions from their spectral data.

Kim, Jieun, Path analysis of the visual attention network using fMRI data.

Kim, Youngeun, Bidomain simulation of spiral waves of cardiac tissue in electrical cardiology.

Lee, Taewon, Statistical error analysis in numerical solutions of shock physics problems.

Li, Juan, Longitudinal, survival and joint modeling analysis with Bayesian applications.

Tintle, Nathan, Reclassification as a cost effective sample design for estimation and testing association when misclassification errors are present.

Yu, Yan, Errors in numerical solutions of shock physics problems.

MATHEMATICS

Chiose, Ionut, On the embedding of q-complete manifolds.

Friedman, Joshua, The Selberg trace formula and Selberg zeta-function for cofinite Kleinian groups with finite-dimensional unitary.

Gonzalez, Eduardo, Quantum cohomology and symplectomorphism type of S^1-manifolds with isolated fixed point.

Janks, Gregory, Some remarks on local connectivity at the Feigenbaum point.

Javaheri, Mohammad, Conformally compact Einstein metrics with symmetry in dimension 5.

Kim, Young Deuk, The Thurston boundary of Teichmüller space and complex of curve.

Liu, Yuan, Einstein metrics of positive sectional curvature on weighted projective planes.

Moraru, Dan, A new construction of anti-self-dual 4-manifolds.

Namazi, Hossein, Heegaard splittings and hyperbolic geometry.

Radulescu, Anca, The connected isentropes conjecture in a space of quartic polynomials.

Valdez, Rogelio, Self-similarity of the Mandelbrot set and parabolic bifurcation.

Xu, Ming, Bauer-Furuta invariant and cohomotopy refined Ruberman invariant.

University of Rochester (2)

MATHEMATICS

Qiu, Xing, On stochastic flows and backward stochastic differential equations with reflections.

Tang, Wan, Decay rates of oscillatory integral operators.

NORTH CAROLINA

Duke University (11)

INSTITUTE OF STATISTICS AND DECISION SCIENCES

Gunn, Laura, Bayesian order restricted methods with biomedical applications.

Rappold, Ana, Using expert knowledge when the data model is not known in modeling the mixed layer of the Atlantic Ocean.

Rigat, Fabio, A beta-Stacy proportional hazards model and Bayesian Weibull survival trees.

MATHEMATICS

Buckingham, Robert, Long-time asymptotics of the nonlinear Schrödinger equation shock problem.

Cain, John, Issues in the one-dimensional dynamics of a paced cardiac fiber.

Curto, Carina, Matrix model superpotentials and Calabi-Yau spaces: An ADE classification.

Feist, Andrew, Two problems in delay differential equations.

Fox, Daniel, Second order families of coassociative 4-folds.

Yang, Guoqiang, Quantitative models for dorsal closure in drosophila embryos.

Yasaki, Dan, On the existence of spines for $\mathbb{Q}$-rank 1 groups.

Ying, Wenjun, A multilevel adaptive approach for computational cardiology.

North Carolina State University (27)

MATHEMATICS

Bidwell, John, Discrete nonautonomous dynamical systems, periodic dynamical systems.

Cook, William, Affine Lie algebras, vertex operator algebras and combinatorial identities.

Dozier, Richard, Existence and analysis of the limiting spectral distribution of large dimensional information-plus-noise.

Finkel, Daniel, Global optimization with the DIRECT algorithm.

Gibson, Nathan, Terahertz-based electromagnetic interrogation techniques for damage detection.

Hatch, Andrew, Model development and control design for high speed atomic force microscopy.

He, Taiping, Reaction-diffusion systems with discontinuous reaction functions.

Hillman, Rebecca, Relationship between symmetric brace algebras and pre-Lie algebras.

Jackson, Farrah, Characterization of involutions of $SP(2N, K)$.

Kyei, Yaw, Numerical method and control theory.

Levy, Rachel, Partial differential equations of thin liquid films: Analysis and numerical simulation.

Perry, John, Combinatorial criteria for Gröbner bases.

Taylor, Dewey, Fine Bruhat intersections for reductive monoids.

Wood, Lisa, Solvable length in Lie algebras, associative algebras and matrix groups.

Yang, Xingzhou, Immersed interface method for elasticity problems with interfaces.

STATISTICS

Chen, Li, Bayesian hierarchical spatial-temporal models for wind prediction.

Feng, Sheng, Statistical studies of genomics data.

Gosky, Ross, Bayesian analysis and matching errors in closed population capture recapture models.

Hwang, Sang Pil, Dynamic time series analysis using logistic function.

Li, Erning, Estimation for generalized linear models when covariates are subject specific parameterina mixed models with longitudinal measurements.

Lin, Jiang, Topics in application of nonparametric smoothing.

Lokhnygina, Yuliya, Topics in design and analysis of clinical trials.

Lu, Na, Statistical issues in coherent risk management.

Rao, Harshavardhana, Contagion in financial markets: Two statistical approaches.

Remlinger, Katja, Statistical design and analysis of high throughput screening data using pooling experiments and data mining techniques.

Wang, Jing, An optimization approach for the parameter estimation of the nonlinear mixed effects models.

Wu, Yujun, Controlling variable selection by the addition of pseudo-variables.

University of North Carolina at Chapel Hill (14)

BIOSTATISTICS

Ahn, Chaehyung, Detecting linked changes in fast evolving genomes.

Begum, Munni, Statistical TK/TK dose response modeling of toxicity.

Capuano, George, A joint latent autoregressive model for patient dropout and longitudinal health related quality of life subject to informative missingness.

Deng, Shibing, Some aspects on linear model analysis of microarray gene expression data.

Gurka, Matthew, The Box-Cox transformation in the general linear mixed model for longitudinal data.

Jung, Inkyung, Robust inference in unbalanced heteroscedastic one-way random effects models using rank-based methods.

Lu, Bing, Estimating correlation parameters in cluster intervention trials with binary responses using estimating equations.

Neelon, Brian, Bayesian order restricted inference.

Pan, Zhiying, Regression analysis for complex longitudinal survey data.

Robbins, Tania, Combining microarrays with QTL analysis.

Schwartz, Todd, A study of sample size recalculation with particular focus on active- and placebo-controlled non-inferiority trials.

Wang, Lily, Some statistical aspects of the analysis of genomic sequences.

MATHEMATICS

Chang, Soo-Ah, Factorizations in some special block monoids.

DiFranco, Jeffrey, Gibbs phenomenon for the defocusing nonlinear Schrödinger equation.

University of North Carolina at Charlotte (7)

MATHEMATICS AND STATISTICS

Guo, Xunxiang, On frame wavelets.

Herron, John, Weighted conditional expectation operators on L^p space.

Hill, David, Time delayed dynamical systems and the Duffing equation.

Hill, Jennifer, An inventory optimization model with Markov-modulated commodity prices.

Jang, Bong Soo, Homogenization of irregular shaped composite materials in periodic structures.

Jin, Xiaodong, Contributions to kernel methods and estimation of extreme value index.

Xiong, Huaiyu, Nonparametric and semiparametric functional coefficient instrumental variable models.

OHIO

Bowling Green State University (6)

MATHEMATICS AND STATISTICS

Grinevitch, Oxana, Student understanding of abstract algebra: A theoretical examination.

Harrar, Solomon, Linear models under non-normality.

Kerns, (Gary) Jay, Signed measures in exchangeability and infinite divisibility.

Rolli, William, Frames and operator decompositions in Hilbert spaces.

Sanders, Rebecca, Hypercyclic and supercyclic operators in the weak topology of Banach spaces.

Xu, Jin, Robustness study of some multivariate tests in generalized linear models.

Case Western Reserve University (12)

EPIDEMIOLOGY AND BIOSTATISTICS

Beaird, Heather, Putative DNRH agonist therapy and dementia: An application of medicare hospitalization claims data.

Kasehagen, Laurin, Duffy-negativity and vivax malaria epidemiology: A study of dual and multiple-record system estimation and patterns of association in Papua New Guinea.

Mascha, Edward, Assessing individual treatment effect heterogeneity for binary outcomes.

Nock, Nora, Development and application of DNA damage and DNA repair indices to prostate cancer.

Orloff, Mohammed, Analysis of genes associated with focal segmental glomerulosclerosis.

Stein, Catherine, Genetic and environmental influences on tuberculosis susceptibility.

Traore, Fatoumata, A conceptual model for understanding sexual risk among persons living with HIV/AIDS.

Zhu, Guohua, Ascertainment in two-phase sampling designs for segregation and linkage analysis.

MATHEMATICS

Hahn, Philip, Origination and propagation of reaction diffusion waves in three spatial dimensions.

STATISTICS

Kitska, David, Simultaneous inference for functional linear models.

Piryatinska, Alexandra, Inference for the Lévy models and their applications in medicine and statistical physics.

Snyder, Scott, Evaluation of an implantable medical device: Design and modeling of a three dimensional workspace.

Kent State University (2)

MATHEMATICAL SCIENCES

Fontes, Natacha, Multi-dimensional polynomial inequalities; norms of interpolation operators.

Zeibig, Gerd, Categorical methods in functional analysis.

Ohio State University (15)

MATHEMATICS

Antal, Tamas, Cyclic homology and Hopf algebras.

Ghazaryan, Anna, Nonlinear convective instability of fronts: A case study.

Guloglu, Ahmet M., On low-lying zeros of automorphic L-functions.

Herbig, Anne-Katrin, A sufficient condition for subellipticity of the $\overline{\partial}$-Neumann problem.

Kaygun, Atabey, Bialgebra cyclic homology with coefficients.

Liu, Xing, Rigorous exponential asymptotics for a nonlinear third order difference equation.

Manukian, Vahagn, Existence and stability of multi-pulses with applications to nonlinear optics.

Roman, Cosmin, Baer and quasi-Baer modules.

Wang, Jin, A numerical approach for the interfacial motion between two immiscible incompressible fluids.

STATISTICS

Chen, Haiying, Ranked set sampling for binary and ordered categorical variables with applications in health survey data.

Duncan, Kristin, Case and covariate influence: Implications for model assessment.

Gibellato, Marilisa, Stochastic modeling of the sleep processes.

Pavlicova, Martina, Thresholding in fMRI images.

Sun, Junfeng, Stochastic models for compliance analysis and applications.

Wang, Tao, Statistical analysis of gene expression experiments.

Ohio University (4)

MATHEMATICS

Al-Hazmi, Husain, A study of CS and Σ-CS rings and modules.

Alsulami, Saud, On evolution in Banach spaces and commuting semigroups.

Castillo, Rene, Generalized non-autonomous Kato classes and nonlinear Bessel potentials.

Constantin, Elena, Optimization and flow invariance via high order tangent cones.

University of Akron (1)

THEORETICAL AND APPLIED MATHEMATICS

Kim, Shinuk, A numerical study of parameter identification in linear and nonlinear elastic and viscoelastic plates.

University of Cincinnati (4)

MATHEMATICAL SCIENCES

Galstyan, Anahit, Existence and number of global solutions to model nonlinear partial differential equations.

Oh, Jiyeon, Error analysis of the exponential Euler method and the mathematical modeling of the retinal waves in neuroscience.

Zhao, Shuhong, Statistical inference on binomial proportions.

Zhou, Rong, Bayesian analysis of log-binomial models.

OKLAHOMA

Oklahoma State University-Stillwater (1)

STATISTICS

Bagour, Ali, Probability proportional to size sampling.

University of Oklahoma (4)

MATHEMATICS

Borovikova, Marina, Partial regularity of weak solutions of quasilinear elliptic systems and weak Harnack inequalities.

Gomarteli, Mamouka, On the normal accessibility property of actions on manifolds: Ramifications in pseudo semigroups of local diffeomorphisms.

Ou, Ye-Lin, P-harmonic morphisms, minimal foliations, and conformal deformations of metrics.

Xu, Tao, Model-data synthesis in terrestrial ecosystem modeling: Inverse analysis and uncertainty analysis.

OREGON

Oregon State University (2)

STATISTICS

Amer, Safaa, Neural network imputation: A new fashion or a good tool.

Jia, Siwei, Optimization, conservation and valuation of contingent claims in economic resource management under uncertainty.

Portland State University (2)

MATHEMATICS AND STATISTICS

Fish, Daniel, Metriplectic systems.

Santoro, Emanuele, Thermodynamic metrics and the geometry of equilibrium surfaces.

University of Oregon (5)

MATHEMATICS

Harker, Hayden, Cohomology of a sub-Hopf algebra of a Steenrod algebra.

Loft, Brian, Connected components of the space of positive scalar curvature metrics on spheres.

Merchant, Eric, Structural properties of Hadamard designs.

Nordstrom, Hans, Associated primes over Ore extensions and generalized Weyl algebras.

Ruiz, Efren, A classification theorem for direct limits of extensions of circle algebras by purely infinite C^*-algebras.

PENNSYLVANIA

Carnegie Mellon University (14)

MATHEMATICAL SCIENCES

Baia, Margarida, Variational multiscale problems and applications to thin films.

Brown, Chad, Set comprehension in Church's type theory.

Janecek, Karel, Futures trading model with transaction costs.

Ojakian, Kerry, Combinatorics in bounded arithmetic.

Pankavich, Stephen, The Vlasov Poisson system with infinite mass and energy.

Petrelli, Luca, Variational principle for general diffusion problems.

Pirvu, Traian, Maximizing portfolios growth rate under risk constraints.

Popovici, Cristina, Coupled singular perturbations and homogenization.

Rivera, Juan, Portfolio choice under risk limits: A coherent approach.

Tudorascu, Adrian, Optimal mass transportation methods for gradient flows in the weak topology.

Winger, Aris, On pattern formation in a one dimensional viscoelastic system with numerical computation.

STATISTICS

Araneda, Anita, Statistical inference in mapping and localization for mobile robots.

Dunn, Michelle, Applying particle-filter and path-stack methods to detecting anomalies in network traffic volume.

Slavkovic, Aleksandra, Statistical disclosure limitation beyond the margins: Characterization of joint distributions for contingency tables.

Lehigh University (1)

MATHEMATICS

Moller, Trisha, t-Split interval orders.

Pennsylvania State University, University Park (18)

MATHEMATICS

Damjanovic, Danijela, Local rigidity of partially hyperbolic higher rank Abelian actions on the torus.

Gerenrot, Dmitry, Residue formulation of Chern character on smooth manifolds.

Handzy, Nestor, Experimental observations and mathematical description of micellar fluid flow.

Krat, Svetlana, Approximation problems in length geometry.

Lee, Young-Ju, Modelling and simulations of non-Newtonian fluid flows.

Raven, Jeffrey, An equivariant bivariant Chern character.

Saunders, Christopher, Floer homology for almost Hamiltonian isotopies.

Shoenthal, David, Several results concerning low-dimensional length spaces.

Sostarecz, Michael, Experiments and modeling in viscoelastic fluids: Dimpled drops and beaded filaments.

Ugarcovici, Ilie, Symbolic dynamics for geodesic flows, hyperbolic measures and periodic orbits.

STATISTICS

Antoniou, Efi, Nonparametric imputation and (mid-)rank test for mixed effects models with missing data.

Bai, Steven, Cluster analysis of high dimensional data and dimension reduction for regression.

Ding, Rui, Multiple response ridge analysis.

Kwanisai, Mike, Estimation in link-tracing designs with subsampling.

Wang, Haiyan, Testing in multifactor heteroscedastic anova and repeated measures design with large number of levels.

Wang, Shaoli, Dimension reduction in regression.

Yang, Ke, Using the Poisson kernel in model building and selection.

Zhan, Xiaojiang, Bayesian semiparametric inference based on ranks.

Temple University (8)

MATHEMATICS

Mammo, Behailu, A mean value theorem for discriminants of abelian extensions of a number field.

Nguyen, Truyen Van, On Monge-Ampère type equations arising in optimal transportation problems.

Tesemma, Mohammed Seid, Reflection groups and semigroup algebras in multiplicative invariant theory.

Wen, Xiangdong, Rigorous experimental mathematics applied to the Goulden-Jackson method, construction of symmetric chains and the Sprague-Grundy function.

STATISTICS

Cai, Gengqian, Further results on Simes test and Benjamin-Hochberg false discovery rate procedure.

Deng, Ling, Heterogeneous and space-dependence of substitution rates—an application of zero-inflated models GEE and composite likelihood methods.

Li, Li, Design and analysis of DNA microarray data—model validation and sensitivity analysis.

Zhang, Hongyan, A Cox proportional hazard model for monotonic severity marked failures.

University of Pennsylvania (14)

MATHEMATICS

Bana, Gergely, Soundness and completeness results for the formal model of symmetric encryption.

Barwick, Clark, (∞, n)-Cat as a closed model category.

Byun, Jungyoon, A generalization of Connes-Kreimer Hopf algebra.

Hindawi, Mohamad, Asymptotic invariants of Hadamard manifolds.

Lee, Dong Uk, p-Adic monodromy of the ordinary subscheme of Picard modular variety.

Maxim, Laurentiu, Alexander invariants of hypersurface complements.

Mehrotra, Sukhendu, Triangulated categories of singularities, matrix factorizations and LG-models.

Sabitova, Maria, Root numbers of Abelian varieties and representations of the Weil-Deligne group.

Tripp, James, Contact structures on open 3-manifolds.

Yap, Shirley, Prescribing curvature forms: Solvability and obstruction results.

STATISTICS

Greery, Robert Alan, Jr., Noncompliance, covariance adjustment, and matching in randomized controlled trials.

Liu, Naiping, Covariance selection and estimation through modified Cholesky decomposition and the value/growth spreads as predictors of returns.

Wang, Liang, A new adaptive variable selection criterion and its applications in financial markets.

Zhang, Liangyue, Efficient estimation in marginal partially linear models for longitudinal/clustered data using splines.

University of Pittsburgh (17)

BIOSTATISTICS

Dang, Qianyu, Using trajectories from a bivariate growth curve of covariates in a Cox model analysis.

He, Shui, Generalized additive models for data with concurvity: Statistical issues and a novel model fitting approach.

Sang, Weilian, Empirical comparison of U.S. Census Bureau population estimates used in morality and population data system of the University of Pittsburgh, Department of Biostatistics.

MATHEMATICS

Cross, Wesley, Principal value volumes of p-adic rational polyhedra.

Domokos, Andras, On the regularity of p-harmonic functions in the Heisenberg group.

Dunca, Argus Adrian, Space averaged Navier-Stokes equations in the presence of walls.

Grigoryan, Vahan, Multimodal biometric analysis for monitoring of wellness.

Kaya, Songul, Numerical analysis of a variational multiscale method for turbulence.

Krisner, Ed, Multi-bump solutions of a one dimensional Wilson-Cowan type model.

Merdan, Huseyin, Renormalization group methods in applied mathematical problems.

Pahlevani, Faranak, Sensitivity analysis of eddy viscosity models.

Scott-Pomerantz, Colleen, The k-epsilon model.

STATISTICS

Czanner, Gabriela, Applications of statistics in neuroscience.

Gogtas, Hakan, Improving coverage of rectangular confidence interval.

Jia, Gang, Use of simultaneous inference under order restriction, stepdown testing procedure and stage-wise sequential optimal design in clinical dose study.

Sengul, Tulay, The time varying autoregressive model with covariates to analyze longitudinal data with missing values.

Sun, Zhuoxin, Repeated measures mixture modeling with application to neuroscience.

RHODE ISLAND

Brown University (15)

APPLIED MATHEMATICS

Chen, Shanqin, The heterogeneous multiscale method based on the discontinuous Galerkin and finite volume schemes.

Chen, Ting-Li, On the statistics of natural images.

Curran, John, Adaptive learning among interacting agents: An analysis of the many-agent, long-term limit.

Gao, Yun, Statistical models in neural information processing.

Harrison, Matthew, Discovering compositional structure.

Sirisup, Sirod, Issues in low-dimensional modeling of unsteady flows: Convergence, asymptotic stability and reconstruction procedures.

Strain, Robert, Some applications of an energy method in collisional kinetic theory.

Xu, Jin, High Reynolds number simulation and drag reduction techniques.

Xu, Zhengfu, Anti-diffusive flux corrections for high order finite difference WENO schemes.

Zhang, Xiao, On large deviations approximations for occupancy models.

MATHEMATICS

Acquista, Karen, A generalization of class field theory using motivic complexes.

Jones, Rafe, Galois martingales and the hyperbolic subset of the p-adic Mandelbrot set.

Joyce, Michael, Rational points on the E_6 cubic surface.

Lauzon, Michael, Harmonic analysis for vector-valued functions with operator weights.

Wick, Brett, Analytic projections, the geometry of holomorphic vector bundles and applications to the corona problem.

University of Rhode Island (3)

MATHEMATICS

Chatterjee, Esha, Global behavior in rational difference equations.

Collins, Jarred, Moore-Greig designs.

Faubert, Glenn, Caterpillar tolerance representations of graphs.

SOUTH CAROLINA

Clemson University (4)

MATHEMATICAL SCIENCES

Hunt, Brian, Multiobjective programming with convex cones: Methodology and applications.

Limbupasiriporn, Jirapha, Partial permutation decoding for codes from designs and finite geometrics.

Limbupasiriporn, Prasit, Hidden subgroup problem in quantum computing.

Roop, John Paul, Variational solution of the fractional advection dispersion equation.

Medical University of South Carolina (1)

BIOSTATISTICS, BIOINFORMATICS AND EPIDEMIOLOGY

Yoo, Wonsuk, Bayesian hierarchical changepoint model for longitudinal biomarkers.

University of South Carolina, Columbia (9)

EPIDEMIOLOGY AND BIOSTATISTICS

Moran, Robert, Working and analyzing clinical data in a family practice.

Shoultz, Gerald, Sprawl, measures of sprawl and chronic obstructive pulmonary disease: A Bayesian spatial analysis.

Sutton, Shae, Modeling of spatially-referenced event data in a South Carolina population.

MATHEMATICS

Kidd, Travis, On the irreducibility of Laguerre polynomials of $L_m(m)(x)$.

Vatchev, Vesselin, Analysis of the intrinsic mode functions.

Zhao, Jie, Multigrid methods for fourth order problems.

STATISTICS

Hare, David, Simultaneous inference for ratios of linear combinations of general linear model parameters.

Han, Jun, Parametric latent class model for longitudinal markers and recurrent events.

Stocker, Russell, A general class of parametric models for recurrent event data.

TENNESSEE

University of Memphis (3)

MATHEMATICAL SCIENCES

Montagh, Balázs, Unavoidable substructures.

Schroeder, Jason, Estimation from response-biased incomplete data and supplementary information.

Zhong, Ping, Stochastic modeling of HIV pathogenesis under therapy and vaccine.

University of Tennessee, Knoxville (2)

MATHEMATICS

Iskra, John, Decidability in algebraic geometry.

Vasilevska, Violeta, Fibrator properties of PL manifolds.

Vanderbilt University (1)

MATHEMATICS

Sonkin, Dmitriy, On groups of large exponents n and n-periodic products.

TEXAS

Baylor University (3)

MATHEMATICS

Da Cunha, Jeffrey, Lyapunov stability and Floquet theory for nonautonomous linear dynamic systems on time scales.

Karna, Basant K., Comparison of smallest eigenvalues and extremal points.

STATISTICAL SCIENCE

Clark, Deeanna Antosh, Statistical issues concerning modeling and evaluating student achievement and school accountability.

Rice University (3)

MATHEMATICS

Meng, Zheng, Geometric variational problems with cross-sectional constraints.

Trout, Aaron, Spaces with positive combinatorial curvature.

Zhang, Jun, Geometric compactification of moduli space of cubic surfaces and Kirwan blowup.

Texas A&M University (24)

MATHEMATICS

Feng, Zhaosheng, Some results on the wave equation with Van der Pol type nonlinear boundary condition and the Burgers-Korteweg-de Vries equation.

Hamid, Sami, On the structure of a class of operators.

Hoang, Luan, Asymptotic expansions of the regular solutions to the 3D Navier-Stokes equations and applications to the analysis of the helicity.

Kolev, Tzanio, Dual least-squares methods for computational electromagnetics.

Ryan, John, Global existence of reaction diffusion equations over multiple domains.

Wang, Yanqiu, Preconditioning for the mixed formulation of linear plane elasticity.

Yao, Xudong, A min-max method for finding multiple critical points in Banach space.

STATISTICS

Apanasovich, Tatiyana, Testing for spatial correlation and semiparametric spatial modeling of binary outcomes with application in aberrant crypt foci in colon carcinogenesis experiments.

Bae, Kyounghwa, Bayesian model based approaches with MCMC computation to some bioinformatics problems.

Chang, Ilsung, Bayesian inference on mixture models and their applications.

Dunlap, Mickey, Using the bootstrap to analyze variable stars data.

Hu, Zonghui, Semiparametric functional data analysis for longitudinal/clustered data: Theory and application.

Ju, Hyunsu, Topics in analyzing longitudinal data.

Jung, Jeesun, High resolution linkage and association study of quantitative trait loci.

Kim, Hyun Sun, Topics in ordinal logistic regression and its applications.

Ko, Kyungduk, Bayesian wavelet approaches for parameter estimation and change point detection in long memory processes.

Lee, Ho-Jin, Functional data analysis classification and regression.

Leyk Williams, Malgorzata (Gosia), FLARE assay images in colon carcinogenesis.

Liu, Li-Yu Daisy, Coefficient of intrinsic dependence a new measure of association.

Pokta, Suriani, Bayesian model selection using exact and approximated posterior probabilities with applications to star data.

Ryu, Duchwan, Bayesian regression analysis with longitudinal measurements.

Song, Joon Jin, Bayesian multivariate spatial models and their applications.

Song, Juhee, Bootstrapping in a high dimensional but very low sample size problem.

Spinka Holan, Christine, Gene environment interactions in genetic epidemiology.

Texas Tech University (5)

MATHEMATICS AND STATISTICS

Franklin, Scott, A computational three-field methodology for non-conforming finite elements over partitioned domains.

Khoujmane, Ali, Improving regression function estimators.

Murphy, Eric, Complex variables and circle packing.

Swim, Edward, Non-conforming finite element methods for fluid-structure interaction.

Willis, Nicholas, Singular points of real sextic curves.

University of Houston (4)

MATHEMATICS

Boiarkine, Oleg, Mixed hybrid finite element methods for diffusion equations on nonmatching meshes.

Jacobs, Philip, Symmetric attractors with non-trivial isotropy.

Martynenko, Andrey, Numerical methods for advection-diffusion equations on locally refined meshes.

Pepper, Ryan, Binding independence.

University of North Texas (2)

MATHEMATICS

Coiculescu, Ion, Dynamics, thermodynamic formalism and perturbations of transcendental entire functions of finite singular type.

Ghenciv, Petre, Hamiltonian cycles in subset and subspace graphs.

University of Texas, Arlington (2)

MATHEMATICS

Dimitrov, Dobromir, Nonstandard finite difference methods for dynamical systems with applications in mathematical biology.

Zhu, Xiao Ping, Preliminary test and shrinkage estimators for the mean of bivariate normal distribution.

University of Texas, Austin (13)

MATHEMATICS

Baker, Kenneth, Knots on once-punctured torus fibers.

Condon, John, Mahler measure evaluations in terms of polylogarithms.

Fukshansky, Leonid, Algebraic points of small height with additional arithmetic conditions.

Kelliher, James, The vanishing viscosity limit for incompressible fluids in two dimensions.

LaMar, M. Drew, Human acoustics: From vocal chords to inner ear.

Lehr, Heather, Analysis of a Darcy-Stokes system modeling fluid flow in vuggy porous media.

Parker, Adam, An elementary construction of $M_{0,0}(\mathbb{P}^r, d)$.

Petersen, Kathleen, One-cusped congruence subgroups of $PSL_2(\mathcal{O}_K)$.

Portillo-Bobadilla, Francisco, Computations on an equation of the BSD type.

Silvestre, Luis, Regularity of the obstacle problem for a fractional power of the Laplace operator.

Sinclair, Christopher, Multiplicative distance functions.

Stoikov, Sasha, Optimal strategies in incomplete financial markets.

Teixeira, Eduardo, Regularity of free boundary in variational problems.

University of Texas, Dallas (5)

MATHEMATICAL SCIENCES

Banks, Troy, Invariant kernels and their orthogonal polynomials.

Barakat, Moe, Polynomials in several noncommuting variables and some of their asymptotic properties.

Costa, Fred, Structured matrix calculations via quaternions.

Navarra-Madsen, Junalyn, Colorability, tangles and quandles.

Odushkin, Taras, Mathematical models of atomic scale deformations and spatial nonuniformities in solid bodies.

UTAH

Brigham Young University (1)

MATHEMATICS

Brown, Sarah, A numerical scheme for Mullins-Sekerka flow in 3-space dimensions.

University of Utah (4)

MATHEMATICS

Cavaleri, Renzo, A topological quantum field theory of intersection numbers for moduli spaces of admissible covers.

Folias, Stefanos, Stimulus-induced waves and breathers in synaptically-coupled neural networks.

Le, An, Nonlinear eigenvalue problems.

Sato, Fumitoshi, Relations in tanto logical rings by localization.

VIRGINIA

Old Dominion University (2)

MATHEMATICS AND STATISTICS

Mav, Deepak, Statistical analysis of longitudinal and multivariate discrete data.

Walker, Steven, The straggling Green's function method for ion beam transport.

University of Virginia (6)

MATHEMATICS

Helmstutter, Randall, Quillen equivalent categories of functors.

Richardson, Pamela, Centroids of quadratic Jordan superalgebras.

Roche, Jennifer, Radices and matrix rings.

STATISTICS

Chan, Kuo-Chen, Proposal of a new semiparametric method that does not rely on the assumption of normality in the transformed data and is suitable for non-normally distributed transformed data.

Guise, Thomas, D-optimal biased coins for clinical trials.

Soukup, Matthew, Evaluating classification performance.

Virginia Polytechnic Institute and State University (9)

MATHEMATICS

Brunnhofer, Harald, Forced capillary-gravity waves in a 2D rectangular basin.

Chinyoka, Tirivanhu, Numerical simulation of stratified flows and droplet deformation in 2D shear flow of Newtonian and viscoelastic fluids.

Cline, Danny, On the computation of invariants in non-normal, non-pure cubic fields and in their normal closures.

Colon-Reyes, Omar, Monomials dynamical systems over finite fields.

Krueger, Denise, Stabilized finite element methods for feedback control of convection diffusion equations.

Pierson, Mark, Theory and application of a class of abstract differential-algebraic equations.

Rothstein, Ivan, Semiclassical scattering for two and three body problems.

Singler, John, Sensitivity analysis of partial differential equations with applications to fluid flow.

Vugrin, Kay, On the effects of noise on parameter identification optimization problems.

WASHINGTON

University of Washington (15)

APPLIED MATHEMATICS

Farnum, Edward, Stability and dynamics of solitary waves in nonlinear optical materials.

Hewitt, Sarah, Dynamics and stability of periodic spatial patterns in the optical parametric oscillator.

Komuro, Rie, Multi-objective evolutionary algorithms for ecological process methods.

Medlock, Jan, Integro-differential-equation models in ecology and epidemiology.

Pelanti, Marica, Wave propagation algorithms for multicomponent compression flow with applications to volcanic jets.

Peters, Matthew, Moist convection and the large scale tropical calculation.

Williams, David, Solving singular perturbation problems: An amplitude equation approach.

MATHEMATICS

Blair, Matthew, Strichartz estimates for wave equations with coefficients of Sobolev regularity.

Chebolu, Sunil, Refinements of chromatic towers and Krull-Schmidt decompositions in stable homotopy categories.

Hanusa, Christopher, A Gessel-Viennot-type method for cycle systems with applications to Aztec pillows.

Meyer, Daniel, Melting snowballs.

Nichifor, Alexandra, Iwasawa theory for elliptic curves with cyclic isogenies.

Skokan, Michael, Regularity of ghosts of geodesic X-ray transform.

Swanson, Jason, Topics in stochastic analysis.

STATISTICS

Gottardo, Raphael, Robust Bayesian analysis of gene expression microarray data.

Washington State University (5)

MATHEMATICS

Edmeade, Dean, Nonlinear stability analysis of hexagonal optical pattern formation in an atomic sodium vapor ring cavity.

Goff, Matthew, Multivariate discrete phase-type distributions.

Miller, James, Exon and intron detection in human genomic DNA.

Nag, Parthasarathi, Energy decay estimates for certain class of nonlinear systems arising in models of power systems.

Sasaki, Takashi, Maxwell's equations with temperature effect.

WEST VIRGINIA

West Virginia University (2)

MATHEMATICS

Martinez-Montejano, Jorge, Results on hyperspaces.

Niu, Jianbing, Graph minor.

WISCONSIN

Marquette University (1)

MATHEMATICS, STATISTICS AND COMPUTER SCIENCE

Luo, Jinghui, Construction and analysis of airway water clearance models.

Medical College of Wisconsin (1)

BIOSTATISTICS

Wong, Hong, Inference for the shared power variance function frailty model and correlated gamma frailty model.

University of Wisconsin, Madison (10)

STATISTICS

Barrios, Ernesto, Topics on engineering statistics.

Cheng, Bin, Some hypothesis testing results for two-way linear models in clinical trials.

Dahl, David, Conjugate Dirichlet process mixture models: Efficient sampling, gene expression and clustering.

Hong, Quan, A pseudo empirical likelihood approach to nonignorable nonresponse.

Jin, Chunfang, Contributions to the design and analysis of quantitative trait loci experiments.

Leng, Chenlei, Some problems in model selection.

Ma, Shuangge, Penalized M-estimation for partly linear transformation models with current status data.

Song, Yang, Two-way latent variable clustering.

Yuan, Ming, Automatic smoothing and variable selection.

Yuan, Zhilong, Designs for phase I cancer trials: Incorporation of grade information and multiple risk group studies.

University of Wisconsin, Milwaukee (2)

MATHEMATICAL SCIENCES

Bartl, Michael, On a hyper-Hilbert transform and singular integrals.

Yousuf, Muhammad, Smoothing schemes for inhomogenous linear and semilinear parabolic problems with nonsmooth data.

WYOMING

University of Wyoming (4)

MATHEMATICS

Christian, Justin, Three problems in combinatorial matrix theory.

Kim, In-Jae, Spectral properties of combinatorial classes.

STATISTICS

El-Houbi, Ashraf, Methods for resource selection studies using correlated data.

Greenwood, Mark, Functional data analysis for glaciated valley profile analysis.

2005 Election Results

In the elections of 2005 the Society elected a president elect, 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 2006 and ending on 31 January 2009, except for the president elect, whose term is for one year (followed by two years as president and one year as immediate past president), and for the trustee, whose term is for five years ending on 31 January 2011. Members elected to the Nominating Committee begin serving immediately, and their terms end on 31 December 2008.

President Elect

Elected as the new president elect is **James G. Glimm** from Stony Brook University.

Vice President

Elected as the new vice president is **Ruth M. Charney** from Brandeis University.

Trustee

Reelected as trustee is **John B. Conway** from the University of Tennessee and the National Science Foundation.

Members at Large of the Council

Elected as new members at large of the Council are

William M. Goldman from the University of Maryland
Craig L. Huneke from the University of Kansas
Judy Anita Kennedy from the University of Delaware
Ken Ono from the University of Wisconsin, Madison
Judy L. Walker from the University of Nebraska

Editorial Boards Committee

Elected as new members of the Editorial Boards Committee are

Robert L. Bryant from Duke University
Stephen Lichtenbaum from Brown University

Nominating Committee

Elected as new members of the Nominating Committee are

Michael G. Crandall from the University of California at Santa Barbara
M. Susan Montgomery from the University of Southern California
Lisa Traynor from Bryn Mawr College

CALL FOR Suggestions

Your suggestions are wanted by:

The President, for the following contested seats in the 2006 AMS elections:

three members of the Nominating Committee
two members of the Editorial Boards Committee

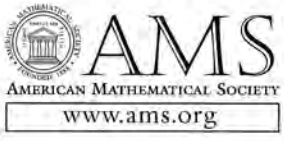
Deadline for suggestions: February 26, 2006

The Editorial Boards Committee, for appointments to various editorial boards of AMS publications

Deadline for suggestions: Can be submitted any time

Send your suggestions for any of the above to:

Robert J. Daverman, Secretary
American Mathematical Society
312D Ayres Hall
University of Tennessee
Knoxville, TN 37996-1330 USA
email: secretary@ams.org



2006 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 2006. The Council intends to nominate at least two candidates, among whom may be candidates nominated by petition as described in the rules and procedures.

Five positions of member at large of the Council for a term of three years are to be filled in the same election. The Council intends to nominate at least ten candidates, among whom may be candidates nominated by petition in the manner described in the rules and procedures.

Petitions are presented to the Council, which, according to Section 2 of Article VII of the bylaws, makes the nominations. The Council of 23 January 1979 stated the intent of the Council of nominating all persons on whose behalf there were valid petitions.

Prior to presentation to the Council, petitions in support of a candidate for the position of vice president or of member at large of the Council must have at least fifty 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 USA, and must arrive by 25 February 2006.
2. The name of the candidate must be given as it appears in the *Combined Membership List* (`www.ams.org/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 by the candidate contacting the AMS headquarters in Providence (amsmem@ams.org).
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. 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 2006 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, 2007

Return petitions by 25 February 2006 to:
Secretary, AMS, 312 D Ayres Hall, University of Tennessee, Knoxville, TN 37996-1330 USA

Name and address (printed or typed)	Signature

AMS EXEMPLARY PROGRAM PRIZE

At its meeting in January 2004, the AMS Council approved the establishment of a new award called the AMS Award for an Exemplary Program or Achievement in a Mathematics Department. It is to be presented annually to a department that has distinguished itself by undertaking an unusual or particularly effective program of value to the mathematics community, internally or in relation to the rest of society. Examples might include a department that runs a notable minority outreach program, a department that has instituted an unusually effective industrial mathematics internship program, a department that has promoted mathematics so successfully that a large fraction of its university's undergraduate population majors in mathematics, or a department that has made some form of innovation in its research support to faculty and/or graduate students, or which has created a special and innovative environment for some aspect of mathematics research.

The prize amount is $1,200. All departments in North America that offer at least a bachelor's degree in the mathematical sciences are eligible.

The Prize Selection Committee requests nominations for this award, which will be announced at the Joint Mathematics Meetings in New Orleans, Louisiana, in January 2007. Letters of nomination may be submitted by one or more individuals. Nomination of the writer's own institution is permitted. The letter should describe the specific program(s) for which the department is being nominated as well as the achievements that make the program(s) an outstanding success, and may include any ancillary documents which support the success of the program(s). The letter should not exceed two pages, with supporting documentation not to exceed an additional three pages.

All nominations should be submitted to the AMS Secretary, Robert J. Daverman, American Mathematical Society, 312D Ayres Hall, University of Tennessee, Knoxville TN 37996-1330. Include a short description of the work that is the basis of the nomination, with complete bibliographic citations when appropriate. The nominations will be forwarded by the Secretary to the Prize Selection Committee, which will make the final decision on the award.

Deadline for nominations is April 1, 2006.

AMERICAN MATHEMATICAL SOCIETY

Leroy P. Steele Prizes

Call for Nominations

The selection committee for these prizes requests nominations for consideration for the 2006 awards. Further information about the prizes can be found in the November 2005 *Notices*, pp. 1251-1255 (also available at http://www.ams.org/prizes-awards).

Three Leroy P. Steele Prizes are awarded each year in the following categories: (1) the Steele Prize for Lifetime Achievement: for the cumulative influence of the total mathematical work of the recipient, high level of research over a period of time, particular influence on the development of a field, and influence on mathematics through Ph.D. students; (2) the Steele Prize for Mathematical Exposition: for a book or substantial survey or expository-research paper; and (3) the Steele Prize for Seminal Contribution to Research: for a paper, whether recent or not, that has proved to be of fundamental or lasting importance in its field, or a model of important research. In 2007 the prize for Seminal Contribution to Research will be awarded for a paper in geometry/topology.

Nominations with supporting information should be submitted to the Secretary, Robert J. Daverman, American Mathematical Society, 312D Ayres Hall, University of Tennessee, Knoxville, TN 37996-1330. Include a short description on the work that is the basis of the nomination, including complete bibliographic citations. A curriculum vitae should be included. The nominations will be forwarded by the Secretary to the prize selection committee, which will, as in the past, make final decisions on the awarding of prizes.

Deadline for nominations is March 31, 2006.

AMS
AMERICAN MATHEMATICAL SOCIETY

Mathematics Calendar

The most comprehensive and up-to-date Mathematics Calendar information is available on e-MATH at http://www.ams.org/mathcal/.

March 2006

*10-12 **Recent Developments in Higher Dimensional Algebraic Geometry**, The Japanese American Mathematics Institute and the Johns Hopkins University, Baltimore, Maryland.

Topics: Birational geometry and topics related to the minimal model program. Of special interest are new developments concerning derived categories of coherent sheaves, Fano varieties, Mori-Fano fiber spaces, the explicit geometry of threefolds, minimal log discrepancies, new points of view on singularities, and rational curves on varieties.

Organizers: J. Kollar (Princeton University), S. Mori (RIMS - Kyoto), V. Shokurov (Johns Hopkins University), N. Budur (Johns Hopkins University). Additional Principal Japanese Organizers: S. Ishii (Tokyo Instiute of Technology), Y. Kawamata (University of Tokyo), and S. Mukai (RIMS-Kyoto).

Invited Speakers: A. Bondal, A. Corti, R. Lazarsfeld, Y. Kawamata, J. McKernan, S. Mukai, M. Mustata, A. Pukhlikov, K. Smith, J. Starr.

Information: http://www.mathematics.jhu.edu/new/jami/Jami2006.htm.

*13-17 **Workshop on 3-manifolds after Perelman**, International Centre for Mathematical Sciences, Edinburgh, United Kingdom.

Workshop Summary: The objective of this workshop is the examination of recent developments in 3-dimensional topology in the light of Perelman's probable proof of Thurston's Geometrization Conjecture, and of other important advances such as the proof of Thurston's Ending Lamination Conjecture, and of Marden's Tameness Conjecture and the development of Heegaard Floer homology theory. The meeting will take stock of the subject and set out directions for future research.

Organizers: Cameron Gordon (Univ. of Texas at Austin), James Howie (Heriot-Watt Univ.), Alan Reid (Univ. of Texas at Austin).

Speakers: Jeffrey Brock (Brown Univ.), David Gabai (Princeton Univ.), Marc Lackenby (Univ. of Oxford), Peter Ozsvath (Columbia Univ.), Peter Shalen (Univ. of Illinois at Chicago), Ian Agol (Univ. of Illinois at Chicago), Michel Boileau (Univ. Paul Sabatier, Toulouse), Brian Bowditch (Univ. of Southampton), Martin Bridson (Imperial College), Shelly Harvey (Rice Univ.), Craig Hodgson (Univ. of Melbourne), Hyam Rubinstein (Univ. of Melbourne), Zlil Sela (Hebrew Univ.), Richard Weidmann (Univ. of Frankfurt).

Deadline: The meeting is limited in numbers in order to maintain its workshop character. Applications are invited now. An application form may be found on the website. The application period will close on January 15, 2006.

Information: http://www.icms.org.uk/meetings/2006/3-manifolds/index.html.

*17-19 **Transport Properties of Random Schrödinger Operators**, University of Kentucky, Lexington, Kentucky.

Organizers: Jean Bellissard, Georgia Institute of Technology, Peter D. Hislop, University of Kentucky.

Program: This is an intensive, three-day workshop on transport properties of Schrödinger operators with random potentials and related problems of transport theory. The focus will be on topics of recent research including linear response theory and kinetic equations, noncommutative geometry and the quantum Hall effect, edge and bulk conductivities, the Kubo formula for conductivity, classical and quantum diffusion, and other transport phenomena in random media. The workshop consists of hour-long expository talks by leading researchers in random Schrödinger operators and transport theory, short talks by new researchers in the field, a

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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 **eight 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/July, 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 the AMS website on the World Wide Web. To access the AMS website, use the URL: http://www.ams.org/.

poster session, and round table discussions on open problems and new directions.
Partially Sponsored by: Institute for Mathematics and its Applications, University of Kentucky, Georgia Institute of Technology.
Confirmed Invited Speakers (as of November 2005):: Michael Aizenman (Princeton University), Jean-Michel Combes (Université de Toulon, France), Laszlo Erdös (Ludwig-Maxilmilianssität Munchen, Germany), Gian Michele Graf (ETH Zurich, Switzerland), François Germinet (Université de Cergy-Pontoise, France), Dirk Hundertmark (University of Illinois, Urbana-Champaign), Abel Klein (University of California, Irvine), Michael Loss (Georgia Institute of Technology, Atlanta), Jeff Schenker (ETH Zürich, Swittzerland,) Hermann Schulz-Baldes (Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany,) Gunter Stolz (University of Alabama, Birmingham), Dominique Spehner (Université JJoseph Fourier, Grenoble, Franc).
Information and Registration: http://www.math.uky.edu/~hislop/ima06/.

*24-25 **Complex Geometry (in honor of Domingo Toledo's 60th birthday)**, University of Utah, Salt Lake City, Utah.
Organizing Committee: Jim Carlson, Bill Goldman.
Speakers: Daniel Allcock (Univ. of Texas), Luis Hernández (CIMAT), Misha Kapovich (Univ. Calif., Davis), Bruno klingler (Univ. of Chicago), János Kollár (Princeton Univ.), Yum-Tong Siu (Harvard Univ.), Dennis Sullivan (Stony Brook Univ.).
Information: http://www.math.utah.edu/complexgeometry or contact Mary Levine, email: mlevine@math.utah.edu, tel: 801-581-6841; fax: 801-581-4148.

April 2006

*1-2 **Graduate Student Topology Conference**, Indiana University, Bloomington, Indiana.
Objectives: The goal of the Graduate Student Topology Conference is to gather graduate students in topology and provide them with the opportunity to give talks, communicate recent advances, and hear from established researchers in the field.
Plenary Speaker: V. Jones (Berkeley), D. McDuff (Stony Brook).
Deadline: February 15, 2006.
Information: To register, to apply to give a talk, or to ask for funding, go to http://www.indiana.edu/~gstc/; email: gstc@indiana.edu.

*23-May 6 **Rigidity and Flexibility (ESI-Program 2006)**, The International Erwin Schrödinger Institute for Mathematical Physics (ESI), Vienna, Austria.
Description: This program of the International Erwin Schrödinger Institute for Mathematical Physics (ESI) is aimed at the study of various flexible and rigid structures such as flexible polyhedra and frameworks, polyhedral herissons and virtual polytopes, smooth herissons and smooth surfaces. Within this program the two workshops 1. Flexibility of Polyhedra and Frameworks 2. Herissons and Virtual Polytopes will be organized in cooperation with the Institute of Discrete Mathematics and Geometry of the Vienna University of Technology. The organizers of this program invite persons interested in the above-mentioned topics to take part in this program, to share ideas and experiences among different disciplines.
Organizers: Victor Alexandrov, Sobolev Institute of Mathematics, Novosibirsk; Idzhad Kh. Sabitov, Moscow State University; Hellmuth Stachel, Vienna University of Technology.
Information: http://www.geometrie.tuwien.ac.at/esi/.

May 2006

*10-12 **Workshop on Numerical, Mathematical and Modeling Analysis Related to Fluid Dynamics in Hydrogen Fuel Cells**, University of Ottawa, Ottawa, Ontario, Canada.
Workshop Description: Hydrogen fuel cells (HFC) are on the focus of research of several scientific areas, such as chemistry, material sciences, engineering, mathematics etc. The interest for operating efficiently HFC is constantly increasing as HFC produce free pollution electrical power. This workshop will be focused on numerical, computational and mathematical analysis of HFC dynamics. Modeling will be an important face of the workshop.
Invited Speakers: Ned Djilali, University of Victoria, Computational and modeling fuel cell dynamics; two-phase transport dynamics in gas diffusive layers; Yalchin Efendiev, Texas A&M University, Multiscale analysis and computation of multiphase flows in heterogeneous porous media; Peter Minev, University of Alberta, Multiphase computational fluid dynamics; Keith Promislow, Michigan State University, Phase change and Hysteresis in Proton Exchange Membrane Fuel Cells.
Registration Fee: The registration fee is $100 CAN for all academic and industrial researchers, $50 CAN dollars for students. The invited speakers are free of registration fees.
Travel Support: Please note that travel and accommodation support will be available for students. Interested students must contact Arian Novruzi at novruzi@uottawa.ca.
Information: http://www.fields.utoronto.ca/programs/scientific/05-06/fuelcells/index.html.

*15-17 **The First International Conference on Mathematical Sciences**, Al-Azhar University, Gaza, The Palestinian Authority.
Description: The main objective of the conference is to get an international scientific gathering at our University. We would like to overcome the deliberate policy of isolating our people and scientific institutions, and to involve the Palestinian researchers in contact with International Researchers in their fields.
Topics: Pure Mathematics, Applied Mathematics, Mathematical Physics, Theoretical and applied Mechanics, Probability and Statistics, Biometrics, Computer Sciences.
Sponsor: Al Azhar University; http://www.alazhar-gaza.edu/ICMS; email: m.okasha@palnet.com.
Deadline: February 28, 2006.
Information: Dr. Mahmoud K. Okasha, Head of the Organizing Committee, Al-Azhar University, Gaza, P.O. Box 1277, Gaza; email: m.okasha@alazhar-gaza.edu and m.okasha@palnet.com; tel: +970-599-441133.

*15-17 **Workshop on Probabilistic Symmetries and their Applications**, University of Ottawa, Ottawa, Ontario, Canada.
Introduction: In probability theory, random objects may have interesting and important symmetry properties: i.e. distributional invariance under a particular family of measurable transformations. The best known symmetries include stationarity, contractability, exchangeability and rotatability (invariance under shifts, contractions, permutations and rotations, respectively). Stationarity is a classical concept which is treated in most standard textbooks, and so the goal of the workshop is to introduce participants to the remaining three symmetries and their applications.
Speakers: Main Speaker: Professor Olav Kallenberg (Auburn University, Alabama). Invited Speakers: Professor Neville Weber (University of Sydney, Australia), Professor Fabio Spizzichino (Universita La Sapienza-Rome, Italy), Professor André Dabrowski (University of Ottawa).
Registration Fees: The registration fees for this workshop have been set at $80 per participant ($40 for students). Registration forms should be submitted by April 21, 2006.
Information: http://www.mathstat.uottawa.ca/~givanoff/workshop.htm.

*16-18 **LMS Workshop on Cluster Algebras and Teichmüller Theory**, University of Leicester, Leicester, United Kingdom.
Information: http://www.math.le.ac.uk/RESEARCH/LMS/webpage.html.

*30-June 2 **Geometry and Representation Theory: A conference in honor of George Lusztig**, M.I.T., Cambridge, Massachusetts.

Information: http://math.mit.edu/conferences/lusztig60/index.html.

June 2006

*4-10 **Workshop on Commutative Rings**, Cortona, Italy.
Aim: To bring together researchers in the area of commutative ring theory.
Topics: The main emphasis of the workshop is on factorization and divisibility properties, decomposition of ideals, class groups; multiplicative ideal and module systems, star and semistar operations, Gabriel-Popescu localizing systems; Prüfer domains and their generalizations; Krull and Mori domains; integer valued polynomials; chain conditions and prime spectra; analytically irreducible one-dimensional rings and their value semigroups; one-dimensional Noetherian rings and algebroid curves. Young researchers interested in these areas are welcome.
Scientific Committee: Valentina Barucci (Univ. degli Studi "La Sapienza"), Paul-Jean Cahen (Univ. Paul Cézanne, Aix-Marseille III), Marco Fontana (Univ. degli Studi "Roma Tre"), Stefania Gabelli (Univ. degli Studi "Roma Tre"), Evan G. Houston (Univ. of North-Carolina, Charlotte).
Organizing Committee: Florida Girolami (Univ. degli Studi "Roma Tre"), Giampaolo Picozza (Univ. degli Studi "Roma Tre"), Francesca Tartarone (Univ. degli Studi "Roma Tre").
Main Sponsor: NdAM (Istituto Nazionale di Alta Matematica).
Information: http://www.mat.uniroma3.it/users/cortona/cortona_2006.html;email: cortona2006@mat.uniroma3.it.

*12-15 **Journées Peter Shalen**, Centre de Recherches Mathematiques, Montreal, Quebec, Canada.
Organizers: Steve Boyer, Dick Canary, Marc Culler, Nathan Dunfield, Benson Farb.
Speakers (*tentative): Ian Agol (Univ. of Illinois at Chicago), Mladen Bestvina (Univ. of Utah), Marc Culler (Univ. of Illinois at Chicago), Nathan Dunfield (Caltech), Cameron Gordon (Univ. of Texas), *Alex Lubotzky (Hebrew Univ. of Jerusalem), Yair Minsky (Yale Univ.), *Maryam Mirzakhani (Princeton Univ./Clay Institute), John Morgan (Columbia Univ.), *Lenhard Ng (Stanford Univ. /AIM), Peter Ozsvath (Columbia Univ.), Jake Rasmussen (Princeton Univ.), Michah Sageev (Technion).
Information: http://www.math.uic.edu/journees.

*12-16 **EMS mathematical weekend in Pays de Loire**, Université de Nantes, Nantes, France.
Topics: With plenary lectures and parallel sessions, the conference will focus on five topics: Inverse problems, chair Roman Novikov; Large scale stochastics, chair Philippe Carmona; Complex algebraic geometry, chair Christoph Sorger; Global analysis, chair Gilles Carron; Real algebraic varieties, chair Adam Parusinski.
Organizers: Mathematical Institutes from Angers and Nantes, with the support of SMF and SMAI.
Information: http://www.math.sciences.univ-nantes.fr/WEM2006; email: wem2006@math.univ-nantes.fr.

*19-24 **Hodge Theory**, Venice International University, Venice-Island of San Servolo, Italy.
Workshop Topics: This meeting is intended to present the state of the art in Hodge Theory covering the full range of its current developing topics as well as the interrelation between them: from classical transcendental methods and algebraic cycles to mixed, arithmetic, p-adic structures and motives.
Organizers: L. Barbieri-Viale (Padova), B. Chiarellotto (Padova), H. Esnault (Essen), B. Van Geemen (Milano).
Speakers (preliminary list): S. Bloch (University of Chicago, USA), C. Breuil (CNRS & IHES, France), G. Faltings (MPI, Bonn, Germany), J.-M. Fontaine (Universite de Paris-Sud, Orsay, France), P. Griffiths (IAS, Princeton, USA), U. Jannsen (Univ. of Regensburg, Germany), L. Illusie (Universite de Paris-Sud, Orsay, France), K. Kato (Kyoto University, Japan), K. S. Kedlaya (MIT, Boston, USA), M. Nori (University of Chicago, USA), M. Rapoport (Math. Institut, Universität Bonn, Germany), M. Saito (RIMS, Kyoto, Japan), T. Tsuji (Tokyo University, Japan), E. Viehweg (Essen, Germany), C. Voisin (Paris 7, France).
Deadlines: Support, Housing & Registration: February 1, 2006. Housing & Registration: March 1, 2006. Registration: May 1, 2006.
Sponsors: Clay Mathematics Institute (USA), European Research Networks, "Arithmetic Algebraic Geometry" and "Algebraic K-theory, Linear Algebraic Groups & Related Structures", Italian Research Network "Geometria sulle Varieta' Algebriche" financed by MIUR Universities of Padova, Milano and Venice International University.
Information: http://www.mat.uniroma3.it/GVA/HTVIU/.

*19-July 7 **Computational Number Theory and Applications to Cryptography**, University of Wyoming, Laramie, Wyoming.
Purpose: To bring participants up to speed on the most recent developments in computational number theory and mathematical cryptography. Participants will be introduced to the theory and applications of computational number theory and its consequences for cryptography. The conference will take place immediately before the Fall 2006 Fields Institute Thematic Program in Cryptography.
Speakers: E. Bach (University of Wisconsin-Madison), M. Bauer (University of Calgary), M. Jacobson (University of Calgary), E. Gorla (University of Zurich), C. Pomerance (Dartmouth College), R. Scheidler (University of Calgary), O. Schirokauer (Oberlin College),J.H. Silverman (Brown University), J. Sorenson (Butler University),A. Stein (University of Wyoming, E. Teske (University of Waterloo), N. Theriault (University of Waterloo), H.C. Williams (University of Calgary).
Sponsors: Rocky Mountain Mathematics Consortium, The Fields Institute, Alberta Informatics Circle of Research Excellence (iCORE), and the University of Wyoming. IMA funding pending.
Deadline: For application/call for papers: April 1, 2006.
Organizers: M.J. Jacobson, (University of Calgary), A.D. Porter, B.L. Shader, A. Stein (University of Wyoming).
Information: Contact: A. Stein, Mathematics Department, University of Wyoming, Laramie, WY 82071; email: astein@uwyo.edu; http://math.uwyo.edu/RMMC/2006/rmmc06.html.

*20-22 **International Conference on Mathematical, Statistical, and Computer Methods in HIV/AIDS**, Regal Kowloon Hotel, East Kowloon, Hong Kong.
Purpose: To bring together researchers from all over the world to discuss methods for accurate estimates and future predictions of HIV/AIDS incidence and prevalence in different parts of the world.
Information: email: aggarwal@math.ucalgary.ca.

*29-July 4 **21th International Conference on Operator Theory**, West University, Timisoara, Romania.
Topics: Operator theory, operator algebras and their applications.
Steering Committee: W. B. Arveson, K. R. Davidson, N. K. Nikolskii, S. Stratila, F.-H. Vasilescu.
Information: http://www.imar.ro/~ot.

July 2006

*17-21 **Classification theory for abstract elementary classes**, AIM Research Conference Center, Palo Alto, California.
Topics: This workshop, sponsored by AIM and the NSF, will focus on Shelah's categoricity conjecture for abstract elementary classes. Thirty years ago Saharon Shelah proposed a far reaching program of extending first-order classification theory for non-elementary classes. This workshop will be dedicated to discussing the present state of Shelah's conjectures as well as the broader program of developing a classification theory for abstract elementary classes.
Organizers: Rami Grossberg and Monica VanDieren.
Deadline: April 15, 2006.
Information: http://aimath.org/ARCC/workshops/categoricity.html.

* 17–August 11 **Clay Mathematics Institute 2006 Summer School: Arithmetic Geometry**, Mathematisches Institut, Georg-August-Universität, Göttingen, Germany.
Description: Designed for graduate students and mathematicians within five years of their Ph.D., the program will introduce the participants to modern techniques and outstanding conjectures at the interface of number theory and algebraic geometry.
Topics: This school will offer three core courses (on curves, surfaces, and higher-dimensional varieties), supplemented by seminars on computational and algorithmic aspects of arithmetic geometry, and by mini-courses on more advanced topics.
Organizers: Jim Carlson, Henri Damon, David Ellwood, Brendan Hassett and Yuri Tschinkel).
Lecturers: Dan Abramovich, Fedor Bogomolov, Antoine Chambert-Loir, Ching-Li Chai, Henri Damon, David Harari, Brendan Hassett, Andrew Kresch, Yuri Manin, Frans Oort, Jason Starr, Yuri Tschinkel and others.
Deadline: For application is February 28, 2005. For more information and an application form see `http://www.claymath.org/summerschool` or contact email: `summerschool@claymath.org`; telephone: 617-995-2600.

* 24–28 **2nd SIPTA School on Imprecise Probabilities**, Rey Juan Carlos University, Madrid, Spain.
Organizer: By the International Society for Imprecise Probability: Theories and Applications (SIPTA) and by the Group of Statistics and Decision Sciences (GECD) from Rey Juan Carlos University.
Information: You can find all the relevant information on `http://bayes.escet.urjc.es/~emiranda/sipta`.

* 24–28 **Brazilian Operator Algebras Conference**, Florianopolis, Brazil.
Information: `http://mtm.ufsc.br/~exel/oa/`.

* 24–August 4 **Pan-American Advanced Studies Institute (PASI): Analysis and Probability in Quantum Physics**, San Joaquin campus, Pontificia Catolica de Chile, Santiago, Chile.
Program: The PASI Institute is a two-week program for advanced graduate students, post-docs, and assistant professors from the Americas. There will be 6 four-hour minicourses during the first week and an international workshop during the second week. Full support is available for Institute students; partial support is available for workshop participants.
Minicourses and their Presenters: Ira W. Herbst, University of Virginia, The Spectral and Scattering Theory of Quantum Particles in External Fields, Abel Klein, University of California, Irvine, Random Schrödinger Operators, Jean Bellissard, Georgia Institute of Technology, Theory of Quantum Transport, Richard Froese, University of British Columbia, Theory of Quantum Resonances, Rafael Benguria, Pontificia Universidad Católica de Chile, Stability of Matter and Quantum Field Theory, Laszlo Erdos, Ludwig-Maximilians-Universität München, Classical and Quantum Brownian Motion.
Workshop: The International Workshop on Analysis and Probability in Quantum Physics will highlight recent advances in the topics discussed during the first week mini-courses. In addition to invited talks by international experts, the PASI students will have the opportunity to present their own research.
Support: PASI is primarily supported by the U.S. National Science Foundation and the Department of Energy.
Information: Full information, a list of the confirmed Workshop participants, online application forms, etc. available at `http://www.ms.uky.edu/~pasi06/`.

* 25–27 **International Conference on Mathematics**, Institute of Mathematics, National University of Mongolia, Ulaanbaatar, Mongolia.
Organizer: The Mathematical Society of Mongolia jointly with School of Mathematics and Computer Science, National University of Mongolia and the Institute of Mathematics, National University of Mongolia.
Topics: Algebra (ring theory, module theory, commutative algebra and etc.), Functional analysis, Applied mathematics and numerical analysis, Probability theory and mathematical statistics, Geometry and topology, Applied Mathematics and Optimization, Mathematical Education.
Information: email: `mekei@num.edu.mn`.

August 2006

* 7–11 **Partial Differential Equations on Noncompact and Singular Manifolds**, University of Potsdam, Potsdam, Germany.
Topics Include: Qualitative Theory of PDEs (Regularity, Asymptotics), Geometric Analysis on Singular Spaces, K-theoretic Methods, Operator Algebra Aspects, Boundary Value Problems, Noncommutative Geometry, Quantization.
Organizing Committee: B. Fedosov (Moscow), G. Grubb (Copenhagen), T. Krainer (Potsdam), V. Nistor (Penn State), L. Rodino (Torino), B.-W. Schulze (Potsdam), N. Tose (Tokyo), M. W. Wong (Toronto).
Information: PDEs on Noncompact and Singular Manifolds c/o T. Krainer and B.-W. Schulze, Institut für Mathematik, Universität Potsdam, Postfach 60 15 53, D-14415 Potsdam, Germany; email: `pdensm@math.uni-potsdam.de`; `http://pdensm.math.uni-potsdam.de`.

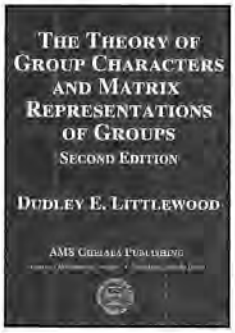
* 14–18 **International Conference on Spectral Theory and Global Analysis**, Carl von Ossietzky University, Oldenburg, Germany.
Topics will include: Spectral asymptotics, Scattering theory, Index Theory and Hodge Theory, Spectral Invariants, Analysis on singular and non-compact spaces.
Organizing Committee: D. Grieser (Oldenburg), T. Krainer (Potsdam), A. Vasy (Stanford).
Information: Spectral Theory and Global Analysis, c/o Prof. Daniel Grieser, Institut für Mathematik, Universität Oldenburg, D-26111 Oldenburg, Germany; email: `stga@mathematik.uni-oldenburg.de`; `http://www.mathematik.uni-oldenburg.de/personen/grieser/stga/`.

August 2007

* 3–6 **First Announcement ACA'2007: 13th International Conference on Applications of Computer Algebra**, Oakland University, Rochester, Michigan.
Conference Theme: The ACA series of conferences is devoted to promoting the applications and development of Computer Algebra and Symbolic Computation. Topics include Computer Algebra and Symbolic Computation in engineering, the sciences, medicine, pure and applied mathematics, education, communication and computer science.
General Chairs: Tony Shaska, Erich Kaltofen, Jaime Gutierrez, Alexander Hulpke.
Program Chair: Tony Shaska.
Organizing Committee: Stanly Steinberg, Michael Wester.
Important Dates: May 15, 2007: Deadline to submit an application for financial support. June 15, 2007: Notification of decisions for financial support. June 15, 2007: Deadline for early registration. July 15, 2007: Deadline for regular registration. August 3-6, 2007 Conference
Information: Contact: `shaska@oakland.edu`; `http://www.oakland.edu/~shaska/aca07.html`.

New Publications Offered by the AMS

Algebra and Algebraic Geometry



The Theory of Group Characters and Matrix Representations of Groups

Second Edition

Dudley E. Littlewood

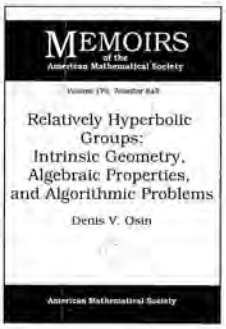
Originally written in 1940, this book remains a classical source on representations and characters of finite and compact groups. The book starts with necessary information about matrices, algebras, and groups. Then the author proceeds to representations of finite groups. Of particular interest in this part of the book are several chapters devoted to representations and characters of symmetric groups and the closely related theory of symmetric polynomials. The concluding chapters present the representation theory of classical compact Lie groups, including a detailed description of representations of the unitary and orthogonal groups. The book, which can be read with minimal prerequisites (an undergraduate algebra course), allows the reader to get a good understanding of beautiful classical results about group representations.

This item will also be of interest to those working in discrete mathematics and combinatorics.

Contents: Matrices; Algebras; Groups; The Frobenius algebra; The symmetric group; Immanants and S-functions; S-functions of special series; The calculation of the characters of the symmetric group; Group characters and the structure of groups; Continuous matrix groups and invariant matrices; Groups of unitary matrices; Appendix; Bibliography; Supplementary bibliography; Index.

AMS Chelsea Publishing

March 2006, 310 pages, Hardcover, ISBN 0-8218-4067-3, 2000 *Mathematics Subject Classification*: 20Cxx, **Individual member US$41**, List US$45, Order code CHEL/357.H



Relatively Hyperbolic Groups: Intrinsic Geometry, Algebraic Properties, and Algorithmic Problems

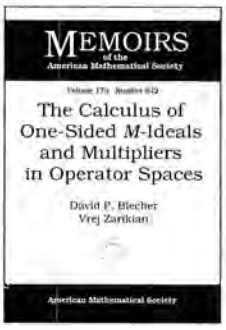
Denis V. Osin

Contents: Introduction; Relative isoperimetric inequalities; Geometry of finitely generated relatively hyperbolic groups; Algebraic properties; Algorithmic problems; Open questions; Appendix. Equivalent definitions of relative hyperbolicity; Bibliography.

Memoirs of the American Mathematical Society, Volume 179, Number 843

December 2005, 100 pages, Softcover, ISBN 0-8218-3821-0, LC 2005053663, 2000 *Mathematics Subject Classification*: 20F65; 20F05, 20F06, 20F10, 20F67, 20F69, **Individual member US$35**, List US$58, Institutional member US$46, Order code MEMO/179/843

Analysis



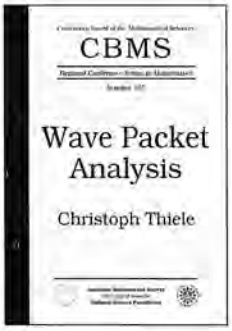
The Calculus of One-Sided M-Ideals and Multipliers in Operator Spaces

David P. Blecher and **Vrej Zarikian**

Contents: Introduction; Preliminaries; Spatial action; Examples; Constructions; One-sided type decompositions and Morita equivalence; Central M-structure for operator spaces; Future directions; Appendix A. Some results from Banach space theory; Appendix B. Infinite matrices over an operator space; Appendix. Bibliography.

Memoirs of the American Mathematical Society, Volume 179, Number 842

December 2005, 85 pages, Softcover, ISBN 0-8218-3823-7, LC 2005053579, 2000 *Mathematics Subject Classification*: 46L07, 46L89; 46B20, 46B04, **Individual member US$35**, List US$58, Institutional member US$46, Order code MEMO/179/842



Wave Packet Analysis

Christoph Thiele

The concept of "wave packet analysis" originates in Carleson's famous proof of almost everywhere convergence of Fourier series of L^2 functions. It was later used by Lacey and Thiele to prove bounds on the bilinear Hilbert transform. For quite some time, Carleson's wave packet analysis was thought to be an important idea, but that it had limited applications. But in recent years, it has become clear that this is an important tool for a number of other applications. This book is an introduction to these tools. It emphasizes the classical successes (Carleson's theorem and the Hilbert transform) in the main development. However, the book closes with a dedicated chapter on more recent results.

Carleson's original theorem is sometimes cited as one of the most important developments of 20th century harmonic analysis. The set of ideas stemming from his proof is now seen as an essential element in modern harmonic analysis. Indeed, Thiele won the Salem prize jointly with Michael Lacey for work in this area.

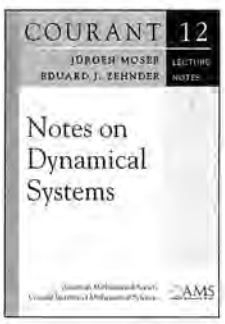
The book gives a nice survey of important material, such as an overview of the theory of singular integrals and wave packet analysis itself. There is a separate chapter on "further developments", which gives a broader view on the subject, though it does not exhaust all ongoing developments.

Contents: Introduction; Wavelets and square functions; Interpolation of multilinear operators; Paraproducts; Wave packets; Multilinear forms with modulation symmetries; Carleson's theorem; The Walsh model; Further applications of wave packet analysis; Bibliography.

CBMS Regional Conference Series in Mathematics, Number 105

February 2006, 86 pages, Softcover, ISBN 0-8218-3661-7, 2000 *Mathematics Subject Classification*: 42-02; 42A99, 47H60, 42A20, **All Individuals US$23**, List US$29, Order code CBMS/105

Differential Equations



COURSE ADOPTION

Notes on Dynamical Systems

Jürgen Moser and **Eduard J. Zehnder**

This book is an introduction to the field of dynamical systems, in particular, to the special class of Hamiltonian systems. The authors aimed at keeping the requirements of mathematical techniques minimal but giving detailed proofs and many examples and illustrations from physics and celestial mechanics. After all, the celestial N-body problem is the origin of dynamical systems and gave rise in the past to many mathematical developments.

Jürgen Moser (1928–1999) was a professor at the Courant Institute, New York, and then at ETH Zurich. He served as president of the International Mathematical Union and received many honors and prizes, among them the Wolf Prize in mathematics. Jürgen Moser is the author of several books, among them *Stable and Random Motions in Dynamical Systems*. Eduard Zehnder is a professor at ETH Zurich. He is coauthor with Helmut Hofer of the book *Symplectic Invariants and Hamiltonian Dynamics*.

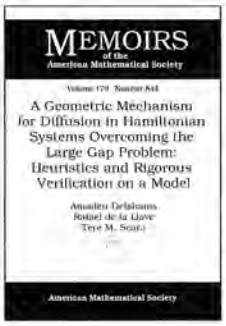
This item will also be of interest to those working in analysis.

Titles in this series are copublished with the Courant Institute of Mathematical Sciences at New York University.

Contents: Transformation theory; Periodic orbits; Integrable Hamiltonian systems; Bibliography.

Courant Lecture Notes, Volume 12

January 2006, 256 pages, Softcover, ISBN 0-8218-3577-7, LC 2005055871, 2000 *Mathematics Subject Classification*: 37-01, 37Kxx, 53Dxx, 58Exx, 70Fxx, 70H05, **All AMS members US$27**, List US$34, Order code CLN/12



A Geometric Mechanism for Diffusion in Hamiltonian Systems Overcoming the Large Gap Problem: Heuristics and Rigorous Verification on a Model

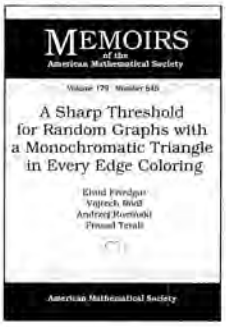
Amadeu Delshams, **Rafael de la Llave**, and **Tere M. Seara**

Contents: Introduction; Heuristic discussion of the mechanism; A simple model; Statement of rigorous results; Notation and definitions, resonances; Geometric features of the unperturbed problem; Persistence of the normally hyperbolic invariant manifold and its stable and unstable manifolds; The dynamics in $\tilde{\Lambda}_\varepsilon$; The scattering map; Existence of transition chains; Orbits shadowing the transition chains and proof of Theorem 4.1; Conclusions and remarks; An example; Acknowledgments; Bibliography.

Memoirs of the American Mathematical Society, Volume 179, Number 844

December 2005, 141 pages, Softcover, ISBN 0-8218-3824-5, LC 2005053662, 2000 *Mathematics Subject Classification*: 37J40, 37C29, 34C37; 70H08, 37C50, 34C29, **Individual member US$37**, List US$62, Institutional member US$50, Order code MEMO/179/844

Discrete Mathematics and Combinatorics



A Sharp Threshold for Random Graphs with a Monochromatic Triangle in Every Edge Coloring

Ehud Friedgut, Vojtech Rödl, Andrzej Ruciński, and **Prasad Tetali**

Contents: Introduction; Outline of the proof; Tepees and constellations; Regularity; The core section (Proof of Lemma 2.4); Random graphs; Summaryt, further remarks, glossary; Bibliography.

Memoirs of the American Mathematical Society, Volume 179, Number 845

December 2005, 66 pages, Softcover, ISBN 0-8218-3825-3, LC 2005053660, 2000 *Mathematics Subject Classification*: 05C15; 05C55, 05C80, **Individual member US$30**, List US$50, Institutional member US$40, Order code MEMO/179/845

General and Interdisciplinary

The Coxeter Legacy

Reflections and Projections

Chandler Davis and **Erich W. Ellers**, Editors

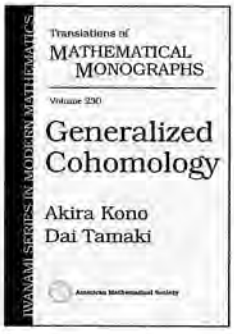
Donald Coxeter infused enthusiasm, even passion, for mathematics in people of any age, any background, any profession, any walk of life. Enchanted by Euclidean geometry, he was interested in the beauty, the description, and the exploration of the world around us. His involvement in art and with artists earned him admiration and friends in the intellectual community all over the globe. Coxeter's devotion to polytopes and his interest in the theory of configurations live on in his students and followers. Coxeter groups arise in various subjects in applied mathematics, and they have a permanent place in some of the most demanding and fascinating branches of abstract mathematics, such as Lie algebras, algebraic groups, Chevalley groups, and Kac-Moody groups. This collection of articles by outstanding researchers and expositors is intended to capture the essence of the Coxeter legacy. It is a mixture of surveys, up-to-date information, history, storytelling, and personal memories; and it includes a rich variety of beautiful illustrations.

This item will also be of interest to those working in discrete mathematics and combinatorics.

Contents: B. Mühlherr, The isomorphism problem for Coxeter groups; **A. V. Borovik**, Coxeter theory: The cognitive aspects; **M. Ronan**, From Galois and Lie to Tits buildings; **B. Kostant**, The Coxeter element and the branching law for the finite subgroups of $SU(2)$; **R. Kellerhals**, Hyperbolic Coxeter groups and space forms; **P. McMullen** and **E. Schulte**, Regular and chiral polytopes in low dimensions; **B. Monson** and **A. I. Weiss**, Polytopes, honeycombs, groups and graphs; **J. M. Wills**, Equivelar polyhedra; **A. Khovanskii**, Combinatorics of sections of polytopes and Coxeter groups in Lobachevsky spaces; **M. Senechal**, Donald and the golden rhombohedra; **B. Grünbaum**, Configurations of points and lines; **J. Richter-Gebert**, Meditations on Ceva's theorem; **D. Schattschneider**, Coxeter and the artists: Two-way inspiration; **M. Emmer**, The visual mind: Art, mathematics and cinema; Publications of H. S. M. Coxeter; Index.

March 2006, 321 pages, Hardcover, ISBN 0-8218-3722-2, 2000 *Mathematics Subject Classification*: 01A99, 14M25, 20E42, 20F55, 22E46, 51A20, 51M20, 52B15, 52C23, 52B70, **All AMS members US$55**, List US$69, Order code COXETER

Geometry and Topology



Generalized Cohomology

Akira Kono and **Dai Tamaki**

In the 1950s, Eilenberg and Steenrod presented their famous characterization of homology theory by seven axioms. Somewhat later, it was found that keeping just the first six of these axioms (all except the condition on the "homology" of the point), one can obtain many other interesting systems of algebraic invariants of topological manifolds, such as K-theory, cobordisms, and others. These theories come under the common name of generalized homology (or cohomology) theories.

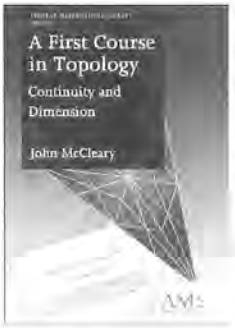
The purpose of the book is to give an exposition of generalized (co)homology theories that can be read by a wide group of mathematicians who are not experts in algebraic topology. It starts with basic notions of homotopy theory and then introduces the axioms of generalized (co)homology theory. Then the authors discuss various types of generalized cohomology theories, such as complex-oriented cohomology theories and Chern classes, K-theory, complex cobordisms, and formal group laws. A separate chapter is devoted to spectral sequences and their use in generalized cohomology theories.

The book is intended to serve as an introduction to the subject for mathematicians who do not have advanced knowledge of algebraic topology. Prerequisites include standard graduate courses in algebra and topology, with some knowledge of ordinary homology theory and homotopy theory.

Contents: Preliminaries; Generalized cohomology; Characteristic classes of vector bundles; K-theory; Spectral sequence; Complex cobordism and its applications; Simplicial techniques; Limits; Spectrum; Bibliography; Index.

Translations of Mathematical Monographs (*Iwanami Series in Modern Mathematics*), Volume 230

March 2006, approximately 272 pages, Softcover, ISBN 0-8218-3514-9, 2000 *Mathematics Subject Classification*: 55N20; 55N15, 55N22, 55N40, 55T05, 55-02, **All AMS members US$39**, List US$49, Order code MMONO/230



COURSE ADOPTION

A First Course in Topology

Continuity and Dimension

John McCleary

How many dimensions does our universe require for a comprehensive physical description? In 1905, Poincaré argued philosophically about the necessity of the three familiar dimensions, while recent research is based on 11 dimensions or even 23 dimensions. The notion of dimension itself presented a basic problem to the pioneers of topology. Cantor asked if dimension was a topological feature of Euclidean space. To answer this question, some important topological ideas were introduced by Brouwer, giving shape to a subject whose development dominated the twentieth century.

The basic notions in topology are varied and a comprehensive grounding in point-set topology, the definition and use of the fundamental group, and the beginnings of homology theory requires considerable time. The goal of this book is a focused introduction through these classical topics, aiming throughout at the classical result of the Invariance of Dimension.

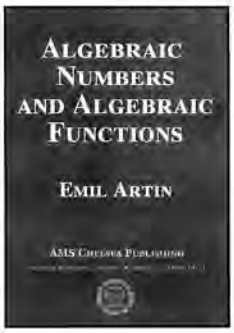
This text is based on the author's course given at Vassar College and is intended for advanced undergraduate students. It is suitable for a semester-long course on topology for students who have studied real analysis and linear algebra. It is also a good choice for a capstone course, senior seminar, or independent study.

Contents: A little set theory; Metric and topological spaces; Geometric notions; Building new spaces from old; Connectedness; Compactness; Homotopy and the fundamental group; Computations and covering spaces; The Jordan Curve Theorem; Simplicial complexes; Homology; Bibliography.

Student Mathematical Library, Volume 31

April 2006, approximately 216 pages, Softcover, ISBN 0-8218-3884-9, 2000 *Mathematics Subject Classification*: 54-01, 55-01, 54F45, **All AMS members US$28**, List US$35, Order code STML/31

Number Theory



Algebraic Numbers and Algebraic Functions

Emil Artin

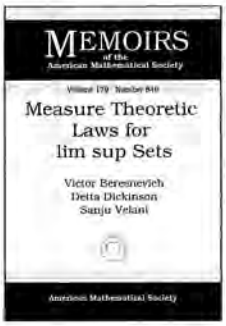
Famous Norwegian mathematician Niels Henrik Abel advised that one should "learn from the masters, not from the pupils". When the subject is algebraic numbers and algebraic functions, there is no greater master than Emil Artin. In this classic text, originated from the notes of the course given at Princeton University in 1950–1951 and first published in 1967, one has a beautiful introduction to the subject accompanied by Artin's unique insights and perspectives. The exposition starts with the general theory of valuation fields in Part I, proceeds to the local class field theory in Part II, and then to the theory of function fields in one variable (including the Riemann-Roch theorem and its applications) in Part III.

Prerequisites for reading the book are a standard first-year graduate course in algebra (including some Galois theory) and elementary notions of point set topology. With many examples, this book can be used by graduate students and all mathematicians learning number theory and related areas of algebraic geometry of curves.

Contents: *General valuation theory:* Valuations of a field; Complete fields; e, f and n; Ramification theory; The different; *Local class field theory:* Preparations for local class field theory; The first and second inequalities; The norm residue symbol; The existence theorem; Applications and illustrations; *Product formula and function fields in one variable:* Preparations for the global theory; Characterization of fields by the product formula; Differentials in PF-fields; The Riemann-Roch theorem; Constant field extensions; Applications of the Riemann-Roch theorem; Differentials in function fields; Theorems on p-groups and Sylow groups; Index of symbols; Subject index.

AMS Chelsea Publishing

January 2006, 349 pages, Hardcover, ISBN 0-8218-4075-4, 2000 *Mathematics Subject Classification*: 11-01, 11Rxx, 11Sxx, **Individual member US$44**, List US$49, Order code CHEL/358.H



Measure Theoretic Laws for lim sup Sets

Victor Beresnevich, Detta Dickinson, and **Sanju Velani**

Contents: Introduction; Ubiquity and conditions on the general setp; The statements of the main theorems; Remarks and corollaries to Theorem 1; Remarks and corollaries to Theorem 2; The classical results; Hausdorff measures and dimension; Positive and full m-measure sets; Proof of Theorem 1; Proof of Theorem 2: $0 \leq G < \infty$; Proof of Theorem 2: $G = \infty$; Applications; Bibliography.

Memoirs of the American Mathematical Society, Volume 179, Number 846

December 2005, 91 pages, Softcover, ISBN 0-8218-3827-X, LC 2005053661, 2000 *Mathematics Subject Classification*: 11J83, 11J13, 11K60, 28A78, 28A80, **Individual member US$35**, List US$58, Institutional member US$46, Order code MEMO/179/846

New AMS-Distributed Publications

Geometry and Topology

Arithmetic, Geometry and Coding Theory (AGCT 2003)

Yves Aubry and **Gilles Lachaud**, *Institut de Mathématiques de Luminy, Marseille, France*, Editors

In May 2003, two events were held in the CIRM (Marseille-Luminy) devoted to arithmetic, geometry and their applications in coding theory and cryptography: a European school "Algebraic Geometry and Information Theory" and the 9th international conference "Arithmetic, Geometry and Coding Theory". Some of the courses of the conferences are published in this volume. Topics covered include: Abelian varieties, function fields and curves over finite fields, Galois group of pro-p extensions, Dedekind zeta functions of number fields, numerical semigroups, Waring numbers, bilinear complexity of the multiplication in finite fields and class number problems.

A publication of the Société Mathématique de France, Marseilles (SMF), distributed by the AMS in the U.S., Canada, and Mexico. Orders from other countries should be sent to the SMF. Members of the SMF receive a 30% discount from list.

Contents: **P. Beelen**, **A. Garcia**, and **H. Stichtenoth**, On towers of function fields over finite fields; **M. Bras-Amorós**, Addition behavior of a numerical semigroup; **O. Moreno** and **F. N. Castro**, On the calculation and estimation of Waring number for finite fields; **G. Frey** and **T. Lange**, Mathematical background of Public Key Cryptography; **A. Garcia**, On curves over finite fields; **F. Hajir**, Tame pro-p Galois groups: A survey of recent work; **E. W. Howe**, **K. E. Lauter**, and **J. Top**, Pointless curves of genus three and four; **D. Le Brigand**, Real quadratic extensions of the rational function field in characteristic two; **S. R. Louboutin**, Explicit upper bounds for the residues at $s = 1$ of the Dedekind zeta functions of some totally real number fields; **S. Ballet** and **R. Rolland**, On the bilindar complexity of the multiplication in finite fields; **Yu. G. Zarhin**, Homomorphisms of abelian varieties.

Séminaires et Congrès, Number 11

September 2005, 216 pages, Softcover, ISBN 2-85629-175-9, 2000 *Mathematics Subject Classification*: 14H05, 14G05, 11G20, 20M99, 94B27, 11T06, 11T71, 11R37, 14G10, 14G15, 11R58, 11A55, 11R42, 11Yxx, 12E20, 14H40, 14K05, **Individual member US$53**, List US$59, Order code SECO/11

Logic and Foundations

The Continuum

A Constructive Approach to Basic Concepts of Real Analysis

Rudolf Taschner, *Vienna University of Technology, Austria*, Editor

In this small text the basic theory of the continuum, including the elements of metric space theory and continuity, is developed within the system of intuitionistic mathematics in the sense of L.E.J. Brouwer and H. Weyl. The main features are proofs of the famous theorems of Browuer concerning the continuity of all functions that are defined on " whole " intervals, the uniform continuity of all functions that are defined on compact intervals and the uniform convergence of all pointwise converging sequences of functions defined on compact intervals. The constructive approach is interesting both in itself and as a contrast to, for example, the formal axiomatic one.

A publication of Vieweg Verlag. The AMS is exclusive distributor in North America. Vieweg Verlag Publications are available worldwide from the AMS outside of Germany, Switzerland, Austria, and Japan.

Contents: Introduction and historical remarks; Real numbers; Metric spaces; Continuous functions; Literature; Index.

Vieweg Monographs

September 2005, 136 pages, Hardcover, ISBN 3-8348-0040-6, 2000 *Mathematics Subject Classification*: 03F55, 26A03, **All AMS members US$43**, List US$48, Order code VW/13

AMERICAN MATHEMATICAL SOCIETY

From the AMS Public Awareness Office...

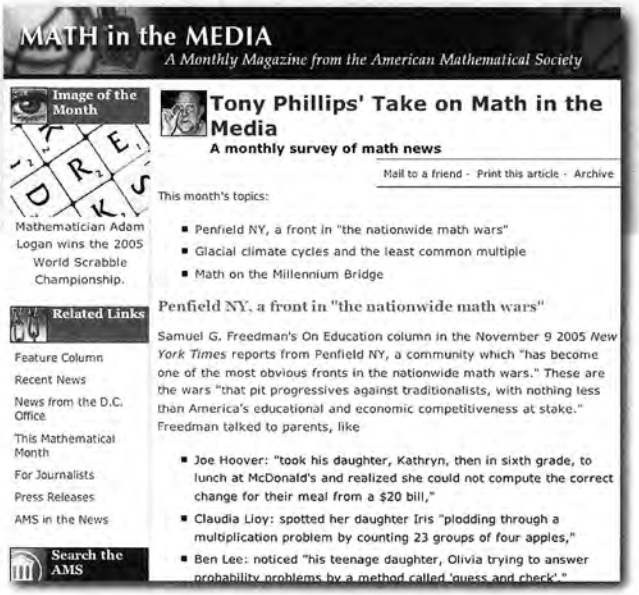
MATH in the MEDIA
www.ams.org/mathmedia

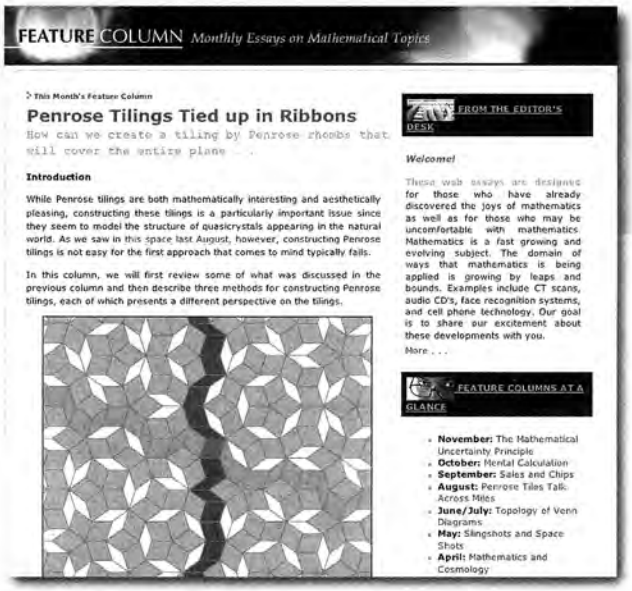
FEATURE COLUMN
www.ams.org/featurecolumn

Math in the Media and the **Feature Column** offer easy access to a wealth of information about current mathematics and its applications.

Math in the Media is a great way to keep abreast of math news as reported in newspapers and general science magazines. The collection—*Tony Phillips' Take on Math in the Media, Math Digest,* and *Reviews* of books, plays, and films with mathematical themes—is a centralized repository of articles in the media about mathematics.

The Feature Column is a series of essays on various mathematical topics—such as voting, Penrose tiles, cosmology, and networks—written by David Austin, Bill Casselman, Joe Malkevitch, and Tony Phillips.





Classified Advertisements

Positions available, items for sale, services available, and more

KENTUCKY

WESTERN KENTUCKY UNIVERSITY
Department of Mathematics

Applications are invited for the position of Head of the Department of Mathematics starting July 1, 2006.

Applicants must have a doctorate in mathematics or a mathematical science with appropriate credentials for a tenured appointment at the rank of professor. We are seeking a dedicated and effective leader who can help promote and strengthen the department's academic, research, and service programs. Qualified candidates must have an established record of high quality teaching and research/scholarly activity and a history of significant professional service. Evidence of additional administrative expertise is desired. Qualified candidates must also be committed to recognizing and encouraging excellence in teaching and research/scholarly activity, and be familiar with current issues involving the mathematics curriculum and technology.

Mathematics is one of nine departments in the College of Science and Engineering. With 35 full-time positions (23 tenured/tenure-track), the department offers baccalaureate and masters programs in mathematics. In addition, mathematics is included in the university general education requirements for all undergraduate degrees and the department is actively involved in teacher preparation.

Western Kentucky University enrolls approximately 18,000 undergraduate and graduate students, including more than 1,400 minority and 500 international students, and has a strong commitment to achieving diversity among faculty, staff, and administration. The university is in Bowling Green, between Louisville and Nashville, TN.

Review of applications will begin January 16, 2006, and will continue until the position is filled. Please send a letter of application, vita, a statement of administrative leadership philosophy, and at least three letters of recommendation to:

Dr. Keith Andrew, Chair,
Mathematics Head Search Committee
Dept. of Physics and Astronomy
Western Kentucky University
1906 College Heights Boulevard
#11077
Bowling Green, KY 42101-1077
email:
MathHeadSearch@physics.wku.edu

For more information about the Department of Mathematics at Western Kentucky University, visit our webpage at http://www.wku.edu/math.

All qualified individuals are encouraged to apply including women, minorities, persons with disabilities, and disabled veterans. Western Kentucky University is an Affirmative Action/Equal Opportunity Employer.

000226

MARYLAND

THE JESS & MILDRED FISHER COLLEGE OF SCIENCE & MATHEMATICS
Department of Mathematics
Assistant Professor, Mathematics

Applicants are invited to apply for a tenure-track appointment in applied mathematics at the rank of Assistant Professor beginning Fall 2006. Position is contingent on final funding approval for FY 07. Preference will be given to candidates that can support the Department of Mathematics graduate program in Applied and Industrial Mathematics. The salary is competitive. Applicants must have an earned doctorate in mathematics at time of hire. Applicants must possess a commitment to teaching, an active research program, and the ability to teach a variety of courses, at both the undergraduate and graduate levels.

The Department of Mathematics http://www.towson.edu/math offers bachelor's degree programs in pure mathematics, applied mathematics, actuarial science and risk management, and mathematics education. Master's degree programs are offered in applied and

Suggested uses for classified advertising are positions available, books or lecture notes for sale, books being sought, exchange or rental of houses, and typing services.

The 2006 rate is $100 per inch or fraction thereof on a single column (one-inch minimum), calculated from top of headline. Any fractional text of 1/2 inch or more will be charged at the next inch rate. No discounts for multiple ads or the same ad in consecutive issues. For an additional $10 charge, announcements can be placed anonymously. Correspondence will be forwarded.

Advertisements in the "Positions Available" classified section will be set with a minimum one-line headline, consisting of the institution name above body copy, unless additional headline copy is specified by the advertiser. Headlines will be centered in boldface at no extra charge. Ads will appear in the language in which they are submitted.

There are no member discounts for classified ads. Dictation over the telephone will not be accepted for classified ads.

Upcoming deadlines for classified advertising are as follows: March 2006 issue–December 30, 2005; April 2006 issue–January 31, 2006; May 2006 issue–February 28, 2006; June/July 2006 issue–April 28, 2006, August 2006 issue–May 26, 2006; September 2006 issue–June 27, 2006.

U.S. laws prohibit discrimination in employment on the basis of color, age, sex, race, religion, or national origin. "Positions Available" advertisements from institutions outside the U.S. cannot be published unless they are accompanied by a statement that the institution does not discriminate on these grounds whether or not it is subject to U.S. laws. Details and specific wording may be found on page 1373 (vol. 44).

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 email to classads@ams.org. AMS location for express delivery packages is 201 Charles Street, Providence, Rhode Island 20904. Advertisers will be billed upon publication.

industrial mathematics, and mathematics education.

Applicants should submit a letter of application, a resume, a description of research, a statement of teaching experience and philosophy, and copies of all graduate transcripts. Additionally, three letters of recommendation, addressing both teaching and research should be sent to:

Dr. Raouf Boules, Chairperson,
Search Committee
Department of Mathematics
Towson University
8000 York Road
Towson, MD 21252-0001

Applications or material sent by email or facsimile will not be considered. Priority will be given to applications received on or before February 15, 2006.

Towson University is an Equal Opportunity/Affirmative Action Employer and has a strong institutional commitment to diversity. Women, minorities, persons with disabilities, and veterans are encouraged to apply.

000228

MASSACHUSETTS

WILLIAMS COLLEGE
Department of Mathematics and Statistics

Williams College Department of Mathematics and Statistics invites applications for a newly authorized visiting position in mathematics for the 2006-2007 year, probably at the rank of assistant professor, however, in exceptional cases, a more advanced appointment might be considered. A Ph.D. is required. Send a vita and three letters of recommendation on teaching and research to: Visitor Hiring Committee, Department of Mathematics and Statistics, Williams College, Williamstown, MA 01267. Consideration of applications will begin on November 15th and continue until the position is filled. Williams College is dedicated to providing a welcoming intellectual environment for all of its faculty, staff and students; as an AA/EOE employer, Williams especially welcomes applications from women and minority candidates.

000102

NEW YORK

THE COOPER UNION
for the Advancement of Science & Art
Department of Mathematics

The Department of Mathematics in the School of Engineering invites applications for a full-time tenure-track faculty position to commence September 2006. Applicants must have a Ph.D. in mathematics and a strong ability to teach mathematics to exceptionally qualified undergraduate students. Candidates with a recent Ph.D. and with outstanding research potential will be given higher priority.

Please apply to Human Resources, The Cooper Union, 30 Cooper Square, NYC 10003 or hr@cooper.edu. The Cooper Union is an AA/EOE employer.

000203

RHODE ISLAND

ROGER WILLIAMS UNIVERSITY
Math Faculty Positions
Bristol, RI

The Mathematics Department of the Feinstein College of Arts and Sciences invites applications for two tenure-track positions, both at the rank of Assistant Professor, to begin in Fall 2006. Candidates for the first position should specialize in some area of analysis, while the second position is open to candidates in any area of specialization. The primary emphasis of either position is teaching both majors and non-majors in an undergraduate setting, but an ongoing program of publishable research and a commitment to departmental and university-wide service are also expected. A Ph.D. in mathematics at the time of appointment is required. Success in obtaining grants and at least three years of full-time teaching experience are highly desirable.

For a full job description please visit http://www.rwu.edu.

To apply send resume to: Roger Williams University, Office of Human Resources, One Old Ferry Road, Bristol, RI 02809 or email: human_resources@rwu.edu. Applications will be considered starting January 15, 2006. Equal Opportunity/Affirmative Action/ Americans with Disabilities Act Employer with a strong commitment to diversity.

000227

GUAM

UNIVERSITY OF GUAM
Department of Mathematics

Asst/Assoc Prof. Math vacancy at UOG. Ph.D. (req.) in Math Sci (prefer Pure/Applied, Math Stat). Send CV, 3 ref. letters, copies of grad transcripts, GovGuam application to Chair, Math Search, HRO, UOG, Mangilao, GU 96923. Visit http://www.uog.edu or email crmtaita@uog9.uog.edu. No email app. accepted. EEO/AA Emp.

000206

SWITZERLAND

UNIVERSITY OF FRIBOURG
Department of Mathematics

The Department for Mathematics at the University of Fribourg (Switzerland) invites applications for the following positions:

1. Senior Assistant in Analysis and its Applications:

It is part of the duties of the senior assistant to teach 4 to 6 hours a week on all levels, mainly in analysis. An intensive research activity is expected. She or he will supervise master theses, coach seminars, and participate in administrative tasks of the department. The successful candidate will have earned a Ph.D. in mathematics, show strong promise of excellence in teaching, and have a strong research record. The position starts October 1, 2006.

2. Doctor assistant in Applied Mathematics:

This is a postdoc position with teaching duties. Preference will be given to candidates in the field of numerical analysis/statistics. Good knowledge of scientific computing and willingness to participate in statistical consulting is expected. The position starts September 1, 2006.

Both positions are limited to 5 years. The candidates are supposed to master French or German and to understand the other language. Send letter of application, current vita, references and research plan to the address below before March 1, 2006. For additional information, please contact:

Prof. Dr. Norbert Hungerbuhler
Department of Mathematics
University of Freiburg, Perolles
CH-1700 Freiburg
http://www.unifr.ch/math
email:
norbert.hungerbuehler@unifr.ch

000229

General Information Regarding Meetings & Conferences of the AMS

Speakers and Organizers: The Council has decreed that no paper, whether invited or contributed, may be listed in the program of a meeting of the Society unless an abstract of the paper has been received in Providence prior to the deadline.

Although an individual may present only one ten-minute contributed paper at a meeting, any combination of joint authorship may be accepted, provided no individual speaks more than once. An author can speak by invitation in more than one Special Session at the same meeting.

Special Sessions: The number of Special Sessions at an Annual Meeting is limited. Special Sessions at annual meetings are held under the supervision of the Program Committee for National Meetings and, for sectional meetings, under the supervision of each Section Program Committee. They are administered by the associate secretary in charge of that meeting with staff assistance from the Meetings and Conferences Department in Providence. (See the list of associate secretaries on page 311 of this issue.)

Each person selected to give an Invited Address is also invited to generate a Special Session, either by personally organizing one or by having it organized by others. Proposals to organize a Special Session are sometimes solicited either by a program committee or by the associate secretary. Other proposals should be submitted to the associate secretary in charge of that meeting (who is an ex officio member of the program committee) at the address listed below. These proposals must be in the hands of the associate secretary at least seven months (for sectional meetings) or nine months (for national meetings) prior to the meeting at which the Special Session is to be held in order that the committee may consider all the proposals for Special Sessions simultaneously. Special Sessions must be announced in the *Notices* in a timely fashion so that any Society member who so wishes may submit an abstract for consideration for presentation in the Special Session.

Talks in Special Sessions are usually limited to twenty minutes; however, organizers who wish to allocate more time to individual speakers may do so within certain limits. A great many of the papers presented in Special Sessions at meetings of the Society are invited papers, but any member of the Society who wishes to do so may submit an abstract for consideration for presentation in a Special Session, provided it is submitted to the AMS prior to the special early deadline for consideration. Contributors should know that there is a limit to the size of a single Special Session, so sometimes all places are filled by invitation. Papers submitted for consideration for inclusion in Special Sessions but not accepted will receive consideration for a contributed paper session, unless specific instructions to the contrary are given.

The Society reserves the right of first refusal for the publication of proceedings of any Special Session. If published by the AMS, these proceedings appear in the book series Contemporary Mathematics. For more detailed information on organizing a Special Session, see `www.ams.org/meetings/specialsessionmanual.html`.

Contributed Papers: The Society also accepts abstracts for ten-minute contributed papers. These abstracts will be grouped by related *Mathematical Reviews* subject classifications into sessions to the extent possible. The title and author of each paper accepted and the time of presentation will be listed in the program of the meeting.

Other Sessions: In accordance with policy established by the AMS Committee on Meetings and Conferences, mathematicians interested in organizing a session at an annual or sectional meeting on employment opportunities inside or outside academia for young mathematicians should contact the associate secretary for the meeting with a proposal by the stated deadline. Also, potential organizers for poster sessions on a topic of choice should contact the associate secretary before the deadline.

Abstracts: Abstracts for all papers must be received by the meeting coordinator in Providence by the stated deadline. Unfortunately, late papers cannot be accommodated.

Submission Procedures: Visit the Meetings and Conferences homepage on the Web at `http://www.ams.org/meetings` and select "Submit an abstract".

See the inside front cover of *Abstracts of Papers Presented to the American Mathematical Society* for information on abstracts published by title and not presented at a meeting.

Site Selection for Sectional Meetings

Sectional meeting sites are recommended by the associate secretary for the section and approved by the Secretariat. Recommendations are usually made eighteen to twenty-four months in advance. Host departments supply local information, ten to fifteen rooms with overhead projectors for contributed paper sessions and Special Sessions, an auditorium with twin overhead projectors for Invited Addresses, space for registration activities and an AMS book exhibit, and registration clerks. The Society partially reimburses for the rental of facilities and equipment and for staffing the registration desk. Most host departments volunteer; to do so, or for more information, contact the associate secretary for the section.

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 the AMS website. See `http://www.ams.org/meetings/`. Final programs for Sectional Meetings will be archived on the AMS website accessible from the stated URL and in an electronic issue of the *Notices* as noted below for each meeting.

Miami, Florida

Florida International University

April 1–2, 2006
Saturday - Sunday

Meeting #1015
Southeastern Section
Associate secretary: Matthew Miller
Announcement issue of *Notices*: January 2006
Program first available on AMS website: February 16, 2006
Program issue of electronic *Notices*: April 2006
Issue of *Abstracts*: Volume 27, Issue 2

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: February 7, 2006

The scientific information listed below may be dated. For the latest information, see `www.ams.org/amsmtgs/sectional.html`.

Invited Addresses

Andrea R. Nahmod, University of Massachusetts, Amherst, *Bilinear operators in analysis and PDEs.*

Edward Odell, University of Texas at Austin, *Embeddings in Banach space theory.*

Karen V. H. Parshall, University of Virginia, *The British development of the theory of invariants, 1841-1895.*

Michael S. Vogelius, Rutgers University, *Electromagnetic imaging—An applied analyst's perspective.*

Special Sessions

Approximation Theory and Orthogonal Polynomials (Code: SS 5A), **Doron S. Lubinsky**, Georgia Institute of Technology, and **Edward B. Saff**, Vanderbilt University.

Commutative Algebra and Algebraic Geometry (Code: SS 1A), **Laura Ghezzi**, Florida International University, **Huy Tài Hà**, Tulane University, and **Aron Simis**, University Federal de Pernambuco.

Composition Operators and Complex Dynamical systems (Code: SS 16A), **Brian P. Kelly**, University of Louisiana, Monroe, and **Christopher N. B. Hammond**, Connecticut College.

Financial Mathematics (Code: SS 17A), **Alec N. Kercheval** and **Craig A. Nolder**, Florida State University.

Geometry of Banach Spaces and Connections with Other Areas (Code: SS 11A), **Edward W. Odell**, University of Texas at Austin, **Thomas B. Schlumprecht**, Texas A&M University, and **Stephen Dilworth**, University of South Carolina.

Geometry of Riemannian Manifolds with Additional Structures (Code: SS 2A), **Tedi C. Draghici**, **Gueo V. Grantcharov**, and **Philippe Rukimbira**, Florida International University.

Harmonic Analysis and Partial Differential Equations (Code: SS 10A), **Mario Milman**, Florida Atlantic University, and **Marius Mitrea**, University of Missouri.

History of Mathematics (Code: SS 18A), **Karen H. Parshall**, University of Virginia.

Imaging, Homogenization, and Shape Optimization (Code: SS 14A), **Michael S. Vogelius**, Rutgers University, and **Shari Moskow**, University of Florida.

Interpolation Theory and Applications (Code: SS 15A), **Michael Cwikel**, Technion, **Laura De Carli**, Florida International University, and **Mario Milman**, Florida Atlantic University.

Invariants of Low-Dimensional Manifolds (Code: SS 9A), **Thomas G. Lennes**, Florida International University, and **Nikolai N. Saveliev**, University of Miami, Coral Gables.

Mathematical Models in Image and High-Dimensional Data Analysis (Code: SS 13A), **Hanna E. Makaruk** and **Robert M. Owczarek**, Los Alamos National Laboratory, and **Nikita Sakhaneko**, University of New Mexico and Los Alamos National Laboratory.

Monomials and Resolutions (Code: SS 3A), **Joseph P. Brennan**, North Dakota State University, and **Heath M. Martin**, University of Central Florida.

Nonlinear Waves (Code: SS 19A), **Andrea R. Nahmod**, University of Massachusetts, Amherst, and **Sijue Wu**, University of Michigan at Ann Arbor.

Partial Differential Equations and Several Complex Variables (Code: SS 6A), **Shiferaw Berhanu**, Temple University, and **Hamid Meziani**, Florida International University.

Qualitative Analysis of Partial Differential Equations (Code: SS 4A), **Congming Li**, University of Colorado.

Recent Developments on Fluid and Geophysical Fluid Dynamics (Code: SS 12A), **C. Cao** and **T. Tachim Medjo**, Florida International University, and **X. Wang**, Florida State University.

Singular Integrals, Geometric Analysis, and Free Boundary Problems (Code: SS 8A), **Marianne Korten** and **Charles N. Moore**, Kansas State University.

Spectral Geometry of Manifolds with Boundary and Singular Spaces (Code: SS 20A), **Juan B. Gil**, Pennsylvania State University, Altoona, and **Patrick T. McDonald**, New College, University of South Florida.

Structure of Function Spaces and Applications (Code: SS 7A), **Jan Lang**, The Ohio State University, and **Osvaldo Mendez**, University of Texas at El Paso.

Notre Dame, Indiana

University of Notre Dame

April 8–9, 2006

Saturday - Sunday

Meeting #1016

Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: January 2006
Program first available on AMS website: February 23, 2006
Program issue of electronic *Notices*: April 2006
Issue of *Abstracts*: Volume 27, Issue 2

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: February 14, 2006

The scientific information listed below may be dated. For the latest information, see `www.ams.org/amsmtgs/sectional.html`.

Invited Addresses

Douglas N. Arnold, Institute for Math and Applications, University of Minnesota, *Title to be announced.*

Béla Bollobás, University of Memphis and Cambridge University, *Inhomogeneous random graphs* (Erdős Memorial Lecture).

Steven C. Hofmann, University of Missouri, *Title to be announced.*

Michael Larsen, University of Indiana, *Title to be announced.*

Christopher M. Skinner, University of Michigan, *Title to be announced.*

Special Sessions

Algebraic Structures of Exactly Solvable Models (Code: SS 9A), **Michael Gekhtman**, University of Notre Dame, **Mikhail Shapiro**, Michigan State University, and **Alexander Stolin**, University of Gothenburg.

Analysis and Geometry of Non-linear Evolution and Equations (Code: SS 19A), **Alexandrou A. Himonas** and **Gerard K. Misiolek**, University of Notre Dame.

Combinatorial Algebraic Geometry (Code: SS 2A), **Juan C. Migliore**, University of Notre Dame, and **Uwe R. Nagel**, University of Kentucky.

Commutative Algebra and Algebraic Geometry (Code: SS 1A), **Alberto Corso**, University of Kentucky, **Claudia Polini**, University of Notre Dame, and **Bernd Ulrich**, Purdue University.

Developments and Applications in Differential Geometry (Code: SS 4A), **Jianguo Cao**, **Xiaobo Liu**, and **Brian Smyth**, University of Notre Dame.

Dynamical Systems (Code: SS 10A), **Francois Ledrappier**, University of Notre Dame, and **Amie Wilkinson**, Northwestern University.

Harmonic Analysis, PDE and Geometric Function Theory (Code: SS 14A), **John L. Lewis**, University of Kentucky, and **Steve C. Hofmann**, University of Missouri.

Holomorphic Methods and Heat Kernels in Harmonic Analysis and Quantization Theory (Code: SS 16A), **Brian Hall** and **William Kirwin**, University of Notre Dame.

Mathematical Biology (Code: SS 11A), **Mark Alber** and **Bei Hu**, University of Notre Dame.

Model Theory and Computability (Code: SS 8A), **Steven Allen Buechler**, **Julia Knight**, and **Sergei Starchenkoa**, University of Notre Dame, and **Steffen Lempp**, University of Wisconsin.

New Developments in Optimization (Code: SS 15A), **Leonid Faybusovich**, University of Notre Dame.

Nonlinear Waves (Code: SS 13A), **Mark S. Alber** and **Pavel Lushnikov**, University of Notre Dame, and **Ildar Gabotiv** and **Vladimir E. Zakharov**, University of Arizona.

Number Theory (Code: SS 21A), **Scott T. Parsell** and **Jonathan P. Sorenson**, Butler University.

Numerical Solution of Polynomial Systems (Code: SS 7A), **Christopher S. Peterson**, Colorado State University, and **Andrew J. Sommese**, University of Notre Dame.

PDEs and Geometric Analysis (Code: SS 22A), **Matt Gursky** and **Qing Han**, University of Notre Dame.

Several Complex Variables (Code: SS 6A), **Nancy K. Stanton** and **Jeffrey A. Diller**, University of Notre Dame.

Special Functions and Orthogonal Polynomials (Code: SS 5A), **Diego Dominici**, State University of New York at New Paltz.

Topics in Representation Theory (Code: SS 17A), **Sam Evens**, University of Notre Dame, and **Jiu-Kang Yu**, Purdue University.

Topology and Physics (Code: SS 18A), **Stephan A. Stolz** and **Bruce Williams**, University of Notre Dame.

Undergraduate Mathematical Research (Code: SS 20A), **Francis X. Connolly**, University of Notre Dame, and **Zsuzsanna Szaniszlo**, Valparaiso University.

Water Waves (Code: SS 12A), **David Nicholls**, University of Illinois at Chicago.

Durham, New Hampshire

University of New Hampshire

April 22–23, 2006

Saturday - Sunday

Meeting #1017

Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: February 2006
Program first available on AMS website: March 9, 2006
Program issue of electronic *Notices*: April 2006
Issue of *Abstracts*: Volume 27, Issue 2

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: February 21, 2006 **NOTE: This date is earlier than previously published.**

The scientific information listed below may be dated. For the latest information, see `www.ams.org/amsmtgs/sectional.html`.

Invited Addresses

Ailana M. Fraser, University of British Columbia, *Title to be announced.*

Dmitri Nikshych, University of New Hampshire, *Algebraic theory of tensor categories.*

Florian Pop, University of Pennsylvania, *Title to be announced.*

Konstantina Trivisa, University of Maryland, College Park, *Title to be announced.*

Special Sessions

Algebraic Groups (Code: SS 5A), **George J. McNinch**, Tufts University, and **Eric Sommers**, University of Massachusetts-Amherst.

Arithmetic Geometry and Modular Forms (Code: SS 6A), **Paul E. Gunnells** and **Farshid Hajir**, University of Massachusetts, Amherst.

Arrangements and Configuration Spaces (Code: SS 10A), **Graham C. Denham**, University of Western Ontario, and **Alexander I. Suciu**, Northeastern University.

Banach Lattices, Regular Operators, and Applications (Code: SS 3A), **A. K. Kitover**, Community College of Philadelphia, **M. Orhon**, University of New Hampshire, and **A. W. Wickstead**, Queen's University of Belfast.

Banach Spaces of Analytic Functions (Code: SS 2A), **Rita A. Hibschweiler**, University of New Hampshire, and **Thomas H. MacGregor**, SUNY Albany and Bowdoin College.

Discrete and Convex Geometry (Code: SS 1A), **Daniel A. Klain**, University of Massachusetts (Lowell), **Barry R. Monson**, University of New Brunswick, and **Egon Schulte**, Northeastern University.

Galois Theory in Arithmetic and Geometry (Code: SS 8A), **Florian Pop** and **David Harbater**, University of Pennsylvania, and **Rachel J. Pries**, Colorado State University.

Geometric Methods in Group Theory and Topology (Code: SS 9A), **Kim Ruane**, Tufts University, **Jennifer Taback**, Bowdoin College, and **Peter N. Wong**, Bates College.

Global Perspectives on the Geometry of Riemann Surfaces (Code: SS 14A), **Eran Makover** and **Jeffrey K. McGowan**, Central Connecticut State University.

Hopf Algebras and Galois Module Theory (Code: SS 4A), **Timothy Kohl**, Boston University, and **Robert G. Underwood**, Auburn University Montgomery.

Mathematical Challenges in Physical and Engineering Sciences (Code: SS 13A), **Marianna A. Shubov**, University of New Hampshire.

Quantum Invariants of Knots and 3-Manifolds (Code: SS 11A), **Charles D. Frohman**, University of Iowa, and **Razvan Gelca**, Texas Tech University.

Symplectic and Contact Topology (Code: SS 7A), **Weimin Chen**, **Michael G. Sullivan**, and **Hao Wu**, University of Massachusetts, Amherst.

Topological Algebras and Applications (Code: SS 12A), **Alexander A. Katz**, St. John's University, and **Genady Y. Grabarnik**, IBM T. J. Watson Research Center.

Accommodations

Participants should make their own arrangements directly with a hotel of their choice as early as possible. Special rates have been negotiated with the hotels listed below. Rates quoted do not include the hotel tax of 8%. 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 (AMS) Meeting at the University of New Hampshire group**. Cancellation and early checkout policies vary; be sure to check when you make your reservation.

The Hotel New Hampshire, 2 Main Street, Durham, NH 03824, 603-868-1234 or info@hotelnewhampshire.net, located next to Durham's historic district and within a 5- to 15-minute walking distance of campus; US$99/single or double, refrigerators in rooms, complimentary continental breakfast; free Internet access. **Deadline for reservations is March 21, 2006.** Be sure to check cancellation and early checkout policies.

The New England Center, 15 Stratford Rd., Durham, NH 03824, 800-590-4334 or 603-862-2801, (international participants may send email for reservations to shelley.burch@unh.edu); located on campus and within walking distance of the train station; US$99/single/double. Amenities include a full service restaurant and lounge on the premises, complimentary access to the university's Hamel Recreation Center, and complimentary Internet access (including wireless) throughout the hotel. **The number of rooms available is limited! Please make your reservations early because of an anticipated sell out.** Be sure to check cancellation and early checkout policies.

Also very close to campus is the **Pines Guest House**, 47 Dover Rd., Durham, 603-868-3361, www.thepinesguesthouse.com, rates are US$79-129.

The Hickory Pond Inn, 1 Stagecoach Rd., Durham, 800-658-0065 or 603-659-2227, www.hickorypondinn.com, is about three miles from campus; rates start at about US$89 depending upon season.

Other hotels in Dover, NH (about four to five miles north) or Portsmouth, NH (about eight to nine miles south) can be found using your favorite Internet hotel search engine, e.g., Orbitz.com or Expedia.com, many of which feature discounted rates. Be careful to read the terms thoroughly; some hotels may require full payment when making the reservation and cancellation penalties vary.

Food Service

Holloway Commons is the campus dining hall offering great buffet-style food. The costs and times are—breakfast: 7:15 a.m.-11:00 a.m., US$6.50; lunch: 11:00 a.m.-4:30 p.m., US$8.75; and dinner: 4:30 p.m.-9:30 p.m., US$11.00. Information on local dining near the campus will be available on site.

Local Information

The university's website is www.unh.edu; the department of mathematics is at www.math.unh.edu. Campus information for visitors, including a map and directions, is at www.unh.edu/welcome/visitingunh.html.

Other Activities

Book Sales: Examine the newest titles from the AMS! Many of the AMS books will be available at special discounts available only at the meeting. Complimentary coffee will be served courtesy of AMS Membership Services.

AMS Editorial Activity: An acquisitions editor from the AMS book program will be present to speak with prospective authors. If you have a book project that you would like to discuss with the AMS, please stop by the book exhibit.

Parking

Parking information will be available at a later date. Watch the meeting website at www.ams.org/amsmtgs/sectional.html for the most up-to-date details.

Registration and Meeting Information

The meeting is on the campus of the University of New Hampshire (UNH), Durham, NH.

The registration desk will be open Saturday, April 22, 7:30 a.m. to 4:00 p.m., and Sunday, April 23, 8:00 a.m. to noon. Fees are US$40 for AMS or CMS members, US$60 for nonmembers; and US$5 for students, unemployed mathematicians, and emeritus members. Fees are payable on site by cash, check, or credit card. Locations for the registration desk, Invited Addresses and Special Sessions will be announced at a later date. Please watch the meeting website at www.ams.org/amsmtgs/sectional.html for the most up-to-date details.

Travel and Campus Map

Boston's Logan International Airport (BOS) is approximately 60 miles from Durham. Some participants may find it less expensive to fly into Manchester Airport (MHT), approximately 40 miles from Durham, however, bus service is not available from Manchester to Durham.

Rail service is available from Boston's North Station on Amtrak directly to the UNH campus. See www.thedowneaster.com. The fare is US$14 each way. Service from Logan Airport to North Station is provided by subway or taxi.

C & J Trailways (800-258-7111 or www.cjtrailways.com) offers very limited bus service (US$13 each way) between Boston and Durham (leaves North Station (Amtrak) once daily at 3:15 p.m. and returns from Durham once daily at 1:00 p.m.). Other options are to take the bus to Portsmouth (10 miles from Durham) or Dover (five miles from Durham), New Hampshire, and then a taxi or Wildcat shuttle (www.unh.edu/transportation/wildcat/index.htm) for service to Durham.

The official airline for the meeting is **Delta Airlines**. Take advantage of Delta's new SimpliFares™ and enjoy the following benefits:

- No Saturday night stay required—more flexibility

• Always affordable—realize up to 50% savings on everyday fares in the contiguous 48 states

• Lower change fees—reduced from US$100 to US$50 to change travel plans

• Just eight fares—less guessing and easier planning

To make immediate reservations call Delta Air Lines at 800-221-1212. Be sure to reference **US738367060** or visit www.delta.com and enter **SkyBonus account number US738367060** in your passenger information screen to be recognized as a participant. Your benefits include:

• No service fees

• 1,000 sky miles for Delta members

• Skip the airport lines; check in online

Car Rental

Avis is the official car rental company for the sectional meeting in Durham, New Hampshire. All rates include unlimited free mileage. Weekend daily rates are available from noon Thursday to Monday at 11:59 P.M. Rates for this meeting are effective April 15, 2006 to April 30, 2006, and begin at US$35.99/day (weekend rate). Should a lower qualifying rate become available at the time of booking, Avis is pleased to offer a 5% discount off the lower qualifying rate or the meeting rate, whichever is lowest. Rates do not include any state or local surcharges, tax, optional coverages or gas refueling charges. Renters must meet Avis's age, driver, and credit requirements. Reservations can be made by calling 800-331-1600 or online at www.avis.com. Avis's Discount Number is **B159266.**

Getting to the University by Car: From the south, including Logan International Airport in Boston, MA: Take I-95 North to Exit 4 (N.H. Lakes and Mountains, Spaulding Turnpike). Continue North to Exit 6W and follow Route 4 West. Exit at Route 155A and turn east toward Durham. Follow 155A through a short stretch of fields. Take a left onto Loop Road, bearing right and driving a short distance until you reach the UNH Visitor Center, a small white clapboard building on your left. Metered parking is available at the lot adjacent to the Visitor Center. Special parking arrangements for meeting participants will be announced at a later date.

Information for International Participants

Visa regulations are continually changing for travel to the United States. Visa applications may take from three to four months to process and require a personal interview, as well as specific personal information. International participants should view the important information about traveling to the U.S. found at http://www7.nationalacademies.org/visas/Traveling_to_US.html and http://travel.state.gov/visa/index.html. If you need a preliminary conference invitation in order to secure a visa, please send your request to dls@ams.org.

If you discover you do need a visa, the National Academies website (see above) provides these tips for successful visa applications:

• Visa applicants are expected to provide evidence that they are intending to return to their country of residence. Therefore, applicants should provide proof of "binding" or sufficient ties to their home country or permanent residence abroad. This may include documentation of the following:

— family ties in home country or country of legal permanent residence

— property ownership

— bank accounts

— employment contract or statement from employer stating that the position will continue when the employee returns;

• Visa applications are more likely to be successful if done in a visitor's home country than in a third country;

• Applicants should present their entire trip itinerary, including travel to any countries other than the United States, at the time of their visa application;

• Include a letter of invitation from the meeting organizer or the U.S. host, specifying the subject, location and dates of the activity, and how travel and local expenses will be covered;

• If travel plans will depend on early approval of the visa application, specify this at the time of the application;

• Provide proof of professional scientific and/or educational status (students should provide a university transcript).

This list is not to be considered complete. Please visit the websites above for the most up-to-date information.

Reminder: Machine-Readable Passports Required by June 26, 2005.

The Department of Homeland Security reminds travelers from the 27 Visa Waiver Program (VWP) countries that as of June 26, 2005, they must have a machine-readable passport to enter the United States without a visa. Beginning June 26, 2005, transportation carriers will be fined US$3,300, per violation, for transporting any VWP traveler to the United States without a machine-readable passport. Similarly, VWP travelers arriving in the United States on that date without a machine-readable passport should not anticipate being granted one-time entry into the country. As an alternative for persons with immediate travel plans who are unable to obtain a machine-readable passport in time, the individual may apply for a U.S. visa at a U.S. Consulate or Embassy abroad.

Weather

Mark Twain once said that if you don't like the weather in New England, just wait a minute. Conditions in Durham during late April can be unpredictable so layered clothing is advisable. Rainfall averages 4" in April, and snow is possible. Temperatures can range from about 35° Fahrenheit at night to 60° Fahrenheit during the day.

San Francisco, California

San Francisco State University

April 29–30, 2006
Saturday - Sunday

Meeting #1018
Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: February 2006
Program first available on AMS website: March 16, 2006
Program issue of electronic *Notices*: April 2006
Issue of *Abstracts*: Volume 27, Issue 2

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: March 7, 2006

The scientific information listed below may be dated. For the latest information, see `www.ams.org/amsmtgs/sectional.html`.

Invited Addresses

Lincoln Chayes, University of California Los Angeles, *Title to be announced.*

C. Robin Graham, University of Washington, *Title to be announced.*

Vadim Kaloshin, California Institute of Technology, *Title to be announced.*

Benoit B. Mandelbrot, Yale University, *The Nature of Roughness in Mathematics, Science, and Art* (Einstein Public Lecture in Mathematics).

Yuval Peres, University of California Berkeley, *Title to be announced.*

Special Sessions

Computational Arithmetic Geometry (Code: SS 13A), **Kenneth A. Ribet**, University of California Berkeley, and **Kristin Estrella Lauter**, Microsoft Corporation.

Elliptic Methods in Geometry (Code: SS 3A), **C. Robin Graham**, University of Washington, and **Rafe Mazzeo**, Stanford University.

Enumerative Aspects of Polytopes (Code: SS 10A), **Federico Ardila** and **Matthias Beck**, San Francisco State University.

Fractal Geometry: Connections to Dynamics, Geometric Measure Theory, Mathematical Physics and Number Theory (Code: SS 4A), **Michel L. Lapidus** and **Erin P. Pearse**, University of California Riverside, and **Machiel van Frankenhuijsen**, Utah Valley State College.

Geometric Dynamics and Ergodic Theory (Code: SS 11A), **Yitwah Cheung** and **Arek Goetz**, San Francisco State University, and **Slobodan Simic**, San Jose State University.

Geometry of Gröbner Bases (Code: SS 2A), **Bernd Sturmfels**, University of California Berkeley, and **Alexander Yong**, University of Minnesota and Fields Institute.

Hilbert Functions and Resolutions (Code: SS 12A), **Benjamin Richert**, California Polytechnic State University, and **Sean Sather-Wagstaff**, California State University, Dominguez Hills.

History and Philosophy of Mathematics (Code: SS 1A), **Shawnee L. McMurran**, California State University, San Bernardino, and **James J. Tattersall**, Providence College.

Homological and K-theoretical Trends in Algebraic Combinatorics (Code: SS 6A), **Joseph Gubeladze** and **Serkan Hosten**, San Francisco State University.

Liapunov Exponents and Nonuniform Hyperbolicity (Code: SS 7A), **Anton Gorodetski** and **Vadim Kaloshin**, California Institute of Technology.

Lie Algebras and Applications (Code: SS 9A), **Dimitar Grantcharov**, San Jose State University, **Vera Serganova**, University of California Berkeley, and **Arturo Pianzola**, University of Alberta.

Partial Differential Equations and Their Applications (Code: SS 14A), **Steve Shkoller**, University of California Davis.

Probability and Statistical Physics (Code: SS 5A), **Marek Biskup**, University of California Los Angeles, **Noam Berger**, California Institute of Technology and University of California Los Angeles, and **Balint Virag**, University of Toronto.

Q-series and Partitions (Code: SS 8A), **Neville Robbins**, San Francisco State University.

Accommodations

Participants should make their own arrangements directly with a hotel of their choice. Rates quoted do not include sales tax. The AMS is not responsible for rate changes or for the quality of the accommodations. When making a reservation, participants should state they are with the American Mathematical Society group (AMS Meeting). None of the hotels listed are within walking distance of the meeting. Cancellation and early checkout policies vary; be sure to check when you make your reservation.

The Great Highway Inn, 1234 Great Highway, San Francisco, CA, 94112; 800-624-6644, 415-731-6644, fax: 415-731-5309. Rates are US$110/single and US$125/double. Cancellation policy requires a 72-hour notice. Cancellation and early checkout policies vary; be sure to check when you make your reservation.

Hampton Inn, 2700 Junipero Serra Blvd., Daly City, CA; 650-755-7500 or 866-519-4851. Rates are US$109 a night, based upon single or double occupancy, plus 10% tax. All terms and conditions are subject to availability. Recently built, the Hampton Inn is located on Junipero Serra Blvd. just two miles South of the campus. All rooms include telephone with complimentary local calls, data ports, cable television, and hairdryers. Free parking on property, hot breakfast, and heated pool are also included. **Deadline for**

reservations is March 31, 2006. Cancellation and early checkout policies vary; be sure to check when you make your reservation.

Sheraton Gateway Hotel-San Francisco Airport, 600 Airport Blvd., Burlingame, CA, 94010; 650-340-8500, http://www.sheratonsfo.com. Rates are US$100 single/double. There is an additional $15 fee per person for triple or quad occupancy. **Deadline for reservations is April 7, 2006**. Cancellation and early checkout policies vary; be sure to check when you make your reservation.

Food Service

A list of restaurants will be available at the registration desk.

Local Information

Please visit the websites maintained by San Francisco State University at http://www.sfsu.edu, the Department of Mathematics at http://math.sfsu.edu, and the site maintained by the San Francisco Convention and Visitors Bureau at http://www.sfvisitor.org.

Other Activities

AMS Editorial Activity: An acquisitions editor from the AMS book program will be present to speak with prospective authors. If you have a book project that you would like to discuss with the AMS, please stop by the book exhibit.

Book Sales: Examine the newest titles from the AMS! Many of the AMS books will be available at a special discount available only at the meeting. Complimentary coffee will be served courtesy of AMS Membership Services.

Special Presentation

The American Mathematical Society sponsors a series of public lectures in mathematics entitled **The AMS Einstein Public Lecture in Mathematics**. The lectures began in 2005, to celebrate the one-hundredth anniversary of Einstein's *annus mirabilis*. They are to be given annually at one of the Society's eight sectional meetings. The Department of Mathematics at San Francisco State University is honored that the AMS has chosen the San Francisco meeting for its second public lecture and that Wolf Prize winner Benoît Mandelbrot, Yale University, will be the speaker. He will speak on "The Nature of Roughness in Mathematics, Science, and Art", Saturday, April 29, in Jack Adams Hall at 8:00 p.m.

Dinner Buffet: Saturday, April 29, 6:00–8:00 p.m. Dinner Buffet at the Seven Hills Conference Center on the San Francisco State University campus. There will be a wide selection of salads, entrees, and desserts, including vegetarian entrees. Cost is $25.00 per person, which must be prepaid by sending a check or money order to:

AMS Dinner Buffet
Department of Mathematics
San Francisco State University
1600 Holloway Avenue
San Francisco, CA 94132

Make the check or money order payable to Math. Dept. SFSU. **The deadline for reservations is April 15.**

Parking

Parking is available in the university parking structure located on South State Street. For more information regarding parking please visit http://www.sfsu.edu/%7Eparking/text/tocampus.html.

Registration and Meeting Information

The registration desk will be located on the third (main) floor of Thornton Hall, and will be open from 7:30 a.m. to 4:00 p.m. on Saturday, and 8:00 a.m. to noon on Sunday. Talks will take place in the Science Building and Thornton Hall.

Registration fees are US$40 for AMS or CMS members, US$60 for nonmembers; and US$5 for students, unemployed mathematicians, and emeritus members. Fees are payable on site by cash, check, or credit card.

Travel Information and Campus Map

San Francisco Airport (SFO): From the departure area take the I-280 North entrance. Take I-280 North, exit at 19th Avenue. Take Junipero Serra Boulevard to Holloway Avenue; turn left on Holloway Avenue to campus at 19th Avenue.

To get to the parking garage, continue on Holloway Ave. to Font Blvd. Turn right onto Font Blvd. and continue to Lake Merced Blvd. Turn right onto Lake Merced Blvd., then take an immediate right onto State Drive which is the entrance to the parking garage.

By Public Transportation: BART: Exit the Daly City BART Station then take the SFSU shuttle or the MUNI 28 bus. SuperShuttle: Call 800-258-3826 for reservations or find supershuttle vans outside of Departures.

By Car: From the North: Take Highway 101 South, cross the Golden Gate Bridge. Take 19th Avenue/Highway 1 exit. Follow 19th Avenue to campus at Holloway Avenue.

To get to the parking garage, turn right onto Holloway Ave. and continue to Font Blvd. Turn right onto Font Blvd. and continue to Lake Merced Blvd. Turn right onto Lake Merced Blvd., then take an immediate right onto State Drive which is the entrance to the parking garage.

From the South: Take I-280 North, exit at 19th Avenue. Take Junipero Serra Boulevard to Holloway Avenue, turn left on Holloway Avenue to campus at 19th Avenue.

To get to the parking garage, continue on Holloway Ave. to Font Blvd. Turn right onto Font Blvd. and continue to Lake Merced Blvd. Turn right onto Lake Merced Blvd., then take an immediate right onto State Drive which is the entrance to the parking garage.

From the East: Take I-80 West across the Bay Bridge to Highway 101 South. Take 101 South to I-280 toward Daly City. Take the San Jose Avenue/Mission St. exit (immediately after the Ocean Avenue exit), bearing right onto Sagamore Street to Brotherhood Way to Junipero Serra Boulevard North. Take Junipero Serra Boulevard to Holloway Avenue, turn left on Holloway Avenue to campus at 19th Avenue.

To get directly to the parking garage stay on Brotherhood Way and turn right onto Lake Merced Blvd. Turn right onto State Drive which is the third light after turning onto Lake Merced Blvd. and immediately after Font Blvd.

Car Rental: Avis is the official car rental company for the sectional meeting in San Francisco, California. All rates include unlimited free mileage. Weekend daily rates are available from noon Thursday to Monday at 11:59 P.M. Rates for this meeting are effective April 22, 2006 to May 7, 2006, and begin at US$24.99/day (weekend rate). Should a lower qualifying rate become available at the time of booking, Avis is pleased to offer a 5% discount off the lower qualifying rate or the meeting rate, whichever is lowest. Rates do not include any state or local surcharges, tax, optional coverages or gas refueling charges. Renters must meet Avis's age, driver, and credit requirements. Reservations can be made by calling 800-331-1600 or online at `http://www.avis.com`. The Avis Discount Number for this meeting is **B159266**.

Special Travel Information for International Participants

Visa regulations are continually changing for travel to the United States. Visa applications may take from three to four months to process and require a personal interview, as well as specific personal information. International participants should view the important information about traveling to the U.S. found at `http://www7.nationalacademies.org/visas/Traveling_to_US.html` and `http://travel.state.gov/visa/index.html`. If you need a preliminary conference invitation in order to secure a visa, please send your request to `wsd@ams.org`. If you discover you do need a visa, the National Academies website (see above) provides these tips for successful visa applications:

• Visa applicants are expected to provide evidence that they are intending to return to their country of residence. Therefore, applicants should provide proof of "binding" or sufficient ties to their home country or permanent residence abroad. This may include documentation of the following:

— family ties in home country or country of legal permanent residence

— property ownership

— bank accounts

— employment contract or statement from employer stating that the position will continue when the employee returns;

• Visa applications are more likely to be successful if done in a visitor's home country than in a third country;

• Applicants should present their entire trip itinerary, including travel to any countries other than the United States, at the time of their visa application;

• Include a letter of invitation from the meeting organizer or the U.S. host, specifying the subject, location and dates of the activity, and how travel and local expenses will be covered;

• If travel plans will depend on early approval of the visa application, specify this at the time of the application;

• Provide proof of professional scientific and/or educational status (students should provide a university transcript).

This list is not to be considered complete. Please visit the websites above for the most up-to-date information.

Reminder: Machine-Readable Passports Required by June 26, 2005.

The Department of Homeland Security reminds travelers from the 27 Visa Waiver Program (VWP) countries that as of June 26, 2005, they must have a machine-readable passport to enter the United States without a visa. Beginning June 26, 2005, transportation carriers will be fined US$3,300, per violation, for transporting any VWP traveler to the United States without a machine-readable passport. Similarly, VWP travelers arriving in the United States on that date without a machine-readable passport should not anticipate being granted one-time entry into the country. As an alternative for persons with immediate travel plans who are unable to obtain a machine-readable passport in time, the individual may apply for a U.S. visa at a U.S. Consulate or Embassy abroad.

Weather

The weather in April is variable, with temperatures from 70° Fahrenheit to 85° Fahrenheit. The weather can turn cold, overcast, and windy due to the close proximity of the San Francisco State University campus to the ocean.

Salt Lake City, Utah

University of Utah

October 7–8, 2006

Saturday - Sunday

Meeting #1019

Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: August 2006
Program first available on AMS website: August 24, 2006
Program issue of electronic *Notices*: October 2006
Issue of *Abstracts*: Volume 27, Issue 3

Deadlines

For organizers: March 7, 2006
For consideration of contributed papers in Special Sessions: June 20, 2006
For abstracts: August 15, 2006

The scientific information listed below may be dated. For the latest information, see `www.ams.org/amsmtgs/sectional.html`.

Invited Addresses

William Arveson, University of California Berkeley, *Title to be announced.*

Alexei Borodin, California Institute of Technology, *Title to be announced.*

Izabella Joanna Laba, University of British Columbia, *Title to be announced.*

Darren Long, University of California Santa Barbara, *Title to be announced.*

Special Sessions

Harmonic Analysis: Trends and Perspectives (Code: SS 1A), **Alex Iosevich**, University of Missouri, and **Michael T. Lacey**, Georgia Institute of Technology.

Nonlinear Differential Equations: Methods and Applications (Code: SS 2A), **David G. Costa**, University of Nevada, and **Zhi-Qiang Wang**.

Cincinnati, Ohio

University of Cincinnati

October 21–22, 2006

Saturday - Sunday

Meeting #1020

Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: August 2006
Program first available on AMS website: September 7, 2006
Program issue of electronic *Notices*: October 2006
Issue of *Abstracts*: Volume 27, Issue 3

Deadlines

For organizers: March 21, 2006
For consideration of contributed papers in Special Sessions: July 5, 2006
For abstracts: August 29, 2006

The scientific information listed below may be dated. For the latest information, see `www.ams.org/amsmtgs/sectional.html`.

Invited Addresses

Suncica Canic, University of Houston, *Title to be announced.*

Bryna R. Kra, Northwestern University, *Title to be announced.*

Ezra N. Miller, University of Minnesota, *Title to be announced.*

Jon G. Wolfson, Michigan State University, *Title to be announced.*

Special Sessions

Analysis and Potential Theory on Metric Spaces (Code: SS 4A), **Thomas Bieske**, University of South Florida, and **Zair Ibragimov** and **Nageswari Shanmugalingam**, University of Cincinnati.

Applied Algebraic Geometry and Cryptography (Code: SS 3A), **Jintai Ding**, **Jason Eric Gower**, and **Timothy J. Hodges**, University of Cincinnati, **Lei Hu**, Chinese Academy of Sciences, and **Dieter S. Schmidt**, University of Cincinnati.

Birational Geometry (Code: SS 2A), **Mirel Constantin Caibar** and **Gary P. Kennedy**, Ohio State University.

Ergodic Theory (Code: SS 1A), **Nikos Frantzikinakis**, Pennsylvania State University, **Bryna R. Kra**, Northwestern University, and **Mate Wierdl**, University of Memphis.

Storrs, Connecticut

University of Connecticut

October 28–29, 2006

Saturday - Sunday

Meeting #1021

Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: August 2006
Program first available on AMS website: September 14, 2006
Program issue of electronic *Notices*: October 2006
Issue of *Abstracts*: Volume 27, Issue 4

Deadlines

For organizers: March 28, 2006
For consideration of contributed papers in Special Sessions: July 11, 2006
For abstracts: September 6, 2006

The scientific information listed below may be dated. For the latest information, see `www.ams.org/amsmtgs/sectional.html`.

Invited Addresses

Changfeng Gui, University of Connecticut, Storrs, *Title to be announced.*

Katrin Wehrheim, Institute for Advanced Study, *Title to be announced.*

Special Sessions

Combinatorial Methods in Equivariant Topology (Code: SS 1A), **Tara Holm**, University of Connecticut, Storrs, and **Tom C. Braden**, University of Massachusetts, Amherst.

Number Theory (Code: SS 2A), **Keith Conrad**, University of Connecticut, Storrs, **David Pollack**, Wesleyan University, and **Thomas A. Weston**, University of Massachusetts, Amherst.

Fayetteville, Arkansas

University of Arkansas

November 3–4, 2006
Friday - Saturday

Meeting #1022
Southeastern Section
Associate secretary: Matthew Miller
Announcement issue of *Notices*: September 2006
Program first available on AMS website: September 21, 2006
Program issue of electronic *Notices*: November 2006
Issue of *Abstracts*: Volume 27, Issue 4

Deadlines
For organizers: April 3, 2006
For consideration of contributed papers in Special Sessions: July 18, 2006
For abstracts: September 12, 2006

The scientific information listed below may be dated. For the latest information, see `www.ams.org/amsmtgs/sectional.html`.

Invited Addresses

Richard P. Anstee, University of British Columbia, *Title to be announced.*

Arun Ram, University of Wisconsin, *Title to be announced.*

Donald G. Saari, University of California Irvine, *Title to be announced.*

Andras Vasy, Massachusetts Institute of Technology, *Title to be announced.*

Special Sessions

Dirac Operators in Analysis and Geometry (Code: SS 1A), **John Ryan**, University of Arkansas, **Marius Mitrea**, University of Missouri, and **Mircea Martin**, Baker University.

New Orleans, Louisiana

New Orleans Marriott and Sheraton New Orleans Hotel

January 4–7, 2007
Thursday - Sunday

Meeting #1023
Joint Mathematics Meetings, including the 113th Annual Meeting of the AMS, 90th 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), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: October 2006
Program first available on AMS website: November 1, 2006
Program issue of electronic *Notices*: January 2007
Issue of *Abstracts*: Volume 28, Issue 1

Deadlines
For organizers: April 1, 2006
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Davidson, North Carolina

Davidson College

March 3–4, 2007
Saturday - Sunday
Southeastern Section
Associate secretary: Matthew Miller
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines
For organizers: August 3, 2006
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Oxford, Ohio

Miami University

March 16–17, 2007
Friday - Saturday
Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: To be announced
Program first available on AMS website: 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

Special Sessions

Finite Geometry and Combinatorics (Code: SS 3A), **Mark A. Miller**, Marietta College.

Geometric Topology (Code: SS 2A), **Jean-Francois LaFont**, SUNY Binghamton and Ohio State University, and **Ivonne J. Ortiz**, Miami University.

Large Cardinals in Set Theory (Code: SS 1A), **Paul B. Larson**, Miami University, **Justin Tatch Moore**, Boise State University, and **Ernest Schimmerling**, Carnegie Mellon University.

Hoboken, New Jersey

Stevens Institute of Technology

April 14–15, 2007

Saturday - Sunday
Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: September 14, 2006
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Tucson, Arizona

University of Arizona

April 21–22, 2007

Saturday - Sunday
Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: September 21, 2006
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Albuquerque, New Mexico

University of New Mexico

October 13–14, 2007

Saturday - Sunday
Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: To be announced
Program first available on AMS website: 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

San Diego, California

San Diego Convention Center

January 6–9, 2008

Sunday - Wednesday
Joint Mathematics Meetings, including the 114th Annual Meeting of the AMS, 91st 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), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: October 2007
Program first available on AMS website: November 1, 2007
Program issue of electronic *Notices*: January 2008
Issue of *Abstracts*: Volume 29, Issue 1

Deadlines

For organizers: April 1, 2007
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Bloomington, Indiana

Indiana University

April 4–6, 2008

Friday - Sunday
Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: To be announced

Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: September 4, 2007
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Rio de Janeiro, Brazil

Instituto Nacional de Matemática Pura e Aplicada (IMPA)

June 4–7, 2008

Wednesday - Saturday
First Joint International Meeting with the Sociedade Brasileira de Matemática.
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: To be announced
Program first available on AMS website: 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

Vancouver, Canada

University of British Columbia

October 4–5, 2008

Saturday - Sunday
Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: March 9, 2008
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Shanghai, People's Republic of China

Fudan University

December 17–21, 2008

Wednesday - Sunday
First Joint Interntional Meeting Between the AMS and the Shanghai Mathematical Society
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: To be announced
Program first available on AMS website: 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

Washington, District of Columbia

Marriott Wardman Park Hotel and Omni Shoreham Hotel

January 7–10, 2009

Wednesday - Saturday
Joint Mathematics Meetings, including the 115th Annual Meeting of the AMS, 92nd 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), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: October 2008
Program first available on AMS website: November 1, 2008
Program issue of electronic *Notices*: January 2009
Issue of *Abstracts*: Volume 30, Issue 1

Deadlines

For organizers: April 1, 2008
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

San Francisco, California

Moscone Center West and the San Francisco Marriott

January 6–9, 2010

Wednesday - Saturday
Joint Mathematics Meetings, including the 116th Annual Meeting of the AMS, 93rd 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), with sessions contributed by the Society of Industrial and Applied Mathematics (SIAM).
Associate secretary: Matthew Miller
Announcement issue of *Notices*: October 2009
Program first available on AMS website: November 1, 2009
Program issue of electronic *Notices*: January 2010
Issue of *Abstracts*: Volume 31, Issue 1

Deadlines

For organizers: April 1, 2009
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

New Orleans, Louisiana

New Orleans Marriott and Sheraton New Orleans Hotel

January 5–8, 2011

Wednesday - Saturday
Joint Mathematics Meetings, including the 117th Annual Meeting of the AMS, 94th Annual Meeting of the Mathematical Association of America, 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), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: October 2010
Program first available on AMS website: November 1, 2010
Program issue of electronic *Notices*: January 2011
Issue of *Abstracts*: Volume 32, Issue 1

Deadlines

For organizers: April 1, 2010
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Boston, Massachusetts

John B. Hynes Veterans Memorial Convention Center, Boston Marriott Hotel, and Boston Sheraton Hotel

January 4–7, 2012

Wednesday - Saturday
Joint Mathematics Meetings, including the 118th Annual Meeting of the AMS, 95th Annual Meeting of the Mathematical Association of America, 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), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: October 2011
Program first available on AMS website: November 1, 2011
Program issue of electronic *Notices*: January 2012
Issue of *Abstracts*: Volume 33, Issue 1

Deadlines

For organizers: April 1, 2011
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

San Diego, California

San Diego Convention Center and San Diego Marriott Hotel and Marina

January 9–12, 2013

Wednesday - Saturday
Joint Mathematics Meetings, including the 119th Annual Meeting of the AMS, 96th Annual meeting of the Mathematical Association of America, 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), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: April 1, 2012
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

AMS PRESIDENTS

A TIMELINE

AMS presidents play a key role in leading the Society and representing the profession. Browse through the timeline to see each AMS president's page, which includes the institution and date of his/her doctoral degree, a brief note about his/her academic career and honors, and links to more extensive biographical information.

John Howard Van Amringe
John Emory McClintock
George William Hill
Simon Newcomb
Robert Simpson Woodward
Eliakim Hastings Moore
Thomas Scott Fiske
William Fogg Osgood
Henry Seely White
Maxime Bôcher
Henry Burchard Fine
Edward Burr Van Vleck
Ernest William Brown
Leonard Eugene Dickson
Frank Morley
Gilbert Ames Bliss
Oswald Veblen
George David Birkhoff
Virgil Snyder
Earle Raymond Hedrick
Luther Pfahler Eisenhart
Arthur Byron Coble
Solomon Lefschetz
Robert Lee Moore
Griffith Conrad Evans
Harold Calvin Marston Morse
Marshall Harvey Stone
Theophil Henry Hildebrandt
Einar Hille
Joseph Leonard Walsh
John von Neumann
Gordon Thomas Whyburn
Raymond Louis Wilder
Richard Dagobert Brauer
Edward James McShane
Deane Montgomery
Joseph Leo Doob
Abraham Adrian Albert
Charles Bradfield Morrey Jr.
Oscar Zariski
Nathan Jacobson
Saunders Mac Lane
Lipman Bers
R H Bing
Peter David Lax
Andrew Mattei Gleason
Julia Bowman Robinson
Irving Kaplansky
George Daniel Mostow
William Browder
Michael Artin
Ronald L. Graham
Cathleen Synge Morawetz
Arthur M. Jaffe
Felix E. Browder
Hyman Bass
David Eisenbud
James G. Arthur

www.ams.org/ams/amspresidents.html

AMERICAN MATHEMATICAL SOCIETY

Meetings and Conferences of the AMS

Associate Secretaries of the AMS

Western Section: Michel L. Lapidus, Department of Mathematics, University of California, Sproul Hall, Riverside, CA 92521-0135; e-mail: lapidus@math.ucr.edu; telephone: 951-827-5910.

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@duke.poly.edu; telephone: 718-260-3505.

Southeastern Section: Matthew Miller, Department of Mathematics, University of South Carolina, Columbia, SC 29208-0001, e-mail: miller@math.sc.edu; telephone: 803-777-3690.

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 can be found at** www.ams.org/meetings/.

Meetings:

Important Information Regarding AMS Meetings

Potential organizers, speakers, and hosts should refer to page 296 in the February 2006 issue of the *Notices* for general information regarding participation in AMS meetings and conferences.

Abstracts

Speakers should submit abstracts on the easy-to-use interactive Web form. No knowledge of LaTeX is necessary to submit an electronic form, although those who use LaTeX may submit abstracts with such coding, and all math displays and similarly coded material (such as accent marks in text) must be typeset in LaTeX. Visit http://www.ams.org/cgi-bin/abstracts/abstract.pl.

Questions about abstracts and requests for paper forms may be sent to abs-info@ams.org.

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 4–June 29, 2006: Joint Summer Research Conferences in the Mathematical Sciences, Snowbird, Utah (see November 2005 *Notices*, page 1296).

Co-sponsored conference: 22nd Annual Workshop on Mathematical Problems in Industry, June 12-16, 2006, Olin College, Needham, MA. For details see http://projects.olin.edu/mpi2006/.

AMERICAN MATHEMATICAL SOCIETY

Figures in History

A HISTORIC EVOLUTION OF IDEAS

Coxeter

The Coxeter Legacy

Reflections and Projections

Chandler Davis and Erich W. Ellers, Editors

NEW BOOK

This collection of articles by outstanding researchers and expositors captures Donald Coxeter's lasting contributions to mathematics and to the artistic and scientific communities. The book covers Coxeter groups, polytopes, configurations, visualization, and the interaction of mathematics and art. Biographical information, personal memories and rich illustrations capture the essence of Coxeter's work and his expression of mathematics' inherent beauty.

2006; 320 pages; Hardcover; ISBN 0-8218-3722-2; List US$69; All AMS members US$55; Order code COXETER

Euler

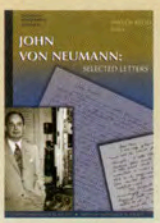
Euler through Time: A New Look at Old Themes

V. S. Varadarajan

COMING SOON

Many of the theories of Leonhard Euler (1707-1783) are still at the center of today's mathematics, especially in the field of number theory. *Euler through Time: A New Look at Old Themes* takes readers on a journey that spans over two hundred years of mathematics history to show how one man's theories can continuously develop and evolve into applications that still dominate today's world.

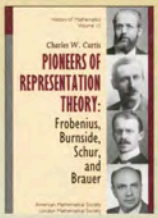
2006; 292 pages; Hardcover; ISBN 0-8218-3580-7; Order code EULER



John von Neumann: Selected Letters

Miklós Rédei, *Eotvos Lorand University, Budapest, Hungary*, Editor

History of Mathematics*, Volume 27; 2005; 301 pages; Hardcover; ISBN 0-8218-3776-1; List US$59; All AMS members US$47; Order code HMATH/27



Pioneers of Representation Theory: Frobenius, Burnside, Schur, and Brauer

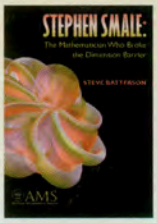
Charles W. Curtis, *University of Oregon, Eugene, OR*

History of Mathematics*, Volume 15; 1999; 292 pages; Softcover; ISBN 0-8218-2677-8; List US$39; All AMS members US$31; Order code HMATH/15.S

Ramanujan: Essays and Surveys

Bruce C. Berndt, *University of Illinois, Urbana-Champaign, IL*, and Robert A. Rankin, *University of Glasgow, Scotland*, Editors

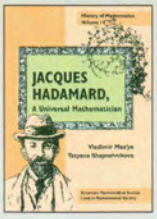
History of Mathematics*, Volume 22; 2001; 347 pages; Hardcover; ISBN 0-8218-2624-7; List US$79; All AMS members US$63; Order code HMATH/22



Stephen Smale: The mathematician who broke the dimension barrier

Steve Batterson, *Emory University, Atlanta, GA*

2000; 306 pages; Hardcover; ISBN 0-8218-2045-1; List US$35; All AMS members US$28; Order code MBDB



Jacques Hadamard, A Universal Mathematician

Vladimir Maz'ya and Tatyana Shaposhnikova, *Linköping University, Sweden*

History of Mathematics*, Volume 14; 1998; 574 pages; Softcover; ISBN 0-8218-1923-2; List US$51; All AMS members US$41; Order code HMATH/14.S

Change Is Possible

Stories of Women and Minorities in Mathematics

Patricia Clark Kenschaft, *Montclair State University, Upper Montclair, NJ*

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