# Notices 

of the American Mathematical Society

November 2008

Volume 55, Number 10

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TATSIEN LI; LIBIN WANG, both Fudan University, Shanghai, China

This monograph describes global propagation of regular nonlinear hyperbolic waves described by first-order quasilinear hyperbolic systems in one dimension. The exposition is clear, concise, and unfolds systematically beginning with introductory material and leading to the original research of the authors.
A systematic theory is established-by means of the concept of weak linear degeneracy and the method of (generalized) normalized coordinates-for the global existence and blow-up mechanism of regular nonlinear hyperbolic waves with small amplitude for the Cauchy problem and many others, including the Cauchy problem on a semi-bounded initial data, the one-side mixed initial-boundary value problem, the generalized Riemann problem, and the generalized nonlinear initial-boundary Riemann problem.
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PROGRESS IN NONLINEAR DIFFERENTIAL EQUATIONS AND THEIR APPLICATIONS

## Explorations in Harmonic Analysis

with Applications to Complex Function Theory and the Heisenberg Group steven g. Krantz, Washington University, St. Louis, Mo, USA

This text on modern harmonic analysis provides an introduction to the subject in the context in which it is actually applied, in particular, through complex function theory and partial differential equations. The exposition begins with the fundamentals of Fourier analysis, complex function theory, and integral operators and further introduces students to cuttingedge ideas about the Heisenberg group.
The subject is introduced through Fourier series and Hilbert transforms, passing into singular integrals, Riesz fractional integrals and the Calderón-Zygmund singular integrals. Function theory of several complex variables is presented as a prelude to the generalized Cayley transform and the Sigel upper halfspace. Finally, the structure of the Heisenberg group, which naturally models the structures of canonical operators of several complex variables, is explored.

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KARL-HERMANN NEEB, Darmstadt University of Technology, Germany; ARTURO PIANZOLA, University of Alberta, Canada (Eds.)

This collection of invited expository papers focuses on recent developments and trends in infinitedimensional Lie theory, which has become one of the core areas of modern mathematics. The book is divided into three parts: infinite-dimensional Lie (super-)algebras, geometry of infinite-dimensional Lie (transformation) groups, and representation theory of infinite-dimensional Lie groups.
Distinguished contributors include: B. Allison, D. Beltita, W. Bertram, H. Glöckner, P. Littelmann, K-H. Neeb, E. Neher, S. Paycha, I. Penkov, A. Pianzola, D. Pickrell, T. Ratiu, N. Scheithauer, C. Schweigert, V. Serganova, and J. Wolf.

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## Ancient Indian Leaps into Mathematics

B.S. YADAV, University of Delhi, India; MAN MOHAN, Ramjas College, University of Delhi, India (Eds.)

This volume presents contributions of mathematicians from ancient India to the broader context of the history of mathematics. Topics include the work of two well-known Indian mathematicians: Brahmagupta and Bhaskaracharya; the relationship of Indian mathematics to the mathematics of China and Greece; and transmission of ideas between the Western and non-Western world. A chapter on calendrical calculations, complete with computer programs, enables the reader to determine Indian dates.

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## Counting Surfaces <br> Combinatorics, Matrix Models and Algebraic Geometry BERTRAND EYNARD, CEA Saclay, Gif-sur-Yvette, France <br> This book explains the "matrix model" method developed by physicists to address the problem of enumerating maps and compares it with other methods. Included in the work are proofs, examples, and a general formula for the enumeration of maps on surfaces of any topology. Connections with more general topics such as algebraic geometry and string theory are also discussed.

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The goal of this book is to introduce newcomers to algebraic statistics, a field in which mathematicians and statisticians come together to solve statistical inference problems using concepts from algebraic geometry as well as related computational and combinatorial techniques. Three points are at the center of the text: several important statistical models correspond to algebraic or semi-algebraic sets of parameters; the geometry of these parameter spaces determines the behavior of widely used statistical inference procedures; computational algebraic geometry can be used to study parameter spaces and other features of statistical models.

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OBERWOLFACH SEMINARS, VOLUME 40

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ISSN 1661-8254 (PRINT)
ISSN 1662-3592 (ELECTRONIC)
2008. VOLUME 1 (2 ISSUES)

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November 2008

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## Features

## 1226 Möbius Transformations Revealed

## Douglas N. Arnold and Jonathan Rogness

The authors’ film, also titled Möbius Transformations Revealed, which presents a visualization of these complex functions, has attracted the attention of the general public as well as a technical audience. Here, the authors explain the mathematics involved, as well as how the video was produced.

## 1248 Cross-Cultural Analysis of Students with Exceptional Talent in Mathematical Problem Solving

Titu Andreescu, Joseph A. Gallian, Jonathan M. Kane, and Janet E. Mertz

The connection, if any, between gender (or other demographic factors) and mathematical skills has been much discussed in the popular and scientific press. In this study, the authors investigate ultra-high-level mathematical ability by looking at top tier mathematics competitions and find that girls and boys do equally well.
of the American Mathematical Society

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SUBSCRIPTION INFORMATION: Subscription prices for Volume 56 (2009) are US\$488 list; US\$390 institutional member; US\$293 individual member. (The subscription price for members is included in the annual dues.) A late charge of $10 \%$ of the subscription price will be imposed upon orders received from nonmembers after January 1 of the subscription year. Add for postage: Surface delivery outside the United States and India-US\$27; in India-US\$40; expedited delivery to destinations in North America-US\$35; elsewhere-US\$88. Subscriptions and orders for AMS publications should be addressed to the American Mathematical Society, P.O. Box 845904, Boston, MA 02284-5904 USA. All orders must be prepaid.

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[Notices of the American Mathematical Society (ISSN 00029920) is published monthly except bimonthly in June/July by the American Mathematical Society at 201 Charles Street, Providence, RI02904-2294USA, GSTNo. 121892046 RT****. Periodicals postage paid at Providence, RI, and additional mailing offices. POSTMASTER: Send address change notices to Notices of the American Mathematical Society, P.O. Box 6248, Providence, RI02940-6248USA.]Publication here of the Society's street address and the other informationin brackets above is a technical requirement of the U.S.Postal Service. Tel: 401-455-4000, email: notices@ams.org.
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## Opinion

## Infrastructures and Policies for Mathematicians

Lately, in many countries, the financing of research has been following a very common trend, according to which, to be financially viable, a project should have a pre-defined critical size as well as cluster a number of activities. There are undoubtedly disciplines for which this is all well and good, but except under very special circumstances this is not at all what fits mathematicians' needs. This trend underpins a number of calls for projects that have flourished recently in many countries: Germany, Japan, France, and Austria, to name a few. In a sense, the first programmes of the European Research Council (ERC) allocating starting grants and senior grants are also of this nature. Thanks to the vision and the vigilance of the mathematicians who have, over time, occupied executive positions at the National Science Foundation and in the councils advising them, it seems that U.S. mathematicians have not (yet?) suffered too much from this negative trend. Nevertheless, mathematical research being an authentically international enterprise, I feel that the issue is worthy of concern to all Notices readers.

Obvious questions include: what forms should infrastructures have in order to help mathematicians develop their research in the best possible conditions? How can these infrastructures be made to grow and become viable in the long run? Even though the Mittag-Leffler Institute (MLI) opened in 1916 in Djursholm, near Stockholm, and the Institute for Advanced Study (IAS) in 1930 in Princeton, it was in the second part of the twentieth century that a number of mathematical infrastructures besides mathematics departments of universities were established in several countries, some of them joining MLI and IAS as landmarks. The Mathematisches Forschungsinstitut Oberwolfach (MFO) is one of them; the Institut des Hautes Études Scientifiques (IHÉS) is another. We owe the creation of both of them to the initiative of single individuals. This is the case too for many that were created later, even if better organised mathematical communities actively helped.

A rough typology of mathematical infrastructures goes as follows: research institutes leaving total freedom to visitors to pursue the goals that matter to them; research institutes organising thematic periods; conference centres hosting events one week after the other; bibliographical databases; networks of libraries; repositories of specific pieces of software; and computing grids. By their very nature, their impact, and their use, mathematical infrastructures are truly international. Just to give an example, a small institute such as IHÉS has been welcoming visitors from more than thirty countries each year for the last ten years, with an average of seventy-eight visitors per year from the U.S.

What characterises these structures when successful? Long-term commitments, as it is indeed in the long run
that they can establish their reputation; open-mindedness vis-à-vis other disciplines-and also within mathematics, as one of the strongest impediments to mathematical research is the insularity of mathematicians themselves; support to a very broad base of subjects, critical to the health of the discipline in the long run, just the opposite of the fashion frenzies that erupt too often here and there; and, last but not least, their limited cost albeit they are infrastructures impacting a whole community.

As one can see, these characteristics are almost word for word in conflict with the fashionable criteria that govern the media-dominated society we live in, namely short-term objectives, clustering as a prerequisite for attractiveness, and also a biased way of interpreting accountability as very short-term. This goes along with the widespread use of numerical indicators, among which bibliometric ones have a leading role. With the specific pattern of publication for mathematicians, this is not a minor problem for us. Fortunately, the recent report prepared by the International Mathematical Union ${ }^{1}$ should help mathematicians tackle it. But mathematicians do not have any choice: they must fight for policies that take their needs into full consideration. To do that effectively, they must find allies who recognise the diversity of needs of scientists as the cornerstone of any sound scientific policy.

A critical component of this battle is to win long-term financial support for the mathematicians' infrastructures. Indeed many are struggling to get the special role they play for the community recognised. In fact, quite often, the limited size of their budgets plays against them. This is the case at the level of the European Commission where, presently, all mathematical infrastructures are being refused this status. Note that IAS has achieved this decisive independence almost from the start, thanks to an efficient management of its initial endowment and further efforts to strengthen it. Some of the mathematical infrastructures have finally won a status that puts them in a stable position thanks to specific state commitments. This is the case for several German infrastructures. IHÉS is presently supported by a state grant covering half its budget, and around thirty other sources, almost all of them outside France. It took steps towards acquiring more financial sustainability only recently, running (successfully) its first international fundraising campaign from 2001 to 2004 and, taking advantage of the celebration of its fiftieth anniversary in 2008, IHÉS has now launched its second fundraising campaign, hoping to guarantee some 30 percent of its annual budget (if successful), still a long step away from full independence.

For a community whose most visible event is called the International Congress of Mathematicians, it should be a natural obligation to learn how to make the case for infrastructures that really meet the needs of mathematicians.
-Jean-Pierre Bourguignon Centre National de la Recherche Scientifique and Institut des Hautes Études Scientifiques
jpb@ihes.fr

[^0]
# Search for an Executive Director for the American Mathematical Society 

## Position

The Trustees of the American Mathematical Society seek candidates for the position of Executive Director of the Society to replace Dr. John Ewing, who plans to retire in January 2009 after 13 years of exemplary service. This position offers the appropriate candidate the opportunity to have a strong positive influence on all activities of the Society, as well as the responsibility of overseeing a large, complex, and diverse spectrum of people, publications, and budgets. The desired starting date is as soon as possible in 2009.

## Duties and terms of appointment

The American Mathematical Society is the oldest scientific organization of mathematicians in the U.S. The Society's activities are mainly directed towards the promotion and dissemination of mathematical research and scholarship, broadly defined; the improvement of mathematical education at all levels; increasing the appreciation and awareness by the general public of the role of mathematics in our society; and advancing the professional status of mathematicians. These aims are pursued mainly through an active program of publications, meetings, and conferences. The Society is a major publisher of mathematical books and journals, including Mathematical Reviews; organizer of numerous meetings and conferences each year; and is a leading provider of electronic information in the mathematical sciences. The Society maintains its Washington office to improve interaction with federal agencies.

The Executive Director is the principal executive officer of the Society and is responsible for the execution and administration of the policies of the Society as approved by the Board of Trustees and by the Council. The Executive Director is a full-time employee of the Society appointed by the Trustees and is responsible for the operation of the Society's offices in Providence and Pawtucket, RI; Ann Arbor, MI; and Washington, DC. The Executive Director is an ex-officio member of the policy committees of the Society and is often called upon to represent the Society in its dealings with other scientific and scholarly bodies.
The economic condition of the Society is robust with an annual budget exceeding \$20 million. The major part of the budget is related to publications. Almost all operations (including the printing) of the publications program are done in-house by the Society. There is a staff of about 200 in the four offices. The directors of the various divisions report directly to the Executive Director.

The Executive Director serves at the pleasure of the Trustees. The terms of appointment, salary and benefits will be consistent with the nature and responsibilities of the position and will be determined by mutual agreement between the Trustees and the prospective appointee.

## Qualifications

Candidates for the office of Executive Director should have a Ph.D. (or equivalent) in mathematics, published research beyond the Ph.D., and significant administrative experience. The position calls for interaction with the staff, membership, and patrons of the Society as well as leaders of other scientific societies and publishing houses; thus leadership, communication skills, and diplomacy are prime requisites.

## Applications

A search committee chaired by John B Conway (conway@gwu.edu) and Eric M Friedlander (eric@math.northwestern.edu or efriedla@usc.edu) has been formed to seek and review applications. All communication with the committee will be held in confidence. Suggestions of suitable candidates are most welcome. Applicants can submit a CV, letter of interest, and an additional statement to:

## Executive Director Search Committee <br> c/o Sandy Golden <br> Office of the AMS Secretary

312D Ayres Hall, Department of Mathematics
University of Tennessee
Knoxville, TN 37996-1330
golden@math.utk.edu


The additional statement should outline the candidate's perspective on the aims and goals of the AMS, should set forth the role he/she might play in achieving these goals, and should describe her/his experiences and skills relevant to the position of Executive Director. For full consideration application materials should be received by October 15, 2008.

## Resurrecting Out-of-Print Books

We have all experienced the frustration of discovering that a favorite book of ours has gone out of print. Bringing such a book back into print is no easy matter. Publishers want some assurance that the book will sell well enough for them to recoup the costs of republishing. Even in today's world of on-demand publishing, someone (perhaps the author, if still alive) still has to go to the trouble of securing the copyright and then making the text available. Few will go to such trouble unless they know that the book is in demand, and the trouble is that ascertaining the demand seems to be difficult.

Fortunately, there is an easy way to estimate demand. At my suggestion, Klaus Schmid has set up a prototype website athttp://outofprintmath. blogspot.com where anyone can suggest a title, and vote for titles that others have suggested. The site tallies votes and displays the total for everyone to see. I encourage all readers of the Notices to visit the site and participate.

A better long-term solution might be for a bookselling website to take over the job of collecting such votes (for any out-of-print book, not just mathematics texts). I have tried to contact several such sites but most have not responded, except for Fetchbook. Info and Booksprice. com, who said they would add the idea to their to-do list. In the meantime, I believe that experimenting with Schmid's prototype will not only yield valuable information about individual titles, but will tell us whether collecting votes in this fashion is a good idea, and if so, what needs to be done to make such a service work well.

> -Timothy Chow
> Center for Communications
> Research
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(Received July 12, 2008)

## Which Way Is Gauss Really Facing?

What happened? Is there something inconsistent with the two images of Gauss, Notices of the AMS (June/July, 2008, page 681)?

The picture of the German 10 DM bill is the mirror image of the colored portrait of Gauss by C. A. Jensen. For how many years has the bill been in error?

> -Agnes M. Herzberg
> -Allan E. Read
> Queen's University, Kingston,
> Canada
> herzberg@post. queensu.ca
(Received July 22, 2008)

## Heironymus Georg Zeuthen

The August 2008 issue of the Notices features an article celebrating the centennial of some work of two great scholars: the Dane Johan Ludvig Heiberg and the Englishman Thomas Little Heath. However, the article makes short shrift of the contribution of the great Danish enumerative algebraic geometer and historian of mathematics Heironymus Georg Zeuthen. He is mentioned only once; on p. 777, we read: "Being a meticulous scholar, Heiberg returned to Constantinople in 1908 to refine and check his earlier work. Then satisfied with his notes, he was joined by a German [sic] colleague, H. G. Zeuthen, who assisted him in verifying a transcription of the text."

A fuller discussion of Heiberg, Zeuthen, and their collaboration is found in the 2002 Birkhauser collection, Writing the History of Mathematics, in three articles by Kirsti Andersen, Christian Marinus Taisbak, and Jesper Lützen. On p. 154, Andersen notes that, owing mainly to the work of Zeuthen and Heiberg, Elling Holst and Gustaf Hjalmar Eneström "the historiographical level increased considerably" in the last decades of the nineteenth century in Denmark, Norway, and Sweden. On p. 443, Taisbak writes: "Heiberg's finest achievement, however, was the identification and reconstruction of the text of Archi-
medes' "Ephodos" (The Method) discovered in Constantinople in 1906. Owing to his familiarity with Archimedes' idioms and way of thinking, he was able to decipher almost immediately the barely-legible palimpsest, in which he was greatly helped by his friend, professor of mathematics H . G. Zeuthen, whose deep understanding of Greek mathematical problems was also a great asset."

On p. 575, Lützen writes: "When doing history of mathematics he [Zeuthen] wanted to uncover the ideas and motives of the ancient masters. These ideas, he argued, were usually formulated in an unfamiliar language, but since the ideas themselves had not changed over time, it was possible for a modern mathematician to appreciate the work of a colleague 2,000 years earlier. Still, Zeuthen repeatedly underlined that one cannot evaluate or understand mathematics of an earlier period on the basis of the mathematics of today. On the contrary, he thought it indispensable to be acquainted with the techniques and symbolism of former times in order to contrast those tools and what they could be used for with what they had actually been used for."

On p. 578, Lützen writes: "The Danish philologist Johan Ludvig Heiberg, who gained fame through his authoritative editions of the works of Greek mathematicians, was probably the person whom Zeuthen consulted most often in connection with his historical research. The achievements of these two connoisseurs of Greek mathematics stand out as remarkable examples of a fruitful collaboration between a scientist and a humanist. Many letters are preserved in which Zeuthen explains technical matters to Heiberg. Considering that the two experts met at least every two weeks in the Royal Danish Academy, there is no doubt that their collaboration was much more intense than the written evidence shows. They published two joint papers (1906 and 1907 [sic]), the first of which created a great sensation. It contained Archimedes' so-called 'Method', thought to be

# Faculty Positions in Mathematical Analysis at the Ecole Polytechnique Fédérale de Lausanne (EPFL) 

EPFL is planning to make a number of appointments in the field of mathematical analysis with non-exclusive emphasis on Partial Differential Equations. Appointments will in principle be made at the Assistant Professor level.

Successful candidates will establish and lead vigorous independent research programs, interact with existing projects and be committed to excellence in undergraduate and graduate teaching. Significant start-up resources and research infrastructure will be available.

Applications should be made via
http://sbpositions.epfl.ch/applications/
by November 30, 2008.

Candidates should submit their curriculum vitae including list of publications, concise statement of research and teaching interests, and the names and addresses (including email) of five referees as a single PDF file (at most 20 A4-format pages, not counting the list of publications).

For additional information, please contact :

Professor Alfio Quarteroni (Chairman) Mathematics Search Committee

Email: alfio.quarteroni@epfl.ch, please specify Subject: «Math Positions» in the email heading

The EPFL School of Basic Sciences aims for a strong presence of women amongst its faculty, and qualified female candidates are strongly encouraged to apply.
lost, but which Heiberg had found as a palimpsest in Constantinople. Heiberg provided a translation of the text and Zeuthen wrote the mathematical commentary. The content particularly pleased Zeuthen, for it showed that the ancients had been in possession of an intuitive infinitesimal method by which they first found the results that they later proved by the method of exhaustion. This was what Zeuthen and others had guessed on the basis of mathematical analyses of the surviving sources. Thus, as Zeuthen himself pointed out, Heiberg's discovery brilliantly supported Zeuthen's approach to the history of mathematics."
-Steven L. Kleiman Massachusetts Institute of

Technology
k1eiman@math.mit.edu
(Received August 14, 2008)

## Submitting Letters to the Editor

The Notices invites readers to submit letters and opinion pieces on topics related to mathematics. Electronic submissions are preferred (notices-1etters@ ams.org); see the masthead for postal mail addresses. Opinion pieces are usually one printed page in length (about 800 words). Letters are normally less than one page long, and shorter letters are preferred.

## Identifications

Affiliations of authors of "Letters to the Editor" are provided for identification purposes only. Opinions expressed in letters are those of the authors and do not necessarily reflect those of their employers or, in the case of American Mathematical Society officers or committee members, policies of the Society. Committee reports to the Council of the Society and official communications of officers of the Society, when published in the Notices, appear in the section of the Notices "From the AMS Secretary".

The American Mathematical Society announces


# Möbius Transformations Revealed 

Douglas N. Arnold and Jonathan Rogness

Möbius Transformations Revealed is a short film that illustrates a beautiful correspondence between Möbius transformations and motions of the sphere. The video received an Honorable Mention in the 2007 Science and Engineering Visualization Challenge, cosponsored by the National Science Foundation and Science magazine. It subsequently received extensive coverage from both traditional media outlets and online blogs. Edward Tufte, the world's leading expert on the visual display of information, came across the video and reported on his blog "Möbius Transformations Revealed is a wonderful video clarifying a deep topic... amazing work..." But the film has also attracted a far less expert audience. As of this writing, it has been viewed nearly 1.5 million times on the video-sharing website YouTube and is rated as the number three top favorite video of all time in YouTube's educational category. Over 11,000 viewers have declared it among their favorites, which makes it one of the YouTube top favorites of all time. From the more than 4,000 written comments left by YouTube viewers it is clear that many of them had little mathematical background, and some were quite young. To view Möbius Transformations Revealed, visit the website http://umn.edu/~ arnold/moebius/.

In this article we discuss some of the technical details behind the video and offer a "behind the

[^1]scenes" look at its production. We begin with a brief overview of the visualization of functions of a complex variable, especially the technique used throughout the video, which we refer to as homotopic image mapping. This is followed by a discussion of Möbius transformations and the specific theorem illustrated in the video. We conclude by describing aspects of the movie that are generally unnoticed by the public but can be appreciated by mathematicians.

## Visualization of Functions

Among the most insightful tools that mathematics has developed is the representation of a function of a real variable by its graph. In fact, historically, graphs of functions appeared before the notion of function itself. A graph of the inclinations of planets as a function of time appears already in a tenth century manuscript [1], and in the fourteenth century Nicolas Oresme published a graphical method for displaying data that leads to graphs that appear quite familiar (see Figure 1).

By the late seventeenth and early eighteenth century, when the notion of function was developed by Leibniz, John Bernoulli, Euler, and others, graphs appeared in their works that would not be out of place in today's calculus texts. Who today would attempt to teach the trigonometric functions, without drawing a graph?

The situation is quite different for a function of a complex variable. The graph is then a surface in four-dimensional space, and not so easily drawn. Many texts in complex analysis are without a single depiction of a function. Nor is it unusual for average students to complete a course in the subject with little idea of what even simple functions, say trigonometric functions, "look like". (Fortunately


Figure 1. Tenth and fourteenth century graphs.
there are some exceptional textbooks, such as the lovely Visual Complex Analysis by Needham [2].)

The most straightforward way to visually represent a function $w=f(z)$ of a complex variable is to depict the image in the $w$-plane of some identifiable point set in the domain. At the simplest level, this may consist of finitely many labeled points or curves, but more information is transmitted by depicting the image of a region labeled with an easily identifiable pattern, such as a checkerboard (see Figure 2). With the aid of computer graphics, one can easily incorporate colors or even images.


Figure 2. A checkerboard on the unit square and its image under $f(z)=z^{3}$.

This can help the viewer to ascertain the configuration of large parts of the image at a glance. See Figures 3 and 4. Note that this image mapping approach to visualizing complex functions offers a great deal of freedom in comparison to standard graphs of real functions, in which the only significant choices to be made are the ranges and scales of the axes. For complex image mapping we have the choice of the region in the $z$-plane to display and the domain pattern, i.e., the pattern, coloring, or other labeling of the region. Different choices


Figure 3. A colored rectangle and its image mapped via $\cos z$.


Figure 4. The first author's photo under $z^{3}$.
of domain pattern can significantly enhance the communication of salient features of the function. Transparency is a commonly implemented feature in many computer graphics systems, and the use of partially transparent domain patterns can help with the difficulties image mapping encounters with multivalent functions (see Figure 5). (An alternative method of depicting complex functions, called domain coloring, avoids the difficulties with multivalence by depicting the inverse image of a pattern in the range [3].)



Figure 5. $f(z)=\left(2 z^{3}-6 z^{2}-z-2\right) / 6$.

Even with a well-chosen domain pattern, it may be difficult to relate points in the image plane to
their inverse images in the domain plane. Animation is a very effective tool in this regard. With homotopic image mapping we depict not just the image of the domain pattern under the mapping $f$, but the evolution of the image under a homotopy connecting the identity map to $f$. In this way a great deal of information can be conveyed quickly. A glance at even four frames from such a homotopy, shown in Figure 6, makes it easy to see how the complex exponential map takes the rectangle $|\operatorname{Re}(z)| \leq a,|\operatorname{Im}(z)| \leq \pi$ onto the annulus $e^{-a} \leq|w| \leq e^{a}$. In this example, we use a simple linear homotopy, $F(z, t)=(1-t) z+t \exp (z)$, $0 \leq t \leq 1$, but the choice of homotopy is another factor that can be used to advantage. For example, to visualize the function $f(z)=z^{3}$ we might want to use a homotopy through power maps: $F(z, t)=z^{1+t}, 0 \leq t \leq 2$.


Figure 6. Homotopy to $f(z)=e^{z}$.

## Möbius Transformations

Möbius transformations, i.e., non-constant rational maps of the form

$$
f(z)=\frac{a z+b}{c z+d}
$$

are fundamental complex maps, useful in many applications, and studied in most courses on complex analysis. They are invertible meromorphic functions (in fact the group of meromorphic automorphisms of the extended complex plane $\mathbb{C}_{\infty}$ consists precisely of the Möbius transformations), and so are conformal everywhere. They also possess the less common geometrical property that they map arcs of circles (understood to include line segments as a limiting case) to arcs of circles. Thus Möbius transformations are natural candidates for
visualization by image mapping. These can be animated effectively by using a homotopy consisting entirely of Möbius transformations that joins the identity (which is a Möbius transformation) to the given transformation. This technique is used extensively in Möbius Transformations Revealed.

The characterization of the Möbius transformations as the meromorphic automorphisms of the extended complex plane can be interpreted geometrically. The extended plane can be identified with the unit sphere in $\mathbb{R}^{3}$ as usual. Namely, we identify the complex plane with the plane $x_{3}=0$ in $\mathbb{R}^{3}$, and map it to the unit sphere by inverse stereographic projection from the north pole. Completing the identification by mapping the point at infinity in $\mathbb{C}_{\infty}$ to the north pole, the Möbius transformations correspond to the holomorphic automorphisms of this Riemann sphere. However, it is not obvious what the holomorphic automorphisms of the sphere look like, and it takes some effort and sophistication to get a clear picture of the Möbius transformations in this way.

Stereographic projection can be used to characterize Möbius transformations in a distinctly different way, which is both elegant and visually accessible. Call a sphere $S$ in $\mathbb{R}^{3}$ admissible if its north pole lies in the upper half-space $H=\left\{x_{3}>0\right\}$, and, for such spheres, denote by $P_{S}$ the stereographic projection from the north pole $s_{0}$ of $S$, which identifies $\mathbb{C}_{\infty}$ with $S$. Choose some such sphere, and also a rigid motion $T$ of $\mathbb{R}^{3}$ such that $S^{\prime}:=T S$ is also admissible, i.e., $T s_{0} \in H$. Consider the composition $P_{S^{\prime}} \circ T \circ P_{S}^{-1}$, which maps $\mathbb{C}_{\infty}$ to itself. It is easy to verify that the composition is a Möbius transformation, either by direct calculation, or, from a more advanced viewpoint, by noting that it corresponds to the map from $S$ to itself given by $P_{S}^{-1} \circ P_{S^{\prime}} \circ T$, which is surely a holomorphic automorphism.

In fact, every Möbius transformation is obtained in this way.

Theorem 1. A complex mapping is a Möbius transformation if and only if it can be obtained by stereographic projection of the complex plane onto an admissible sphere in $\mathbb{R}^{3}$, followed by a rigid motion of the sphere in $\mathbb{R}^{3}$ which maps it to another admissible sphere, followed by stereographic projection back to the plane.

We have not been able to ascertain the origin of this simple, elegant result. A broad, if unscientific, survey of colleagues indicates that the theorem is known by some, but no one has been able to provide a concrete reference. In 2006 it was added by an anonymous contributor as the second sentence of the article on Möbius transformations in the web-based free content encyclopedia Wikipedia ("A Möbius transformation may be performed by performing a stereographic projection from a plane to a sphere, rotating and moving that sphere
to a new arbitrary location and orientation, and performing a stereographic projection back to the plane.") More recently, in 2008 this sentence was removed from Wikipedia by a contributor whose comments indicate a misunderstanding of the result.

To prove Theorem 1, we must show that for any Möbius transformation $f$ there exists an admissible sphere $S$ and a rigid motion $T$ such that $S^{\prime}=T S$ is admissible and that

$$
\begin{equation*}
f=P_{S^{\prime}} \circ T \circ P_{S}^{-1} \tag{1}
\end{equation*}
$$

We rely on the elementary fact that the Möbius transformations are generated by the translations $z \mapsto z+\alpha(\alpha \in \mathbb{C})$, the rotations $Z \mapsto e^{i \theta}(\theta \in \mathbb{R})$, the dilations $Z \mapsto \rho Z(\rho>0)$, and the inversion $z \mapsto 1 / z$. In fact, it is easy to write any Möbius transformation (except a linear polynomial, which is an easier case) as

$$
\begin{equation*}
f(z)=\frac{\rho e^{i \theta}}{z+\alpha}+\beta \tag{2}
\end{equation*}
$$

for appropriate $\alpha, \beta \in \mathbb{C}$ and $\rho, \theta \in \mathbb{R}$. In other words, $f$ is obtained as the composition
(1) translation by $\alpha$
(2) inversion
(3) dilation by $\rho$
(4) rotation by $\theta$
(5) translation by $\beta$

Now, the translation by $\alpha$ may be realized in the form (1) by choosing $S$ to be any admissible sphere and $T$ to be the same translation extended to $\mathbb{R}^{3}$. For each of the other maps, rotation, dilation, and inversion, we choose $S$ to the be the unit sphere. To obtain a rotation, of course, we take $T$ to be the same rotation extended to $\mathbb{R}^{3}$ (rotation about the $x_{3}$-axis). To obtain dilation by $\rho$, we take $T$ to be translation of the sphere upwards a distance $\rho-1$. And to obtain the inversion, we take $T$ to be rotation around the real axis of the complex plane through an angle $\pi$. Therefore, we can write the general Möbius transformation (2) in the form (1) by choosing $S$ to be a sphere of unit radius centered at the point $-\alpha$ of the complex plane, and construct $T$ as the composition of translation by $\alpha$, rotation by $\pi$ around the real axis, rotation by $\theta$ around the axis orthogonal to the plane, translation upwards by $\rho-1$, and translation by $\beta$.

Note that the choice of the sphere $S$ and rigid motion $T$ are far from unique. After all, they offer ten degrees of freedom, while the Möbius group is just six-dimensional. An example of nonuniqueness is shown in Figure 7, which displays two representations of the Möbius transformation $f(z)=[(-1+i) z-\sqrt{2}] /[(-1+i) z+\sqrt{2}]$ using spheres of unit radius. In the first, $T$ is a rotation about the center of the initial sphere $S$, so the final sphere $S^{\prime}$ coincides with $S$. In the second


Figure 7. Distinct representations of the same Möbius transformation.
representation, $T$ involves translation as well as rotation.

## Möbius Transformations Revealed

The video Möbius Transformations Revealed demonstrates various geometric properties of Möbius transformations-e.g., conformality, circle-tocircle mapping, and generation by translations, rotations, dilations, and inversion-using homotopic image mapping. With the addition of 3-dimensional computer animation, it demonstrates the relation between Möbius transformations of the plane to stereographic projections of a sphere and gives a convincing demonstration of the elusive Theorem 1.

A very satisfying aspect of the production of the video is that the theorem it demonstrates-that Möbius transformations can be obtained by simple rigid motions of a sphere through 3-space via stereographic projection-was a key to producing the video itself. As we often teach in the classroom, stereographic projection is the mathematical realization of the physical process of illuminating a plane from a bright light placed at the far pole of
a translucent sphere and following the light rays from the pole through the sphere onto the plane. See Figure 8. The frames of Möbius Transforma-


Figure 8. Stereographic projection.
tions Revealed were produced using ray-tracing software. We used the Persistence of Vision Raytracer (POV-Ray), a totally free and widely available program that runs on most computer platforms. With ray-tracing, the user enters the configurations and attributes (such as texture, color, and transparency) of objects, light sources, and a camera in a virtual 3-dimensional world. The software then renders the 2 -dimensional image seen by the camera as a result of light rays interacting with the objects.

The 3-dimensional world of Möbius Transformations Revealed is very simple. We needed only to provide a sphere, appropriately colored and translucent, a plane with appropriate markings (grid) and reflectivity, and a light source on the pole of the sphere opposite the plane. For each frame we positioned and oriented the sphere and the camera appropriately, and POV-Ray did the rest.

Of course this is oversimplified. The description for POV-Ray of a transparent sphere colored with a translucent image of a rainbow-colored square under inverse stereographic projection involves a messy calculation with spherical coordinates, and we used Mathematica to compute it. A fair amount of calculation was needed as well to choose the positions and orientations, and a lot of adjustment of visual attributes was needed to obtain images of high quality. In mathematical videos, as in other movies, production values are important, and thought has to be given to nonmathematical issues such as color choices, line thickness, viewing area, choice and depiction of axes, speed of the homotopies, etc. As with any educational activity, decisions had to be made about what to include and what to omit, and the level
of presentation. Möbius Transformations Revealed could even be said to have a simple plot, in which the Möbius transformations are introduced in two dimensions, and then "revealed" by moving the camera from straight overhead, looking down at the plane, with the sphere invisible, to a side view in which the sphere becomes visible and can be seen together with the plane. It is set to music, and the affinity between the images on the screen and the selection from Schumann's Kinderscenen performed by pianist Donald Betts undoubtedly contributed to the popularity of the video.

An interesting aspect of the ray-traced frames in the 3-dimensional portion of the video, is that they combine the effects of stereographic projection onto a plane and perspective projection of the plane onto the camera's imaging plane. Because of the perspective projection, the image of a line segment under a Möbius transformation, i.e., the image under stereographic projection on the complex plane of a circular arc on the sphere, does not appear as a circular arc on the screen, but rather as an ellipse. In some cases, the eccentricity of the ellipse is large: circles with a large radius may appear to be nearly straight lines until they bend sharply in the distance; see Figure 9. As was discovered by artists during the Renaissance, a circle rendered as the appropriate ellipse via projection conveys a more genuine sense of a circle, than if it were rendered as a circle.


Figure 9. A circle appears to bend sharply at upper left.

In fact, the situation is more complicated. The black curves drawn as a grid on the sphere are not 1-dimensional curves at all, but have width. Therefore, even without the perspective projection, they would not be projected onto true circles and lines on the plane, but rather onto two-dimensional tubular neighborhoods of circles and lines. These neighborhoods become quite distorted when the curves are close to the light source. Figure 10, for
example, shows a line which should be projected onto the positive imaginary axis, but in fact becomes arbitrarily wide. Readers will also notice the varying width of the circular arcs in the image. Again this contributes to a sense of reality of the image.


Figure 10. A thin segment becomes very thick near infinity.

The correspondence between stereographic projection and its ray-tracing realization illustrated in Figure 8 is not perfect. Mathematically, the case where the sphere intersects the plane is perfectly allowable, but the physical model of stereographic projection we used in the video breaks down in that case. Figure 11 shows this situation clearly. Inside the unit circle $|z|=1$ light rays hit the plane before reaching the color on the sphere. We avoided choosing such spheres in Möbius Transformations Revealed.


Figure 11. The physical model of stereographic projection fails when the sphere intersects the plane.

The first part of Möbius Transformations Revealed is 2-dimensional, but we still used raytracing to generate the Möbius transformations.


Figure 12. In the video, unlike in this image, the sphere underneath the plane is hidden from view and the camera points straight down to get a 2-dimensional view.

How did we hide the sphere? We placed the camera directly above the origin of the plane, looking down at it, but placed the sphere underneath the plane with the light source at the south pole, causing the plane to be illuminated by colors from below. See Figure 12, where the camera has been moved away from the $z$-axis and the plane is transparent enough to see the sphere. Note that this sphere is not admissible, as defined above, showing that Theorem 1 can be generalized further.

In our own experience, computer visualization of mathematical concepts is an insightful tool for both research and education. The reaction to Möbius Transformations Revealed demonstrates the breadth of its appeal.

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François Labourie

Quadruples of distinct lines are endowed with a unique invariant, the projective cross ratio: two quadruples are equivalent under a linear transformation if and only if they have the same cross ratio. The projective cross ratio turns out to characterise the geometry of the projective line. In projective coordinates, the cross ratio is computed as a ratio involving four terms with some "crossing symmetries", hence its name.

Consider four pairwise distinct lines ( $x, y, z, t$ ) in the plane, all passing through the origin. There exist essentially unique coordinates so that $x$ is generated by $(1,0), y$ by $(0,1), z$ by $(1,1)$ and $t$ by $(b, 1)$. Then, $b:=\mathbf{b}(x, y, z, t)$ is the projective cross ratio of the four lines. The projective cross ratio satisfies a certain set $\mathcal{R}$ of functional rules. We single out two of these rules: a multiplicative cocycle rule (1) on the first and second variables and an additive rule (2):

$$
\begin{align*}
& \text { (1) } \mathbf{b}(x, y, z, t)=\mathbf{b}(x, w, z, t) \mathbf{b}(w, y, z, t),  \tag{1}\\
& \text { (2) } \mathbf{b}(x, y, z, t)=1-\mathbf{b}(t, y, z, x) .
\end{align*}
$$

Conversely, any set endowed with a function $\mathbf{b}$ of quadruples of points satisfying $\mathcal{R}$ can be realised as a subset of the projective line so that the function $\mathbf{b}$ is the restriction of the projective cross ratio. This elementary though remarkable statement asserts that the projective cross ratio completely characterises the projective line. Consequently, we may define the projective cross ratio as a function on quadruples satisfying some functional rules.

The projective cross ratio has many descendants in algebraic geometry: invariants of configurations of planes, lines, or flags. We shall not pursue this development here but rather restrict to real and complex projective lines and the relationships of the cross ratio with negatively curved manifolds, hyperbolic dynamics, and Teichmüller theory.

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Cross ratio and distance.

One can describe the real hyperbolic plane as a metric extension of the real projective line. In the complex line $\mathbb{C}$, seen as an affine chart of the complex projective line, a circle is the set of complex lines intersecting a given real plane and thus is in bijection with a real projective line. In the Poincaré disk model, the hyperbolic plane is the disk bounded by the unit circle $\mathbb{U}$, which we identify with a real projective line. The geodesics of the hyperbolic plane are circles orthogonal to $\mathbb{U}$. A pair of points in the real projective line $\mathbb{U}$ then determines a unique geodesic. The cross ratio is related to the hyperbolic distance as follows. A horosphere centred at a point $x$ of the projective line is a circle in the Poincaré model tangent to $\mathbb{U}$ at the point $x$. Let $\gamma$ be the unique geodesic joining two points $A$ and $B$ in the hyperbolic plane; let $x$ and $y$ be the end points at infinity of $\gamma$; let $C_{x}$ and $C_{y}$ be the horospheres centred at $x$ and $y$ and passing through $A$ and $B$, respectively; let finally $z$ and $t$ be the centres of the two horospheres tangent to both $C_{x}$ and $C_{y}$. Then the hyperbolic distance between $A$ and $B$ is the logarithm of the projective cross ratio of the four points $x, y, z, t$.

This construction allows us to derive the hyperbolic distance from the cross ratio and vice versa.

Conversely, the real projective line appears as the boundary at infinity of the hyperbolic plane. In the Poincaré disk model, two oriented geodesics end up at the same point in $\mathbb{U}$ if they are asymptotic, that is, they eventually remain at finite distance from each other. This permits the extension of these ideas to Hadamard surfaces. A two-dimensional Riemannian manifold $M$ is a Hadamard surface if it is simply connected, negatively curved, and complete. This boundary at infinity $\partial_{\infty} M$ of $M$ is the set of equivalence classes of asymptotic oriented geodesics. For the hyperbolic plane, the boundary at infinity is the projective line U. A horosphere is now the limit of metric spheres passing through a given point but whose centres go to infinity.

Otal generalised the cross ratio to $\partial_{\infty} M$ by reversing the construction of the picture. Starting from four points in $\partial_{\infty} M$, draw four horospheres and define the cross ratio of $x, y, z, t$ as the exponential of the distance between the two points $A$ and $B$, with some sign convention. In general, the corresponding function satisfies all rules of $\mathcal{R}$ except the additive relation (2). Define a cross ratio as any function which satisfies this relaxed set of rules. Using these ideas, Otal proved that a metric of negative curvature on a surface is characterised by the length of closed geodesics. Bourdon used similar cross ratios to define a coarse geometry on the boundary at infinity of a general negatively curved metric space.

We now turn to dynamics and Teichmüller theory. Assume that $M$ is the universal cover of a closed surface $S$. Although $\partial_{\infty} M$ was defined from the metric geometry of $M$, it depends only on $\pi_{1}(S)$. Therefore we denote it $\partial_{\infty} \pi_{1}(S)$. The boundary at infinity is homeomorphic to a circle and admits an action of $\pi_{1}(S)$. Thus: every negatively curved metric on $S$ gives rise to a $\pi_{1}(S)$-invariant cross ratio on $\partial_{\infty} \pi_{1}(S)$.

A cross ratio has a dynamical interpretation. Consider the quotient of the space of triples of pairwise distinct points of $\partial_{\infty} \pi_{1}(S)$ by the diagonal action of $\pi_{1}(S)$. This quotient, which we denote $U S$, is compact. A cross ratio gives rise to a one-parameter group of transformations $\left\{\phi_{t}\right\}$ on $U S$, defined by $\phi_{t}(x, y, z)=(x, y, w)$ where $t=\mathbf{b}(x, y, z, w)$. The mutiplicative cocycle rule (1) translates into $\phi_{t+s}=\phi_{t} \circ \phi_{s}$. This construction recovers the geodesic flow when the cross ratio comes from a negatively curved metric. In general, there is an intimate relation between dynamics and the cross ratio.

What is the space $\mathcal{M}_{S}$ of all cross ratios on $\partial_{\infty} \pi_{1}(S)$ ?The Fricke space of hyperbolic structures on $S$, usually identified with the Teichmüller space $\mathcal{T}(S)$ of complex structures on $S$ by the Uniformisation Theorem, naturally sits in $\mathcal{M}_{S}$ as the subset of projective cross ratios. Every such
cross ratio identifies $\partial_{\infty} \pi_{1}(S)$ with the projective line and thus defines a representation of $\pi_{1}(S)$ in $\operatorname{PSL}(2, \mathbb{R})$ and a hyperbolic structure on $S$. Similarly, a space of representations of $\pi_{1}(S)$ in $\operatorname{PSL}(n, \mathbb{R})$, called the Hitchin component, has been identifed by the author as the space of cross ratios satisfying rules generalising the additive rule (2). Finally, $\mathcal{M}_{S}$ also contains the space of all negatively curved metrics on $S$.

The space $\mathcal{M}_{S}$ is suspected to have an interesting structure generalising the Poisson structure on Hitchin components described by Goldman. Recall that a Poisson structure on a set $Y$ is a Lie algebra structure on a set of functions on $Y$, such that the Lie bracket satisfies a Leibniz rule with respect to multiplication. This notion arises from classical mechanics and leads to quantum mechanics. By construction, every quadruple of points ( $x, y, z, t$ ) of the boundary at infinity defines a function on $\mathcal{M}_{S}$ by $\mathbf{b} \mapsto \mathbf{b}(x, y, z, t)$. These functions, when restricted to Fricke space, yield a natural class of functions whose Poisson brackets have been computed by Wolpert and Penner. These functions were later quantised-that is represented as operators on Hilbert spaces-by Chekhov, Fock, and Penner. A more sophisticated construction led Fock and Goncharov to quantise Hitchin components.

In other directions, cross ratios are instrumental in generalising many properties of classical Teichmüller theory, such as McShane identities, to a higher Teichmüller-Thurston theory, that is, the study of Hitchin components.

The complex projective cross ratio strongly relates to hyperbolic 3-dimensional geometry. Two recent and beautiful examples are W. Neumann's study of Hilbert's third problem in hyperbolic geometry, and the Quantum Hyperbolic Geometry developed by Baseilhac, Bonahon, Benedetti, Kashaev, etc.

The simple functional rules satisfied by the ubiquitous cross ratio are flexible enough to describe various geometric and dynamical situations. Yet they are rigid enough to carry important information about dynamics, Poisson structures, and surface group representations.

## Further Reading

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# Mathematics at Berkeley: AHistory 

Reviewed by Rob Kirby

Mathematics at Berkeley: A History<br>Calvin C. Moore<br>A K Peters, 2007<br>US\$39.00, 376 pages<br>ISBM 978-1568813028

Cal Moore has given us a work of admirable scholarship that belongs in the library of any mathematics historian and should be interesting to a range of other mathematicians, from those who spent part of their careers at Berkeley, to those who just want to see if they or their friends are mentioned (many are).

The book starts with the origins of the University of California, Berkeley, and concludes (except for some endnotes) in 1985 with the establishment of Berkeley's Mathematical Sciences Research Institute (due in great part to the work of Moore). I will outline some of the highlights and add a few stories and pictures.

UC Berkeley was created in 1868 as the offspring of two parents. One was the College of California, founded in 1855 and located on the current site of the Berkeley campus. The site (and eventual town) was named in 1866 after the Irish philosopher Bishop George Berkeley, a patron of education who also had a hand in founding Kings College (now Columbia University) and the College of Philadelphia (now University of Pennsylvania). The Bishop is also known in mathematics for his attack on fluxions, the basis of Newton's calculus.

The other parent was the Agricultural, Mining, and Mechanical Arts College, chartered by the California legislature under the Morrill Act,

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which funded this land-grant college. (It is interesting to note that Yale University was also a land-grant institution, receiving funds through its college of forestry.)

The former parent had land and the latter had money, and after a difficult courtship they united to form Berkeley. Yale graduates played a large role during these years and it is speculated that the school colors, blue and gold, came from the school color of Yale and the gold of the Golden Gate, the golden hills, and the gold of California. However, all mathematics department chairs from 1882 to 1954 held Harvard degrees.

For a few decades Berkeley was undistinguished as a research university. Professors were paid US\$3,600 per year, or less, and taught five courses per term, mostly following the West Point curriculum. This was two years of what we would call pre-calculus and then a year of calculus. The college algebra text, by Davies, was not liked and a tradition began with a nighttime funeral procession through campus with a coffin containing the offending book, which was then "cremated" to song and oratory. The tradition grew to include other unpopular texts.

By the early 1930s the physics and chemistry departments at Berkeley had achieved considerable
reknown (think of Lawrence and Oppenheimer), and it had been realized that the math department had fallen far behind and something needed to be done. Griffith Evans, chair at Rice University, was the agreed-upon choice to revitalize the math department, but negotiations to bring him to Berkeley were lengthy. A primary issue was salary, and this being the Depression, a grand offer of US\$9,000 was made, but with the proviso that it would likely be subject to a $10 \%$ cut by the legislature, and possibly as much as a one-third cut. Since Evans was facing the same $10 \%$ cut at Rice, US $\$ 8,100$ was accepted after he was assured that it would be cut no further. (If the days of actual salary cuts seem impossible now, it should be remembered that faculty salaries did not nearly keep up with inflation during the 1970s, and one source claims that faculty lost $24 \%$ of their purchasing power during those years.)

Evans successfully recruited Charles Morrey, Hans Lewy, and Jerzy Neyman in the 1930s, and the department had taken a long step towards its future eminence. David Blackwell might have also come to Berkeley at that time (he did later in 1955), but an offer died due to the opposition of Evans' wife, who felt that "she could not invite a Negro to her house or attend a department function at which one was present."

In 1936 the math department still had no secretaries, but Evans was able to obtain a half-time position for Sarah Hallam, at the rate of US\$400 per half-year. Comparing her salary to Evans' US $\$ 8,100$ per year shows that in those days there was a bigger discrepancy between staff and professorial salaries than there is today. Sarah Hallam presided over considerable growth in the size of the staff and ran the department with an iron hand until she retired in 1972. She died in 1994, leaving US $\$ 300,000$ for graduate fellowships.

Under Evans the department grew slowly through World War II and then more quickly until Evans stepped down as chair in 1949, having added Alfred Tarski, Raphael Robinson, Derrick H. Lehmer, and John Kelley. In those days the standard teaching load was three courses per semester, and office space was scarce with four instructors to an office. (I recall Irving Kaplansky telling me that when he went to Harvard in 1940, professors did not have offices, but worked at home and held office hours and met students in a common room.)

The famous (loyalty) oath controversy began in 1949, died down in 1952, and in the words of Clark Kerr, "caused the single greatest confrontation between a faculty and its board of trustees in American history." The author devotes a chapter to giving a balanced account of the controversy, which I will summarize here.

The oath stated:
I do solemnly swear (or affirm) that I will support the Constitution of the United States and the Constitution of the State of California, and that I will faithfully discharge the duties of my office according to the best of my ability; that I am not a member of the Communist Party or under any oath, or a party to any agreement, or under any commitment that is in conflict with my obligation under this oath.

The part before the semicolon had always been required of public employees in California, but the Regents of UC added the latter part in June 1949.

Since 1940 it had been the policy of the regents to ban employment of members of the Communist Party, and since this had caused no furor, the addition to the oath was not expected to be a problem, but rather a form of implementation of the ban on members. However, it quickly became a power struggle between the faculty and the regents that came to dominate faculty life.

The issue was not the ban against membership in the Communist Party, for $79 \%$ of the faculty voted in favor of that, and some of the most distinguished opponents of the loyalty oath stated that they nonetheless favored the ban. Rather, the opposition was fueled by the fact that only university professors (among state employees) were required to sign an oath, amid growing disagreement over the degree of risk posed by Communists and sympathizers in the U.S.

Eventually, all but 36 professors signed the loyalty oath, and then the issue shifted to whether the faculty or the regents had the authority to determine the fitness of a person to be a member of the faculty. The Committee on Privilege and Tenure held hearings on the 36 non-signers and recommended against dismissal of 31 and for dismissal of the other 5 . The committee found no evidence of disloyalty in any of the non-signers, but the 5 who declined to discuss the issues were those recommended for dismissal. The regents at first upheld the committee but then on a 12-10 vote decided to dismiss all 36.

After the regents' vote, 12 decided to sign, and 24 were dismissed, among them John Kelley, Hans Lewy, Stefan Peters, and Pauline Sperry; also, assistant professors Charles Stein and Paul Garabedian resigned before being required to sign the oath.

Legal battles were fought, and the California legislature passed a slightly stronger version of an oath, the Levering oath, which applied to all public employees, not just the UC faculty. In 1953, the Supreme Court ruled in favor of the faculty, but on a narrow ground that the Levering oath superseded the regents' oath. The non-signers were then offered reinstatement provided they signed
the Levering oath. Many accepted reinstatement, including Kelley and Lewy, but signed the Levering oath with great reluctance.

Looking back, the battle over the loyalty oath rested on the differing views of membership in the Communist Party and what that meant about fitness to be a member of the faculty. In extreme forms one side saw membership as just a form of progressive or leftist politics that should enjoy the traditional protections, but the other side saw membership as joining a group under the control of a foreign power that advocated the violent overthrow of our government. That the focus became a signature on a relatively worthless piece of paper is curious.

However, it could be argued that the most important outcome of the controversy was this: before 1950, tenure was a custom but it was not written in any regulations, but after the loyalty oath and the dismissals, considerable effort led, in 1958, to a formal regents' policy of tenure.

The controversy over the loyalty oath could have sent the math department into decline, but instead a significant expansion in quantity and quality began in the late 1950 s under chair John Kelley and chancellor Clark Kerr. Kerr wrote in his memoirs that he had concluded "if a campus was to have one preeminent department in modern times, it should be mathematics." Berkeley had been weak in geometry/topology and algebra, but the additions of S.-S. Chern, Edwin Spanier, and Steve Smale in the former, and Gerhard Hochschild and Maxwell Rosenlicht in the latter, together with other notables, brought Berkeley to a high level by the time that the unrest of the late 1960s began.

California was full of optimism in the 1950s and early 1960s, with dams and freeways constructed, and three new UC campuses-Irvine, San Diego, and Santa Barbara-planned and built. The university switched from semesters to quarters in 1967, so as to have a summer term on an equal footing with the other quarters. This implied more faculty to teach the extra term. (The summer term died from lack of funds, and Berkeley switched back to semesters in 1983, but made such a hash of the switch that the other eight campuses refused to switch and are to this day on quarters.)

The math department grew from about 20 fulltime employees in 1955 to 41 FTE in 1960, and plans were formed for further expansion and a new building, to be named after Griffith Evans. Plans included increasing the number of graduate students in all areas to over half the student body at Berkeley, with a concomitant increase in math graduate students and hence math faculty to 110 FTE.

The math department had long been in cramped quarters and was still spread over five buildings including T4, which was one of 12 temporary wood frame buildings constructed after WWII. These
were only gradually torn down, with T4 lasting into this century. I spent the summer of 1966 in T4 with a fine bunch of other young topologists including Dennis Sullivan, George Cooke, Greg Brumfiel, Anthony Phillips, and others; despite the aged building with its worn wooden floors, T 4 had great atmosphere.

Plans for Evans increased through the 1960s until a contract for the present massive building was let in 1967. The cost was about US\$9 million dollars, and US $\$ 2.4$ million came from the federal government, which at that time (less than a decade after Sputnik) wished to subsidize infrastructure for graduate education (imagine getting money for a building now!).

Coincidentally, Ronald Reagan took over the governor's office in January 1967, and grand plans soon came to a grinding halt. The math department reached a maximum of nearly 80 FTE in 1972, but then 13 FTE disappeared that year via six retirements (including Morrey) and the loss of seven unfilled positions. Mathematics, in Berkeley and elsewhere, has never regained the heady days of the early, post-Sputnik 1960s. The 1970s brought years of around 800 new Ph.D.'s, around 200 retirements at U.S. institutions, and a serious job crunch. Berkeley went from entering graduate classes of about 100 in 1971 and 1972, to a more reasonable 60, until 1991 when it dropped to an average of about 35 new students per year. Graduate expectations changed also, for many arrived at Berkeley in the early 1970s without any promise of monetary support, whereas after 1990 it became normal to promise four to five years of support, which often meant six.

When Evans Hall was finished in 1971, it was seen as a "brutalist building" and "aesthetically challenged", and it was nicknamed Fort Evans. In keeping with the times, a self-generated group in the math department decided to paint some walls. John Rhodes organized a seminar titled "Fascism and Architecture" (with slides of Hitler waving to the crowds from the balconies of Berlin buildings) and afterwards handed out paintbrushes to all (including Sarah Hallam).

Thus began a series of murals on the interior walls, which many visitors to the Berkeley department have seen: "Death of Archimedes", "La Mort de Galois", a curve in the thrice-punctured plane painted by Dennis Sullivan and Bill Thurston, and a large painting of the Reeb foliation by Richard Bassein. Despite some opposition from the administration, and some bills (never paid) for damages to the walls, most of the murals survived for decades and when deteriorated were photographed for posterity as art worth preserving. One appeared on the cover of the March 2003 Notices to accompany Lee Mosher's column "WHAT IS... a train track?".

The 1960s and early 1970s were a time of political turmoil in the U.S., and this was reflected
at Berkeley. The math department may have been the most active in opposing the Vietnam war and supporting the Free Speech Movement. One of Reagan's election planks was to "Clean up the mess in Berkeley", and the National Guard was called in to demonstrate, well, something. Sullivan recalls half-tracks stationed just off campus, and tear gas occasionally wafted in through open windows during seminars. The department ardently embraced affirmative action, overwhelmingly voted that it was the sense of the department not to accept Defense Department contracts, and supported the custodians who went on strike for two months. Enrollment dropped somewhat as some parents thought Berkeley was
 not appropriate for their children, although the activism at Berkeley may have induced others to come. Faculty recruitment was not harmed.

On the lighter side, two faded photographs (not from the book) show the abilities of Doris Fredrickson, the chair's secretary (and now wife of the book's author), at designing and sewing costumes. In the first we see the chair, John Addison with crown and scepter, and Serge Lang in jester's garb, no doubt trying to induce the king to embrace one of his many causes.


Top photo: John Addison in crown and scepter and Serge Lang in jester's hat. Below: left to right: John Simons, Cal Moore, and John Addison (see text). Photos courtesy of Doris Moore.

In the second, Jim Simons (under "Satan"), then chair at the State University of New York at Stony Brook, is trying, with a wad of money in his right hand, to lure the author to Stony Brook, while the Berkeley chair, again John Addison (under "God"), tries to retain Cal Moore.

Doris Frederickson also appears as the author of an interesting letter (photographed in the book) to the Mother Functor, an irreverent department publication, in which she gives the perspective of a secretary.

Life at Berkeley turned quiet in the last three decades, after some difficulties in the 1970s over money. During two years, no state employee got a raise, and these were days of considerable inflation, sometimes over 10\%. And then in a third year, the legislature singled out only the employees of the university and did not give them a raise, with Jerry Brown, then governor, remarking that the profession offered psychic rewards that made up for the loss of income.

The establishment of MSRI, in which Moore played a central role, finishes out the book, save for a few notes on events after 1985. Throughout the book are biographical sketches-consisting of one, two, or more paragraphs-of each of the faculty hired from the beginning to 1985.

If you have connections to Berkeley or are merely interested in how a great math department came into being, then this thorough and well written book is at least worth a browse, and you may find the entire book as enjoyable as I did.


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# The Mathematician's Brain 

Reviewed by David Corfield

The Mathematician's Brain<br>David Ruelle<br>Princeton University Press, 2007<br>\$22.95, 172 pages<br>ISBN-13:978-0691129822

The Mathematician's Brain may be seen as having several intentions. It could be taken as an account written by a professional mathematician to apprise the man-in-the-street of the nature of mathematics. Since I have no insight into what such a person might require, I shall instead restrict my review to considering this book solely as a contribution to philosophy, broadly construed.

As a philosopher, I consider some of the most important literature written about mathematics to have come from the pens of mathematical practitioners. Indeed this book faces the challenge of finding its place in a set of works which includes such notable predecessors as Hermann Weyl's Philosophy of Mathematics and Natural Science, Saunders Mac Lane's Mathematics: Form and Function and Gian-Carlo Rota's Indiscrete Thoughts.

That one of Ruelle's intentions is to contribute to philosophy is made clear from the opening page, where after reciting that old chestnut about the famous inscription on Plato's Academy, dictating its entrance requirements in geometry, he writes:

Today mathematics still is, in more ways than one, an essential preparation for those who want to understand the nature of things. But can one enter the world of mathematics without long and arid studies? Yes, one can to some extent, because what interests the curious and cultivated person (in older days called a philosopher) is not an extensive technical knowledge. Rather, the old-style philosopher (i.e., you and me) would like to see how the human

[^3]mind, or we may say the mathematician's brain, comes to grips with reality. (p. vii)

Now, already something of the timbre of the book is apparent here, an enthusiasm blended with a lack of precision. I struggle to think of an age in which a "curious and cultivated person" has acted as the definition of the term "philosopher", and I think Ruelle would have been better advised to stick with the word "mind" rather than "brain" for his title. There is a philosophical position which might justify this substitution, but the only relevant chapter in the book-"The computer and the brain"-does not suggest that the author wishes to adopt such a reductionist position. Indeed, the book is precisely about how the mathematician's mind comes to grip with mathematical reality, an infinitedimensional labyrinth, as Ruelle describes it.

There is an enormous amount
 to admire in the book. It is good to see the Erlanger Program given its due place, followed by an enjoyable example-The Butterfly Theorem-which gives an excellent illustration of how, in order to solve a problem, one needs to view it in its right setting, projective rather than Euclidean geometry here. The range of topics treated is very generous. Alongside standard subjects, such as foundations, proof, and the infinite, Ruelle treats us to his views on the mathematical reward system, beauty, Grothendieck, computers, emergence, psychoanalysis, and mathematical physics. I am happy to admit the bearing of all he writes on philosophy, which I rather imagine puts me in a small minority within my small field, even down to the incident he discusses of a mathematician's slip of the tongue where "anti-Semitic" is uttered
for "anti-symmetric". But with this praise comes a serious reservation: there's little sense of how this work stands, or could stand, in relation to other works.

There is, in my opinion, something of a hole in academic space at the present time which needs to be filled by a disciplined approach to the understanding of the place of mathematics in the system of human thought. Clearly, Ruelle shares something of this sense that something is missing:

How does a problem arise? How does it get solved? What is the nature of scientific thinking? Many people have asked these sorts of questions. Their answers fill many books and come under many labels: epistemology, cognitive science, neurophysiology, history of science and so on. I have read a number of these books and have been in part gratified, in part disappointed. (p. 1)

But to take steps to fill the void, we surely cannot respond to this disappointment by ignoring what is well done in these fields. The history of mathematics has changed significantly over recent decades and offers us impressive views of the changes which have transformed the field. So when Ruelle writes

Between Euclid and the nineteenth century the proper way to handle real numbers was through geometry: a real number was represented as a ratio of the length of two line segments. (p. 24)
and
...the remarkable thing is that modern mathematics is done precisely in the way that Euclid presented geometry. (p. 8),
you know what he means, but I can hear my historian friends' teeth grating from many a mile away. Regarding the second claim, should we not admit at the very least that styles of definition have changed from a time when it was thought proper to write "A line is a breadthless length" and "A straight line is a line which lies evenly with the points on itself"? We could take Ruelle's pronouncements as broad brush comments, strictly false yet morally true, just as, since a truth about Plato is conveyed by the story, we could little care that the documentary evidence for the inscription "Let none enter who is ignorant of mathematics" coming from the best part of a millennium after Plato flourished provides minimal support for its veracity. But my sense is that we do now need a disciplined accuracy.

By way of comparison, let us consider what sixty years ago the same publisher, Princeton University Press, saw fit to publish by way of a mathematical
physicist turning to philosophy. Dip into Weyl's Philosophy of Mathematics and Natural Science, a book much of which had been written in 1926, and you meet many very challenging passages, phrased in the philosophical language of his day. Weyl, conversant with the writings of Leibniz, Locke, Hobbes, Hume, Kant, Fichte, Mach, and Husserl, could see himself as taking the next step in a flourishing discipline. We are not likely to see the equal of him again for a very long time. Besides his mathematical brilliance he had the good fortune to mature in an exceptional environment, where an educated person was versed in philosophy as a matter of course. Weyl comes from a time when a student of Weierstrass, Edmund Husserl, could turn to philosophy and be taken on by Hilbert at Göttingen.

Saunders Mac Lane caught the tail end of the mathematical and philosophical activity of prewar Göttingen (McLarty 2007), something which shows in his 1986 book Mathematics: Form and Function. Its author, too, perceives something very much lacking in the academic treatment of mathematics and is highly critical of the professional philosophical work on mathematics in the preceding half century. It could be said that this book has not been especially influential, but with its inner coherent vision it does stand a chance of proving a pile on which to build a new discipline. Ruelle's aspirations in writing The Mathematician's Brain were lower, but we may still ask of it whether it provides us with any useful materials.

As I have said, I take every one of the dominant themes of its twenty three chapters to be relevant to philosophy. But following the argument of the book is like following a butterfly flit, apparently purposelessly, from plant to plant. Even within a chapter, each of which comes to a close after a near regular six pages, there are frequent minor excursions. Take Chapter 21, "The strategy of mathematical invention", as an example. The thrust of the chapter is to recognize a form of intuition which governs the invention of a theory, although one which needs to ground itself via a formalism. Now this is a topic about which there is much to say, and indeed much has been said. In successive single paragraphs we hear about the role of Mathematica in grinding out facts; the drive to use "structural ideas", exemplified by the Grothendieck group construction in K-theory; and the use of analogy, any one of which could be the subject of a lengthy article. Any coherence of a thread in the chapter is then finally dispersed by a paragraph on the greater degree of religious belief found on average in mathematicians than in physicists.

If inner coherence is lacking, perhaps some stability could have been engendered by indicating points of attachment to the existing literature. But little is provided along these lines either in the text or in the endnotes. For even Ruelle's most obscure
topics there is a body of work worth consulting. For instance, there is a tradition of thinking about mathematics in psychoanalytic terms, one in which Imre Hermann's Parallélismes (Hermann 1980) features, published in Ruelle's own country. As a mathematician Ruelle would not publish without a thorough literature search, why not then in his chapter on beauty compare his views to those of his fellow mathematician Gian-Carlo Rota in "The phenomenology of mathematical beauty", Chapter X of Indiscrete Thoughts (Rota 1996)?

Perhaps I have been too severe in this review through the disappointment of excessive expectations. As a doctoral student, I read thoroughly and many times over Ruelle's "Is our mathematics natural?" (1988). There was, I recall thinking at the time, an unresolved tension in the paper between the claim that parts of our mathematics would not have been devised had it not been for the fortuitous boost provided by the needs of parts of physics, such as equilibrium statistical mechanics, and the claim that the same pieces of mathematics may find use in many situations and may be integrated well into the rest of mathematics, suggesting multiple potential routes to their discovery. But where "Is our mathematics natural?" made me think very hard, inspired a chapter of my book (Corfield 2003), and provided me with an excellent case study for another, I don't see that The Mathematician's Brain can do much more than furnish me with a checklist of features of mathematics I might want to assure myself I had taken into account, if ever I felt I had reached some sort of complete philosophy of mathematics. No doubt the timing of one's encounter with a book is all-important to the opinion one forms of it. Over the years I have read an enormous amount of mathematicians' informal writings about their discipline. Daily I converse with mathematicians on the blog I jointly run. So, while little in the book struck me as new, perhaps those at earlier stages of their careers will be stimulated by the breadth of Ruelle's reach.

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# Cross-Cultural Analysis of Students with Exceptional Talent in Mathematical Problem Solving 

Titu Andreescu, Joseph A. Gallian, Jonathan M. Kane, and Janet E. Mertz

At a conference held in January 2005, Lawrence Summers, then president of Harvard University, hypothesized that a major reason for the paucity of women mathematicians among the tenured faculty of elite research universities in the USA might be sex-based differences in "intrinsic aptitude" for mathematics, especially at the very high end of the distribution [36]. This commonly held belief is largely based upon data from standardized tests such as the quantitative section of the Scholastic Aptitude Test (SAT) I. This test, designed to determine mathematical proficiency of USA eleventh and twelfth graders, identifies students who have mastered grade-level material, but does not distinguish the profoundly gifted, that is, those who are four or more standard deviations above the mean, from the merely gifted who also score in the ninety-ninth percentile on this exam.

To identify students who perform above grade level, the Study of Mathematically Precocious Youth (SMPY) administered the SAT I to children

[^4]younger than thirteen years of age. The SMPY defined children as highly gifted in mathematics if they scored at least 700 (on a 200 to 800 scale) on the quantitative section of this test. Using this criterion, Benbow and Stanley reported in 1980 large gender differences in "mathematical reasoning ability" [4]. They concluded that "sex differences in achievement in and attitude towards mathematics result from superior male mathematical ability ... [it] is probably an expression of a combination of both endogenous and exogenous variables."

Since these tests lack questions that require creative thinking and insight into higher-level mathematical concepts, they do not identify children with extremely high innate ability in mathematics, that is, ones who may go on to become top research mathematicians. They cannot differentiate between profoundly and moderately gifted children, regardless of age at which the examinations are administered. Thus, the SMPY identified thousands of children who, while quite bright and ambitious, were not necessarily profoundly gifted in mathematics.

The SMPY also failed to identify many children with extreme ability in mathematics who lacked one or more of the socio-economically privileged environmental factors necessary to be recognized by this mechanism. Coincidentally, the ratio of boys to girls identified in the SMPY has dramatically declined during the past quarter century from the high of 13:1 originally reported in 1983 [5] to 2.8:1 in a 2005 report [6]. The fact that $29 \%$ of Ph.D.'s awarded to USA citizens in the mathematical sciences went to women in the 2006-2007 academic year [30] supports the idea that this latter ratio is a more accurate reflection of current
interest and ability in mathematics among USA females. This dramatic change likely reflects in part increased educational opportunities available to USA girls since enactment in 1972 of Title IX that banned sex discrimination in schools.

While the USA has been producing many more women mathematicians in recent years, they remain poorly represented among tenured professors at the very top-ranked USA research universities and people identified as profoundly gifted in the field. This article presents for the first time a comprehensive compilation of data, including cross-cultural comparisons, regarding young people identified during the past twenty years as possessing profound aptitude for mathematics based upon their performances in extremely difficult examinations in mathematical problem solving. We show that many girls exist who possess such extremely high aptitude for mathematics. The frequency with which they are identified is due, at least in part, to a variety of socio-cultural, educational, or other environmental factors that differ significantly among countries and ethnic groups and can change over time. Girls were found to be $12 \%-24 \%$ of the children identified as having profound mathematical ability when raised under some conditions; under others, they were 30 -fold or more underrepresented. Thus, we conclude that girls with exceptional mathematical talent exist; their identification and nurturing should be substantially improved so this pool of exceptional talent is not wasted.

## Methods

To identify college and high school students who possess profound intrinsic aptitude for mathematics, we compiled complete data sets from the past ten to twenty years of the top-scoring participants in the William Lowell Putnam Mathematical Competition [40], International Mathematical Olympiad (IMO) [22], and USA Mathematical Olympiad (USAMO) [39]. These competitions consist of extremely difficult problems whose solutions require the writing of rigorous proofs. The top scorers on these examinations have truly exceptional skills in mathematical problem solving, that is, at the one-in-a-million level. Since the IMO is taken by the very top mathematics students from approximately ninety-five countries throughout the world, it provides information regarding cultural differences among countries as well.

The names of the top scorers were determined from the following sources: Putnam top twentyfive, articles published annually in the American Mathematical Monthly that summarize the results of the Putnam; country-by-country IMO members, the medals they won and team ranks, IMO Compendium Group and IMO official websites [21], [22]; and USAMO top twelve award winners, American Mathematics Competitions (AMC) website [39].

To look at the pipeline for these exceptional USA students, we also examined data from the following sources: the participants in the Mathematical Olympiad Summer Program (MOSP), AMC website [2]; and MATHCOUNTS ${ }^{\circledR}$ top twelve, MATHCOUNTS ${ }^{\circledR}$ website [32]. Wherever not obvious from the student's name and IMO team membership, gender, birth country, ethnicity, and sources of mathematical training were confirmed, to a large extent, by consultation with members of the Putnam Mathematical Competition Committee, IMO team leaders and contestants, staff at the American Mathematics Competitions headquarters, photographs and articles accessible via the World Wide Web, referenced literature, and people with personal knowledge of the individuals. In cases of gender-ambiguous names, the student was assumed to be male unless we had definitive evidence of female identity. For many countries, our data on girl participants in the IMO is $100 \%$ accurate; for some, we estimate the numbers presented here to be at least $80 \%$ accurate, that is, we may have occasionally mis-identified someone's gender. In the tables indicating ethnicity/race, all students were assigned to the one most consistent with their family name unless we had definitive information indicating a different country of origin or bi-racial/ ethnic background. Bi-racial/ethnic students were assigned to their ethnicity that is the lesser-represented one in their country unless it is a smaller percentage of their identity. We counted Jews as a separate ethnic category from other non-Hispanic whites because they have been historically highly overrepresented among mathematicians. Data on faculty in the top five graduate mathematics departments, based upon 2008 U.S. News \& World Report rankings [38], were determined likewise from university and faculty websites; personnel who work in these departments; personal knowledge of individuals; information available on the World Wide Web; and a 2007 report on diversity among science, technology, engineering, and mathematics (STEM) faculty [27].

Our data on race/ethnicity of the USA and Canadian females is $100 \%$ accurate. We did not determine definitively the race/ethnicity of the greater than 900 USA and Canadian males. We are confident the estimates presented for Asian and ethnic Jewish males are accurate to within $90 \%$ and $70 \%$, respectively; they are more likely under-estimates due to intermarriage and Anglicization of family names leading to some misassignments. Correspondingly, the data presented for "other non-Hispanic whites" are more likely overestimates. We also may have failed to identify one or two historically underrepresented minorities, especially if he is bi- or multi-racial.

The percentages of IMO team members who were girls varied among countries. To determine whether these differences could be due to statistical
fluctuation, we tested the hypothesis that the chance each position on an IMO team is filled by a girl is a fixed probability independent of country by constructing a contingency table listing the numbers of girls and boys making the IMO teams for countries with high-ranked teams during the twenty-year period 1988-2007 and performing a chi-square test.

To determine the degree of correlation between the racial/ethnic/gender distribution of very top-ranked mathematics faculty versus USA and Canadian IMO and MOSP participants, we created, using data from 2007, two lists containing the total number of faculty versus total number of


| Name (alphabetical order within category) | $\frac{\text { IMO Team }}{(\text { Birth Country }}$ | IMO Medals |
| :---: | :---: | :---: |
| Putnam Fellows (top 5) |  |  |
| Hangsheng Diao | China | 1 gold |
| Daniel Kane | USA | 2 gold |
| Tiankai Liu | USA (China) | 3 gold |
| Po-Ru Loh | USA | 2 gold, 1 silver |
| Yufei Zhao | Canada (China) | 1 gold, 1 silver, 1 bronze |
| $6^{\text {th }}-15^{\text {th }}$ |  |  |
| Timothy Abbott | USAMO top $12^{3}$ | - |
| Ralph Furmaniak | Canada | - (2003 Putnam Fellow) |
| Anders Kaseorg | USA | 1 gold, 1 silver |
| Sung-Yoon Kim | Korea | 1 gold |
| Yuncheng Lin | China | 1 gold |
| Alison Miller | USA | 1 gold |
| Kevin Modzelewski | USAMO top $24^{3}$ |  |
| Andrei Negut | Romania | 1 gold, 2 silver |
| Aaron Pixton | USA | 2 gold |
| Eric Price | USA | 1 gold |
| $16^{\text {th }}-26^{\text {th }}$ |  |  |
| Saran Ahuja | Thailand | 2 bronze |
| Doo Sung Park | Korea | 1 gold |
| Shinn-Yih Huang | Taiwan | 1 gold, 1 silver |
| Matthew Ince | USA | 1 silver |
| Theodore Johnson-Freyd | USAMO top $27^{3}$ | - |
| Cedric Lin | Taiwan | 1 silver |
| Thomas Mildorf | USA | 1 gold |
| Xuancheng Shao | China | 1 gold |
| Andrei Ungureanu | Romania | 2 gold, 1 silver |
| Yeo-II Yoon | Korea | 1 gold |
| Rumen Ivanov Zarev | Bulgaria | 2 gold, 1 silver |
| ${ }^{1}$ Woman indicated in bold. |  |  |
| ${ }^{2}$ Birth country presumed to be ${ }^{3}$ Scored among top 12 Award but did not qualify for 6 -mem | ee as IMO Team except ners or top 25 or so Hon USA IMO team. | here indicated otherwise in pa able Mention group on USAN |

IMO and MOSP participants in each of the nine ethnic/gender/birth country categories presented below in Table 7 and calculated the correlation between them.

## Results

Putnam. The Putnam Mathematical Competition is an inter-collegiate six-hour, twelve-problem essay examination that has been given annually (with a few exceptions) since 1938 [15], [40]. In recent years it has been taken annually by 3,500-3,750 undergraduate mathematics students who are attending colleges in the USA and Canada. Most of these already highly self-selected students are unable to solve any of the twelve problems within the allotted six-hour time period, attesting to the extreme difficulty of the examination. The top twenty-five scorers usually solve five or more of the problems; the top five scorers, designated "Putnam Fellows", typically solve eight to eleven of them.

Table 1 shows the names and countries of origin of the eleven women who ranked among the top twenty-five students in the Putnam during the past sixteen years. Three of these women even achieved Putnam Fellow, proving the existence of women with this profound ability in mathematical problem solving. Interestingly, only approximately eight women ranked among the top twenty-five during the half century prior to 1992 , a number that is not known exactly because gender identification was not requested of examinees prior to that year. This increase is consistent with postTitle IX changes in participation of USA women in STEM fields [9]. However, since only three of these eleven recent Putnam top twenty-five women were born in the USA, much of this increase is actually due to exceptional foreign students matriculating to colleges in the USA and Canada following the collapse of the Soviet Bloc and the opening up of China. Approximately half of recent top-ranked men were foreign-born as well [29], (Table 2). Remarkably, two of the three women Fellows were from Romania, a country with a population only one-fifteenth that of the USA. Thus, USA-born women remain highly underrepresented among top Putnam scorers.

Almost all of these foreign-born women and men who excelled in the Putnam had received instruction in mathematical problem solving prior to coming to the USA and Canada. Many of these women (Table 1) and $100 \%$ of the 2006 non-USA/ Canadian-born men (Table 2) had been members of IMO teams. For example, Ana Caraiani and Suehyun Kwon had achieved gold medals as members of the Romanian and South Korean IMO teams, respectively, before matriculating to Princeton University. After training with the Russian IMO team, Olena Bormashenko immigrated to Canada where she achieved a gold medal as the top-
scoring member of Canada's 2003 IMO team. Ioana Dumitriu achieved Fellow after training with, but not quite qualifying for Romania's IMO team. Almost all of the Americans had also either been members of Canadian or USA IMO teams; the few exceptions had received similar instruction at the MOSP or elsewhere (Table 3). Thus, the Putnam has become in recent years an inter-collegiate IMO-like competition in which essentially all of the top performers are not only profoundly gifted in mathematics, but also had previously obtained extensive extra-curricular training in mathematical problem solving.

IMO. The International Mathematical Olympiad is a pre-collegiate nine-hour, six-problem essay style examination that has been given annually (with one exception) since 1959. In recent years as many as ninety-five countries have sent sixstudent teams to participate. Table 4 lists the twelve countries that have ranked among the top fifteen in the world in the IMO in at least ten of the past fourteen years. All but one of these countries is located in Asia or Eastern Europe. India also used to be a member of these top-ranked countries, but was dropped from the list in 2008 due to worse-than-fifteenth rankings in 2005 through 2008. No country from Western Europe made the list. Germany was the closest, with only one year better than tenth and six years worse than fifteenth. The USA did make the list, but with approximately half of its team members being immigrants or children of immigrants from these other eleven countries plus India. China and India likely produce topranked teams in part because they have huge populations of students from which to identify a few with profound mathematical ability. However, population size cannot account for why a tiny country such as Bulgaria, with only 8 million people, also consistently produces a top-ranked team. Neither can gross national product nor per capita income explain why Romania readily makes the list. Rather, what most of these countries have in common are rigorous national mathematics curricula along with cultures and educational systems that value, encourage, and support students who excel in mathematics.

Table 4 also summarizes participation in the IMO of girls from these top-ranked countries. The number of medals they won is typically greater than the number of girls because some of these girls participated more than once. Gold medals are awarded to the top-scoring one-twelfth of these outstanding students; silver medals to the next one-sixth; bronze medals to the next one-third. Chenchang Zhu of China, Maryam Mirzakhani of Iran, and Evgenia Malinnikova of Russia are among the girls who achieved perfect scores, a feat typically accomplished by only a few students per year. Three girls, Maria Ilyukhina of Russia, Sherry Gong

Table 3. Mathematics Education Prior to College Matriculation of USA Students Among Top 26 in 2006 Putnam.

## Name

Daniel Kane
Tiankai Liu
Po-Ru Loh
Timothy Abbott
Anders Kaseorg Alison Miller
Kevin Modzelewski Aaron Pixton
Eric Price
Matthew Ince
Theodore MOSP, Washington U.-St. Louis, Home-schooled
Thomas Jonson-Freyd Canada/USA Mathcamp, U. Oregon-Eugene
${ }^{1}$ Many participated as well in a variety of summer programs for mathematically gifted students.
${ }^{2}$ UWW-Mathematics Talent Search, a correspondence competition in mathematical problem solving.
${ }^{3}$ PEA, Phillips Exeter Academy, a private high school with MOSP Director/USA IMO Team Leader on staff. ${ }^{4}$ BAMC, Bay Area Math Circle, Sunday seminars for $7^{\text {th }}$ - through $12^{\text {th }}$-grade students led by former IMO Team members.
${ }^{5}$ TJHSSH, Thomas Jefferson HS for Science and Technology, a Virginia public high school for gifted students that offers college-level mathematics courses and a club that provides training for the AIME and USAMO.

| Table 4. Countries Ranking Among T |  | No. Different No. Different |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Region of World | Team Median Rank (Range) | 1st Year Participated | Girls on Team | Girls <br> Since 1988 | Medals by Girls 88 Since 1988 |
| Asia (6) |  |  |  |  |  |
| China | $1^{\text {st }}$ (1-2) | 1985 | 7 | $5 \quad 2 \mathrm{~g}$ | 2 gold, 2 silver, 1 bronze |
| Iran | $8.5{ }^{\text {th }}(1-11,17,18)$ | ) 1987 | 2 | 2 | 2 gold, 1 silver |
| Japan | $11^{\text {th }}(7-15,16)$ | 1990 | 1 | 1 | 1 gold, 1 silver |
| South Korea | $6^{\text {th }}$ (3-12) | 1988 | 5 | $5 \quad 5 \mathrm{~g}$ | 5 gold, 1 silver, 3 bronze |
| Taiwan | $9^{\text {th }}(5-14,16,20)$ | 1992 | 5 | 5 | 2 silver, 2 bronze |
| Vietnam | $6^{\text {th }}(3-15)$ | 1974 | 6 | 4 | 1 silver, 3 bronze |
| Eastern Europe (5) |  |  |  |  |  |
| Bulgaria | $5.5{ }^{\text {th }}(1-14,21)$ | 1959 | 21 | 61 g | 1 gold, 9 silver, 1 bronze |
| Hungary | $9.5{ }^{\text {th }}(2-12,16,17,21)$ | ,21) 1959 | 7 | $4 \quad 1 \mathrm{~g}$ | 1 gold, 4 silver, 2 bronze |
| Romania | $7.5^{\text {th }}(4-11,17)$ | 1959 | 5 | 3 | 3 gold, 4 silver |
| Russia (USSR) | $2.5{ }^{\text {rd }}$ (1-6) | 1992 (1959) | 15 | 116 g | 6 gold, 8 silver, 1 bronze |
| Ukraine | $12.5{ }^{\text {th }}(6-15,18,20,21$, | ,21,23)1992 | 6 | 6 | 3 gold, 3 bronze |
| Americas (1) |  |  |  |  |  |
| USA ${ }^{\text {a }}$ | $3^{\text {rd }}(2-11)$ | 1974 | 3 | 3 | 2 gold, 3 silver |
| Rest of World |  |  |  |  |  |
| None |  |  |  |  |  |
| ${ }^{1} \sim 50 \%$ of recent USA IMO Team members were 1st- or 2nd-generation immigrants from these other Asian and Eastern European countries or India, with the latter a member of this list until 2008. |  |  |  |  |  |

of the USA, and Livia Alexandra Ilie of Romania, ranked among the top eleven in the 2007 IMO, a year in which none of the 522 participants obtained a perfect score. Thus, numerous girls exist who possess truly profound ability in mathematical problem solving.

The frequency with which girls are members of top-ranked IMO teams varies considerably from country to country (Table 4). For example, Bulgaria's teams have often included girls, beginning with the very first IMO competition held in 1959 (Table 5). One of them, Greta Panova, attended college at MIT where she also ranked among the top twenty in the Putnam. Russia's teams have also frequently included girls (Table 5), accounting for $20 \%$ of their members during the decade from 1988-1997 (Table 6). In contrast, Japan's teams have only included one girl, the gold-medal top-scoring member of their 1996 team, in the nineteen years in which they have participated. The USA's teams were girl-less throughout their first twenty-three competitions, with Melanie Wood finally making its 1998 team. USA IMO team members Melanie

Table 5. Girl Participants in IMO from Some Top 20-Ranked Countries: Year(s) Participated.

| East German/German Team - 19 girls |  | USSR/Russian Team - 15 girls |
| :---: | :---: | :---: |
| Tsvetana Penkovska: 1959 | Ingrid Seidel: 1959 | Lidia Goncharova: 1962 |
| Nedka Ivanova: 1959 | Irene Neumann : 1959 |  |
| Brezitsa Popova: 1960 | Elke Genz: 1959 | Tatyana Khovanova: 1975, 1976 |
| Atanaska Stoianova: 1961 | Mary Schleifstein: 1961 | Olga Leonteva: 1985 |
| Rumiana Proikova: 1961 | Heike Wenzel: 1961 | Maria Roginskaya: 1989 |
| Milka Popova: 1961 | Katharina Görke: 1962 | Evgenia Malinnikova: 1989,1990,1991 |
| Milena Ivanova: 1962 | Ilona Zinke: 1964 | Yulia Pevtsova: 1992 |
| Lidia Vashtinska: 1965 | Monika Titze: 1964,1965 | Elizaveta Rosenblum: 1993 |
| Ludmila Krasteva: 1966 | Ursula Tyl: 1970 | Anna Dyubina: 1994 |
| Diana Petkova: 1967 | Karin Gröger: 1984 | Natalia Dobrinskaya: 1994 |
| Donka Pashkuleva: 1969 | Angelika Drauschke: 1985 | Veronika Essaoulova: 1995, 1996 |
| Virdzhinia Hristova: 1969,1970 | Uta Hövel: 1987 | Elena Roudo: 1996 |
| Nadezhda Ribaska: 1977,1978 | Ingrid Voigt: 1990 | Irina Anno: 1997, 1998 |
| Milena Moskova: 1978 | Astrid Mirle: 1990 | Nadejda Petukhova: 2004 |
| Galia Simeonova: 1983 | Anja Wille: 1994 | Maria llyukhina: 2007 |
| Zvezdelina Stankova: 1987,1988 | Eva Mierendorff: 1998 |  |
| Dessislava Bakardzhieva: 1987,1988 | Annika Heckel: 2004 | United Kingdom Team - 11 girls |
| Ludmila Kamenova: 1996 | Lisa Sauermann: 2007, 2008 | (1967-2008) |
| Greta Panova: 1999, 2000, 2001 | Jessica Fintzen: 2008 | Alison McDonald: 1983 |
| Tsvetelina Tseneva: 2005, 2006, 2007 |  | Katherine Christie: 1989 |
| Elina Robeva: 2006, 2007 | Canadian Team - 9 girls | Eva Myers: 1992 |
|  | (1981-2008) | Karen Page: 1992 |
| USA Team - 3 girls | Lily Yen: 1984 | Catriona McClean: 1993,1994 |
| (1974-2008) | Etsuko Amano: 1990 | Louisa Orton: 1995 |
| Melanie Wood: 1998,1999 | Alyssa Ker: 1994,1995 | Rebecca Palmer: 1999 |
| Alison Miller: 2004 | Mihaela Enachescu: 1997,1998 | Hannah Burton: 2001 |
| Sherry Gong: 2005, 2007 (also 2002, 2003, 2004 on Puerto Rico's Team) | Yin (Jessie) Lei: 1998,1999 | Jennifer Gardner: 2002, 2003 |
|  | Denise Cheung: 2001 | Anne Marie Shepherd: 2004 |
|  | Olena Bormashenko: 2002, 2003 | Alison Zhu: 2007, 2008 |
| Japanese Team - 1 girl | Viktoriya Krakovna: 2006 |  |
| (1990-2008) | Yan Li: 2007, 2008 | West German Team - 0 girls |
| Sachiko Nakajima: 1996,1997 |  | (1977-1990) |

Wood and Alison Miller also ranked among the Putnam top fifteen. With the Bulgarian, Russian, and USA teams as a whole and their girl members as individuals performing at similar levels, these differences in girl participation rate cannot be due to country-specific differences in difficulty in girls qualifying for the IMO. Thus, some countries routinely identify and nurture both boys and girls with profound mathematical ability to become world-class mathematical problem solvers; others, including the USA, only rarely identify girls of this caliber.

Bulgaria and Russia are not alone in producing girls with IMO medallevel ability in mathematical problem solving. South Korea, Taiwan, and the Ukraine, despite only participating in the IMO since 1988, 1992, and 1992, respectively, have already had five, five, and six different girls on their teams, respectively (Table 4). Romania has only had five girls

Table 6. Percent Girl Participants in IMO Over Time Among Top 34 Countries ${ }^{1}$ Median $\%$ of $1^{\text {st }}$ Year IMO Participants


Asia

| Asia | 1 | 20 | 1985 | $2 / 18(11)$ | $4 / 60(7)$ | $1 / 60(2)$ |
| :--- | :---: | :--- | :---: | :---: | :---: | :---: |
| China | 14.5 | 17 | 1989 | - | $0 / 54(0)$ | $4 / 66(6)$ |
| India | 8.5 | 1.1 | 1987 | $0 / 7(0)$ | $3 / 60(5)$ | $0 / 66(0)$ |
| Iran | 21.5 | 0.11 | 1979 | $0 / 36(0)$ | $0 / 60(0)$ | $3 / 66(5)$ |
| Israel | 11 | 1.9 | 1990 | - | $2 / 48(4)$ | $0 / 66(0)$ |
| Japan | 07 | 0.23 | 1992 | - | $0 / 30(0)$ | $1 / 66(2)$ |
| Kazakhstan | 27 | 0.72 | 1988 | - | $2 / 60(3)$ | $7 / 66(11)$ |
| South Korea | 6 | 9 | 0.34 | 1992 | - | $3 / 36(8)$ |
| Taiwan | 9 | $2 / 66(3)$ |  |  |  |  |
| Turkey | 17.5 | 1.1 | 1985 | $0 / 8(0)$ | $3 / 60(5)$ | $2 / 66(3)$ |
| Vietnam | 6 | 1.3 | 1974 | $2 / 55^{2}(4)$ | $2 / 60(3)$ | $2 / 66(3)$ |


| ietnam | 6 | 1.3 | 1974 | 2/55 ${ }^{2}$ (4) | 2/60 (3) | 2/66 (3) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Europe |  |  |  |  |  |  |
| Belarus | 18.5 | 0.15 | 1992 | - | 1/31 (3) | 5/66 (8) |
| Bulgaria | 5.5 | 0.11 | 1959 | 19/192 (10) | 3/60 (5) | 8/66 (12) |
| Czechoslovakia | - | - | 1959 | $4 / 92^{2}(4)$ | 0/30 (0) |  |
| Czech Republic | 34 | 0.16 | 1993 |  | 2/30 (7) | $2 / 66$ (3) |
| Slovakia | 28 | 0.08 | 1993 |  | $2 / 30$ (7) | 10/66 (15) |
| France | 31 | 0.96 | 1967 | 1/62 ${ }^{2}(2)$ | 0/60 (0) | 4/66 (6) |
| Germany | 15 | 1.2 | 1991 |  | 1/42 (2) | 5/66 (8) |
| East Germany | 7('84-'90) |  | 1959 | 13/184 (7) | 2/18 (11) |  |
| West Germany | 7('84-'90) |  | 1977 | 0/66 (0) | 0/18(0) | - |
| Hungary | 9.5 | 0.15 | 1959 | 3/200 (2) | 2/60 (3) | 5/66 (8) |
| Poland | 19 | 0.57 | 1959 | 6/191 ${ }^{2}(3)$ | 1/59 (2) | 0/66 (0) |
| Romania | 7.5 | 0.32 | 1959 | 2/107 ${ }^{(2)}$ | 0/60 (0) | $7 / 66$ (11) |
| Russia (USSR) | 2.5 | 2.1 | 1959 | 5/180 (3) | 12/60 (20) | 3/66 (5) |
| Serbia \& Montene | gro 21.5 | 0.16 | 1992 | - | 2/24 (8) | $17 / 72$ (24) |
| Ukraine | 12.5 | 0.69 | 1992 |  | 1/35 (3) | 6/66 (9) |
| United Kingdom | 19.5 | 0.91 | 1967 | 1/146 (0.7) | 6/60 (10) | 7/66 (11) |
| Other |  |  |  |  |  |  |
| Australia | 22.5 | 0.32 | 1981 | $2 / 42$ (5) | 2/60 (3) | 5/66 (8) |
| Brazil | 26 | 2.8 | 1979 | 1/44 ${ }^{2}(3)$ | 2/60 (3) | 3/66 (5) |
| Canada | 19.5 | 0.5 | 1981 | 1/40 (3) | 4/60 (7) | 9/66 (14) |
| USA | 3 | 4.5 | 1974 | 0/90 (0) | 0/60 (0) | 5/66 (8) |

[^5]on its teams since 1959; however, two additional Romanian girls who did not quite qualify for their country's IMO teams achieved Putnam top twenty-five, one even as Fellow (Table 1). Top-ranked (Table 4) and high-ranked (Table 6) IMO teams are clustered predominantly in Eastern Europe and Eastern Asia, but even neighboring countries can show marked disparities in whether they successfully identify and nurture their mathematically very gifted girls. Some examples are East Germany vs. West Germany, Slovakia vs. the Czech Republic, and South Korea vs. Japan. Chi-square analysis indicated it is virtually impossible that this observed country-to-country fluctuation was caused by random chance (statistic $=98.396$; df $=25$; $p$-value $=<0.0001$ ). Thus, the probability that a position on a team was filled by a girl varied from country to country. These findings suggest that socio-cultural, educational, or other environmental factors that differ among countries are significant determinants of whether (i) students are produced with exceptional skills in mathematical problem solving, and (ii) girls are frequently included among them.

These factors can change over time within a country. Like the USA, the United Kingdom IMO teams were almost girl-less from 1967 through 1988; however, they have included ten individual girls representing $11 \%$ of their participants during the past two decades (Tables 5 and 6). France's IMO teams were also almost girl-less for almost four decades

Table 7. Race/Ethnicity of USA and Canadian IMO Participants, MOSP Participants, and Top 5-Ranked Math Department Faculty

|  |  |  | ale |  |  |  | Female |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Other |  |  |  | her Non-H | ispanic White |  |
|  | Asian ${ }^{1}$ | Jewish | Non-Hispanic White ${ }^{2}$ | URM ${ }^{3}$ | Asian | Jewish | European born | - Canadianand USA-born | URM |
| USA IMO Team 198 | 8-2007 |  |  |  |  |  |  |  |  |
| No. Students (\%) | 40 (33) | ~25 (21) | $\sim 50$ (42) | 0 (0) | 2 (2) | 1 (0.8) | 0 (0) | 2 (2) | 0 |
| \% Population ${ }^{4}$ | 1.5-2.3 | ~1.0 | 41-38 | ~12-15 | 1.4-2.2 | $\sim 1.0$ | $0.6{ }^{5}$ | 38-35 | ~11-14 |
| \%/\% Population | 18 | $\sim 21$ | $\sim 1.1$ | 0 (0) | 0.9 | $\sim 0.8$ | 0 | 0.05 | 0 |
| Canada IMO Team | 1988-2007 |  |  |  |  |  |  |  |  |
| No. Students (\%) | 60 (50) | ~12 (10) | ~36 (30) | 0 (0) | 5 (4) | 0 (0) | 5 (4) | 2 (2) | 0 |
| \% Population | 5 | $\sim 0.6$ | $\sim 43$ | $\sim 7$ | 5 | $\sim 0.6$ | $\sim 2.0{ }^{5}$ | ~39 | $\sim 7$ |
| \%/\% Population | 10 | ~17 | $\sim 0.7$ | 0 (0) | 0.8 | 0 | 2 | $\sim 0.04$ | 0 |
| MOSP 1998-2007 |  |  |  |  |  |  |  |  |  |
| No. Students (\%) | 216 (42) | ~56 (11) | ~209 (40) | 2 (0.4) | 22 (4) | 5 (1) | 3 (0.6) | 5 (1) | 0 |
| \%/\% Population | 20 | $\sim 11$ | ~1.0 | $\sim 0.03$ | 2.1 | $\sim 1$ | 1 | 0.03 | 0 |
| Profs. Top 5 USA | ath Depts |  |  |  |  |  |  |  |  |
| No. Tenured (\%) | 18 (10) | ~33 (18) | ~120 (67) | 1 (0.6) | 1 (0.6) | 2 (1) | 4 (2) | 1 (0.6) | 0 (0) |
| No. Jr. Faculty (\%) | 7 (13) | $\sim 5$ (9) | ~30 (55) | 1 (2) | 2 (4) | 0 (0) | 7 (13) | 3 (6) | 0 (0) |
| \%/\% Population | 6 | $\sim 16$ | $\sim 1.7$ | $\sim 0.06$ | 0.7 | $\sim 0.9$ | 3 | 0.03 | 0 |

${ }^{1}$ Includes West Asians, Middle Easterners, Pacific Islanders, and bi-racial Asian-whites as well as East Asians.
${ }^{2}$ Includes Jews and Hispanics unidentified due to intermarriages or Anglicization of family names.
${ }^{3}$ Underrepresented minorities were Hispanic; no African- or Native-Americans were identified. Some underrepresented minorities may have been missed.
${ }^{4}$ Range indicates approximate change in demographics between 1988 and 2007, with girls comprising $48 \%$ of high school-age children and 50\% of working-age adults.
${ }^{5}$ Percentage of high school-age population; $1.8 \%$ of total US population.
${ }^{6}$ Data determined from [27] and web sites for mathematics departments at Harvard, MIT, Princeton, Stanford, and UC-Berkeley; excluded faculty whose primary appointment was in mathematics education or other department.
${ }^{7}$ Birth countries of male faculty hired since July, 1997 were Belgium, Bulgaria, $4 \times$ Canada, $4 x$ China, $5 x$ Denmark, $3 x$ France, $3 x$ ermany, Hong Kong, 2xHungary, 2xIndia, 3xIsrael, Italy, New Zealand, Poland, Portugal, 2xRomania, 7xRussia, Slovakia, Sweden, Switzerland, Taiwan, $2 x$ United Kingdom, and 29xUSA, with the latter consisting of 5 Asians and 24 non-Hispanic whites (including Jews).
${ }^{8}$ Birth countries of female faculty were Belgium, $2 x$ Canada, China, $3 x$ Germany, Iran, Italy, $2 x$ Romania, $2 x$ Russia, Serbia,
Switzerland, USSR, and $4 x$ USA, with the latter consisting of 1 Asian/white, 1 Jew, and 2 non-Hispanic whites.
before including four individual girls in the past four years. On the other hand, participation by girls on the USSR/Russian teams has dropped off significantly from nine individual girls during the 1988-1997 decade to only two new girls during the most recent 1998-2008 eleven-year period. Likewise, China's teams included six individual girls, two of whom had perfect scores, during their first twelve years of participation, but only one new girl since 1996. It is improbable that these fairly large changes in girl participation rate were merely due to statistical fluctuation. In some cases, they could have been due to the country's team leader altering the method used to select the team members, for example, from simply asking one's friends to suggest candidates to performing an open, nationwide search. In other cases, they probably reflect socio-cultural, educational, economic, or other environmental changes that have occurred within the country.

One can observe effects of culture by looking at IMO participation rates among children from different ethnicities raised within the same country. Because the number of USA IMO girls is too small to draw any significant conclusions, we also examined the effect of race/ethnicity on IMO participation rate among Canadian girls and USA and Cana-
dian boys (Table 7). While native-born white girls were found to be very highly underrepresented in proportion to their percentages of their country's population, ethnic Asian girls were not underrepresented. White girls who were immigrants from the top-ranked IMO countries such as Romania, Russia, and the Ukraine were also not underrepresented. Analysis of the USA and Canadian boy participants led to a similar conclusion: Asian and ethnic Jewish boys were approximately ten- to twenty-fold more likely to become IMO participants than other nonHispanic white boys. Historically underrepresented minorities were not identified among the 240 USA and Canadian IMO participants. Analysis of MOSP participants from the past decade, a constituency of over 500 students, led to remarkably similar findings (Table 7). Taken together, these data indicate that the scarcity of USA and Canadian girl IMO participants is probably due, in significant part, to socio-cultural and other environmental factors, not race or gender per se. These factors likely inhibit native-born white and historically underrepresented minority girls with exceptional mathematical talent from being identified and nurtured to excel in mathematics. Assuming environmental factors inhibit most mathematically gifted girls being raised in most cultures in most

${ }^{1}$ Resided in the USA at the time of the competition unless indicated otherwise in parenthesis. ${ }^{2}$ Female indicated in bold.
${ }^{3} \mathrm{Bi}$-ethnic.
countries at most times from pursuing mathematics to the best of their ability, we estimate the lower bound on the percentage of children with IMO medal-level mathematical talent who are girls to be in the $12 \%-24 \%$ range, that is, the higher of the percentages observed in the data presented in Table 6. In a gender-neutral society, the real percentage could be significantly higher; however, we currently lack ways to measure it.

We also determined likewise these percentages among tenured and junior faculty in the five highest ranked USA graduate mathematics departments (Table 7). A high correlation (0.727; $\mathrm{p}=0.026$ ) was found between the race/ethnicity/birth country/gender distributions for IMO and MOSP participants versus these outstanding research mathematics faculty. The only significant difference was somewhat fewer Asians, consistent with USA-citizen Asians being only slightly overrepresented among recent USA mathematics Ph.D. recipients [18], [30]. Noteworthy is the fact that only $20 \%$ of the tenured and junior female faculty in these departments, most of whom were fairly recent hires, had been born in the USA. Thirty-eight percent of their male faculty counterparts hired during the past decade were USA born. Many of the foreign-born women (see Footnote 8 of Table 7) are immigrants from countries in which girls are frequently members of IMO teams (Table 6) and women make up $20 \%-40 \%$ of the tenured instructors of mathematics at the university level [11]. Thus, we conclude that the mathematics faculty being hired by these very highest-ranked research universities reflects the pool of IMO medal-caliber students of mathematics coming through the pipeline. If a goal is to have research university faculty who are representative of the diversity of the USA population, we need to increase greatly both the diversity and number of USA-born students in this particular pool.
USAMO. Why is the USA not among the countries with a good record of female participation in the IMO? To begin to answer this question, we consider
data from the primary competition and training camp that leads up to selection for membership on the USA IMO Team. Table 8 lists the high school students who were the 2005 and 2006 USAMO award winners, that is, the top twelve scorers, in the USA Mathematical Olympiad [39], the first of two IMO-like examinations used to select the six members of the USA IMO Team. The 250-525 students invited each year to write this examination are seventh through twelfth graders attending schools in the USA and Canada who ranked among the top scorers on two prior qualifying exams, the AMC10/12 and the American Invitational Mathematics Examination (AIME). Only one girl, Sherry Gong, a five-time IMO participant, made the list, doing so in both 2005 and 2006 and, again, in 2007. Also notable is the paucity of USA- and Cana-dian-born, non-Jewish white boys; they accounted for only two, one, and, one of the twelve students in 2005, 2006, and 2007, respectively. In fact, half of the 2005 and 2006 USAMO award winners were born in other top-ranked IMO countries.

The results of the 2004 USAMO were similar [1], [39]. Of the top twenty-four scorers, three were girls: Alison Miller (½ Jewish, home-schooled), PoLing Loh (Chinese-American child of immigrants), and Elena Udovina (Russian emigrant). The twentyone boys were three immigrants to Canada (Chinese, Russian-Israeli Jew, Eastern European), a Thai (member of Thailand's 2003 IMO Team), eleven USA students who were immigrants or children of immigrants from China, South Korea, Russia, or India, and six USA-born whites, two of whom were home-schooled. Thus, USA-born white boys as well as girls are underrepresented among the top scorers on the USAMO; historically underrepresented minorities are almost non-existent. Except for the three home-schooled students, all were attending pre-collegiate schools in the USA or Canada at the time they took the USAMO. Thus, parental, sociocultural or other environmental factors, even more so than educational systems, play a major role in determining who excels in this examination.
MOSP. Very few USA high schools teach the advanced mathematical skills, such as writing rigorous essay-style proofs, needed to excel in the USAMO. Most USAMO award winners acquire this knowledge by a combination of self-study and participation in summer mathematics camps. The premier mathematics training camp in the USA is the Mathematical Olympiad Summer Program, which all USA IMO team members are required to attend prior to participation in that summer's IMO. Admission to MOSP is extremely selective, traditionally restricted to the top twenty-four to thirty pre-college students in the USA based upon their scores in the USAMO, AIME, and AMC10/12. Typically, one-to-three of the thirty students qualifying for the MOSP each year by these criteria are female [2]. With generous support from the Akamai

Foundation, MOSP has been expanded in recent years to include some ninth graders admitted by separate criteria. In 2002, the first year in which additional ninth graders were admitted, there were 162 mostly ninth-grade participants. Eleven of them were girls, with eight of them being ethnic Asian (Table 9). Of the three non-Asians, one was born in Russia, one was home-schooled, and one lived in Lexington, Massachusetts, a town highly populated by Boston-area academics. Less than one percent of the MOSP 2002 participants were USAborn, public school-educated, white girls; none of the girls was a historically underrepresented minority.

The data were similar for MOSPs 2003-2007 where girls were three out of thirty, six out of fifty-five, four out of fifty-five, two out of fiftyfive, and three out of fifty-five of the participants, respectively (Table 9). MOSP 2008 included two ninth-grade girls out of the forty-eight participants plus ten additional girls who qualified to train for the China-sponsored Girls’ Mathematical Olympiad (CGMO). Again, most of these girls were ethnic Asian. The three non-Asian girls attended special high schools for gifted students or a public high school highly populated by children of Chicagoarea academics. One had been home-schooled prior to ninth grade. Even the USA-born Asian girls were mostly children of immigrants. Only $4.5 \%$ of the USA population is currently classified as Asian. Thus, by ninth grade, Asian-American girls and boys were 2.1- and twenty-fold overrepresented in proportion to their percentages of the USA population, respectively, among USA students who excelled at the highest level in these mathematics competitions (Table 7). Jewish boys and Eastern European-born girls were also overrepresented. USA-born, non-Jewish, non-Hispanic white boys were still represented in ninth grade in proportion to their percentage of the USA population, but USAborn white girls and historically underrepresented minorities were already almost non-existent. Of the thirteen girls who have represented the USA in the 2007 or 2008 CGMO based upon their being among the top eight or ten girl scorers in the 2006 and 2008 USAMO, respectively, all but one, Jennifer Iglesias, were Chinese- or Korean-American (Table 9). Socio-cultural factors, including parental expectations and beliefs (for example, see [35]), likely account for why Chinese-American girls are overrepresented among this group of mathematics students while USA-born non-Asian girls with exceptional mathematical talent are rarely identified.

While Asian girls were 2.1-fold overrepresented in proportion to their percentage of the USA population overall, they were only $9.3 \%$ of the Asian participants at the MOSP during 1998-2007. Since Asian girls growing up in the USA also hear the messages "girls can't excel at math" and "only

Table 9. Race/Ethnicity/Birth Country of USA Girl Participants in 1998-2008 MOSP or 2007 China Girls' Mathematical Olympiad.

| Name | Race/Ethnicity/ Birth Country ${ }^{1}$ | Years at MOSP | USAMO Award Winner (Honorable Mention) (2006,2008 Top Girl ${ }^{2}$ ) |
| :---: | :---: | :---: | :---: |
| Melanie Wood | White | 1996-1999 | 1998,1999 |
| Shuang You | China | 2000 | - |
| Alison Miller | Jewish/White ${ }^{3}$ | 2000-2004 | 2002, (2003), 2004 |
| Inna Zakharevich | Russia | 2001-2002 | 2002 |
| Po-Ling Loh | Chinese-American | 2002-2004 | 2003, (2004) |
| Sarah Cheng | China | 2002 | - |
| Ann Chi | Chinese-American | 2002 | - |
| Atoshi Chowdhury | Indian-American | 2002 | - |
| Rong Hu | Chinese-American | 2002 | - |
| Tiffany Ko | Chinese-American ${ }^{4}$ | 2002 | - |
| Elizabeth Marcil | White | 2002 | - |
| Irena Wang | China | 2002 | - |
| Stephanie Zhang | Chinese-American | 2002 | - |
| Sherry Gong | Chinese-American | $\begin{gathered} \text { 2003-2005, } \\ 2007^{5} \end{gathered}$ | $\begin{aligned} & (2003), 2005, \\ & 2006,2007 \end{aligned}$ |
| Linda Liu | China | 2004 | - |
| Maria Monks | White | 2004-2005 |  |
| Livia Zarnescu | Romania | 2004 | - |
| Sway Chen | Chinese-American | 2005 | (2006) |
| Wendy Hou | Chinese-American | 2005 | (2006) |
| Patricia Li | Chinese-American | $2006{ }^{6}$ | $(2006,2008)$ |
| Jennifer Iglesias | White/Hispanic ${ }^{3}$ | 2008 | $(2006,2008)$ |
| Colleen Lee | Chinese-American | 2008 | $(2006,2008)$ |
| Marianna Mao | Chinese-American | 6 | $(2006,2008)$ |
| Wendy Mu | Chinese-American | 2008 | $(2006,2008)$ |
| Iris Xu | Canada/Chinese | 2007,2008 | (2008) |
| Lynnelle Ye | Chinese-American | 2007,2008 | (2008) |
| In Young Cho | Korea | 2008 | (2008) |
| Qian Huang | China | 2008 | (2008) |
| Ning (Jenny) Jin | China | 2008 | (2008) |
| Carolyn Kim | Korean-American | 2008 | (2008) |
| Katherine Rudolph | White ${ }_{4}$ | 2008 | (2008) |
| Elizabeth Synge | White ${ }^{4}$ | 2008 | (2008) |
| Shijie (Joy) Zheng | Australia/Chinese | 2008 | (2008) |
| ${ }^{1}$ USA born unless indicated otherwise. |  |  |  |
| ${ }^{2}$ Qualified for 2007 China Girls' Mathematics Olympiad by ranking among top 8 pre-12 ${ }^{\text {th }}$ grade US citizen/permanent resident girls in 2006 USAMO or for MOSP 2008 by ranking among top 12 girls in 2008 USAMO. |  |  |  |
| ${ }^{3}$ Bi-ethnic. |  |  |  |
| ${ }^{4}$ Birth country not determined. |  |  |  |
| ${ }^{5}$ Also qualified for MOSP 2006, but participated in Intl. Physics Olympiad, instead. <br> ${ }^{6}$ Qualified for MOSP 2008, but participated in Research Science Institute, instead. |  |  |  |

nerds enjoy math," this number, too, is only a lower bound on the percentage of children with very high intrinsic aptitude for mathematics who are girls.
AwesomeMath Summer Program (AMSP). Several summer mathematics camps aimed at exposing children to numerous areas of pre-calculus mathematics not typically taught in schools have been started in the USA during the past decade. AwesomeMath is one such program, begun in 2006 for sevenththrough twelfth-graders who can demonstrate a high-level interest in learning areas of mathematics needed to perform well in the AIME and USAMO. It is run by the same instructors who direct the MOSP and coach the USA IMO Team. Of the ninety-three USA students who participated in the camp in 2006, fourteen (15\%) were girls. Eleven of these girls were Asian-American, with family names originating from China, India, Korea, and Vietnam. Sixty-eight percent of the boys attending AMSP 2006 were also Asian-American. The data for 2007 were quite similar: of the 112 USA participants (excluding the seven who attended to train for the CGMO),

Table 10. Race/Ethnicity and Gender ${ }^{1}$ of Top 12 Students in National MATHCOUNTS Competition

| 2006 Ranking | 2005 Ranking |  |
| :---: | :---: | :---: |
| Neal Wu - Chinese | Neal Wu | - Chinese |
| Daniel Li - Chinese | Mark Zhang | - Chinese |
| Kevin Chen - Chinese | Patricia Li | - Chinese |
| Nathan Benjamin - Chinese/Jewish ${ }^{2}$ | Karlanna Lewis | - White |
| Daesun Yim - Korean | Sergei Bernstein | - Russian/Jewish ${ }^{2}$ |
| Sam Keller - White | Nathan Benjamin | - Chinese/Jewish ${ }^{2}$ |
| Brian Hamrick - Asian/White ${ }^{2}$ | David Benjamin | - Chinese/Jewish ${ }^{2}$ |
| George Silvis - White | Mike Jin | - Chinese |
| Rolland Wu - Chinese | Andrew Ardito | - White |
| Andrew Ardito - White | Alan Huang | - Chinese |
| George Yu - Chinese | Pardha Ponugoti | - Indian |
| Arjun Puranik - Indian | Kiran Kota | - Indian |

${ }^{1}$ Girls indicated in bold.
${ }^{2}$ Bi-racial.
awarded by USA universities in 2007. Of the Ph.D.'s awarded in mathematics by USA universities in 1993-2002, women received $27 \%$ of them, with only $32 \%$ of these women being non-resident aliens [19]. Thus, many women exist in the USA with both the interest and ability to master college- and graduate-level mathematics who are neither AsianAmerican nor foreign. Some of them likely possessed the intrinsic aptitude to excel in the AIME, USAMO, IMO and Putnam, but were not identified, encouraged, and nurtured to do so.
Social Stigma Associated with Mathematics. Many USA-born white and historically underrepresented minorities who are gifted in mathematics do not participate in MATHCOUNTS ${ }^{\circledR}$, AMC examinations, or, even, school mathematics clubs and teams. When asked why, a typical response is, "Only Asians and nerds do math (extracurricularly)." In other words, it is deemed uncool within the social context of USA middle and high schools to do mathematics for fun; doing so can lead to social ostracism. Consequently, gifted girls, even more so than boys, usually camouflage their mathematical talent to fit in well with their peers. This peer group social problem has been noted in interviews with top Putnam students [29] and USA female Olympians [13], [28]. The overwhelming preponderance of foreign-born and Asian-American students in high school mathematics clubs is a nationwide phenomenon (for example, see [41]). Almost all of the girls who have achieved USAMO Award Winner or Honorable Mention (that is, top twenty-five) in this examination's thirty-five-year history were foreign-born, Asian-American, or home-schooled. Thus, we hypothesize that the extreme scarcity of USA-born non-Asian girls among the top scorers in the AIME, USAMO, and Putnam is not due to a lack of girls with profound intrinsic aptitude for mathematics; rather, it is due to their choosing to spend their free time on nonmathematical pursuits. The substantial overrepresentation of Asian-American and foreign-born boys indicates that USA-born non-Asian boys are also being adversely affected by the social stigma associated with doing mathematics, although not to the extreme extent it is affecting girls. Likely, some boys feel comfortable doing mathematics for fun because they are either less socially astute or less concerned about their social status than are most girls.

## Discussion

One commonly held belief to explain the extreme scarcity of females who excel at the highest level in mathematics is that women simply lack sufficient aptitude for the field (for examples, see [25], [31], [36]). The data presented here neither prove nor disprove whether the frequency of occurrence of people with profound intrinsic aptitude for mathematics differs between women and men. What they do indicate, however, is that this scarcity is
due, in significant part, to changeable factors that vary with time, country, and ethnic group. First and foremost, some countries identify and nurture females with very high ability in mathematics at a much higher frequency than do others. This phenomenon is observed, not only in the degree to which girls participate in the IMO (Tables 4, 5 and 6; see also [23]), but also in the representation of women among students earning Ph.D.'s in the mathematical sciences [10] and among tenured mathematics faculty employed at universities [10], [11], with fairly high positive correlations existing among these variables. A strong correlation also exists between the magnitude of measured gender difference in mathematics performance by eighth and tenth graders in a country and other measures of gender stratification such as participation in the labor force and politics [3], [16]. Second, girls perform as well if not better than boys in mathematics throughout elementary school; it is during the middle school years, an age when children begin to feel pressure to conform to peer and societal expectations, that they start to lose interest and fall behind in most, but not all countries [37], (see also [17], [20], [34] for comprehensive recent reviews on the general topic of girls and math). In some of the most gender-equal cultures, a gender gap is not observed in mathematics among fifteen-year-old students on the Programme for International Student Assessment, not only with respect to median score, but also in the ratio of girls to boys performing above the ninety-fifth and ninety-ninth percentiles [16]. Third, Asian girls and white girls who are immigrants from Eastern Europe are well represented among the very top students identified in the extremely difficult mathematics competitions discussed here; it is only USA-born white and historically underrepresented minority girls who are underrepresented, underrepresented by almost two orders-ofmagnitude relative to Asian girls educated in the same school systems (Table 7). Fourth, the scarcity of females is much less pronounced in the sciences and engineering, fields that depend upon a solid understanding of mathematics. Their percentages in these other STEM fields have been steadily increasing post-Title IX [9]. In 2007 girls accounted for twenty of the forty Intel Science Talent Search finalists, including six of the top ten. However, as with the USAMO Award Winners, a survey of the 2004 Intel Finalists found that $60 \%$ of them were children of immigrants [1]. Girls accounted for seven of the sixteen 2006 Fellows of the Davidson Institute for Talent Development [12], (Table 11), a foundation that provides scholarships to USA children identified, without regard to gender, as profoundly gifted in mathematics, science, technology, literature, philosophy, or music. Again, most of the Davidson Fellows in the STEM fields were children of immigrants or Asian-American,

Table 11. Race/Ethnicity and Gender ${ }^{1}$ of Davidson Institute for Talent Development 2006 Fellows by Category

a phenomenon consistently observed since these fellowships were first awarded in 2001. On the other hand, the Fellows in literature and music were mostly white. Profoundly gifted children are frequently multi-talented, for example, prodigious in both music and mathematics; they usually invest more of their effort in the fields that provide more positive feedback. Thus, socio-cultural factors strongly influence the fields in which profoundly gifted children are identified.

The skill sets necessary to excel in mathematical problem solving and mathematics research are not identical. Research requires the stamina to work on problems over extended periods of time without knowing whether solutions even exist; the competitions discussed here require the ability to solve difficult problems known to be solvable under timed conditions. Thus, some world-class research mathematicians exist who attempted, but did not excel in the Putnam, IMO, or its qualifying examinations. Nevertheless, a high correlation exists between exceptional ability in mathematical research and problem solving since both require outstanding mathematical intuition and creativity along with the interest in devoting considerable time and effort toward acquiring extensive knowledge in the field. Numerous Putnam Fellows have gone on to receive the Fields Medal (the so-called Nobel Prize of Mathematics) or the Nobel Prize in Physics. Some who never quite achieved Fellow status have also been awarded Nobel Prizes. Eight of the eighteen Fields medalists from 1990 through 2006 were IMO gold or silver medalists in their youth, with Grigorij Perelman, who recently resolved the Poincaré Conjecture, having achieved a perfect forty-two in the 1982 IMO. Five of the eight most recent three-time and four-time Putnam Fellows, two of whom also achieved perfect forty-two's in the IMO, were winners or honorable mention awardees of the Frank and Brennie Morgan Prize [24] for outstanding research in mathematics by an undergraduate student (with a sixth eligible for the 2009 Morgan Prize). Likewise, all three of the
women Putnam Fellows were winners of the Alice Schafer Prize [33] for excellence in mathematics by an undergraduate woman; one also won the Morgan Prize. Comparison of the list of the Fellows [40] against the lists of tenured mathematics professors at the top five-ranked USA research universities indicates that less than $10 \%$ of these world-class mathematicians managed to achieve Putnam Fellow in college (albeit some of them, including most foreign-educated ones, never took this examination). Therefore, most of the women who excel in these competitions probably possess the ability to become world-class mathematics researchers and university professors if provided the educational opportunities and working environments afforded their male peers.

## Conclusions and Proposals

In summary, some Eastern European and Asian countries frequently produce girls with profound ability in mathematical problem solving; most other countries, including the USA, do not. Children, including girls, of immigrants to the USA and Canada from some of the countries that excel in the IMO are overrepresented among students identified as profoundly gifted in mathematics; USA-born girls from all other ethnic/racial backgrounds, including white, are very highly underrepresented. There exist many girls with profound intrinsic aptitude for mathematics; however, they are rarely identified due to socio-cultural, educational, or other environmental factors.

Girls and boys with mathematical ability, whether profound, gifted, or merely above average, should be identified and encouraged to study mathematics beyond the high school level so they may pursue careers in STEM fields because these jobs are plentiful, well-paying, challenging, interesting, and beneficial to society. Their doing so is vital to the future of the USA economy as elegantly documented in Thomas Friedman's The World Is Flat: A Brief History of the Twenty-First Century [14]. Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future [8], Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering [7], and Foundations For Success: The Final Report of the National Mathematics Advisory Panel [26] outline numerous steps the USA should take to ensure we have the well-educated labor force needed to fill the STEM jobs of the future. To reduce loss of mathematical talent, especially of profoundly gifted students who have a high potential to make major contributions to society, the USA urgently needs to improve how it identifies and nurtures children of both genders with aptitude for mathematics. Here is a list of some proposals, most previously suggested by others but worth reiterating, to help stimulate the national discussion necessary to induce the needed changes.

1. First and foremost, the myth that females cannot excel in mathematics must be put to rest. Teachers, guidance counselors, parents, principals, university presidents, the lay public, and, most importantly, girls themselves need to be informed about the fact that females can excel in mathematics, even at the very highest level. When people believe they cannot do something, it becomes a self-fulfilling prophecy. To quote Henry Ford, "If you think you can or can't, you are right."
2. We need to improve greatly the lay public's perception of mathematicians via the news media, movies, and TV shows such as Numb3rs so preteens and teenagers of both genders will feel it is socially acceptable to study and to enjoy doing mathematics. To quote the science fiction writer Jack Vance, "That which is never attempted, never transpires." Girls, especially, must be made aware that mathematicians do important, interesting work, and most of them are not nerds. Mathematics Olympians in the other top-ranked IMO countries are highly honored and similarly praised as sports Olympians. The same should be true in the USA.
3. Mathematics courses should be taught starting in sixth or seventh grade at the latest by mathematics-certified teachers who majored in the field. Foreign languages, music, art, machine shop, cooking, and physical education are usually taught by specialists in middle school. Why not mathematics and science as well?
4. There need to exist many more schools such as the Thomas Jefferson High School for Science and Technology, Stuyvesant High School, Illinois Math and Science Academy, and Davidson Academy of Nevada to provide a socially and academically supportive environment in which mathematically gifted children can pursue their interests with like-minded peers under the mentorship of highly qualified teachers. Essentially all USA-born students identified by the very high-level mathematics examinations discussed here attended a special public or elite private high school, had access to college mathematics courses, selfstudied mathematics with help from a parent highly knowledgeable in the field, or were home-schooled (for examples, see Table 3). Unfortunately, only a tiny percentage of pre-college students in the USA currently have access to any of these educational opportunities. Without them, the USA is squandering a valuable resource.
5. We should facilitate the ease with which mathematically precocious pre-college students who lack access to programs for gifted children within their own schools can study mathematics above their grade level at local colleges and via correspondence and online programs such as Stanford University's Education Program for Gifted Youth, Northwestern University's Center for Talent

Development's Gifted LearningLinks, and the Art of Problem Solving Foundation.
6. We should encourage mathematically gifted children to participate in summer camps such as MathPath ${ }^{\circledR}$, All Girls/All Math, AwesomeMath, Canada/USA Mathcamp, Hampshire College Summer Studies in Mathematics, Program in Mathematics for Young Scientists, and the Ross Mathematics Program so they can be exposed to areas of mathematics not currently taught in USA high schools and get to know other children who share their enjoyment of mathematics.

Yes, some of these proposals cost money. However, there will be a far greater cost to the future of the USA economy and our standard of living if we fail to nurture and develop the talents of the vast majority of our mathematically gifted children, boys as well as girls. Hopefully, passage by the U.S. Congress of the America COMPETES Act, "10,000 Teachers, 10 Million Minds" Science and Math Scholarship Act, and Sowing the Seeds through Science and Engineering Research Act will lead to funding to help enable success.

## Acknowledgments

We wish to thank Kiran Kedlaya and members of the Putnam Mathematical Competition Committee for some of the data regarding participants in the Putnam Mathematical Competition; Donita Bowers and Steve Dunbar for some of the data regarding participants in the USAMO and the MOSP; Zvezdelina Stankova, Zuming Feng, and several IMO team leaders for the names of girl IMO participants from Bulgaria, China, and several of the other top- and high-ranked countries, respectively; administrators in the top five-ranked mathematics departments for data regarding their faculty; numerous MOPpers for help in obtaining data needed to complete some of the tables; and an anonymous reviewer for suggestions to improve an earlier draft of this article. We are also indebted to Nancy Hopkins for inducing us to conduct this study; and Janet Hyde for discussions regarding the literature on girls and mathematics.

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# William J. LeVeque (1923-2007) 

James W. Maxwell

William J. "Bill" LeVeque, who retired as executive director of the American Mathematical Society in 1988, died of a lingering illness on December 1, 2007, at the age of eighty-four. LeVeque had spent most of the past decade on Bainbridge Island, Washington, with his wife Ann and in close proximity to his son Randall, daughter-in-law Loyce, and grandson Benjamin.

LeVeque was no stranger to Society operations when he assumed the executive director position in 1977. His first experience as a Society employee was during 1961 when he came to Providence to work for the summer on the Mathematical Reviews backlog of papers that needed to be assigned to reviewers. In 1965 he assumed the position of executive editor of MR with the express charge of relocating MR operations from Providence to Ann Arbor, Michigan. With MR's operations up and running in Ann Arbor, he returned to his position as professor of mathematics at the University of Michigan in the fall of 1966. But over the next eleven years, LeVeque continued his close association with MR, serving on several key MR-related AMS committees. He was also the editor for the sixvolume set Reviews in Number Theory, published by the AMS in 1973.

LeVeque was active in the broader mathematical policy arena. He chaired the Advisory Panel of the Mathematical Sciences Section of the National Science Foundation, 1971-1972, chaired the Conference Board of the Mathematical Sciences, 1973-1975, and was a member of the U.S. National Committee for the International Mathematical Union of the National Academy of Sciences, 19691975. He was a U.S. delegate to the International Mathematical Union in 1970 and 1974.

[^6]Society operations grew enormously during LeVeque's tenure as executive director. The Society reported total revenues of US\$5 million for 1977 and US\$14.9 million for 1988. Nonetheless, the period from 1977 to 1988 was a roller coaster ride in terms of the financial fortunes of the Society. The Society needed to make significant investments in its operational infrastructure to support its growing membership, programmatic,


William J. Leveque and publishing operations. Furthermore, during the first half of this period, the U.S. economy experienced unusually high inflation, and the Society's operations were not immune from its effects. These two factors contributed to significant annual operating deficits between 1981 and 1983. On the other hand, the investments made during this period secured the foundation for what would become MathSciNet and for numerous advances in operational efficiencies. While the practical challenges of operating at what was then the "bleeding edge" of technology caused considerable anxiety for LeVeque (and the Society trustees), he supported these investments throughout his term as executive director. By the time of his retirement, Society operations had achieved four consecutive years of strong operating surpluses.

LeVeque championed the delivery of Mathematical Reviews to its users via the dial-up database services typical of the time, such as Lockheed Dialogue and BRS. The only option for this service at the time was through university library subscriptions to these services. Anyone who has used this

William LeVeque earned his doctorate in mathematics from Cornell University. He was an instructor at Harvard before joining the University of Michigan as the first number theorist on the mathematics faculty.

LeVeque's research areas included transcendental numbers, uniform distribution and Diophantine approximation. His two-volume 1956 monograph Topics in Number Theory was highly influential in the development of number theory in the United States, as was the MAA monograph he edited called Studies in Number Theory.

In 1960 he conceived the idea of updating L. E. Dickson's History of the Theory of Numbers that covered the subject from antiquity to 1910. In 1974 he accomplished part of his goal by publishing a six-volume collection Reviews in Number Theory containing all reviews in number theory that appeared in Mathematical Reviews (MR) from 1940-72 assembled by topic, for easy reference and for ease in seeing historical developments. The Special Libraries Association gave him an award for this effort.
-From the University of Michigan
service is in a position to appreciate the enormous advance in accessibility and usability reflected in today's MathSciNet. The production of MathSci for these early online services was a critical step in the development of the current MathSciNet.

LeVeque valued the role the AMS staff played in carrying out the mission of the AMS, and he was committed to providing the tools necessary for them to carry out their work. During the first year of his term as executive director, the Society began placing computer terminals on the desks of the majority of its staff in Providence. Many of the staff were struggling to become proficient in the software tools that this system required. Central among these was the text editor known then (and now) as Emacs. Seeing the challenge that many staff faced in learning Emacs, LeVeque wrote a manual for users of Emacs and used it to conduct a series of classes for staff. This example typifies his hands-on approach to meeting whatever challenges he encountered in moving the Society forward.

The Notices published an article about LeVeque’s pending retirement in the July/August 1988 issue, pages 783-784. This article provides a more complete description of his mathematical biography along with two personal reflections on his service from two AMS presidents serving during the final years of his term as executive director: Presidents Daniel Mostow and Irving Kaplansky. (The full article can be viewed atwww.ams.org/ams/1ev1.
pdf.) Two brief excerpts highlight the contributions that LeVeque made to the Society and to the broader U.S. mathematical sciences community.

From President Mostow: "Very often, in scientific societies, there is a divergence of viewpoints among the staff and the scholars. Fortunately for the AMS, Bill has never drifted far from the moorings of his distinguished academic career as a mathematician. His great vigor has consistently been directed at the right target: the advancement of mathematics."

From President Kaplansky: "What was it like to work with Bill? In a word: great. I remember with pleasure his courtesy, his wit, and his untiring efforts to get everybody to do their jobs right. When needed, there was also a hint of steel inside the velvet glove. Many times, when a tricky discussion was bogging down, he would wait till the right moment and then firmly point to the nub of the matter."

The same issue of Notices contains an article by LeVeque based on a talk he gave at the spring sectional meeting of the Society in Las Cruces, New Mexico, in April of 1988. The article, titled "The AMS-Then, now, and soon", pages 785-789, provides considerable insights into the AMS's development during the period from 1960 to 1988, as seen by one of its volunteer and staff leaders during this period. It is available at www.ams. org/ams/lev2.pdf.

Editor's Note: Graduate students, early career faculty, and other mathematicians may have professional questions that they are reluctant to pose to colleagues, junior or senior. The Notices advice column, "Ask Professor Nescio", is a place to address such queries. Nomen Nescio is the pseudonym of a distinguished mathematician with wide experience in mathematics teaching, research, and service. Letters to Professor Nescio are redacted to eliminate any details that might identify the questioner. They are also edited, in some cases, to recast questions to be of more general interest and so that all questions are first person. Some letters may be edited composites of several submitted questions. Query letters should be sent to notices@math.ou.edu with the phrase "A question for Professor Nescio" in the subject line.
-Andy Magid

## Dear Professor Nescio,

I am an undergraduate mathematics major considering where to go for graduate school. In a recent teatime discussion, one of the professors talked about how mathematics departments separate into different tiers according to their level of research excellence. He claimed that each tier likes to hire only students from other schools in the same tier, so that students from first-tier schools can actually have a hard time getting jobs in schools in the second and lower tiers. Is this true, and should it be a consideration for me in choosing a graduate school?
-Puzzled

## Dear Puzzled,

This is not true, though there is a variation on this that is true. Nevertheless, there is no ironclad law like this. I know many mathematicians who have broken the tier ceiling, in both directions. They did this by their merit and the quality of their work.

Which graduate school you attend is indeed an important decision. In Professor Nescio's opinion, your Professor X did not do right by you. If what you report is accurate, this might reflect some insecurity on his part. I have run into several people who do not want to recruit new faculty from those who finish at a lower tiered institution than their own, but seldom the reverse. One can only conjecture why he would say such a thing, but I have seen such attitudes on hiring committees. Sometimes this is a defeatist attitude where they think hiring someone from a better institution is impossible; sometimes it is a fear of hiring mathematicians better than themselves. So understand a lesson it took me time to learn: having a Ph.D. in mathematics does not imply the possession of wisdom.

In fact statistics show that Professor X is dead wrong. A glance at AMS data shows that Group I Ph.D. programs (as defined by the AMS) produce far more mathematicians than they consume. (It is true, however, that most of those they hire are from similar institutions.) I guarantee you that their remaining students find employment in universities that are ranked lower, provided they do not go into government or private industry. In fact my experience is that the Ph.D.'s produced by Group I departments get tenure-track jobs at institutions covering the entire spectrum, including liberal arts colleges. Similar things happen with those produced by departments in Groups II and III, though few of their products make it as tenure-track faculty at Group I departments without first completing a successful postdoctoral appointment.

As you might guess, Professor Nescio's advice is to ignore this counsel from Professor X. Yes, when you get your degree there may be someone on a hiring committee at a department to which you apply whose attitude is precisely that expressed by him. But count yourself lucky that you will not have them as a colleague. There will be many more who look more closely at what you accomplish. Do good work and you will be appreciated, irrespective of where you get your degree-though that appreciation may be longer in coming the lower ranked your degree granting department.

Apply to a spectrum of institutions-some from at least two tiers. I would also advise you to forget about geography, proximity to home, and weather; your stay there will be for a limited time and you are not making a home. Focus on programs that offer a variety of courses and where you feel you can succeed. You should spend the first two years in graduate school taking courses in many different areas; this will be useful to you no matter what
your eventual path is. Large departments offer a wider variety of courses, but you are likely to receive less personal attention there than at a smaller one. Deciding which factor is more important to you is a matter where outside advice will be of limited value since no one knows your personal needs better than you do.

Do not decide on an area of mathematics that you will major in too soon. In fact my experience with students is that even those who start graduate school "knowing" what they want to specialize in eventually change their minds. But if there are some parts of mathematics that have intrigued you as an undergraduate, apply to some places that have strength in those areas. Talk to your professors (but not Professor X) about the schools you are considering. If it is possible, visit some of the schools that accept you and offer you support. (Many departments will help defray the cost of such a visit.) During the visit talk to professors and students (especially the students, who are likely to be more open and frank, even though they may express a self-centered view of their experience). Good luck.

> -Respectfully, Professor N. N.

## Dear Professor Nescio,

While your column is to be evaluated on the basis of the quality of the advice only, I was nonetheless astounded to find a mathematical mistake contained therein. In your response to a concern that in your opinion might be only a bagatelle, you counseled that "...every swell in that sea is not a...storm." I will not embarrass you further by pointing out how this is incorrect. To be sure, the history of this mistake is long and storied, including no less an authority than Shakespeare, who thought that "all that glisters is not gold." But I do not accept the suggestion that, as a logician, I'm overly sensitive to such errors. After all, that would be like saying that I don't have to know what $1+1$ is, since I'm not a number theorist!

Anyway, what my question is has to do with my Math for Liberal Arts ("math for poets") class. I often try to sensitize them to issues having to deal with the standard quantifiers (for all / there exists), by discussing just the topic above (including the Shakespeare quote). (As well as my other favorite, from another authority, this one King James, or Pete Seeger I suppose. They said "there is...a time for every purpose under heaven," whereas they really meant "for every purpose under heaven there is a time." But I digress.) So I would like to know, if as distinguished a mathematician as Professor Nescio can make this mistake, and get it by the editorial staff of the Notices, is there any value in bringing this to the attention of my introductory students?

- Dr. R. K.


## Dear Dr. R. K.,

In answer to your question, No.

> - Respectfully, Professor N. N.
P.S. I am flattered being placed in the same category as Shakespeare.

## Dear Professor Nescio,

I am a young faculty member who has had only one graduate student so far. When he finished his Ph.D. and applied for jobs, he asked me to write a letter of recommendation. I was happy to do so-until I got a set of guidelines from one of the institutions he is applying to. These guidelines warned me that any applicant for a job at that institution has a right to see his or her letters of recommendation. I feel uncomfortable knowing that my former student would read my frankest assessment of him. Is this a common policy in universities nowadays? Do you have any advice about how I can handle this situation?
-Perplexed

## Dear Perplexed,

This is a common policy, but not a universal one. My sense of the situation is that at most private universities the letters are still confidential, but not so at almost all public ones. Usually the state institutions have this imposed on them by state law, which does not apply to private entities. I don't know exactly when this started or why, but I believe it has been with us for quite some time. I have the impression that it was believed that a totally confidential letter might allow misinformation (from honest errors to slander) to affect someone's future. It is, I think, a question of where you want to draw the line between civil liberties and privacy.

In the abstract it is a bad idea; in practical terms it seldom leads to problems. I know of no cases where a job applicant has asked to see their letters. I know of a few cases where promotion or tenure was the issue and the candidate read the letters, and in all these cases they had been denied the promotion. A more prevalent problem, one that can occur at all types of institutions, is where someone who has legitimate access to the letters or phone conversations or email reveals the content of that communication to the candidate. Professor Nescio himself was the victim of such an incident when comments he made during a phone conversation about an unsuccessful candidate for a position were revealed to the candidate. (Professor Nescio, when confronted by the candidate, adopted the position of the Godfather and said that it was nothing personal, just business. I then informed the dean that someone in his mathematics department violated my confidence.)

In most cases where confidentiality is not honored, the applicant has to follow a procedure of asking to see the letters. There is enough social pressure not to do this that it seldom happens.

So what to do? Given some of what I have already said and the fact that policies vary from one university to another, my advice is to ignore these things. The one exception I would make would be when a form has a space for the candidate to surrender the right to read the letter and he/she hasn't agreed to that. This has never happened to me, but if it did I would not write the letter. I would think the candidate has asked me for a favor and is refusing to reciprocate.

If you really don't want someone to know what you are saying, don't say it (especially in email). If you feel the candidate is a mangy cur, don't agree to write the letter. This could lead to unpleasantness, but, frankly, do you care what a mangy cur thinks of you? If they never speak to you again, is that so bad? Besides, their bark is probably worse than their bite.

When you write, give an honest, candid, professional assessment. This is something you can always defend and feel comfortable about. After you have read enough letters you will come to appreciate the phrase "damned by faint praise". A letter to a research department that does not greatly extol the research accomplishments of your student will not get him/her a position there. Anyone reading a phrase such as, "He/She is a sincere researcher," will know exactly what you are saying.

As a final piece of advice, take a look at Steve Krantz's A Primer of Mathematical Writing (published by the AMS). It contains a section on writing reference letters.
-Respectfully, Professor N. N.

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# The Last Poem of James Clerk Maxwell 

Daniel S. Silver



James Clerk Maxwell
"My soul's an amphicheiral knot," proclaimed the greatest mathematical physicist of the nineteenth century. Many are familiar with James Clerk Maxwell for his elegant equations describing the electromagnetic field or for his profound ideas about the kinetic theory of gases and thermodynamics. Fewer know that Maxwell was a compulsive poet. This is the story of Maxwell's last poem, written during his final days in 1878. An enigmatic piece, expressed with odd references to topology, cosmology, and evolution, Paradoxical Ode in fact reflects Maxwell's private thoughts about the relationship between science and religion, choice and chance, death and eternity.

Paradoxical Ode was composed for a close friend, the Scottish physicist Peter Guthrie Tait. The two had known each other since their school days at Edinburgh Academy. In 1867 Tait had demonstrated the mutual interaction of smoke-rings in his laboratory for the benefit of William Thomson (the recently knighted Lord Kelvin). Thomson rashly proposed a "vortex atom theory", asserting that knotted vortices in the ether comprise all chemical elements. Tait was now laboring hard to classify knots.

The original version of Paradoxical Ode was written on three sheets of plain paper. It is preserved in a scrapbook that was recently donated to the James Clerk Maxwell Foundation, Edinburgh,

[^7]by a relative of Tait. The poem was published in The Life of James Clerk Maxwell, an extensive and definitive biography written in 1882 by Lewis Campell and William Garnett. It has since been reproduced many times, often altered and with little or no explanation. The poem appears below in its original form including Maxwell's indentation.

Superscripts in the poem and text refer to endnotes. Some words and phrases in the poem reappear later in boldface as they are explained.

To Hermann Stoffkraft, Ph.D.
A Paradoxical Ode
After Shelley
I
My soul's an amphicheiral knot Upon a liquid vortex wrought
By Intellect in the Unseen residing,
While thou dost like a convict sit With marlinspike ${ }^{1}$ untwisting it
Only to find my knottiness abiding; ${ }^{2}$
Since all the tools for my untying In four-dimensioned space are lying, Where playful fancy intersperses Whole avenues of universes; Where Klein and Clifford fill the void With one unbounded, finite homaloid, Whereby the Infinite ${ }^{3}$ is hopelessly destroyed.

## II

But when thy Science lifts her pinions In Speculation's wild dominions,
I treasure every dictum thou emittest; While down the stream ${ }^{4}$ of Evolution We drift, and look for no solution
But that of the survival of the fittest. ${ }^{5}$ Till in that twilight of the gods

When earth and sun are frozen clods, When, all its energy degraded, ${ }^{6}$ Matter in æther shall have faded, We, that is, all the work we've done, As waves in æther, shall for ever run In swift-expanding spheres, through heavens beyond the sun.

## III

Great Principle of all we see, Thou endless Continuity!
By thee are all our angles gently rounded; ${ }^{7}$ Our misfits are by thee adjusted, And as I still 8 in thee have trusted,
So let my methods never be confounded! O never may direct Creation Break in upon my contemplation, Still may the causal chain, ascending, Appear unbroken and unending, And, where that chain is lost to sight
Let viewless fancies ${ }^{9}$ guide my darkling ${ }^{10}$ flight Through Æon ${ }^{11}$-haunted worlds, in order infinite.

$$
\frac{\partial p}{\partial t}^{12}
$$

Besides wordplay, Maxwell's nonscientific passions included literature and philosophy. Paradoxical Ode is a pastiche of a passage from the lyrical drama, Prometheus Unbound, by the English romantic poet Percy Shelley.

The first verse of Paradoxical Ode accurately suggests that Maxwell was familiar with new mathematical ideas of the day. He understood a knot to be a simple closed curve in 3-dimensional space, just as we do today. An amphicheiral knot is one that can be deformed to its mirror image, while liquid vortex is a reference to Thomson's vortex atom theory.

From correspondence between Tait and Maxwell, we know that Maxwell was directly involved in the nascent subject of knot theory, although he did not publish any knot theoretical results of his own.

Maxwell's interest in knots, and topology in general, had a serious side. It was Maxwell who informed Tait about the work of Johann Benedict Listing, a student of Gauss, who coined the word "topology" in 1848 and had begun his own study of knots. Maxwell's Treatise on Magnetism and Electricity made early and profound use of Listing's homological notions. In it, we find a new interpretation of Gauss's linking integral for two disjoint, simple closed curves as the work done by a charged particle moving along a path described by one knot against the magnetic field induced by an electrical current running though the other. Maxwell was fascinated by the idea that two knots can have zero algebraic linking number and yet be inseparable.

Intellect in the Unseen is the first of several references to The Unseen Universe or Physical Speculations on a Future State, a book that Tait co-authored with (yet another) Scottish physicist, Balfour Stewart, in 1875 . In it they argued that religious miracles and the immortality of the soul are compatible with modern science. God is hidden from us because all human thought is "conditioned", an idea that traces back to Kant. Nevertheless, the "principle of Continuity", which Unseen Universe announced, comforts all with the gentle reassurance that nature will never do anything to confound us permanently:
> [W]hat the principle of Continuity demands is an endless development of the conditioned. We claim it as the heritage of intelligence that there shall be an endless vista, reaching from eternity to eternity, in each link of which we shall be led only from one form of the conditioned to another, never from the conditioned to the unconditioned or absolute, which would be to us no better than an impenetrable intellectual barrier. ... Finally our argument has led us to regard the production of the visible universe as brought about by an intelligent agency residing in the unseen.

Stewart and Tait wrote Unseen Universe in response to John Tyndall's Presidential Address to the British Association for the Advancement of Science during the previous year. As controversy raged over the teaching of science at the Catholic University in Ireland, Tyndall, an Irish physicist and successful popularizer of science, had felt the need to speak out. "All religious theories, schemes and systems, which embrace notions of cosmogony, or which otherwise reach into the domain of science," Tyndall contended, "must, in so far as they do this, submit to the control of science,


John Tyndall and relinquish all thought of controlling it." Tyndall's call for reason over revelation was seen by some, including Stewart and Tait, as an attack on religion. Unseen Universe was hastily written and was a huge success. The authors published anonymously until the fourth edition appeared. A trefoil knot adorned the spine and title page.


Title page of Unseen Universe.

Just a few years before Paradoxical Ode was composed, Felix Klein had published a proof that any knot can be undone in fourdimensioned space. By the time that the poem was sent to Tait, the American magician and medium Henry Slade had incorporated the idea into his act, claiming to unknot ropes in the fourth dimension. Edwin Abbott's multidimensional exploration, Flatland, would appear five years later.

Like many, Maxwell was interested in speculations about a fourth dimension. In an amusing letter to C. J. Monroe, dated 1871, he doubted that we live in a universe of more than 3 spatial dimensions: "If you have 4 dimensions this becomes a puzzle-for first, if three of them are in our space, then which three?"

In a multidimensional world, many things such as whole avenues of universes are possible. Stewart and Tait were not timid about transporting a novel scientific theory to unfamiliar surroundings. Readers of Unseen Universe learned that their every thought and action broadcasts eternal vibrations throughout the perfect ether. Inconveniently, nothing in our visible world, including fluids, is perfect. The authors were undeterred. Particles of good ether were next to particles of better ether, readers were told, while particles of better ether next to even better, ad infinitum. In effect, Unseen Universe postulated parallel avenues of universes. More importantly, it described a world in which miracles and life after death were scientifically possible.

At the age of thirty-three, William Kingdon Clifford had already established himself as one of the most brilliant and iconoclastic mathematicians. An atheist, Clifford had little use for Unseen Universe. His review in the Fortnightly Review was biting and entertaining. ${ }^{13}$

Like his slightly younger German colleague Klein, Clifford was fascinated by the possibility that the universe is non-Euclidean. He even speculated that gravity might be the effect of "a variation in the curvature of space". Two years before Maxwell penned Paradoxical Ode, Clifford had coined the term homaloid and had used it in the title of an article in the Proceedings of the London

Mathematical Society. By the term, Clifford meant a "flat" space of any number of dimensions, that is, a space with curvature zero. Maxwell's use of the term is perplexing. ${ }^{14}$ However, his intention becomes clearer when we understand that most scientists of his day believed that the universe is flat and that a


Ludwig Büchner flat universe is necessarily infinite. Likely, Maxwell understood that while the first assertion might be true, the second is not. He attended the 1873 Bradford meeting of the British Association for the Advancement of Science at which Clifford showed how to construct flat tori as quotients of Euclidean space.

At Northwestern University in 1893, Klein summarized the situation:

It is evident from this point of view many assertions concerning space made by previous writers are no longer correct (e.g., that infinity of space is a consequence of zero curvature), so that we are forced to the opinion that our geometrical demonstrations have no absolute objective truth, but are true only for the present state of our knowledge.

Tyndall and Clifford were just two of many Victorians who hoped that modern science would sweep away Christian dogma. The second verse of Paradoxical Ode enters a noisy debate about science and religion that continues today.

Maxwell declared more than once that science had nothing to say on matters of religion. ${ }^{15}$ Maxwell's biographer, Campbell, wrote that while his subject was devout, he distrusted the "practical applications or the popular dissemination of what appeared to him as crude and half-baked theories about the highest subjects."

In response to a rumor that Stewart and Tait were writing a sequel, Maxwell wrote to Tait, using characteristic humor to cloak annoyance with his friend's public religious pronouncements.

[^8]original work, do not forget to insert "How happy could I be with Ether."

Paradoxical Philosophy, the sequel to Unseen Universe, appeared in 1878. It takes the form of a debate between scientifically-minded Christians and a fictitious philosopher, Hermann Stoffkraft. A blunt polemic eventually convinces Stoffkraft to trade his erroneous convictions for belief in the doctrines of Unseen Universe.

Stoffkraft's convictions were paraphrased from Kraft und Stoff (Force and Matter), an influential work published by Ludwig Büchner in 1855. An atheist, Büchner had found reassurance for his "scientific materialism" in Charles Darwin's writings. Natural selection provided a mechanism for survival and reproduction without an appeal to divine power. Büchner summarized his views in the following way.

No force without matter-no matter without force!

Hermann Stoffkraft, Ph.D., is both the hero of Paradoxical Philosophy and the dedicatee of Paradoxical Ode. ${ }^{16}$ In fact, Maxwell seems to be speaking directly to him.

Maxwell's public attitudes about Paradoxical Philosophy were dismissive. In his review, published in the 1878 volume of Nature, he concluded:

The progress of science, therefore, so far as we have been able to follow it, has added nothing of importance to what has always been known about the physical consequences of death, but has rather tended to deepen the distinction between the visible part, which perishes before our eyes, and that which we are ourselves, and to shew that this personality, with respect to its nature as well as to its destiny, lies quite beyond the range of science.
Questions about the soul's immortality were no longer merely academic for Maxwell. He was dying, and possibly knew it by now. For months he had been suffering from stomach pains but he had consulted no doctors. By the time that Maxwell wrote his review, he was having difficulty swallowing. ${ }^{17}$ He would soon learn that he had the same cancer that took his mother at the very age that he was now. He would die within a year.

Maxwell wrote his last poem borrowing from Percy Shelley's popular Prometheus Unbound. Shelley had been ejected from Oxford for publishing an atheistic tract. Prometheus, the hero of Shelley's four-act play, resembled Jesus in the sense that he was not afraid to speak the truth to his oppressor. Paradoxical Ode is addressed to Stoffkraft, who like Prometheus attempted to liberate man from the ancient gods.


Original version of Paradoxical Ode.
Taped to the bottom of the page of Tait's scrapbook is an addendum, sent by Maxwell some time afterwards: ${ }^{18}$

Last three lines of Ode to Stoffkraft should be as follows.

While Residents in the Unseen-
Æons or Emanations-intervene, And from my shrinking soul the Unconditioned screen. ${ }^{19}$

Was Maxwell teasing Tait by pointing out an unfortunate consequence of his philosophy-that the Principle of Continuity should prevent us from ever encountering the Unconditioned, even after death?

Maxwell's thoughts about dying remain hidden from us. Whatever they were, they must have been certain and comforting to him. According to an attending physician, "No man ever met death more consciously or more calmly."

## Acknowledgments

I am grateful for the insights of my student Adam Brown, who investigated aspects of Maxwell's Paradoxical Ode as a course assignment. I also thank Susan Williams for numerous valuable
suggestions, and the James Clerk Maxwell Foundation for making its materials available.

## Notes

1. Convicts in Victorian England were punished with the unpleasant task of recovering hemp from worn, tarred rope. Sailors employed a pointed tool called a marlinspike to unravel the rope; convicts had to use their fingers.
2. Professor Keith Moffatt observes: "The invariance of helicity is embedded in this verse. Perhaps Maxwell really was a hunderd years ahead of his time!"
3. The Infinite was often identified with God.
4. In Shelley's poem, Asia also drifted down a stream.
5. Inspired by Darwin's On the Origin of Species, the English philosopher and economist Herbert Spencer introduced the popular phrase "survival of the fittest" in his 1851 work Social Statics.
6. Dr. Stoffkraft asserts that all energy degrades. With the end of humanity, collective consciousness will disappear.
7. Maxwell appears to be assuming a Principle of Differentiability.
8. always.
9. invisible spirits.
10. in the dark.
11. divine power.
12. Maxwell often signed his letters to Tait with $\partial p / \partial t, \quad \partial p / \partial t=J C M$ being short-hand for one of the laws of thermodynamics.
13. Clifford wrote: Let us contemplate the reposeful picture of the universal divan, where these intelligent beings whiled away the tedium of eternity by blowing smoke-rings from sixty-three kinds of mouths...How fertile of resource is the theologic method, while it once has clay for its wheel!
14. A review of Life of James Clerk Maxwell that appeared in the journal Nature in 1882 called Maxwell's use here of the term "poetic license".
15. It appears that Maxwell regarded religious ideas much like the analogies and mechanical devices that guided his scientific intuition. The attitude is suggested in the draft of a letter (never sent) to the Victoria Institute, a society that attempted to reconcile Christianity with science:

Sir - I do not think it my duty to become a candidate for admission into the Victoria Institute. Among the objects of the Society are some of which I think very highly. I think men of science as well as other men need to learn from Christ, and I think Christians whose minds are scientific are bound to study science that their view of the glory of God may be as extensive as their being is capable. But I think that the results which each man arrives at in his attempts to harmonize his science with his Christianity ought not to be regarded as having any significance except to the man himself, and to him only for a time, and should not receive the stamp of a society... .
16. The appended title "Ph.D." would have seemed exotic to English ears. Although the Ph.D. degree had been awarded in Europe since the twelfth century, its significance as the highest possible degree had begun in German universities
during the early nineteenth century. The Ph.D. degree was not awarded in Britain until 1917.
17. According to Campbell, Maxwell's illness had begun by the spring of 1877 .
18. The addendum bears no date.
19. hide from view.

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# 2007 Annual Survey of the Mathematical Sciences in the United States 

# Faculty Profile Enrollment and Degrees Awarded Profile Graduate Student Profile 

Polly Phipps, James W. Maxwell, and Colleen A. Rose

## Introduction

The Annual Survey of the Mathematical Sciences collects information each year about departments, faculties, and students in the mathematical sciences at four-year colleges and universities in the United States. The information presented in this report was gathered on a questionnaire called the Departmental Profile which was mailed to all mathematical sciences departments in Groups I, II, III, IV, Va, and M and to a stratified random sample drawn from Group B. The questionnaire gathered information about the number of faculty in various categories, the recruitment of new faculty, undergraduate and graduate course enrollments, bachelor's andmaster's degrees awarded during the preceding year, and the number of graduate students, all as of fall 2007. The 2007 First Report, Part II, presented data collected earlier about faculty salaries (pages 387-93 of the March 2008 issue of Notices of the AMS). Definitions of the various departmental groupings used in the Annual Survey reports can be found on page 1276 of this report.

The careful reader will note that a row or column total may differ slightly from the sum of the individual entries. All the table entries are the rounded values of the individual projections associated with each entry, and the differences are the result of this rounding (as the sum of rounded numbers is not always the same as the rounded sum). Further details on the statistical procedures used with the survey are described on page 1276.


#### Abstract

This Third Report of the 2007 Annual Survey gives information about faculty size, departmental enrollments, majors, and graduate students for departments of mathematical sciences in four-year colleges and universities in the United States.

The 2007 Annual Survey represents the fifty-first in an annual series begun in 1957 by the American Mathematical Society. The 2007 Survey is under the direction of the Data Committee, a joint committee of the American Mathematical Society, the American Statistical Association, the Institute of Mathematical Statistics, the Mathematical Association of America, and the Society of Industrial and Applied Mathematics. The current members of this committee are Richard Cleary, Richard M. Dudley, John W. Hagood, Abbe H. Herzig, Ellen Kirkman, David J. Lutzer, Joanna Mitro, James W. Maxwell (ex officio), Bart Ng, Polly Phipps (chair), Douglas Ravanel, Jianguo (Tony) Sun, and Marie Vitulli. The committee is assisted by AMS survey analyst Colleen A. Rose. Comments or suggestions regarding this Survey Report may be directed to the committee.


## Faculty Size

Table 1A gives the number of faculty for different categories of faculty broken down by survey group, Table 1B gives the same information for females only, and Table 1C gives some percentages based on the information in Tables 1A and 1B. The estimated total number of full-time faculty in the mathematics groups (Groups I, II, III, Va, M, and B combined) is 21,470 , with a standard error of 292, down 616 from last year. The doctoral mathematics departments (Groups I, II, III, and Va) are up 254

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## Highlights

Changes in the numbers of faculty in various categories from 2006 to 2007 were modest. The estimated number of full-time faculty in all mathematics departments combined is 21,470 , down slightly from 22,086 last year. The number of nondoctoral full-time faculty is 3,839 , down modestly from 4,107 last year. The number of part-time faculty is 7,065 , up $8 \%$ from 6,543 last year.
For the doctoral math departments combined, the number of fulltime non-tenure-track doctorate-holding faculty continued its slow but steady climb since 2000. This number reached 1,576 for 2007, up $59 \%$ over its 2000 figure of 993 . Faculty holding a postdoctoral position have been tracked separately since 2003 and accounted for just over half of the non-tenure-track faculty reported for fall 2007.
Overall, women comprised $27 \%$ ofthe full-time faculty in mathematics departments in fall 2007, unchanged from the $27 \%$ reported for fall 2006. For the doctoral mathematics departments, women comprised $12 \%$ of the doctoral-holding tenured and tenure-track faculty and $25 \%$ of the doctoral-holding non-tenure-track faculty in fall 2007. For Group M faculty these same percentages are 25 and 39 respectively, and for Group B faculty they are 27 and 33 respectively. Among the nondoctoral full-time faculty in all math departments combined, women comprise $52 \%$.
For all mathematics departments combined, the number of full-time positions under recruitment during 2006-2007 dropped slightly from last year's high of 1,798 to 1,786 . The number of tenured/ tenure-track positions under recruitment during this period was 1,131 , down $8 \%$ from the previous year's figure of 1,231 . The number of full-time positions filled was 1,487 , with 810 of these tenured/tenure-track positions. These figures are down $3 \%$ and 4\%, respectively, from the figures reported for fall 2006.
For all mathematics departments combined, the number of new doctoral hires for positions beginning in fall 2007 was down 10\% from the previous year's number, to 634. Most of the declinewas due to a significant drop-off in the new doctoral hires in Group M departments. The number of new doctoral hires into tenure-track positions is down $19 \%$ to 331 for fall 2007, with all the decrease coming in Group M and Group B departments where the total was 283, down $22 \%$ from fall 2006 's figure of 362 .
Among the 268 individuals hired into tenure-track positions in the doctoral mathematics departments, 164 held a non-tenure-track position when hired and $70 \%$ of these were postdoctoral positions. Forthe 543 individuals hired into tenure-track positions in Groups M and B combined, $39 \%$ (211) held a non-tenure-track position when hired and $32 \%$ of these were postdoctoral positions.
The reported number of full-time graduate students at doctoral mathematics departments decreased slightly to 0,937 for fall 2007 after reaching a ten-year high of 10,984 for fall 2006. The number of women among these graduate students also decreased slightly to 3,249 after also reaching a ten-year high of 3,279 for fall 2006. The percentage of women remained steady at $30 \%$. The percent of U.S. citizens among the total full-time graduate students remained steady at $56 \%$. The percentage of underrepresented minorities among the U.S. citizen graduate students is reported for the first time. The figure for 2007 is $10 \%$, in line with the figures for the prior years. This data was first collected in 2003.
full-time faculty members, Group M is down 204 faculty members, and Group B is down 666. The total faculty size in the statistics and biostatistics group (Group IV) is down to 1,691 this year from 1,702 last year.

This year the estimated number of part-time faculty in Groups I, II, III, Va, B, and M combined is 7,065 , up $8 \%$ from last year's 6,543 . The number of non-tenure-track doctoral faculty (including postdoctoral positions) is estimated at 2,170 this year, down $5 \%$ from 2,289 last year. The number of nondoctoral full-time faculty is estimated at 3,839 in Groups I, II, III, Va, M, and B combined, down from 4,107 last year, a 7\% decrease. In Group IV the number of part-time faculty decreased from 201 last year to 149 this year, and the number of non-tenure-track doctoral faculty decreased from 402 last year to 378 this year due to the decreased number of postdoctoral appointments.

Table 1D gives an eight-year history of tenured/ tenure-track, and non-tenure-track doctorateholding faculty, and all part-time faculty for Groups I, II, III, and Va combined, for Group M, and for Group B. Also shown for each number in this table is the percentage of females. Comparing the 2007 values to the 2000 values, we see that for Groups I, II, III, and Va combined the number of tenured/tenure-track faculty is up $3 \%$, the number of non-tenure-track faculty is up $59 \%$, and the number of part-time faculty is down $18 \%$. For Group M, the number of tenured/tenure-track faculty is down $9 \%$, the number of non-tenure-track faculty is down $11 \%$, and the number of part-time faculty is down $2 \%$. Finally in Group B, the number of tenured/tenure-track faculty is up $17 \%$, the number of non-tenure-track faculty is down $11 \%$, and the number of part-time faculty is up $13 \%$.

Table 1E gives a summary of the various types of faculty found in departments of mathematical sciences by sex and group.

Tables 1 F and 1 G give more information about two types of faculty: full-time faculty without a doctorate and part-time faculty. The Table 1F shows the information for the 3,839 full-time faculty in the mathematics departments who do not have doctoral degrees. The majority of these faculty, $3,070(80 \%)$, are found in Groups M and B departments. Table 1G shows the part-time faculty broken down by sex and whether they have a doctoral degree. Comparing Table 1G to last year's table, we see an overall increase in parttime faculty with the largest increase in Group B part-time faculty ( $12 \%$, from 2,187 last year to 2,454 this year).

## Female Faculty

Table 1B gives a complete breakdown of all categories of female faculty by group. For 20072008 the estimated total number of full-time faculty in Groups I, II, III, Va, M, and B combined is 21,470 , of which 5,891 are females. While the number of females is down from 6,063 last year,

Table 1A: Total Faculty, Fall 2007

|  | GROUP |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $\begin{gathered} \text { I } \\ \text { Public } \end{gathered}$ | $\stackrel{1}{\text { Private }}$ | II | III | Va | $\begin{gathered} \mathrm{I}, \mathrm{II}, \mathrm{III}, \\ \& \& \mathrm{Va}, \end{gathered}$ | M | B | $\begin{gathered} \text { I, II, III, } \\ \text { Va, M, \& B } \end{gathered}$ | IV |
| Total full-time faculty (Standard error) ${ }^{1}$ | 1781 | 1035 | 2714 | 2225 | 299 | $\begin{array}{r} 8054 \\ (64) \end{array}$ | $\begin{array}{r} 4491 \\ (58) \end{array}$ | $\begin{aligned} & 8925 \\ & (284) \end{aligned}$ | $\begin{array}{r} 21470 \\ (292) \end{array}$ | $\begin{array}{r} 1691 \\ (33) \end{array}$ |
| Doctoral full-time faculty | 1705 | 1028 | 2393 | 1875 | 284 | 7285 | 3556 | 6790 | 17631 | 1618 |
| Tenured | 1107 | 566 | 1589 | 1264 | 168 | 4693 | 2475 | 4504 | 11672 | 851 |
| Untenured, tenure-track | 175 | 91 | 332 | 366 | 52 | 1016 | 849 | 1923 | 3789 | 390 |
| Postdoctoral appointments | 221 | 271 | 235 | 45 | 35 | 807 | 12 | 14 | 833 | 102 |
| Other non-tenure-track | 202 | 100 | 237 | 200 | 29 | 769 | 219 | 349 | 1337 | 276 |
| Nondoctoral full-time faculty (Standard error) ${ }^{1}$ | 76 | 7 | 322 | 350 | 15 | $\begin{aligned} & 769 \\ & (24) \end{aligned}$ | $\begin{aligned} & 935 \\ & \text { (29) } \end{aligned}$ | $\begin{aligned} & 2135 \\ & (142) \end{aligned}$ | $\begin{aligned} & 3839 \\ & (146) \end{aligned}$ | $\begin{aligned} & 73 \\ & \text { (5) } \end{aligned}$ |
| Total part-time faculty (Standard error) | 196 | 30 | 373 | 525 | 19 | $\begin{array}{r} 1143 \\ (27) \\ \hline \end{array}$ | $\begin{array}{r} 1868 \\ (71) \end{array}$ | $\begin{aligned} & 4053 \\ & (407) \end{aligned}$ | $\begin{aligned} & 7065 \\ & (410) \end{aligned}$ | $\begin{aligned} & 149 \\ & (14) \end{aligned}$ |

1 See 'Remarks on Statistical Procedures' page 1276.
females comprise $27 \%$ of the full-time faculty in both 2006-2007 and 2007-2008. In Group B the estimated number of doctoral female faculty decreased from 1,903 last year to 1,863 this year, tenured female faculty decreased from 1,158 to 1,123, untenured but tenure-track female faculty increased from 610 to 620, and non-tenure-track doctoral female faculty (including postdoctoral appointments) decreased from 135 to 119. In Group M the doctoral full-time female faculty increased from 916 last year to 925 this year.

Table 1C compares the number of full-time and female full-time faculty that fall into each reporting group for fall 2007. The percentage who are female in each group is given in the bottom row of Table 1C. These percentages vary considerably among the groups, from a low of $13 \%$ for Group I Private to a high of $32 \%$ for Groups M and B.

Table 1D contains information about the percentage of female faculty among the tenured/ tenure-track and non-tenure-track doctoral fulltime faculty and among the part-time faculty for the years 2000 to 2007.

Table 1E gives the male/female breakdown by count and percentage for Groups I, II, III, and Va combined, Groups M and B combined, and Group IV for various categories of faculty. It shows that the percentage of women is generally higher in statistics (Group IV) than in the doctoral mathematics groups (Groups I, II, III, and Va combined) and that the percentage of tenured faculty who are women is highest in Groups M and B combined.

Table 1F shows that of the 3,839 nondoctoral full-time faculty in Groups I, II, III, Va, M, and B combined, 2,001 (52\%) are females. From Table 1 G we see that in these same groups there are 7,065 part-time faculty, of which $2,872(41 \%)$ are females.

## Faculty Recruitment

Table 2A contains detailed information on the number of full-time doctoral faculty positions under recruitment during 2006-2007 for employment beginning in the academic year 2007-2008. Among mathematics departments (Groups I, II, III, Va, M, and B), 1,786 positions were under recruitment, down $1 \%$ compared to those under recruitment during 2005-2006. Of those 1,786 positions, 1,564 ( $88 \%$ ) were available to new doctoral recipients, and of those 1,564 positions, $935(60 \%)$ were tenured/ tenure-track positions. The 935 tenured/tenuretrack positions open to new doctoral recipients is down $13 \%$ from the 1,073 such positions under recruitment in 2005-2006 primarily reflecting declines in Groups M and B. The total number of tenured/tenure-track full-time doctoral positions under recruitment in Groups I, II, III, Va, M, and B combined is 1,131 , down from last year's 1,231 (a decrease of $8 \%$ ). In Groups I, II, III, and Va combined, the total number of posted doctoral positions open at the associate/full level increased from 93 last year to 126 this year.

Table 2B condenses the information in Table 2A. It also reorganizes the doctoral hires into one section for new doctoral hires and another for other doctoral hires (so excludes posted doctoral positions that were temporarily filled with a person without a doctorate). Table 2C is derived from Table 2B, with the percentage of the filled positions that were tenured/tenure-track included in the table.

This year the estimated total number of new doctoral hires in mathematics departments is down $10 \%$ (to 634 from 701) from last year; it is up $10 \%$ (to 298 from 271) in Groups I, II, III, and Va combined, and down $22 \%$ (to 335 from 430) in Groups M and B combined. The number of new doctoral tenure-track hires in the math groups combined is down $22 \%$ as a result of a decrease

Table 1B: Female Faculty, Fall 2007

|  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $\underset{\text { Public }}{1}$ | $\underset{\text { Private }}{\text { I }}$ | II | III | Va | $\begin{gathered} \mathrm{I}, \mathrm{II}, \mathrm{III}, \\ \& \mathrm{Va} \end{gathered}$ | M | B | $\begin{gathered} \mathrm{I}, \mathrm{II}, \mathrm{III}, \\ \mathrm{Va}, \mathrm{M}, \& \mathrm{~B} \end{gathered}$ | IV |
| Female full-time faculty (Standard error) | 246 | 139 | 590 | 546 | 48 | $\begin{array}{r} 1569 \\ (24) \end{array}$ | $\begin{array}{r} 1428 \\ (25) \end{array}$ | $\begin{gathered} 2895 \\ (232) \end{gathered}$ | $\begin{gathered} 5891 \\ (233) \end{gathered}$ | $\begin{aligned} & 485 \\ & \text { (13) } \end{aligned}$ |
| Doctoral full-time faculty | 204 | 136 | 379 | 343 | 39 | 1101 | 925 | 1863 | 3890 | 452 |
| Tenured | 78 | 37 | 152 | 180 | 16 | 462 | 544 | 1123 | 2129 | 167 |
| Untenured, tenure-track | 41 | 17 | 81 | 94 | 8 | 241 | 293 | 620 | 1154 | 147 |
| Postdoctoral appointments | 38 | 51 | 46 | 11 | 5 | 152 | 4 | 2 | 158 | 29 |
| Other non-tenure-track | 47 | 31 | 100 | 59 | 9 | 246 | 86 | 117 | 449 | 108 |
| Nondoctoral full-time faculty | 42 | 3 | 211 | 203 | 9 | 468 | 502 | 1031 | 2001 | 33 |
| Female part-time faculty | 63 | 3 | 142 | 208 | 3 | 418 | 720 | 1734 | 2872 | 59 |

Table 1C: Full-Time Faculty, Fall 2007

|  | GROUP |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $\begin{gathered} \text { I } \\ \text { Public } \end{gathered}$ | $\begin{gathered} 1 \\ \text { Private } \end{gathered}$ | II | III | Va | M | B | IV | TOTAL |
| Full-time faculty | 1781 | 1035 | 2714 | 2225 | 299 | 4491 | 8925 | 1691 | 23161 |
| Percentage of total full-time faculty | 8\% | 4\% | 12\% | 10\% | 1\% | 19\% | 39\% | 7\% | 100\% |
| Female full-time faculty | 246 | 139 | 590 | 546 | 48 | 1428 | 2895 | 485 | 6376 |
| Percentage of total female full-time faculty | 4\% | 2\% | 9\% | 9\% | 1\% | 22\% | 45\% | 8\% | 100\% |
| Percentage of total female faculty within group | 14\% | 13\% | 22\% | 25\% | 16\% | 32\% | 32\% | 29\% | 28\% |

Table 1D: Mathematics Faculty Counts and Percentage Female, Fall 2000-2007

|  | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Groups I, II, III, \& Va |  |  |  |  |  |  |  |  |
| Doctoral full-time faculty |  |  |  |  |  |  |  |  |
| Tenured/tenure-track | 5568 | 5598 | 5616 | 5559 | 5604 | 5686 | 5668 | 5709 |
| Percentage female | 9\% | 10\% | 10\% | 10\% | 11\% | 11\% | 12\% | 12\% |
| Non-tenure-track | 993 | 1233 | 1274 | 1343 | 1314 | 1401 | 1461 | 1576 |
| Percentage female | 21\% | 21\% | 23\% | 25\% | 25\% | 24\% | 25\% | 25\% |
| Part-time faculty | 1399 | 1467 | 1504 | 1389 | 1355 | 1054 | 1128 | 1143 |
| Percentage female | 37\% | 38\% | 35\% | 35\% | 37\% | 37\% | 40\% | 37\% |
| Group M |  |  |  |  |  |  |  |  |
| Doctoral full-time faculty |  |  |  |  |  |  |  |  |
| Tenured/tenure-track | 3670 | 3191 | 3188 | 3005 | 3113 | 3351 | 3400 | 3325 |
| Percentage female | 21\% | 23\% | 22\% | 22\% | 23\% | 24\% | 25\% | 25\% |
| Non-tenure-track | 262 | 183 | 276 | 230 | 277 | 263 | 283 | 232 |
| Percentage female | 29\% | 24\% | 39\% | 33\% | 48\% | 36\% | 28\% | 38\% |
| Part-time faculty | 1906 | 2323 | 2393 | 1952 | 1888 | 1842 | 1493 | 1868 |
| Percentage female | 35\% | 36\% | 37\% | 37\% | 37\% | 37\% | 41\% | 39\% |
| Group B |  |  |  |  |  |  |  |  |
| Doctoral full-time faculty |  |  |  |  |  |  |  |  |
| Tenured/tenure-track | 5486 | 5665 | 5569 | 6172 | 5770 | 6875 | 6623 | 6427 |
| Percentage female | 22\% | 24\% | 23\% | 26\% | 25\% | 25\% | 27\% | 27\% |
| Non-tenure-track | 407 | 504 | 507 | 460 | 472 | 516 | 545 | 363 |
| Percentage female | 30\% | 29\% | 36\% | 20\% | 29\% | 32\% | 25\% | 33\% |
| Part-time faculty | 3580 | 4197 | 4117 | 3997 | 4846 | 3630 | 3922 | 4053 |
| Percentage female | 40\% | 43\% | 45\% | 42\% | 44\% | 41\% | 40\% | 43\% |

Table 1E: Summary of Full-Time and Part-Time Faculty, Fall 2007
in Groups M \& B combined (down to 283 from 362). Among the new doctoral hires in Groups I, II, III, and Va combined, $13 \%$ of all males and $24 \%$ of all females took tenuretrack positions. In contrast, for new doctoral hires in Groups M and B combined, $81 \%$ of all males and $88 \%$ of all females took tenuretrack positions. From Table 2C we see that in Groups I, II, III, and Va $16 \%$ of the hires of new doctoral recipients are in tenured/tenuretrack positions (the same as last year), while in Groups M and B $84 \%$ of the new doctoral hires are in tenured/tenure-track positions (the same as last year).

From Table 2B we find that the total number of full-time doctoral positions filled in mathematics departments (Groups I, II, III, Va, M , and B combined) is 1,385 down from 1,435 last year (a decrease of 4\%); it is up 14\% in Groups I, II, III, and Va combined and down $16 \%$ in Groups M and B combined. This year Groups I, II, III, and Va combined filled 663 doctoral positions, of which 268 ( $40 \%$ ) were tenured/tenure-track positions. Last year these same groups filled 581 doctoral positions, of which $230(40 \%)$ were tenured/tenuretrack. Groups M and B combined filled 722 doctoral positions this year, and 543 (75\%) of these were tenured/tenure-track positions. Last year these two groups filled 854 doctoral positions, of which 613 ( $72 \%$ ) were tenured/tenure-track.

Beginning with the 2004 Annual Survey, departments were asked to report the number of doctoral hires into tenured/tenure-track positions filled by individuals who held a non-tenure-track position the previous year and of those, how many were in postdoctoral appointments. For Groups I, II, III, and Va combined, 164 individuals reported having held a non-tenure-track position the previous year ( $61 \%$ of the 268 tenure-track hires), with 115 (43\%) having held a postdoctoral appointment the previous year. This compares with last year's figure of 121 (53\%) positions filled by individuals who held a postdoctoral appointment the previous year. For Groups M and B combined, 211 individuals ( $39 \%$ of the 543 tenure-track hires) reported having held a non-tenure-track position the previous year, with 67 (12\%) having held a postdoctoral appointment the previous year. This compares with last year's figure of $137(22 \%)$ positions filled by individuals

|  | GROUP |  |  |  |  |  |  |  |  |  |  |
| :--- | ---: | ---: | ---: | ---: | ---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | I, II, III, \& Va |  |  |  |  |  |  | M \& B |  | IV |  |
|  | Male | Female | Male | Female | Male | Female |  |  |  |  |  |
|  | 6485 | 1569 | 9094 | 4322 | 1206 | 485 |  |  |  |  |  |
| Percentage | $81 \%$ | $19 \%$ | $68 \%$ | $32 \%$ | $71 \%$ | $29 \%$ |  |  |  |  |  |
| Doctoral full-time faculty | 6184 | 1101 | 7557 | 2789 | 1167 | 452 |  |  |  |  |  |
| Percentage | $85 \%$ | $15 \%$ | $73 \%$ | $27 \%$ | $72 \%$ | $28 \%$ |  |  |  |  |  |
| Tenured | 4231 | 462 | 5312 | 1667 | 684 | 167 |  |  |  |  |  |
| Percentage | $90 \%$ | $10 \%$ | $76 \%$ | $24 \%$ | $80 \%$ | $20 \%$ |  |  |  |  |  |
| Untenured, tenure-track | 775 | 241 | 1860 | 913 | 243 | 147 |  |  |  |  |  |
| Percentage | $76 \%$ | $24 \%$ | $67 \%$ | $33 \%$ | $62 \%$ | $38 \%$ |  |  |  |  |  |
| Postdoctoral appointments | 655 | 152 | 20 | 6 | 73 | 29 |  |  |  |  |  |
| Percentage | $81 \%$ | $19 \%$ | $78 \%$ | $22 \%$ | $71 \%$ | $29 \%$ |  |  |  |  |  |
| Other non-tenure-track | 523 | 246 | 365 | 203 | 167 | 108 |  |  |  |  |  |
| Percentage | $68 \%$ | $32 \%$ | $64 \%$ | $36 \%$ | $61 \%$ | $39 \%$ |  |  |  |  |  |
| Nondoctoral full-time faculty | 301 | 468 | 1537 | 1533 | 39 | 33 |  |  |  |  |  |
| Percentage | $39 \%$ | $61 \%$ | $50 \%$ | $50 \%$ | $54 \%$ | $46 \%$ |  |  |  |  |  |
| Part-time faculty | 725 | 418 | 3467 | 2454 | 90 | 59 |  |  |  |  |  |
| Percentage | $63 \%$ | $37 \%$ | $59 \%$ | $41 \%$ | $60 \%$ | $40 \%$ |  |  |  |  |  |

Table 1F: Nondoctoral Full-Time Faculty, Fall 2007

| Full-time Faculty | GROUP |  |  |  |  |  |  |  |
| :--- | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
|  | I, II, III, \& Va |  | M \& B |  | TOTAL |  | IV |  |
|  | Male | Female | Male | Female | Male | Female | Male | Female |
| Without a Doctorate | 301 | 468 | 1537 | 1533 | 1838 | 2001 | 39 | 33 |
| Tenured | 14 | 7 | 554 | 260 | 568 | 267 | 1 | 0 |
| Untenured, tenure-track | 3 | 1 | 139 | 136 | 142 | 137 | 2 | 1 |
| Postdoctoral appointments | 1 | 3 | 5 | 0 | 6 | 3 | 0 | 0 |
| Other non-tenure-track | 283 | 456 | 839 | 1137 | 1122 | 1593 | 36 | 32 |

Table 1G: Part-Time Faculty, Fall 2007

|  | GROUP |  |  |  |  |  |  |
| :--- | :--- | :---: | :---: | ---: | ---: | ---: | ---: |
|  | I, III, III, \& Va | M \& B |  |  | IV |  |  |
|  | Male | Female | Male | Female | TOTAL | Male | Female |
|  | 337 | 105 | 1015 | 545 | 2002 | 79 | 37 |
|  | 388 | 313 | 2452 | 1909 | 5063 | 11 | 22 |
|  | 725 | 418 | 3467 | 2454 | 7065 | 90 | 59 |

who held a postdoctoral appointment the previous year.

The estimated number of not-new doctoral hires in mathematics departments is 750, up from 734 last year. The total of not-new doctoral hires into tenured/tenure-track positions in all the mathematics groups combined is 479, up 10\% from last year. It is up 19\% in Groups I, II, III, and Va combined (to 220 from 185 last year), and up 3\% in Groups M and B combined (259 from 251).

Figure 1 shows the number of full-time doctoral positions posted for all groups combined except Group IV, as well as the number of those that were tenured/tenure-track for the years 1995 to 2007.

Table 2A: Recruitment of Faculty with a Doctorate, Fall 2007

|  | GROUP |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $\underset{\text { Public }}{\text { I }}$ | I <br> Private | II | III | Va | $\mathrm{I}, \mathrm{II}, \mathrm{III},$ $\& \mathrm{Va}$ | M | B | $\begin{gathered} \text { I, II, III, } \\ \text { Va, M, \& B } \end{gathered}$ | IV |
| Posted Doctoral Positions |  |  |  |  |  |  |  |  |  |  |
| Total number ${ }^{1}$ | 203 | 113 | 251 | 169 | 25 | 762 | 279 | 745 | 1786 | 160 |
| (Standard error) |  |  |  |  |  | (34) | (24) | (81) | (85) | (18) |
| Tenured/tenure-track | 80 | 31 | 107 | 124 | 19 | 360 | 245 | 526 | 1131 | 130 |
| Open to new doctoral recipients | 142 | 84 | 212 | 147 | 21 | 607 | 245 | 712 | 1564 | 102 |
| Tenured/tenure-track | 30 | 8 | 79 | 107 | 16 | 240 | 210 | 485 | 935 | 95 |
| Open at assoc/full level | 30 | 19 | 27 | 46 | 4 | 126 | 28 | 53 | 207 | 50 |
| Reported Hires for Above |  |  |  |  |  |  |  |  |  |  |
| Total number | 184 | 102 | 227 | 138 | 19 | 669 | 220 | 597 | 1487 | 109 |
| Male doctoral hires | 159 | 73 | 178 | 102 | 16 | 527 | 138 | 317 | 982 | 64 |
| Tenured/tenure-track | 51 | 12 | 64 | 66 | 13 | 207 | 119 | 210 | 536 | 58 |
| Female doctoral hires | 25 | 29 | 45 | 34 | 3 | 135 | 64 | 203 | 402 | 43 |
| Tenured/tenure-track | 9 | 4 | 20 | 27 | 0 | 61 | 56 | 157 | 274 | 27 |
| Male temporary hires | 0 | 0 | 3 | 1 | 0 | 4 | 17 | 43 | 64 | 0 |
| Female temporary hires | 0 | 0 | 1 | 1 | 0 | 3 | 2 | 35 | 39 | 2 |
| Total new doctoral hires | 82 | 67 | 102 | 40 | 7 | 298 | 63 | 272 | 634 | 37 |
| Male new doctoral hires | 61 | 50 | 83 | 26 | 4 | 224 | 37 | 149 | 410 | 19 |
| Tenured/tenure-track | 4 | 0 | 10 | 14 | 1 | 29 | 29 | 122 | 180 | 19 |
| Female new doctoral hires | 21 | 17 | 19 | 14 | 3 | 74 | 27 | 123 | 224 | 17 |
| Tenured/tenure-track | 3 | 0 | 4 | 12 | 0 | 18 | 27 | 105 | 151 | 15 |
| Unfilled positions | 18 | 12 | 25 | 31 | 7 | 92 | 59 | 147 | 299 | 52 |

${ }^{1}$ Number of full-time doctoral positions under recruitment in 2006-2007 to be filled for 2007-2008.

Table 2B: A Summary of Recruitment of Faculty with a Doctorate, Fall 2007

|  | GROUP |  |  |
| :--- | :---: | :---: | :---: |
|  | I, II, III, \& Va | M \& B | IV |
| Posted Doctoral Positions |  |  |  |
| Total number | 762 | 1024 | 160 |
| Tenured/tenure-track | 360 | 771 | 130 |
| Open to new doctoral recipients | 607 | 957 | 102 |
| Tenured/tenure-track | 240 | 695 | 95 |
| Reported Hires for Above, |  |  |  |
| excluding temporary hires |  |  |  |
| Total doctoral hires | 663 | 722 | 107 |
| Tenured/tenure-track | 268 | 543 | 85 |
| Previously in non-tenure-track | 164 | 211 | 25 |
| Previously in postdoc | 115 | 67 | 10 |
| Total new doctoral hires 1 | 298 | 335 | 37 |
| Tenured/tenure-track | 48 | 283 | 35 |
| Male | 224 | 186 | 19 |
| Tenured/tenure-track | 29 | 151 | 19 |
| Female | 74 | 150 | 17 |
| Tenured/tenure-track | 18 | 132 | 15 |
| Total not-new doctoral hires | 364 | 386 | 70 |
| Tenured/tenure-track | 220 | 259 | 50 |
| Male | 304 | 269 | 45 |
| Tenured/tenure-track | 178 | 178 | 39 |
| Female | 61 | 117 | 25 |
| Tenured/tenure-track | 42 | 81 | 12 |

[^9]The number of positions posted and the number of available tenured/tenure-track positions steadily increased, reaching a maximum in 2001. These numbers declined for the next two years, then
increased in 2004 and again in 2006. This year both the number of positions posted and the number of tenured/tenure-track positions posted have decreased slightly from last year.

Figure 1A shows the number of full-time doctoral positions filled for all groups combined except Group IV, as well as the number of tenured/tenuretrack for the years 2001 to 2007. Since 2004 the number of tenured/tenure-track positions filled has remained relatively stable, while the number of other positions filled shows more variability across these years.

## Faculty Attrition

Table 3 displays losses of full-time mathematical sciences faculty due to retirements and deaths between 1 September 2006 and 31 August 2007 for each departmental grouping. The fall 2007 faculty attrition rate for Groups I, II, III, Va, M, and B combined is $2.5 \%$, and it is $1.7 \%$ for Group IV. For fall 2007, Group I (Pri) had the lowest attrition rate at $0.4 \%$, while Group B had the highest at $3.3 \%$.

Figure 2 shows the trends in these attrition rates between 1994 and 2007. While the rates vary from group to group and from year to year within each group, for most of the 1990s the dominant tend was one of increasing attrition for all groups combined. In the late 1990s attrition leveled off then began dropping in 2003; it reached a low in 2006 and has increased slightly for 2007.

Figure 1: Number of Full-Time Doctoral Positions under Recruitment Groups I, II, III, Va, M, \& B Combined, Fall 1995 to Fall 2007
-Tenured/Tenure-Track Posted -Other Full-Time Posted


Figure 1A. Number of Full-Time Doctoral Positions Filled
Groups I, II, III, Va, M, \& B Combined, Fall 2001 to Fall 2007


Table 2C: Positions Posted and Filled, Fall 2007

| Positions | GROUP |  |  |
| :--- | :---: | :---: | :---: |
|  | I, II, III, \& Va | M \& B | IV |
| Posted positions opened to |  |  |  |
| new doctoral recipients |  |  |  |
| tenured/tenure-track | $40 \%$ | 957 | 102 |
| Positions filled by |  |  |  |
| new doctoral recipients | 298 | $73 \%$ | $92 \%$ |
| \% tenured/tenure-track |  |  |  |

${ }^{1}$ Not-new doctoral recipients are individuals who have held their doctorate for more than one year.

## Enrollment Profile and Degrees Awarded Profile

The Departmental Profile Survey obtained information about course enrollments and numbers of undergraduate degrees awarded in mathematical sciences departments. Tables 4A and 4B give the total undergraduate and total graduate enrollments in mathematics courses in fall 2007 for each group. The estimated total undergraduate enrollment in fall 2007 for all groups combined is $2,228,000$. Table 4A gives these totals for fall 2002 to fall 2007. Total undergraduate enrollments for all groups combined is up $3 \%$ from last year; Group M is the only group showing a decline (4\%).

Table 4B gives total graduate enrollments for fall 2002 to fall 2007. Total graduate course enrollments for all groups combined is up 9\% from last year; the total is up for Group I Pu, III, Va, and IV, and down 6\% in Group M.

The historical data on enrollment numbers presented in Tables 4A and 4B for fall 2002 to fall 2007 suggest a trend of gradually increasing undergraduate and graduate enrollments.

Table 4C gives the undergraduate enrollments per faculty member and the graduate enrollments per faculty member for each group. Table 4D gives the undergraduate

Table 3: Faculty Deaths \& Retirements, ${ }^{1}$ Fall 2007

|  | GROUP |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $\begin{gathered} \text { I } \\ \text { Public } \end{gathered}$ | $\underset{\text { Private }}{\text { I }}$ | II | III | Va | $\begin{gathered} \mathrm{I}, \mathrm{II}, \mathrm{III}, \\ \& \& \mathrm{Va} \end{gathered}$ | M | B | $\begin{gathered} \text { I, II, III, } \\ \text { Va, M, \& B } \end{gathered}$ | IV |
| Full-time faculty who retired or died <br> Total number <br> (Standard error) <br> Percentage | 39 $2.2 \%$ | 4 $0.4 \%$ | 46 $1.7 \%$ | 52 $2.3 \%$ | 7 $2.2 \%$ | $\begin{gathered} 149 \\ (9) \\ 1.8 \% \end{gathered}$ | $\begin{gathered} 98 \\ (10) \\ 2.2 \% \end{gathered}$ | $\begin{aligned} & 292 \\ & (45) \\ & 3.3 \% \end{aligned}$ | $\begin{aligned} & 539 \\ & (46) \\ & 2.5 \% \end{aligned}$ | $\begin{aligned} & 29 \\ & \text { (6) } \\ & 1.7 \% \end{aligned}$ |

1 Number and percentage of full-time faculty who were in the department in fall 2006 but were reported to have retired or died by fall 2007.

Figure 2: Faculty Retired/Died

enrollments per faculty member in each group for fall 2002 to fall 2007 and shows a slightly downward trend over the period shown, with the exceptions of Groups Va and B

For a comprehensive survey of undergraduate courses, please refer to the report of the 2005 CBMS survey. This publication is available from the AMS website at www.ams.org/cbms/.

## Undergraduate and Master's Degrees

Tables 5A and 5C display the (estimated) number of undergraduate and master's degrees reported for 2006-2007 for each departmental group. Table 5B shows the total undergraduate degrees awarded for the period 2002-2003 through 2006-2007. (These data were not collected prior to 2002.) The number of undergraduate degrees awarded has dropped from 24,638 in 2006 to 23,930 in 2007. Table 5D shows the total number of master's degrees awarded for the period 2003-2004 through 2006-2007. (These data were not collected prior to 2004.) The number of master's degrees awarded in mathematics increased from 4,267 reported in 2006 to 4,291 reported in 2007.

The reader should be aware that at least 44 of the 189 departments in the 2007 Group M population and at least 274 of the 1,037 departments in the 2007 Group B population also offer a computer science program in addition to their offerings in
mathematics. In some instances, these computer programs account for a significant fraction of the department's undergraduate degrees. This year's estimated 23,930 undergraduate degrees awarded includes 445 in statistics and 2,297 in computer science. (The report of the 2005 CBMS survey provides a more comprehensive study of departmental bachelor's degrees.) Of the 4,291 master's degrees awarded, 408 were in statistics, and 374 were in computer science.

## Graduate Student Profile

Table 6A summarizes information gathered by the 2007 Departmental Profile survey about graduate students enrolled in fall 2007. This table gives the number of full-time, full-time first-year, and part-time graduate students for each type of graduate department. These same numbers are also given for female graduate students and for U.S. citizen graduate students.

The estimated total number of graduate students in all mathematics groups combined increased from 13,794 in 2006 to 14,148 in 2007, and the total number of full-time graduate students in Groups I, II, III, and Va combined decreased from 10,984 in 2006 to 10,937 in 2007. The number of U.S. citizen full-time graduate students in Groups I, II, III, and Va combined increased less than $1 \%$ to 6,142 . The number of first-year full-time students in Groups I, II, III, and Va combined increased from 2,960 last year to 2,964 this year (both the number of first-year U.S. citizens and the number of first-year non-U.S. citizens were up). The number of female full-time graduate students in Groups I, II, III, and Va combined decreased from 3,279 to 3,249 .

In Group IV the number of full-time graduate students decreased by $8 \%$ to 4,187 and the number of U.S. citizen full-time graduate students decreased by $4 \%$ to 1,656 . The first-year full-time graduate students in Group IV decreased by 171 to 1,271 and the number of first-year full-time U.S. citizens was down from 628 to 560 . The number of female full-time graduate students in Group IV decreased from 2,127 to 2,020, an 5\% decrease.

The percentage of full-time graduate students who are U.S. citizens in the mathematics groups combined is $60 \%$ while the percentage of full-time graduate students who are U.S. citizens in Group IV is $40 \%$; the percentage of women is $31 \%$ in mathematics groups combined and $48 \%$ in Group

Table 4A: Total Undergraduate Course Enrollments (thousands)

| Fall | GROUP |  |  |  |  |  |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | I <br> Public | I <br> Private | II | III | Va | M | B | IV | Total |  |
|  | 187 | 41 | 275 | 250 | 16 | 507 | 774 | 76 | 2125 |  |
| 2003 | 185 | 41 | 283 | 255 | 17 | 498 | 774 | 72 | 2125 |  |
| 2004 | 159 | 42 | 277 | 261 | 16 | 492 | 782 | 72 | 2101 |  |
| 2005 | 177 | 43 | 273 | 249 | 12 | 509 | 872 | 70 | 2205 |  |
| 2006 | 172 | 43 | 290 | 251 | 15 | 496 | 826 | 77 | 2170 |  |
| 2007 | 172 | 43 | 297 | 253 | 17 | 474 | 896 | 78 | 2228 |  |
| (Standard error) | (0) | (0) | (7) | (4) | (2) | (8) | (49) | (3) | (50) |  |

${ }^{1}$ Standard errors reported as zero reflect rounding of values that are less than 500.
Table 4B: Total Graduate Course Enrollments (thousands)

| Fall | GROUP |  |  |  |  |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | I <br> Public | I <br> Private | II | III | Va | M | IV | Total |  |
|  | 10 | 4 | 11 | 10 | 3 | 12 | 29 | 79 |  |
| 2003 | 10 | 5 | 11 | 11 | 2 | 16 | 31 | 87 |  |
| 2004 | 9 | 4 | 12 | 10 | 2 | 12 | 31 | 81 |  |
| 2005 | 10 | 4 | 13 | 9 | 2 | 16 | 29 | 84 |  |
| 2006 | 9 | 4 | 13 | 10 | 2 | 15 | 29 | 82 |  |
| 2007 |  |  |  |  |  |  |  |  |  |
| (Standard error) | 10 | $(0)$ | 4 | 13 | 12 | 3 | 14 | 32 |  |
| (0) | $(0)$ | $(0)$ | $(0)$ | $(0)$ | $(1)$ | $(1)$ |  |  |  |

[^10]Table 4C: Undergraduate and Graduate Enrollments per Full-Time Faculty Member, Fall 2007

|  | GROUP |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Fall | $\underset{\text { Public }}{1}$ | $\underset{\text { Private }}{\text { I }}$ | II | III | Va | M | B | IV |
| Undergraduate Course Enrollments Number per full-time faculty member | 96 | 42 | 109 | 114 | 56 | 105 | 100 | 46 |
| Graduate Course Enrollments Number per full-time faculty member | 6 | 4 | 5 | 5 | 10 | 3 | - | 19 |

Table 4D: Undergraduate Enrollments per Full-Time Faculty Member

| Fall | GROUP |  |  |  |  |  |  |  |
| :---: | ---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | I <br> Public | I <br> Private | II | III | Va | M | B | IV |
|  | 107 | 43 | 114 | 121 | 50 | 117 | 95 | 55 |
| 2003 | 104 | 42 | 113 | 121 | 46 | 121 | 89 | 46 |
| 2004 | 90 | 44 | 113 | 126 | 49 | 120 | 89 | 49 |
| 2005 | 96 | 44 | 108 | 116 | 43 | 113 | 91 | 43 |
| 2006 | 98 | 43 | 105 | 113 | 56 | 106 | 82 | 45 |
| 2007 | 96 | 42 | 109 | 114 | 56 | 105 | 100 | 46 |

Table 5A: Undergraduate Degrees Awarded, Fall 2007

|  | GROUP |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $\underset{\text { Public }}{\text { I }}$ | $\begin{gathered} \mathrm{I} \\ \text { Private } \end{gathered}$ | II | III | Va | M | B | $\begin{gathered} \text { I, II, III, } \\ \text { Va, M, \& B } \end{gathered}$ | IV |
| Total Undergraduate Degrees Awarded | 2203 | 989 | 2280 | 1785 | 333 | 4673 | 11666 | 23930 | 508 |
| (Standard error) | (0) | (44) | (69) | (33) | (62) | (158) | (690) | (716) | (43) |
| Statistics only | 37 | 15 | 66 | 125 | 3 | 118 | 82 | 445 | 312 |
| Computer science only | 32 | 13 | 0 | 105 | 0 | 150 | 1996 | 2297 | 4 |
| Female Undergraduate |  |  |  |  |  |  |  |  |  |
| Degrees Awarded | 623 | 270 | 838 | 740 | 111 | 2023 | 4706 | 9310 | 212 |
| Statistics only | 13 | 7 | 34 | 55 | 0 | 52 | 31 | 192 | 133 |
| Computer science only | 6 | 5 | 0 | 10 | 0 | 145 | 264 | 431 | 0 |

Table 5B: Undergraduate Degrees Awarded Groups I, II, III, Va, M \& B Combined

| Fall | 2003 | 2004 | 2005 | $2006^{1}$ | 2007 |
| :--- | ---: | ---: | ---: | ---: | ---: |
| Total Undergraduate <br> Degrees Awarded | 22017 | 24395 | 23432 | 24638 | 23930 |
| Female Undergraduate <br> Degrees Awarded <br> Percentage female | ( 9047 | 10223 | 9264 | 9964 | 9310 |

1 Numbers in this column reflect corrections of those previously reported. For further information visit at http://www.ams.org/employment/surveyreports.html
IV. The number of full-time graduate students in Group M increased from 2,810 to 3,211.

The (estimated) number of part-time graduate students in Groups I, II, III, and Va decreased 10\% to 1,713 this year, and in Group IV increased $18 \%$ to 917 . Group III has 857 (50\%) of the part-time graduate students in the doctoral mathematics groups. In the doctoral mathematics groups, 36\% of the part-time graduate students are females and $78 \%$ are U.S. citizens, and in Group IV 53\% of the part-time graduate students are females and $56 \%$ are U.S. citizens. The number of Group M part-time graduate students increased from 2,412 to 2,467. For Group M, $48 \%$ of the part-time graduate students are females and $84 \%$ are U.S. citizens.

Table 6B gives the total number of full-time and full-time first-year graduate students in Groups I, II, III, and Va combined, and the percentages of women and of U.S. citizens for fall 1998 through fall 2007 and the percentage of underrepresented minorities in each category for fall 2003 through fall 2007. From these data we can see that the total number of full-time graduate students in the doctoral mathematics groups had been generally increasing since 1999 reaching a high in 2006, while this year's enrollment has decreased slightly to 10,937 . Similarly, the number of fulltime graduate students who are U.S. citizens has been increasing since 2002 and remains stable this year at $56 \%$. The number of first-year full-time graduate students who are U.S. citizens had been increasing until 2004 when it reached $60 \%$; after dropping slightly the next two years it remains relatively stable at $56 \%$ this year. The percentage of females among full-time graduate students in the combined mathematics groups has remained relatively stable over the 10 -year period shown.

## Previous Annual Survey Reports

The 2007 Annual Survey First Preliminary, First Report, Part II, and Second Reports were published in the Notices of the AMS in the February, March, and August 2008 issues respectively. The previous version of this report, the 2006 Annual Survey

Table 5C: Masters Degrees Awarded, Fall 2007

|  | GROUP |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | I Public | I <br> Private | II | III | Va | M | I, II, III, Va \& M | IV |
| Total Master's |  |  |  |  |  |  |  |  |
| Degrees Awarded | 432 | 228 | 768 | 741 | 236 | 1886 | 4291 | 1427 |
| (Standard error) | (0) | (32) | (29) | (18) | (31) | (105) | (119) | (78) |
| Statistics only | 40 | 0 | 42 | 128 | 0 | 197 | 408 | 984 |
| Computer science only | 8 | 0 | 0 | 83 | 0 | 284 | 374 | 2 |
| Female Master's |  |  |  |  |  |  |  |  |
| Degrees Awarded | 123 | 61 | 287 | 313 | 65 | 867 | 1717 | 698 |
| Statistics only | 21 | 0 | 23 | 59 | 0 | 77 | 180 | 464 |
| Computer science only | 3 | 0 | 0 | 21 | 0 | 143 | 167 | 0 |

Table 5D: Master's Degrees Awarded Groups I, II, III, Va \& M Combined

| Fall | 2004 | 2005 | $2006^{1}$ | 2007 |
| :--- | :--- | :--- | :--- | :--- |
| Total Master's <br> Degrees Awarded | 4620 | 4254 | 4267 | 4291 |
| Female Master's <br> Degrees Awarded <br> Percentage female | 2054 <br> $44 \%$ | 1699 <br> $40 \%$ | 1808 <br> $42 \%$ | 1717 |
| $40 \%$ |  |  |  |  |

1 Numbers in this column reflect corrections of those previously reported. For further information visithttp://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 AMS 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.

Third Report was published in the Notices of the $A M S$ in the November 2007 issue. 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.htm7.

Table 6A: Graduate Students, Fall 2007

|  | GROUP |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $\begin{gathered} \text { I } \\ \text { Public } \end{gathered}$ | $\begin{gathered} \text { I } \\ \text { Private } \end{gathered}$ | II | III | Va | $\begin{gathered} \mathrm{I}, \mathrm{II}, \mathrm{III}, \\ \& \mathrm{Va} \end{gathered}$ | M | $\begin{gathered} \mathrm{I}, \mathrm{II}, \mathrm{III}, \\ \mathrm{Va}, \& \mathrm{M} \end{gathered}$ | IV |
| Total Graduate Students Full-time (Standard error) <br> First-year full-time (Standard error) Part-time (Standard error) |  |  |  |  |  |  |  |  |  |
|  | 3027 | 1429 | 3364 | 2438 | 679 | 10937 | 3211 | 14148 | 4187 |
|  |  |  |  |  |  | (95) | (250) | (288) | (108) |
|  | 676 | 436 | 909 | 731 | 211 | 2964 | 1142 | 4106 | 1271 |
|  |  |  |  |  |  | (32) | (63) | (88) | (52) |
|  | 151 | 222 | 392 | 857 | 91 | 1713 | 2467 | 4180 | 917 |
|  |  |  |  |  |  | (44) | (203) | (221) | (77) |
| Female Graduate Students Full-time First-year full-time Part-time |  |  |  |  |  |  |  |  |  |
|  | 719 | 342 | 1071 | 928 | 189 | 3249 | 1205 | 4454 | 2020 |
|  | 181 | 121 | 318 | 276 | 53 | 950 | 438 | 1388 | 609 |
|  | 57 | 42 | 181 | 323 | 21 | 624 | 1179 | 1802 | 482 |
| U.S. Citizen Graduate Students Full-time (Standard error) <br> First-year full-time Part-time (Standard error) |  |  |  |  |  |  |  |  |  |
|  | 1760 | 656 | 2046 | 1347 | 334 | 6142 | 2377 | 8519 | 1656 |
|  |  |  |  |  |  | (67) | (180) | (198) | (49) |
|  | 399 | 171 | 581 | 440 | 113 | 1704 | 842 | 2546 | 560 |
|  | 114 | 122 | 323 | 698 | 75 | 1332 | 2076 | 3408 | 515 |
|  |  |  |  |  |  | (38) | (155) | (168) | (52) |

Table 6B: Full-Time Graduate Students in Groups I, II, III, \& Va by Sex and Citizenship, Fall 1998-2007

|  | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | $2006^{2}$ |
| :--- | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
|  | 2007 |  |  |  |  |  |  |  |  |
| Total full-time graduate students | 8791 | 8838 | 9637 | 9361 | 9972 | 10444 | 10707 | 10565 | 10984 |
| Female | 2770 | 2766 | 3016 | 2899 | 3136 | 3215 | 3245 | 3111 | 3279 |
| \% Female | $32 \%$ | $31 \%$ | $31 \%$ | $31 \%$ | $31 \%$ | $31 \%$ | $30 \%$ | $29 \%$ | $30 \%$ |
| \% U.S. citizen | $55 \%$ | $53 \%$ | $53 \%$ | $49 \%$ | $51 \%$ | $54 \%$ | $55 \%$ | $56 \%$ | $56 \%$ |
| \% Underrepresented minorities 1 |  |  |  |  |  | $56 \%$ |  |  |  |
| Total first-year graduate students | 2458 | 2664 | 2839 | 2875 | 2996 | 2711 | 3004 | 2832 | 2960 |
| Female | 859 | 866 | 879 | 1014 | 1038 | 902 | 983 | 851 | 961 |
| \% Female | $35 \%$ | $33 \%$ | $31 \%$ | $35 \%$ | $35 \%$ | $33 \%$ | $33 \%$ | $30 \%$ | $32 \%$ |
| \% U.S. citizen | $55 \%$ | $53 \%$ | $54 \%$ | $53 \%$ | $55 \%$ | $56 \%$ | $60 \%$ | $59 \%$ | $55 \%$ |
| \% Underrepresented minorities |  |  |  |  |  | $12 \%$ | $9 \%$ | $10 \%$ | $10 \%$ |

[^11]
## Definitions of the Groups

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

The subdivision of the Group I institutions into Group I Public and Group I Private was new for the 1996 survey. With the increase in the number of Group I departments from 39 to 48, the 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 doctoral-granting departments with scores in the 3.00-5.00 range. Group I Public and Group I Private are Group I doctoral-granting departments at public institutions and private institutions respectively.
Group II is composed of 56 doctoral-granting departments with scores in the 2.00-2.99 range.
Group III contains the remaining U.S. doctoral-granting departments, including a number of departments not included in the 1995 ranking of program faculty.
Group IV contains U.S. doctoral-granting departments (or programs) of statistics, biostatistics, and biometrics reporting a doctoral program.
Group V contains U.S. doctoral-granting departments (or programs) of applied mathematics/applied science, operations research, and management science.
Group Va is applied mathematics/applied science doctoralgranting departments; Group Vb, which is no longer surveyed as of 1998-99, was operations research and management science.
Group M or Master's contains U.S. departments granting a master's degree as the highest graduate degree.
Group B or Bachelor's contains U.S. departments granting a baccalaureate degree only.
Listings of the actual departments which comprise these groups
are available on the AMS website atwww. ams.org/outreach.

[^12]
## Remarks on Statistical Procedures

The questionnaire on which this report is based, "Departmental Profile", is sent to every doctoral department and starting with 2006 to every master's department. It is sent to a stratified random sample of Group B departments, the stratifying variable being the undergraduate enrollment at the institution.

The response rates vary substantially across the different department groups. For the doctoral departments it ranges between 60 and 80 percent. For Group M it ranges between 50 and 60 percent. For Group B, the response from the approximately 318 sampled departments drawn from the 1,037 total bachelor's departments typically ranges between 40 and 50 percent. For most of the data collected on the Departmental Profile form, the year-to-year changes in a given department's data are very small when compared to the variations among the departments within a given group. As a result of this, the most recent prior year's response is used for a nonresponding department, provided the response is within three years of the current survey. After the inclusion of prior responses, standard adjustments for the remaining nonresponse are then made to arrive at the estimates reported for the entire groups.

Beginning with the 2007 Annual Survey, standard errors were calculated for some of the key estimates for Groups I, II, III, and Va combined, for Groups M and B, and for Group IV. Standard errors are calculated using the variability in the data and can be used to measure how close our estimate is to the true value for the population. As an example, the number of full-time faculty in Group M is estimated at 4,491, with a standard error of 58. This means the actual number of full-time faculty in Group M is most likely between 4,491 plus or minus two standard errors, or between 4,607 and 4,381 . This is much more informative than simply giving the estimate of 4,491 .

Estimates are also given for parameters that are totals from all groups, such as the total number of full-time faculty. For example, an estimate of the total number of full-time faculty in all groups but group IV is 21,470, with a standard error of 292. Standard errors, when calculated for an estimate, appear in the tables in parentheses underneath the estimate.

# Mathematical Association of America 

A Guide to Complex Variables is the first in a series of MAA Guides written by experts who will provide an overview of a large variety of mathematical topics. Each guide will include key definitions, theorems, and references. They will be useful to students, especially graduate students preparing for qualifying exams and for faculty who have been away from the subject for a number of years. Other volumes in preparation include guides to algebra, number theory and real analysis.

## A Guide to Complex Variables

SERIES: Dolciani | Volume 1, The MAA Guides

Steven G. Krantz

This is a book about complex variables that gives the reader a quick and accessible introduction to the key topics. While the coverage is not comprehensive, it gives the reader a solid grounding in this fundamental area. There are figures and examples to illustrate the principal ideas, and the exposition is lively and inviting.

Most every mathematics Ph.D. student must take a qualifying exam in complex variables. The task is a bit daunting, because the literature is vast and diverse. It is difficult for students to focus on the essential parts of the subject. What must one absolutely know for the qualifying exam? What will be asked? What techniques will be stressed? What are the key facts? The purpose of this Guide is to answer these questions.

Undergraduate students who want to have a first look at this subject will find that this book provides a good place to start. Professional mathematicians will find it a useful resource as well.

## Table of Contents:

1. The Complex Plane: Complex Arithmetic; The Exponential and Applications; Holomorphic Functions; Holomorphic and Harmonic Functions. 2. Complex Line Integrals: Real and Complex Line Integrals; Complex Differentiability and Conformality; The Cauchy Integral Formula and Theorem; The Limitations of the Cauchy Formula. 3. Applications of the Cauchy Theory: The Derivatives of a Holomorphic Function; The Zeros of a Holomorphic Function. 4. Laurent Series: Behavior Near an Isolated Singularity; Expansion around Singular Points; Examples of Laurent Expansions; The Calculus of Residues; Applications to Integrals; Singularities at Infinity. 5. The Argument Principle: Counting Zeros and Poles; The Local Geometry of Holomorphic Functions; Further Results; The Maximum Principle; The Schwarz Lemma. 6. The Geometric Theory: The Idea of a Conformal Mapping; Linear Fractional Transformations; The Riemann Mapping Theorem; Conformal Mappings of Annuli. 7. Harmonic Functions: Basic Properties of Harmonic Functions; The Maximum Principle and the Mean Value Property; The Poisson Integral Formula; Regularity of Harmonic Functions; The Schwarz Reflection Principle; Harnack's Principle; The Dirichlet Problem; The General Solution of the Dirichlet Problem. 8. Infinite Series and Products: Basic Concepts; The Weierstrass Factorization Theorem; Weierstrass and Mittag-Leffler Theorems; Normal Families. 9. Analytic Continuation: Definition of an Analytic Function Element; Analytic Continuation along a Curve; The Monodromy Theorem; The Idea of a Riemann Surface; Picard's Theorems. Glossary of Terms.
www.maa.org

# Mathematics People 

## Szemerédi Awarded Schock Prize

Endre Szemerédi of Rutgers University and the Alfréd Rényi Institute of Mathematics, Hungarian Academy of Sciences, has been awarded the Rolf Schock Prize in Mathematics by the Royal Swedish Academy of Sciences, the Royal Academy of Fine Arts, and the Royal Academy of Music. The prize carries a cash award of 500,000 Swedish kroner (approximately US $\$ 80,000$ ).

Szemerédi was honored "for his deep and pioneering work from 1975 on arithmetic progressions in subsets of the integers, which has led to great progress and discoveries in several branches of mathematics."

The Rolf Schock Prizes are awarded triennially in the fields of logic and philosophy, mathematics, the visual arts, and musical arts. The prize amount is 500,000 kroner per category. The awards ceremony will take place on October 22, 2008, in Stockholm.
-From a Royal Swedish Academy of Sciences
announcement

## Maldacena, Polchinski, and Vafa Awarded Dirac Medal

JUAN MARTÍN MALDACENA of the Institute for Advanced Study, Joseph Polchinski of the Kavli Institute for Theoretical Physics, University of California at Santa Barbara, and Cumrun Vafa of Harvard University have been awarded the 2008 Dirac Medal by the Abdus Salam International Centre for Theoretical Physics (ICTP). According to the prize citation, they were honored for "their fundamental contributions to superstring theory. Their studies range from early work on orbifold compactifications, physics and mathematics of mirror symmetry, D-branes and black hole physics, as well as gauge theory-gravity correspondence."

The ICTP awarded its first Dirac Medal in 1985. Given in honor of P. A. M. Dirac, the medal is awarded annually on Dirac's birthday, August 8, to an individual or individuals who have made significant contributions to
theoretical physics and mathematics. The medalists also receive a prize of US $\$ 5,000$. An international committee of distinguished scientists selects the winners from a list of nominated candidates. The Dirac Medal is not awarded to Nobel laureates, Fields Medalists, or Wolf Foundation Prize winners.
-From an ICTP announcement

## Rice Receives 2008 Jerome Sacks Award

John Rice of the University of California Berkeley has been named the 2008 recipient of the Jerome Sacks Award for Cross-Disciplinary Research by the National Institute of Statistical Sciences (NISS). He was recognized "for his outstanding, diverse cross-disciplinary contributions to ion channel receptors, energy demand, transportation, astronomy, and functional data analysis."

The NISS Board of Trustees established the Jerome Sacks Award for Cross-Disciplinary Research in 2000 to honor Sacks's service as the founding director of NISS, a capacity in which he served from 1991 to 2000. The annual prize of US $\$ 1,000$ recognizes sustained, highquality cross-disciplinary research involving the statistical sciences.
-From an NISS announcement

## Prizes of the Canadian Mathematical Society

The Canadian Mathematical Society (CMS) has awarded several major prizes.

Harley Weston of the University of Regina has been awarded the Adrien Pouliot Award for 2008. The award recognizes individuals or teams of individuals who have made significant and sustained contributions to mathematics education in Canada. According to the prize citation, Weston was honored for his "outstanding contributions to mathematics education at the local, regional, and
national levels," having devoted his career to advancing mathematics and mathematics education in his home province of Saskatchewan, as well as Canada and the world in general. "Key among his contributions has been his creation of the Math Central website and his outreach to aboriginal communities."

EdWARD Bierstone of the University of Toronto has been honored with the 2008 Excellence in Teaching Award for sustained and distinguished contributions in teaching at the postsecondary undergraduate level at a Canadian institution. According to the citation, "his colleagues describe as 'extraordinary' the influence he has on generations of students" and "praise his enthusiasm for teaching students at all levels in mathematics, engineering, and other programs."

Ronald van Luijk of Simon Fraser University has been awarded the G. de B. Robinson Award for 2007. The award recognizes the publication of excellent papers in the Canadian Journal of Mathematics and the Canadian Mathematical Bulletin. He was honored for his paper "A K3 Surface Associated with Certain Integral Matrices Having Integral Eigenvalues", which appeared in the Canadian Mathematical Bulletin 49 (2006).
-From a CMS announcement

## Bursztyn and Crainic Receive Lichnerowicz Prize

In July 2008 the first André Lichnerowicz Prize was awarded to Henrique Bursztyn and Marius Crainic.

Henrique Bursztyn holds a Ph.D. in mathematics, which he completed in 2001 at the University of California at Berkeley under the direction of Alan Weinstein. After postdoctoral positions at the Mathematical Sciences Research Institute in Berkeley, the University of Toronto, and the Fields Institute, he was appointed associate researcher in the Arminio Fraga chair at the Instituto Nacional de Matematica Pura e Aplicada in Rio de Janeiro in 2005. His numerous publications range from the theory of deformation quantization to Morita equivalence in the categories of Poisson manifolds and symplectic groupoids. His work in Dirac geometry not only advanced the subject, it also was the source of inspiration for many further developments.

Marius Crainic completed his Ph.D. in mathematics in 2000 at the University of Utrecht under the direction of Ieke Moerdijk. Since then he has held prestigious research fellowships at the University of California at Berkeley and at the University of Utrecht, where he is presently teaching. His work is an important contribution to the theory of Lie groupoids with applications to noncommutative geometry, to foliation theory, Lie algebroid cohomology, momentum map theories, and questions of rigidity and stability in Poisson geometry. Together with Rui Lo ja Fernandes he solved the deep question of generalizing Sophus Lie's third theorem from the setting of Lie groups to that of Lie groupoids, and he developed applications of this result to Poisson geometry.

The André Lichnerowicz Prize in Poisson geometry was established in 2008. It will be awarded for notable contributions to Poisson geometry every two years at the International Conference on Poisson Geometry in Mathematics and Physics, to researchers who completed their doctorates at most eight years before the year of the conference. The prize was named in memory of André Lichnerowicz (1915-1998), whose work was fundamental in establishing Poisson geometry as a branch of mathematics. The prize is awarded by a jury composed of the members of the scientific committee of the conference who may invite members of the organizing committee to participate in their deliberation and vote. In 2008 the prize amount was 500 euros (approximately US\$750) for each recipient. The funds have been provided by the host institution of the conference, the Centre Interfacultaire Bernoulli of the École Polytechnique Fédérale de Lausanne, Switzerland.
-Announcement of the Centre Interfacultaire Bernoulli

## ONR Young Investigator Award

Six researchers whose work involves the mathematical sciences have been selected to receive Young Investigator Awards from the Office of Naval Research (ONR) in the 2008 ONR Young Investigators Program competition. Their names, affiliations, and the titles of their proposals follow.

Joel A. Tropp, California Institute of Technology, "Compressive Signal Processing: Theory and Algorithms"; Justin Romberg, Georgia Institute of Technology, "Compressive Sampling for Next-Generation Signal Acquisition"; Carlos A. Guestrin, Carnegie Mellon University, "Novel Computational Paradigm for Integration of Uncertain Information in Adversarial Activity Recognition"; DAVID KEMPE, University of Southern California, "Game-Theoretic Views of Social Networks and Their Interactions"; ADRIAN Lew, Stanford University, "Computational Solid Mechanics in the Navy for the Era of Streaming Computing"; and LeIGH McCue, Virginia Polytechnic Institute and State University, "Tool Development at the Intersection of Nonlinear Dynamics and Computational Fluid Mechanics".

The Young Investigator Program supports basic research by exceptional faculty at U.S. universities who have received Ph.D.'s or equivalent degrees within the preceding five years. Grants to their institutions provide up to US $\$ 100,000$ per year for three years. The funds may be applied to a variety of research costs, including salary, graduate student support, laboratory supplies, and operating costs. Young Investigators are selected on the basis of prior professional achievement, the submission of a meritorious research proposal, and evidence of strong support by their respective universities. The program supports outstanding research in a wide range of science and engineering fields that are critical to the evolution of a first-rate navy and Marine Corps.
-From an ONR announcement

## MAA Awards for Mathematical Modeling

The Mathematical Association of America (MAA) holds a Mathematical Contest in Modeling (MCM), a competition designed to test students' abilities to solve realistic problems and work in a team setting. Two teams of students were honored in 2008. Jason Chen, Joonhahn Cho, and Brian Choi of Duke University were honored for their work on Problem A, which involved modeling the effects of the melting of the north polar ice cap, specifically along the Florida coastline. MARTIN Hunt, CHRISTOPHER Pong, and George Tucker of Harvey Mudd College were honored for their work on Problem B, which focused on creating an algorithm to construct Sudoku puzzles of varying difficulty. The teams were awarded plaques and certificates for their work. The solutions will be published in The UMAP Journal: Undergraduate Mathematics and Its Applications.
-From an MAA announcement

## 2008 International Mathematical Olympiad

The forty-ninth International Mathematical Olympiad (IMO) was held in Madrid, Spain, July 10-22, 2008. The IMO is the preeminent mathematical competition for high-school-age students from around the world. This year 535 young mathematicians from 97 countries competed. The IMO consists of solving six extremely challenging mathematical problems in a nine-hour competition administered over two days.

The team from China finished first, with 217 points and five gold medals; the Russian Federation was second, with 199 points and six gold medals; and the United States finished third, with 190 points and four gold medals.

The U.S. team consisted of Alex Zhai (University Laboratory High School, Urbana, Illinois), Colin SANDON (Essex High School, Essex Junction, Vermont), Krishanu Roy Sankar (Horace Mann School, Riverdale, New York), Shaunak Kishore (Unionville High School, Kennett Square, Pennsylvania), Evan O’Dorney (Berkeley Math Circle, Berkeley, California), and Paul Christiano (The Harker School, San Jose, California). Zhai, Sandon, Sankar, and Kishore received gold medals; O'Dorney and Christiano won silver. Zhai achieved a perfect score.

The Mathematical Association of America sponsors the U.S. team through its American Mathematics Competitions program, with travel support provided by a grant from the Army Research Office. Training for the team at the University of Nebraska-Lincoln is aided by a grant from the Akamai Foundation. Additional support for the team is provided by the National Council of Teachers of Mathematics.
-Elaine Kehoe

## NSF Postdoctoral Fellowships Awarded

The Mathematical Sciences Postdoctoral Research Fellowship program of the Division of Mathematical Sciences (DMS) of the National Science Foundation (NSF) awards fellowships each year for postdoctoral research in pure mathematics, applied mathematics and operations research, and statistics. Following are the names of the fellowship recipients for 2008, together with their Ph.D. institutions (in parentheses) and the institutions at which they will use their fellowships.

Jarod D. Alper (Stanford University), Columbia University; John A. Baldwin (Columbia University), Princeton University; NAWAF Bou-Rabee (California Institute of Technology), New York University; Jeremy S. BrandMAN (University of California Los Angeles), New York University; Steven K. Butler (University of California San Diego), University of California Los Angeles; MATTHEW B. DAY (University of Chicago), California Institute of Technology; InESSA EPSTEIN (University of California Los Angeles), California Institute of Technology; Joel W. Fish (New York University), Stanford University; DAVID S. Freeman (University of California Berkeley), Stanford University; William D. Gillam (Columbia University), Brown University; MARK Hoefer (University of Colorado, Boulder), Columbia University; William P. Hooper (State University of New York, Stony Brook), Northwestern University; Angela B. Hugeback (University of Chicago), University of Washington; Justin C. KAO (Northwestern University), Massachusetts Institute of Technology; SARA C. Koch (Cornell University\}, University of Warwick; Alex Kontorovich (Columbia University), Brown University; Karen M. Lange (University of Chicago), University of Notre Dame; Lionel Levine (University of California Berkeley), Massachusetts Institute of Technology; Joel C. Miller (University of Cambridge), Harvard University; Erin C. Munro (Tufts University), Boston University; Scott A. Norris (Northwestern University), Harvard University; Katharine A. Ott (University of Virginia), University of Kentucky; MANISH M. Patnaik (Yale University), Harvard University; Jonathon R. Peterson (University of Minnesota), University of Wisconsin; PaUL P. Pollack (Dartmouth College), University of Illinois, Urbana-Champaign; Brendon P. RHOADES (University of Minnesota), University of California Berkeley; MATHEW D. Rogers (University of British Columbia), University of Illinois, Urbana-Champaign; YaNIR A. Rubinstein (Massachusetts Institute of Technology), Johns Hopkins University; SUSAN J. SIERRA (University of Michigan), University of Washington; Katherine E. Stange (Brown University), Harvard University; Samuel N. Stechmann (New York University), University of California Los Angeles; Brian T. Street (Princeton University), University of Toronto; John R. TAYLOR (University of California San Diego), Massachusetts Institute of Technology; Frank H. Thorne (University of Wisconsin), Stanford University; IAN I. Tice (New York University), Brown University; Robert E. WAELDER (University of California Los Angeles),

University of Illinois, Chicago; JARED WEINSTEIN (University of California Berkeley), University of California Los Angeles; Jonathan Wise (Brown University), Stanford University; TATIANA Yarmola (New York University), University of Maryland, College Park; Josephine T. Yu (University of California Berkeley), Massachusetts Institute of Technology; Jessica V. Zuniga (Cornell University), Stanford University.

## -NSF announcement

## William E. Odom, 1932-2008

Lt. General William E. Odom died May 30, 2008. He was a specialist in Russian affairs and in intelligence. From 1985 to 1988 he served as director of the National Security Agency (NSA), having previously headed the Army Intelligence Service. Odom frequently told Congress that if it provided funds to recruit sufficiently many quality mathematicians and high-end computers, NSA would always know what the Russians were about. As director of NSA he broke down some of the barriers between NSA mathematicians and mathematicians outside of NSA and he began NSA funding of academic mathematicians.

In the mid-1990s, Odom headed the National Science Foundation (NSF) Senior Assessment Panel of U.S. Mathematics, which compared U.S. mathematics with that in other regions of the world, specifically Europe and the Pacific Rim. The report, of which he was very proud, was published in 1998 and made the case that U.S. mathematics was the leader but that other regions were rapidly becoming its equal. The report called for greater funding for U.S. mathematics and for mathematicians to be leaders in interdisciplinary research. A strong advocate for mathematics and its role in other disciplines, Odom knew many in Congress and in the administration and did not hesitate to make the case for mathematics. The increase in funding for NSF's Division of Mathematical Sciences in the early years of this century can be attributed to his advocacy.

General Odom saw action in Vietnam, earned a Ph.D. from Columbia University in 1970 in comparitive politics, and was the U.S. military attaché to the U.S. embassy in Moscow from 1972 to 1974 . He served as military advisor to Zbigniew Brzezinski when the latter was national security advisor to President Carter. In 1988 Odom retired from the military and began an academic career as a Senior Fellow at the Hudson Institute and as a professor at Yale and Georgetown. He authored seven books. While a military hawk during the cold war, he was a vocal opponent of the Iraq war from its beginning.

General Odom was not a mathematician, but he was a very strong advocate for mathematics and a dear friend to me and many mathematicians.
-D. J. Lewis, University of Michigan, Ann Arbor

Research topic:
Arithmetic of L-functions

Education Theme:
Making Mathematical Connections

A three-week summer program for graduate students undergraduate students mathematics researchers undergraduate faculty secondary school teachers math education researchers

## IAS/Park City Mathematics Institute (PCMI) June 28 - July 18, 2009

Park City, Utah
Organizers: Cristian Popescu, University of California, San Diego; Karl Rubin, University of California, Irvine; and Alice Silverberg, University of California, Irvine.
Graduate Summer School Lecturers: David Burns, Kings College, London; Henri Darmon, McGill University; Benedict Gross, Harvard University; Guido Kings, Regensburg University; Manfred Kolster, McMaster University; Cristian Popescu, University of California, San Diego; David Rohrlich, Boston University; Karl Rubin, University of California, Irvine; John Tate, University of Texas at Austin; and Doug Ulmer, University of Arizona.
Clay Senior Scholars in Residence: Benedict Gross, Harvard University; and John Tate, University of Texas at Austin.
Other Organizers: Undergraduate Summer School and Undergraduate Faculty Program: Aaron Bertram, University of Utah; and Andrew Bernoff, Harvey Mudd College. Secondary School Teachers Program: Gail Burrill, Michigan State University; Carol Hattan, Vancouver, WA; and James King, University of Washington.

Applications: pcmi.ias.edu
Deadline: January 28, 2009
IAS/Park City Mathematics Institute
Institute for Advanced Study, Princeton, NJ 08540
Financial Support Available

City University of Hong Kong is one of eight tertiary institutions funded by the Government of the Hong Kong Special Administrative Region through the University Grants Committee of Hong Kong. A young and dynamic institution, the University aspires to be internationally recognized as a leading university in the Asia-Pacific region through excellence in professional education and applied research. It has a growing international reputation, as evidenced by applied research. It has a growing international reputation, as evidenced by its surge up the rankings of the world's top 200 universities according to the Times Higher Education Supplement. The mission of the University is to nurture and develop the talents of students and to create applicable knowledge in order to support social and economic advancement. Currently, approximately 26,000 students are enrolled in over 180 programmes ranging from associate degrees to PhD. The medium of instruction is English.

The University invites applications for the following posts. Candidates with applied research achievements will receive very positive consideration. Relevant experience in business and industry will be a definite asset.

## Associate Professor/Assistant Professor (2 posts)

 Department of Mathematics [Ref. A/539/49]Duties : Teach undergraduate and postgraduate courses, supervise research students, conduct research in areas of Applied Mathematics, and perform any other duties as assigned.

Requirements : A PhD in Mathematics/Applied Mathematics/Statistics with an excellent research record.

Salary and Conditions of Service
Salary offered will be highly competitive and commensurate with qualifications and experience. Appointment will be on a fixed-term gratuity-bearing contract. Fringe benefits include annual leave, medical and dental schemes, and housing benefits where applicable.

## Application and Information

Further information about the posts and the University is available at http://www.cityu.edu.hk or from the Human Resources Office, City University Of Hong Kong, lat Chee Avenue, Kowloon, Hong Kong [Fax : (852) 2788 1154 or (852) 2788 9334/email: hrojob@cityu.edu.hk]. Please send an application letter enclosing a current curriculum vitae to the Human Resources Office by 16 January 2009. Please quote the reference of the post applied for in the application and on the envelope.
The University reserves the right to consider late applications and nominations, and to fill or not to fill the positions. Personal data provided by applicants will be used for recruitment and other employment-related purposes.

# Mathematics Opportunities 

## American Mathematical <br> Society Centennial Fellowships

## Invitation for Applications for Awards for 2009-2010 <br> Deadline December 1, 2008

Description: The AMS Centennial Research Fellowship Program makes awards annually to outstanding mathematicians to help further their careers in research. The number of fellowships to be awarded is small and depends on the amount of money contributed to the program. The Society supplements contributions as needed. One fellowship will be awarded for the 2009-2010 academic year. A list of previous fellowship winners can be found at:http://www.ams.org/prizes-awards.

Eligibility: The eligibility rules are as follows. The primary selection criterion for the Centennial Fellowship is the excellence of the candidate's research. Preference will be given to candidates who have not had extensive fellowship support in the past. Recipients may not hold the Centennial Fellowship concurrently with another research fellowship such as a Sloan or National Science Foundation Postdoctoral Fellowship. Under normal circumstances, the fellowship cannot be deferred. A recipient of the fellowship shall have held his or her doctoral degree for at least three years and not more than twelve years at the inception of the award (that is, received between September 1, 1997, and September 1, 2006). Applications will be accepted from those currently holding a tenured, tenure-track, postdoctoral, or comparable (at the discretion of the selection committee) position at an institution in North America. Applications should include a cogent plan indicating how the fellowship will be used. The plan should include travel to at least one other institution and should demonstrate that the fellowship will be used for more than reductions of teaching at the candidate's home institution. The selection committee will consider the plan in addition to the quality of the candidate's research and will try to award the fellowship to those for whom the award would make a real difference in the development of
their research careers. Work in all areas of mathematics, including interdisciplinary work, is eligible.

Grant amount: The stipend for fellowships awarded for 2009-2010 is expected to be US $\$ 77,000$, with an additional expense allowance of about US $\$ 7,700$. Acceptance of the fellowship cannot be postponed.

Deadline: The deadline for receipt of applications is December 1, 2008. Awards will be announced in February 2009 or earlier, if possible.

Application information: Application forms are available via the Internet at http://www.ams.org/ employment/centf1yer.htm7. For paper copies of the form, write to the Membership and Programs Department, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294; or send email to prof-serv@ ams.org; or call 401-455-4060.
-AMS announcement

## Graduate Student Travel Grants to 2009 JMM

## Deadline October 27, 2008

The AMS, with funding from a private gift, is accepting applications for partial travel support for graduate students attending the Joint Mathematics Meetings in Washington, DC, January 5-8, 2009. The awards, in the amount of US $\$ 500$, must be matched by travel funds from the student's institution. It is expected that awards will be made sometime in December, 2008.

This program is open to full time graduate students (in good standing) in a mathematical sciences department at a North American institution. A form to be signed by a representative of the department, agreeing to matching funding, will be part of the application package. Applications will be evaluated by a panel of mathematical scientists.

The application form is available on the AMS web site at http://www.ams.org/employment/studentJMM.htm7. The deadline for submitting applications is October 27, 2008. All information about the Joint Mathematics Meetings can be found in the Meetings section of
the AMS web site, http://www.ams.org/meetings. This travel grant program is being administered by the AMS Membership \& Programs Department, AMS, 201 Charles Street, Providence, RI 02904. You can reach the department at student-JMM@ams.org, or 800-321-4267, ext. 4124, or 401-455-4124.
-Diane Boumenot, AMS Membership and Programs

## AMS Congressional Fellowship

The AMS, in conjunction with the American Association for the Advancement of Science (AAAS), will sponsor a Congressional Fellow from September 2009 through August 2010. The fellow will spend the year working on the staff of a member of Congress or a congressional committee as a special legislative assistant in legislative and policy areas requiring scientific and technical input. The fellowship is designed to provide a unique public policy learning experience, to demonstrate the value of sciencegovernment interaction, and to bring a technical background and external perspective to the decision-making process in the Congress. Prospective fellows must demonstrate expertise in some area of the mathematical sciences; have a good scientific and technical background; be cognizant of and demonstrate sensitivity toward political and social issues; and, most important, have a strong interest and some experience in applying personal knowledge toward the solution of societal problems.

Deadline for applications is January 31, 2009. Applicants should have a Ph.D. or an equivalent doctoral-level degree in the mathematical sciences by the application deadline. For further information, please consult the webpage at http://www.ams.org/government/ congressfe71owann.htm7 or contact the AMS Washington office at 202-588-1100, email: amsdc@ams.org.
-AMS Washington office

## NSF Graduate Research Fellowships

The National Science Foundation (NSF) awards Graduate Research Fellowships to graduating seniors and firstyear graduate students. These are three-year fellowships awarded to U.S. students for full-time graduate study at the institutions of their choice. The fellowships include a stipend, tuition coverage, and possible international travel allowances. Awards are made based on the candidates' intellectual merit and potential for research achievement. The deadline for full proposals in mathematical sciences is November 5, 2008. For more information see http://www.nsf.gov/pubs/2008/nsf08593/ nsf08593.htm?govDe7=USNSF_25.
-From an NSF announcement

## Research Opportunities for U.S. Graduate Students in Asia and Australia

The National Science Foundation (NSF) and the National Institutes of Health (NIH) are cosponsoring a summer research program in Australia, China, Japan, Korea, Taiwan, New Zealand, and Singapore for U.S. graduate students during the summer of 2009. The East Asia and Pacific Summer Institutes (EAPSI) provide U.S. graduate students in science and engineering with firsthand research experience in Australia, China, Japan, Korea, Taiwan, New Zealand, or Singapore; an introduction to the science and science policy infrastructure of the respective location; and orientation to the culture and language. The primary goals of EAPSI are to introduce students to East Asian and Pacific science and engineering in the context of a research laboratory and to initiate personal relationships that will better enable them to collaborate with foreign counterparts in the future. The institutes last approximately eight weeks, from June to August, and are administered in the United States by the NSF. The NIH cosponsors the summer institute in Japan.

Applicants must be U.S. citizens or permanent residents. They must be enrolled at U.S. institutions in science or engineering Ph.D. programs, in M.D. programs with an interest in biomedical research, or in master's degree programs with at least one full academic year completed by the end of the calendar year of application. They must be pursuing studies in fields of science or engineering that are supported by the NSF or the NIH (for Japan) and that also are represented among the potential host institutions. International travel will be provided, and each awardee will receive an allowance of US $\$ 4,000$.

The deadline for application materials to be postmarked is expected to be December 9, 2008; please check the website below for exact date. Proposers are required to prepare and submit all proposals for this announcement/solicitation through the FastLane system. Detailed instructions for proposal preparation and submission via FastLane are available at:http://www.nsf.gov/ funding/pgm_summ.jsp?pims_id=5284.
-From an NSF announcement

## EDGE Summer Program

The Enhancing Diversity in Graduate Education (EDGE) Program is a postbaccalaureate summer enrichment program designed to strengthen the ability of women and minority students to successfully complete graduate programs in the mathematical sciences.

The summer program consists of two core courses in analysis and algebra/linear algebra. There will also be minicourses in vital areas of mathematical research in pure and applied mathematics, short-term visitors from academia and industry, guest lectures, graduate student mentors, and problem sessions. In addition, a follow-up mentoring
program and support network will be established with the participants' respective graduate programs.

Applicants to the program should be women who are (1) graduating seniors who have applied to graduate programs in the mathematical sciences, (2) recent recipients of undergraduate degrees who are now entering graduate programs, or (3) first-year graduate students. All applicants should have completed standard junioror senior-level undergraduate courses in analysis and abstract algebra and have a desire to earn the doctorate degree. Women from minority groups who fit one of the above three categories are especially encouraged to apply. A stipend of US $\$ 2,000$ plus travel, room, and board will be provided to participants. Final acceptance to the program is contingent on acceptance to a graduate program in the mathematical sciences.

The next EDGE summer program will be held in the summer of 2009 at Spelman College. The application deadline is March 2, 2009. See the website http://www. edgeforwomen.org/?page_id=5 for further information as it becomes available.
-From an EDGE Program announcement

## AAUW Educational Foundation Fellowships and Grants

The American Association of University Women (AAUW) awards Selected Professions Fellowships to women who intend to pursue a full-time course of study at accredited institutions during the fellowship year in a designated degree program in which women's participation has traditionally been low. All women who are candidates for the master of science (M.S.) degree in mathematics or statistics are eligible to apply.

Applications are now available for Master's and First Professional Awards, which carry cash awards of between US\$5,000 and US\$12,000. The deadline for applications to be postmarked is January 10, 2009. The fellowship year runs from July 1, 2009, to June 30, 2010. For more information, see the AAUW's website at http://www. aauw.org/fga/fe11owships_grants/se1ected.cfm or contact the AAUW Educational Foundation, Selected Professions Fellowships, Dept. 60, 301 ACT Drive, Iowa City, IA 52243-4030; telephone: 319-337-1716, ext. 60; email: aauw@act.org.
-From an AAUW announcement

## NRC-Ford Foundation Diversity Fellowships

The National Research Council (NRC) administers the Ford Foundation Diversity Fellowships program. The program seeks to promote the diversity of the nation's college and university faculties by increasing their ethnic and racial diversity, to maximize the educational benefits of diver-
sity, and to increase the number of professors who can and will use diversity as a resource for enriching the education of all students. Predoctoral fellowships support study toward a Ph.D. or Sc.D.; dissertation fellowships offer support in the final year of writing the Ph.D. or Sc.D. thesis; postdoctoral fellowships offer one-year awards for Ph.D. recipients. Applicants must be U.S. citizens or nationals in research-based fields of study and members of one of the following groups: Alaska Native (Eskimo or Aleut), Black/African American, Mexican American/Chicana/ Chicano, Native American Indian, Native Pacific Islander (Polynesian/Micronesian), or Puerto Rican.

Approximately sixty predoctoral fellowships will be awarded for 2009. The awards provide three years of support and are made to individuals who, in the judgment of the review panels, have demonstrated superior academic achievement, are committed to a career in teaching and research at the college or university level, show promise of future achievement as scholars and teachers, and are well prepared to use diversity as a resource for enriching the education of all students. The annual stipend is US $\$ 20,000$, with an institutional allowance of US $\$ 2,000$. The deadline for applying online is November 14, 2008.

Approximately thirty-five dissertation fellowships will be awarded for 2009 and will provide one year of support for study leading to a Ph.D. or D.Sc. degree. The stipend for one year is US $\$ 21,000$. The deadline for applying online is November 28, 2008.

The postdoctoral fellowship program offers one year of postdoctoral support for individuals who have received their Ph.D.'s no earlier than November 30, 2001, and no later than November 29, 2008. The stipend is US\$40,000, with an employing institution allowance of US $\$ 1,500$. Approximately twenty postdoctoral fellowships will be awarded for 2009. The deadline for applying online is November 28, 2008.

More detailed information and applications are available at the website http://www7. nationa1academies. org/FORDfe11owships/. The postal address is: Fellowships Office, Keck 576, National Research Council, 500 Fifth Street, NW, Washington, DC 20001. The telephone number is 202-334-2872. The email address is infofe11@ nas.edu.
-From an NRC announcement

## DMS Opens New Institute Competition

The Division of Mathematical Sciences (DMS) of the National Science Foundation (NSF) now supports programs at seven U.S.-based institutes: the American Institute of Mathematics (AIM), the Institute for Advanced Study (IAS), the Institute for Mathematics and its Applications (IMA), the Institute for Pure and Applied Mathematics (IPAM), the Mathematical Biosciences Institute (MBI), the Mathematical Sciences Research Institute (MSRI), and the Statistical and Applied Mathematical Sciences Institute (SAMSI). DMS is soliciting proposals for institutes with clearly defined
imaginative missions that match the objectives of the DMS Mathematical Sciences Research Institutes program. Projects supported by this program must involve the mathematical sciences in a significant way and have the scope to justify the funding, duration, and infrastructure of an institute. The goals of the program include advancing research in the mathematical sciences, increasing the impact of the mathematical sciences in other disciplines, enabling the mathematical sciences to respond to national needs, and expanding the talent base engaged in mathematical research in the United States.

Proposals may be submitted by nonprofit, nonacademic organizations such as independent museums, observatories, research labs, professional societies, and similar organizations in the United States associated with educational or research activities and by universities and two- and four-year colleges (including community colleges) located and accredited in the United States and acting on behalf of their faculty members. The deadline for proposals is February 27, 2009. The complete program solicitation is available at http://www.nsf.gov/funding/pgm_summ. jsp?pims_id=5302.
-From an NSF announcement

## News from the Institut MittagLeffler

The Institut Mittag-Leffler, Djursholm, Sweden, announces its programs for the academic year 2009-2010. The fall term 2009 will be devoted to Mathematical Logic: Set Theory and Model Theory. The steering committee consists of Jouko Väänänen (chair), University of Helsinki and University of Amsterdam; Dag Normann, University of Oslo; Erik Palmgren, University of Uppsala; and Hugh Woodin, University of California Berkeley.

The spring term 2009 will be devoted to Dynamics and PDEs. The scientific steering committee consists of Michael Benedicks (chair), KTH, Stockholm; Håkan Eliasson, University of Paris VII; Jörg Schmeling, University of Lund; and Jean-Christophe Yoccoz, Collège de France.

The application deadline for postdoctoral fellowships is January 20, 2009. Applications may be sent to MarieLouise Koskull, email: kosku11@mittag-1effler.se. The postal address is: Institut Mittag-Leffler, Auravägen 17, SE-182 60 Djursholm, Sweden.

For further information and application forms, see our homepage, http://www.mittag-1eff1er.se/ programs/0910/grants.php.
-Institut Mittag-Leffler announcement

## New From OXFORD

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# For Your Information 

## Santosa Appointed IMA Director

In July 2008 Fadil Santosa took the position of director of the Institute for Mathematics and its Applications (IMA) at the University of Minnesota. He succeeds Douglas Arnold, who had been director for IMA since 2001.

Santosa received his bachelor's degree in mechanical engineering from the University of New Mexico in 1976, and a master's degree and Ph.D. in theoretical and applied mechanics from the University of Illinois at Urbana-Champaign in 1977 and 1980, respectively. He was on the faculty of Cornell University in the theoretical and applied mechanics department before spending ten years at the University of Delaware in the mathematical sciences and mechanical engineering departments. He joined the University of Minnesota in 1995 as professor in the School of Mathematics. Santosa also serves as director of the Minnesota Center for Industrial Mathematics and has been involved with the IMA, first as associate director for industrial programs from 1997 to 2001, and later as deputy director from 2001 to 2004.

Santosa's research interests are in the areas of photonics, inverse problems, optimal design, and financial data analysis. Many of the problems he investigates are those that arise in industrial applications or in other areas of science and engineering. Santosa has served as a consultant for a number of companies and holds a 2006 patent for a spectacle lens design method.

Notices senior writer Allyn Jackson carried out the following email interview with Santosa.

Notices: The IMA was founded more than twenty-five years ago. What do you see as the institute's main accomplishments in that time?

Santosa: I credit the IMA's founding director, Hans Weinberger, with the vision of creating an institute that looks
outside of mathematics for new opportunities for mathematicians. As a result, the IMA has had an impact on the direction of mathematical research, especially in fostering interdisciplinary research and education. Its accomplishments include establishing communitiesnetworks of mathematicians and scientists-that work on mathematical problems arising in diverse applications such as materials science, biology,


Fadil Santosa imaging, applied dynamical systems, wave phenomena. This kind of activity not only increases the impact of mathematics but also enriches mathematical research.

Another accomplishment is the postdoctoral program. Over the twenty-five years, the IMA has had more than 270 postdoctoral fellows. Many of our former postdocs are established leaders in their fields, holding prestigious appointments in universities or high-ranking positions in companies. The sum of their influence on the mathematical landscape and on the national economy is tremendous.

IMA has been fortunate to have had visionary directors such as Avner Friedman, Willard Miller, and Douglas Arnold. They have each increased the importance of the IMA to the mathematical community, from development of industrial mathematics programs to training programs aimed at the mid-career university professoriate, as well as outreach activities to industry and the general public.

Notices: There are nowadays many more math institutes than at the time of the IMA's founding. Does the IMA have a special or unique role or niche in the international landscape of math institutes?

Santosa: Yes, I think the IMA does have a special niche. Unlike the other NSF math institutes, it runs yearlong
programs. By focusing on a topic over a longer period, the IMA is able, through its programs and activities, to make a deeper impact in a field. It also makes a lot of sense in terms of postdoctoral training. A year is enough time to be immersed in a new area and to start contributing to that area. A typical annual program brings over one thousand visitors to the IMA. For a postdoc it is a great opportunity to network with the best and the brightest from the topical area.

The other unique aspect is that the IMA, through its very scientifically broad and strong board of governors and its academic and industrial advisory boards, has a pulse on the hottest areas of applications. More often than not, the focus area of the year becomes "red hot" partly because it is well timed and partly because of the intense activities around the area at the IMA. The other aspect that makes the IMA somewhat different is its active outreach to industry and government labs. We have become the math institute for one-stop shopping for industry, whether it is for mathematical expertise or talent.

Notices: What do you see as today's role for mathematics in industry? Are the problems different than in the past?

Santosa: I think mathematics is increasingly important and valued in industry. Mathematical training brings a unique perspective to industrial research. A mathematician can usually take apart a very complex problem and answer very fundamental questions by building simple models that capture the complexity of the problem. Companies appreciate mathematicians for their problemsolving abilities. In some ways, it's not what mathematics you are trained in; it is the way our training allows us to approach the problem that makes us particulary useful. I think it is for this reason that mathematicians continue to find employment in industry.

Over the years I have had the opportunity to talk to, and work with, people in industry who develop products such as implantable defibrillators, imaging systems, barcode readers, photolithographic devices, etc. I have first-hand information about how mathematics is used in each instance and often refer to mathematics as industry's secret weapon.

There has also been a major change in how companies do R\&D in the past fifteen years or so. There are very few companies with large centralized research groups that serve as consulting units to the corporations. Today, companies form smaller research groups that support a particular product or service. There has also been a trend towards "crowd sourcing". This is where you pose your problem online and seek submissions from problem solvers. The best example of this is NetFlix's challenge. This is both a challenge and an opportunity for mathematics-a challenge because there is no longer a single place to go to talk to mathematicians in a company and an opportunity because mathematics can have a greater influence in the outcome of a product's development.

Notices: Can you describe a particularly striking example of how mathematics made a real difference in an application area, an example that captures what the IMA is about?

Santosa: I think one of the most compelling stories is how the IMA had a hand in creating new ferromagnetic shape memory alloys. Back in 1990, Donald Lord, who was then at Ford Motor Company, gave a talk at the IMA in which he showed beautiful and mysterious domain patterns in an alloy called Terfenol. The material exhibits a change of shape when a magnetic field is applied. In the audience were Dick James and David Kinderlehrer. They began working on a mathematical theory for this type of material. They conjectured that if a material could be found with both martensitic and ferromagnetic properties, such a material could be made to undergo much larger field-induced strains than Terfenol.

In the mid-1990s their theory led directly to the discovery of a new family of alloys of nickel, magnesium, and gallium, which are now termed ferromagnetic shape memory materials or FMSAs. A decade later these materials have been developed to the point of exhibiting magnetic fieldinduced strains one hundred times those of Terfenol, so that a magnetic field of less than 1 Tesla can induce shape changes of up to $10 \%$.

This is a developing story, because people are discovering uses of FMSA's in microdevices such as valves and pumps for biomedical applications and microactuators and sensors. In fact, there have been several small businesses around the world based on products built out of FMSAs.

While we cannot plan for this sort of synergy to happen, we do set up the IMA to maximize serendipity like this. We are not alone with success stories like this. Similar ones from all the NSF math institutes can be found at http://www.mathinstitutes.org.

Notices: How do you see the IMA developing in the future?

Santosa: I am fortunate to be the director of a healthy and strong math institute, thanks to the tireless work of my immediate predecessor, Doug Arnold. I would like to continue to bring innovations to the IMA. I would like to see us reach further into new application areas. I would like to see the IMA grow in its role as a catalyst to increase the impact of mathematics in science, technology, and society. I would also like to see us engage an even greater portion of the mathematics community. I think we are poised to directly contribute to American competitiveness through our research and educational programs.

## Correction

The September 2008 issue of the Notices carried the article "Old and new on the exceptional group $G_{2}$ ", by Ilka Agricola. This is an expanded translation of an article by the same author, "Zur geschichte der ausnahme-Lie-gruppe $G_{2}$ ", which appeared in the Mitteilungen der Deutschen-Mathematiker-Vereinigung 15 (2007), 242-248. The original appearance of the article in the Mitteilungen should have been indicated in the Notices translation. The Notices regrets this oversight.

- Allyn Jackson


## Inside the AMS

## AMS Sponsors NExT Fellows

Each year the AMS sponsors six Project NExT (New Experiencees in Teaching) Fellows who are affiliated with Ph.D.-granting institutions and who show promise in mathematics research.

The names, affiliations, and areas of research of the 2008-2009 NExT Fellows are: DANIEL BATES, Colorado State University, numerical algebraic geometry (applied mathematics); Jer-Chin Chuang, Duke University, geometry and topology; Maria Emelianenko, George Mason University, applied mathematics; Christina EubanksTURNER, University of Louisiana at Lafayette, commutative algebra; Jeremy Rouse, University of Illinois, UrbanaChampaign, number theory; Elaine Spiller, Marquette University, applied mathematics.

Project NExT is a professional development program for new or recent Ph.D.'s in the mathematical sciences (including pure and applied mathematics, statistics, operations research, and mathematics education). It addresses all aspects of an academic career: improving the teaching and learning of mathematics, engaging in research and scholarship, and participating in professional activities. It also provides the participants with a network of peers and mentors as they assume these responsibilities. Each year sixty to seventy new Ph.D.'s receive Project NExT Fellowships, which allow them to attend special events at the summer MathFest of the Mathematical Association of America and at the Joint Mathematics Meetings. The AMS also holds activities for the AMS NExT Fellows at the Joint Mathematics Meetings.

For further information about Project NExT, visit the websitehttp://archives.math.utk.edu/projnext/.
-Elaine Kehoe

## From the AMS Public Awareness Office

- Mathematical Research Communities-2008. Three week-long conferences were held at the Snowbird Resort in Utah this past summer: Teichmüller Theory and LowDimensional Topology, Scientific Computing and Advanced Computation, and Computational Algebra and Convexity. Eighty early-career mathematicians participated in the
sessions of this new AMS program, which will also include Special Sessions at the Joint Mathematics Meetings, a longitudinal study, and a continuation of the connections and collaborations via an electronic network. See photographs and read comments of participants and organizers at http://www.ams.org/ams/mrc-2008.htm7
- Mathematical Moments 2008. "Spinning at Infinity" (on modeling colliding black holes), "Steering towards Efficiency"
 (on mathematics used to improve automotive design), "Getting It Together" (on math and collective motion), "Hearing a Master's Voice" (on Grammy Awardwinning mathematician Kevin Short's work), "Going with the Floes" (on how percolation theory helps explain how salt water travels through sea ice), "Bending It like Bernoulli" (on the connections between math and soccer), "Restoring Genius" (on the rediscovery of work by Archimedes), "Improving Stents" (on modeling stents used to treat coronary artery disease), and dozens more PDFs of Mathematical Moments are posted online athttp://www.ams.org/mathmoments/.
- Feature Column. Recent columns include "Percolation: Slipping through the Cracks" and a two-part column on "The Mathematics of Surveying", at http://www.ams. org/featurecolumn/.
-Annette Emerson and Mike Breen AMS Public Awareness Officers paoffice@ams.org.


## Deaths of AMS Members

DONALD H. BALLOU, professor emeritus from Middlebury College, died on September 15, 2008. Born on March 28, 1908, he was a member of the Society for 74 years.

William A. Beck, retired, from Verona, PA, died on August 15, 2008. Born on February 6, 1930, he was a member of the Society for 53 years.

Henri Cartan, professor emeritus from the University of Paris XI, Orsay, died on August 13, 2008. Born on July 8,1904 , he was a member of the Society for 58 years.
E. Allen Cook, from Tulsa, OK, died in July 1983. Born on March 1, 1919, he was a member of the Society for 37 years.
W. Buell Evans, from Huntsville, AL, died on July 13, 2003. Born on June 5, 1918, he was a member of the Society for 54 years.

Robert A. Hall, from Albany, NY, died on June 21, 2000. Born on November 6, 1911, he was a member of the Society for 35 years.

John R. Hamilton, professor, Long Island University, Brooklyn Center, died in October 1981. Born on July 8, 1908, he was a member of the Society for 23 years.

Jim Havens, from Dallas, TX, died on January 9, 2005. Born on July 15, 1944, he was a member of the Society for 30 years.

Alfred Horn, professor emeritus from the University of California Berkeley died on April 17, 2001. Born on February 17, 1918, he was a member of the Society for 59 years.

Wilfred Kaplan, from Ann Arbor, MI, died on December 26, 2007. Born in November 1915, he was a member of the Society for 70 years.

Allan M. Krall, professor emeritus, from Pennsylvania State University, died on July 4, 2008. Born on February 25, 1936, he was a member of the Society for 37 years.

Pierre Leroux, professor from the University of Quebec at Montreal, died on March 9, 2008. Born on August 18, 1942, he was a member of the Society for 40 years.

ANDRZEJ MADRECKI, assistant professor, Wroclaw University, Poland, died in June 2008. Born on August 4, 1954, he was a member of the Society for 11 years.

Paul T. Mielke, professor emeritus, from Wabash College, IN, died on February 3, 2008. Born on September 28, 1920, he was a member of the Society for 62 years.

Richard C. Roberts, professor emeritus from Columbia, MD, died on March 27, 2008. Born on May 26, 1925, he was a member of the Society for 51 years.

Jon A. Schlosser, from Santa Fe, NM, died on July 16, 2008. Born on July 26, 1937, he was a member of the Society for 22 years.

Oded Schramm, Microsoft Research, died on September 1, 2008. Born on December 10, 1961, he was a member of the AMS for 21 years.

Annette Sinclair, from Bradenton, FL, died on March 2, 2005. Born on August 14, 1916, she was a member of the Society for 60 years.
L. Bruce Treybig, professor emeritus from Texas A\&M University, died on June 9, 2008. Born on August 29, 1931, he was a member of the Society for 54 years.

## CALIFORNIA INSTITUTE OF TECHNOLOGY

The Division of Physics, Mathematics, and Astronomy at the California Institute of Technology invites applications for a possible tenure-track position in Mathematics at the assistant professor level. We are particularly interested in the following research areas: Algebraic Geometry/Number Theory, Analysis/Dynamics, Combinatorics, Finite and Algebraic Groups, Geometry/Topology, Logic/Set Theory, and Mathematical Physics, but other fields may be considered. The term of the initial appointment is normally four years for a tenuretrack assistant professor (with a possible to extension to as much as seven years). Appointment is contingent upon completion of the Ph.D. Exceptional candidates may also be considered at the associate or full professor level. We are seeking highly qualified applicants who are committed to a career in research and teaching. Applicants should apply online at mathjobs.org

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## 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

October 15, 2008: Applications for NSF Mathematical Sciences Postdoctoral Research Fellowships. See http:// www.nsf.gov/funding/pgm_summ. jsp?pims_id=5301\&org=DMS.

October 15, 2008: Proposals for NSA Mathematical Sciences Program research grants. See http://www. nsa.gov/msp/index.cfm or contact
the program director, Michelle Wagner (mdwagn4@nsa.gov), or the program administrator, Barbara Johnson (bajohn1@nsa.gov), telephone 301-688-0400.

October 15, 2008: Proposals for NSF Postdoctoral Research Fellowships. See http://www.nsf.gov/ funding/pgm_summ.jsp?pims_ id=5301\&org=DMS.

## Where to Find It

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November 1, 2008: Applications for November review for the National Academies Postdoctoral and Senior Research Associateship Programs. See http://www7.nationalacademies. org/rap/index.htm 1 or contact Research Associateship Programs, National Research Council, Keck 568, 500 Fifth Street, NW, Washington, DC 20001; telephone 202-334-2760; fax 202-334-2759; email: rap@nas .edu.

November 5, 2008: Full proposals for NSF Graduate Research Fellowships. See "Mathematics Opportunities" in this issue.

November 15, 2008: Target date for receipt of applications for NSA Mathematics Sabbatical Program. See http://www.nsa.gov/msp/index. cfm or contact the program director, Michelle Wagner (mdwagn4@nsa. gov), or the program administrator, Barbara Johnson (bajohn1@nsa.gov), telephone 301-688-0400.

December 1, 2008: Applications for AMS Centennial Fellowships. See "Mathematics Opportunities" in this issue.

December 9, 2008: Expected deadline for applications for East Asia and Pacific Summer Institutes (EAPSI) program. See "Mathematics Opportunities" in this issue.

December 15, 2008: Applications for AMS Epsilon Fund grants. See http://www.ams.org/outreach/ epsilon.htm1 or contact Membership and Programs Department, American Mathematical Society, 201 Charles Street, Providence, RI 029042294; telephone: 800-321-4267, ext. 4170; email: prof-serv@ams.org.

January 15, 2009: Applications for AMS-AAAS Mass Media Summer Fellowships. See http://www. aaas.org/programs/education/ MassMedia/; 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; email: spasco@aaas.org. Also see http://www.ams.org/ government/massmediaann.htm1 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 31, 2009: Applications for AMS-AAAS Congressional Fellowship. See "Mathematics Opportunities" in this issue.

February 1, 2009: Applications for AWM Travel Grants. See http:// www.awm-math.org/trave1grants. htm7; telephone: 703-934-0163; email: awm@awm-math.edu. The postal address is: Association for Women in Mathematics, 11240 Waples Mill Road, Suite 200, Fairfax, VA 22030.

February 27, 2009: Submissions for Association for Women in Mathematics (AWM) essay contest. See http://www.awm-math.org/ biographies/contest.htm1.

March 2, 2009: Applications for EDGE Summer Program. See "Mathematics Opportunities" in this issue.

April 15, 2009: Applications for fall 2009 semester of Math in Moscow. See http://www.mccme.ru/ mathinmoscow or write to: Math in Moscow, P.O. Box 524, Wynnewood, PA 19096; fax: +7095-291-65-01; email: mim@mccme.ru. For information on AMS scholarships see http://www. ams.org/outreach/mimoscow.htm7 or write to: Math in Moscow Program, Membership and Programs Department, American Mathematical Society, 201 Charles Street, Providence RI 02904-2294; email: student-serv@ ams.org.

May 8, 2009: Applications for AWM Travel Grants. See http://www. awmmath.org/trave1grants.htm7; telephone: 703-934-0163; email: awm@ awm-math.edu. The postal address is: Association for Women in Mathematics, 11240 Waples Mill Road, Suite 200, Fairfax, VA 22030.

June 2, 2009: Proposals for NSF's Enhancing the Mathematical Sciences Workforce in the Twenty-First Century program. See http://www. nsf.gov/publications/pub_summ. jsp?ods_key=nsf05595.

October 1, 2009: Applications for AWM Travel Grants. See http:// www. awm-math.org/travelgrants. htm7; telephone: 703-934-0163; email: awm@awm-math.edu. The postal address is: Association for Women in Mathematics, 11240 Waples Mill Road, Suite 200, Fairfax, VA 22030.

## NSF Division of Mathematical Sciences

Listed below are names, email addresses, and telephone numbers for the program directors for the present academic year in the Division of Mathematical Sciences (DMS) of the National Science Foundation. The postal address is: Division of Mathematical Sciences, National Science Foundation, Room 1025, 4201 Wilson Boulevard, Arlington, VA 22230. The DMS webpage is http://www.nsf. gov/div/index.jsp?div=DMS.

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## Program Support Manager

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## Division Secretary

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## 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.

An Abundance of Katherines, by John Green. Dutton Juvenile Books, September 2006. ISBN-13:978-0-5254-7688-7. (Reviewed October 2008.)

Amongst Mathematicians: Teaching and Learning Mathematics at University Level, by Elena Nardi. Springer, November 2007. ISBN-13: 978-0-387-37141-2.

The Archimedes Codex, by Reviel Netz and William Noel. Weidenfeld and Nicolson, May 2007. ISBN-13: 978-0-29764-547-4. (Reviewed September 2008.)

Benjamin Franklin's Numbers: An Unsung Mathematical Odyssey, by Paul C. Pasles. Princeton University Press, October 2007. ISBN-13: 978-0-6911-2956-3.

The Book of Numbers: The Secret of Numbers and How They Changed the World, by Peter J. Bentley. Firefly Books, February 2008. ISBN-13: 978-15540-736-10.

The Calculus Wars: Newton, Leibniz, and the Greatest Mathematical Clash of All Time, by Jason Socrates Bardi. Thunder's Mouth Press, April 2007. ISBN-13: 978-1-5602-5992-3.

A Certain Ambiguity: A Mathematical Novel, by Gaurav Suri and Hartosh Singh Bal. Princeton University Press, June 2007. ISBN-13: 978-0-6911-27095. (Reviewed February 2008.)

Descartes: A Biography, by Desmond Clarke. Cambridge University Press, March 2006. ISBN 0-521-82301-3. (Reviewed January 2008.)

Digital Dice, by Paul J. Nahin. Princeton University Press, March 2008. ISBN13: 978-06911-269-82.

Dimensions, by Jos Leys, Etienne Ghys, and Aurélien Alvarez. DVD, 117 minutes. Available at http://www. dimensions-math.org.

Discovering Patterns in Mathematics and Poetry, by Marcia Birken and Anne C. Coon. Rodopi, February 2008. ISBN-13: 978-9-0420-2370-3.

Does Measurement Measure Up?: How Numbers Reveal and Conceal the Truth, by John Henshaw. Johns Hopkins University Press, March 2006. ISBN-13: 978-0-8018-8375-0.
*Einstein's Mistakes: The Human Failings of Genius, by Hans C. Ohanian. W. W. Norton, September 2008. ISBN13: 978-0393062939.

Euclidean and Non-Euclidean Geometries: Development and History, fourth revised and expanded edition, by Marvin Jay Greenberg. W. H. Freeman, September 2007. ISBN-13: 978-0-7167-9948-1.

Fly Me to the Moon: An Insider's Guide to the New Science of Space Travel, by Edward Belbruno. Princeton University Press, January 2007. ISBN-13: 978-0-6911-2822-1. (Reviewed April 2008.)

Geekspeak: How Life + Mathematics = Happiness, by Graham Tattersall. Collins, September 2008. ISBN-13: 978-00616-292-42.

Geometric Folding Algorithms: Linkages, Origami, Polyhedra, by Erik D. Demaine and Joseph O'Rourke. Cambridge University Press, July 2007. ISBN-13: 978-05218-57574.

The Golden Section: Nature's Greatest Secret (Wooden Books), by Scott Olsen. Walker and Company, October 2006. ISBN-13: 978-08027-153-95.

Group Theory in the Bedroom, and Other Mathematical Diversions, by BrianHayes. Hill and Wang, April 2008. ISBN-13: 978-0-8090-5219-6.

Guesstimation: Solving the World's Problems on the Back of a Cocktail Napkin, by Lawrence Weinstein and John A. Adam. PrincetonUniversityPress, April 2008. ISBN-13: 978-0-6911-2949-5.

A History of Abstract Algebra, by Israel Kleiner. Birkhäuser, October 2007. ISBN-13: 978-0-8176-4684-4.

How Mathematicians Think: Using Ambiguity, Contradiction, and Paradox to Create Mathematics, by William Byers. Princeton University Press, May 2007. ISBN-13: 978-0-6911-2738-5. (Reviewed December 2007.)

How Round Is Your Circle, by John Bryant and Chris Sangwin. Princeton University Press, January 2008. ISBN13: 978-0-6911-3118-4.

Impossible?: Surprising Solutions to Counterintuitive Conundrums, by Julian Havil. Princeton University Press, April 2008. ISBN-13: 978-0-6911-3131-3.

The Indian Clerk, by David Leavitt. Bloomsbury USA, September 2007. ISBN-13: 978-15969-1040-9. (Reviewed September 2008.)

An Introduction to Gödel's Theorems, by Peter Smith. Cambridge University Press, August 2007. ISBN-13: 978-0-521-67453-9.

Irreligion: A Mathematician Explains Why the Arguments for God Just Don't Add Up, by John Allen Paulos. Hill and Wang, December 2007. ISBN-13: 978-0-8090-591-95. (Reviewed August 2008.)

Karl Pearson: The Scientific Life in a Statistical Age, by Theodore M. Porter. Princeton University Press, (new edition) December 2005. ISBN13: 978-0-6911-2635-7. (Reviewed December 2007.)
*Kiss My Math: Showing PreAlgebra Who's Boss, by Danica McKellar. Hudson Street Press, August 2008. ISBN-13: 978-1594630491.
*The Last Theorem, by Arthur C. Clarke and Frederik Pohl. Del Rey, August 2008. ISBN-13: 978-0345470218.

The Legacy of Mario Pieri in Geometry and Arithmetic, by Elena Anne Marchisotto and James T. Smith. Birkhäuser, May 2007. ISBN-13: 978-0-8176-3210-6.

Leonhard Euler, A Man to Be Reckoned With, by Andreas K. Heyne and Alice K. Heyne. Birkhäuser, 2007.ISBN13: 978-3-7643-8332-9. (Reviewed March 2008.)

Logic's Lost Genius: The Life of Gerhard Gentzen, by Eckart MenzlerTrott, Craig Smorynski (translator), Edward R. Griffor (translator). AMSLMS, November 2007. ISBN-13: 978-0-8218-3550-0.

Making Mathematics Work with Needlework: Ten Papers and Ten Projects, edited by Sarah-Marie Belcastro and Carolyn Yackel. A K Peters, September 2007.ISBN-13:978-1-5688-1331-8.

Mathematical Mind-Benders, by Peter Winkler. A K Peters, August 2007. ISBN-13: 978-1-5688-1336-3.

Mathematical Omnibus: Thirty Lectures on Classic Mathematics, by Dmitry Fuchs and Serge Tabachnikov.

AMS, October 2007. ISBN-13: 978-08218-431-61.

The Mathematician's Brain, by David Ruelle. Princeton University Press, July 2007. ISBN-13 978-0-691-12982-2. (Reviewed November 2008.)

Mathematics and Democracy: Designing Better Voting and FairDivision Procedures, by Steven J. Brams. Princeton University Press, December 2007. ISBN-13: 978-0691-1332-01.

Mathematics at Berkeley: A History, by Calvin C. Moore. A K Peters, February 2007.ISBN-13:978-1-5688-13028. (Reviewed in this issue.)

The Mathematics of Egypt, Mesopotamia, China, India, and Islam: A Sourcebook, by Victor J. Katz et al. Princeton University Press, July 2007. ISBN-13: 978-0-6911-2745-3.

Measuring the World, by Daniel Kehlmann. Pantheon, November 2006. ISBN 0-375-42446-6. (Reviewed June/ July 2008.)

More Mathematical Astronomy Morsels, by Jean Meeus. WillmannBell, 2002. ISBN 0-943396743.

More Sex Is Safer Sex: The Unconventional Wisdom of Economics, by Steven E. Landsburg. Free Press, April 2007. ISBN-13: 978-1-416-53221-7. (Reviewed June/July 2008.)

Number Story: From Counting to Cryptography, by Peter M. Higgins. Springer, February 2008. ISBN-13: 978-1-8480-0000-1

One to Nine: The Inner Life of Numbers, by Andrew Hodges. W. W. Norton, May 2008. ISBN-13: 978-03930-664-18.

A Passion for Discovery, by Peter Freund. World Scientific, August 2007. ISBN-13: 978-9-8127-7214-5.

Perfect Figures: The Lore of Numbers and How We Learned to Count, by Bunny Crumpacker. Thomas Dunne Books, August 2007. ISBN-13: 978-0-3123-6005-4.

The Poincaré Conjecture: In Search of the Shape of the Universe, by Donal O'Shea. Walker, March 2007. ISBN-13: 978-0-8027-1532-6. (Reviewed January 2008.)

Poincaré's Prize: The Hundred-Year Quest to Solve One of Math's Greatest Puzzles, by George Szpiro. Dutton Adult, June 2007. ISBN-13: 978-0-525-95024-0. (Reviewed January 2008.)

## About the Cover

Extraordinary phenomenon
This month's cover was produced by Douglas Arnold and Jonathan Rogness from the video they describe in their article in this issue. The "extraordinary phenomenon" is the amount of attention it has attracted. This ought to reinforce among all of us the notion that mathematics, if explained well and in spite of its reputation, has a potentially huge audience of admirers.
-Bill Casselman, Graphics Editor (notices-covers@ams.org)


The Presidential Election Game, by Steven J. Brams. A K Peters, December 2007. ISBN-13: 978-1-5688-1348-6.

The Princeton Companion of Mathematics, edited by Timothy Gowers (June Barrow-Green and Imre Leader, associate editors). Princeton University Press, November 2008. ISBN-13: 978-06911-188-02.

The Probability of God: A Simple Calculation That Proves the Ultimate Truth, by Stephen D. Unwin. Three Rivers Press, October 2004. ISBN-13: 978-1-4000-5478-7. (Reviewed February 2008.)

Pursuit of Genius: Flexner, Einstein, and the Early Faculty at the Institute for Advanced Study, by Steve Batterson. A K Peters, June 2006. ISBN 1-56881-259-0. (Reviewed August 2008.)
*Pythagorean Crimes, by Tefcros Michalides. Parmenides Publishing, September 2008. ISBN-13: 9781930972278.

The Pythagorean Theorem: A 4000Year History, by Eli Maor. Princeton University Press, May 2007. ISBN-13: 978-0-6911-2526-8.

Random Curves: Journeys of a Mathematician, by Neal Koblitz. Springer, December 2007. ISBN-13: 978-3-5407-4077-3.

Roots to Research: A Vertical Development of Mathematical Problems, by Judith D. Sally and Paul J. Sally Jr. AMS, November 2007. ISBN-13: 978-08218-440-38.

Sacred Mathematics: Japanese Temple Geometry, by Fukagawa Hidetoshi and Tony Rothman. Princeton University Press, July 2008. ISBN-13: 978-0-6911-2745-3.

Super Crunchers: Why Thinking-by-Numbers Is the New Way to Be Smart, by Ian Ayres. Bantam, August 2007. ISBN-13: 978-0-5538-0540-6.

Superior Beings: If They Exist, How Would We Know? Game-Theoretic Implications of Omnipotence, Omniscience, Immortality, and Incomprehensibility, by Steven Brams. Springer, second edition, November 2007. ISBN-13: 978-0-387-48065-7. (Reviewed February 2008.)

The Symmetries of Things, by John H. Conway, Heidi Burgiel, and Chaim Goodman-Strauss. A K Peters, May 2008. ISBN-13: 978-1-5688-1220-5.

Symmetry: A Journey into the Patterns of Nature, by Marcus du Sautoy. Harper, March 2008. ISBN-13: 978-0-0607-8940-4.

Symmetry: The Ordering Principle (Wooden Books), by David Wade. Walker and Company, October 2006. ISBN-13: 978-08027-153-88.
*Tools of American Math Teaching, 1800-2000, by Peggy Aldrich Kidwell, Amy Ackerberg-Hastings, and David Lindsay Roberts. Johns Hopkins University Press, July 2008. ISBN-13: 978-0801888144.

The Triumph of Numbers: How Counting Shaped Modern Life, by I. B. Cohen. W. W. Norton, July 2006. ISBN-13: 978-0-393-32870-7. (Reviewed December 2007.)

The Unfinished Game: Pascal, Fermat, and the Seventeenth-Century Letter That Made the World Modern, by Keith Devlin. Basic Books, September 2008. ISBN-13: 978-0-4650-0910-7.

Unknown Quantity: A Real and Imaginary History of Algebra, by John Derbyshire. Joseph Henry Press, May 2006. ISBN 0-309-09657-X. (Reviewed May 2008.)

Useless Arithmetic: Why Environmental Scientists Can't Predict the Future, by Orrin Pilkey and Linda Pilkey-Jarvis. Columbia University Press, February 2007. ISBN 0-231-13212-3. (Reviewed April 2008.)

The Volterra Chronicles: The Life and Times of an Extraordinary Mathematician, by Judith R. Goodstein. AMS, February 2007. ISBN-13: 978-0-8218-3969-0. (Reviewed March 2008.)

The Wraparound Universe, by JeanPierre Luminet. A K Peters, March 2008. ISBN-13: 978-1-5688-1309-7.

Zeno's Paradox: Unraveling the Ancient Mystery behind the Science of Space and Time, by Joseph Mazur. Plume, March 2008 (reprint edition). ISBN-13: 978-0-4522-8917-8.

# Backlog of Mathematics Research Journals 

| Journal (Print and Electronic) | Number issues per Year | Approximate Number Pages per Year | 2007 Median Time (in Months) from: |  |  | Editor's Current Estimate of Waiting Time between Submission and Publication (in Months) |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Submission to Final | Acceptance to | Acceptance to Electronic |  |  |
|  |  |  | Acceptance | Print | Posting | Print | Electronic |
| Abstr. Appl. Anal. | * | 600 | 4 | 8 | 1.5 | 6 | 5.5 |
| Acta Inform. | 8 | 640 | 16.3 | 10.6 | 5.7 | 25.2 | 20.3 |
| Acta Math. | 4 | 600 | 8 | 13 | 13 | 15 | 15 |
| Adv. Difference Equ. | * | 400 | 4.5 | 8 | 1.5 | 6 | 6 |
| Aequationes Math. | 6 | 640 | 19 | 11 | 11 | 11 | 11 |
| Algorithmica | 12 | 1300 | 9 | 12 | 2 | 18 | 12 |
| Amer. J. Math. | 6 | 1728 | NA | 13.03 | 12.03 | 16-18 | 15-17 |
| Ann. Mat. Pura Appl. (4) | 4 | 720 | 12.7 | 15.9 | 6.5 | 20.8 | 16.2 |
| Ann. of Math. (2) | 6 | 2100 | 14 | 20 | 20 | 20 | 20 |
| Arch. Hist. Exact. Sci. | 6 | 696 | 3 | 6 | 3 | 5 | 2 |
| Arch. Math. Logic | 8 | 1040 | 16.3 | 10.6 | 5.7 | 25.2 | 20.3 |
| Arch. Ration. Mech. Anal. | 12 | 2200 | 7 | 6 | 3 | 9 | 9 |
| Balkan J. Geom. Appl. | 2 | 250 | 4 | 2 | 5 | 6 | 5 |
| Beitrage Algebra Geom. | 2 | 600 | 16 | 8 | 6 | 15 | 16 |
| Bound. Value Probl. | * | 700 | 4 | 8 | 1.5 | 6 | 5.5 |
| Bull. Austral. Math. Soc. | 6 | 1056 | 3 | 10 | NR | 10 | 9 |
| Bull. London Math. Soc. | 6 | 1152 | 4.5 | 9 | 7 | 9.5 | 9 |
| Bull. Soc. Math. France | 4 | 600 | 6 | 10 | 8 | 9 | 7 |
| Calc. Var. Partial Diff. Equations | 12 | 1630 | 9.1 | 10.8 | 8.6 | 18.8 | 17.3 |
| Canad. J. Math. | 6 | 1440 | 9 | 22 | 23 | 32 | 33 |
| Canad. Math. Bull. | 4 | 640 | 6 | 17 | 18 | 26 | 27 |
| Combinatorica | 6 | 750 | 18 | 12 | 6 | 12 | 6 |
| Comm Algebra | 12 | 4800 | NR | 4 | 4 | NR | NR |
| Comm. Math. Phys. | 24 | 6840 | 6 | 4 | 2 | 3.5 | 1.5 |
| Comm. Partial Diff. Equations | 12 | 2400 | 6 | 9 | 6 | NR | NR |
| Commun. Pure Appl. Anal. | 6 | 280 | 3 | 6 | 2 | 10 | 6 |
| Compos. Math. | 6 | 1632 | 6 | 7.5 | 7 | 11 | 10 |
| Comput. Math. Appl. | 24 | 1600 | 6 | 5 | 4 | 7 | 5 |
| Comput. Methods Funct. Theory | 2 | 700 | 5 | 8 | 3 | 9 | 6 |
| Computing | 8 | 768 | 8.6 | 5 | 4.5 | 9 | 9 |
| Constr. Approx. | 6 | 720 | 9 | 12 | 6 | 10 | 13 |
| Discrete Comput. Geom. | 8 | 1440 | 8 | 11 | 6 | 17 | 13 |
| Discrete Contin. Dyn. Syst. | 12 | 3500 | 4 | 7 | 3 | 11 | 7 |
| Discrete Contin. Dyn. Syst. Ser. B | 8 | 2400 | 4 | 6 | 3 | 10 | 6 |
| Duke Math. J. | 15 | 3000 | 10 | 10 | 10 | 18 | 18 |


| Journal (Print and Electronic) | Number issues per Year | Approximate Number Pages per Year | 2007 Median Time (in Months) from: |  |  | Editor's Current Estimate of Waiting Time between Submission and Publication (in Months) |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Submission to Final | Acceptance to | Acceptance to Electronic |  |  |
|  |  |  | Acceptance | Print | Posting | Print | Electronic |
| Fixed Point Theory Appl. | * | 500 | 3 | 8 | 1.5 | 6 | 4.5 |
| Found. Comput. Math. | 6 | 700 | 10 | 15 | 5 | 17 | 12 |
| Geom. Dedicata | 7 | 1400 | 10 | 6 | 2 | 14 | 10 |
| Georgian Math. J. | 4 | 800 | 6 | 6 | 4 | 14 | 12 |
| Graphs Combin. | 6 | 726 | 13 | 4 | 4 | 16 | 16 |
| Houston J. Math. | 4 | 1275 | 5 | 16 | 14 | 19 | 17 |
| Illinois J. Math. | 4 | 1400 | 6 | 12 | 11 | 12 | 11 |
| Indag. Math. (N.S.) | 4 | 650 | 7 | 6 | 6 | 9 | 12 |
| Indiana Univ. Math. J. | 6 | 3600 | 14.62 | 9.21 | ** | 12 | 6-7 |
| Int. J. Math. Math. Sci. | * | 2000 | 3.5 | 8 | 1.5 | 6 | 5 |
| Invent. Math. | 12 | 2736 | 9.7 | 4.2 | 1.5 | 13.8 | 11.2 |
| Israel J. Math. | 6 | 4500 | 5 | 15 | 15 | 24 | 12 |
| J. Algebraic Geometry | 4 | 800 | 8 | 9 | 3 | 14 | 12 |
| J. Amer. Math. Soc. | 4 | 1200 | 14.1 | 8 | 1.8 | 23.2 | 18.4 |
| J. Anal. Math. | 3 | 1188 | 6 | 13 | 13 | 15 | 15 |
| J. Appl. Anal. | 2 | 150 | 14 | 11 | 9 | 14 | 7 |
| J. Appl. Math. | * | 300 | 5 | 8 | 1.5 | 6 | 6 |
| J. Appl. Math. Stochastic Anal. | * | 400 | 5 | 8 | 1.5 | 6 | 6 |
| J. Aust. Math. Soc. | 6 | 850 | 8 | 17 | NA | 25 | NA |
| J. Complexity | 6 | 1000 | 8 | 6 | 1 | 14 | 9 |
| J. Comput. System Sci. | 6 | 1500 | 14 | 2 | 1 | 14 | 12 |
| J. Convex Anal. | 4 | 900 | 11 | 6 | 1 | 6 | 1 |
| J. Differential Geom. | 9 | 1500 | NR | NR | NR | NR | NR |
| J. Eur. Math. Soc. (JEMS) | 4 | 1000 | 16 | 10 | 9 | 12 | 11 |
| J. Geom. Anal. | 4 | 1000 | 5 | 7 | 7 | 12 | 5 |
| J. Inequal. Appl. | * | 1200 | 3 | 8 | 1.5 | 6 | 4.5 |
| J. Integral Equations Appl. | 4 | 500 | 12 | 12 | 10 | 12 | 10 |
| J. Lie Theory | 4 | 1000 | 6 | 4 | 2 | 7 | 7 |
| J. London Math. Soc. (2) | 6 | 1632 | 6 | 10 | 8 | 11 | 10.5 |
| J. Math. Biol. | 12 | 1776 | 11 | 14.9 | 3.9 | 22 | 14.9 |
| J. Math. Phys. | 12 | 8000 | 2.5 | 2 | 1 | 4.5 | 3.5 |
| J. Operator Theory | 4 | 900 | 8.85 | 19 | 17 | 28.65 | 18 |
| J. Symbolic Logic | 4 | 1320 | 9 | 7 | 5 | 16 | 14 |
| J. Theoret. Probab. | 4 | 1100 | 9.13 | 12 | 9.3 | 16 | 10 |
| J. Topol. | 4 | 1024 | NA | NA | NA | 9 | 8.5 |
| Linear Algebra Appl. | 24 | 6000 | 6 | 6 | 1 | 12 | 7 |
| Linear Multilinear Algebra | 6 | 760 | 6 | 13 | 2 | 13 | 7 |
| Manuscripta Math. | 12 | 1632 | 8 | 3.9 | 2.2 | 11.9 | 10.2 |
| Math. Ann. | 12 | 3000 | 11.5 | 6.2 | 4.5 | 16 | 14 |
| Math. Comp. | 4 | 2400 | 9.8 | 10.4 | 7 | 21 | 16 |
| Math. Control Signals Systems | 4 | 382 | 15 | 6 | 2 | 21 | 17 |
| Math. Oper. Res. | 4 | 1024 | 20.9 | 9 | 9 | 24 | 24 |


| Journal (Print and Electronic) | Number issues per Year | Approximate Number Pages per Year | 2007 Median Time (in Months) from: |  |  | Editor's Current Estimate of Waiting Time between Submission and Publication (in Months) |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | $\begin{aligned} & \text { Submission } \\ & \text { to Final } \end{aligned}$ | $\begin{aligned} & \text { Acceptance } \\ & \text { to } \end{aligned}$ | Acceptance to Electronic |  |  |
|  |  |  | Acceptance | Print | Posting | Print | Electronic |
| Math. Program. | 10 | 1980 | 15.2 | 11.8 | 7.4 | 23.7 | 18.6 |
| Math. Res. Let. | 6 | 1250 | 5 | 4 | 1.5 | 10 | 5 |
| Math. Social Sci. | 6 | 600 | 10 | 4 | 0 | 12 | 9 |
| Math. Z. | 12 | 2900 | 9.6 | 5.2 | 1.6 | 13.5 | 11.4 |
| Michigan Math. J. | 3 | 720 | 5.5 | 10 | 9 | 10 | 9 |
| Monatsh. Math. | 12 | 1056 | 5 | 12 | 5 | 18 | 12 |
| Multiscale Model. Simul. | 4 | 2000 | 5.6 | 15.7 | 4.4 | 18.6 | 10 |
| Numer. Math. | 12 | 2400 | 13.5 | 6 | 4.5 | 16.2 | 14 |
| Probab. Theory Related Fields | 12 | 1920 | 11 | 14.9 | 3.9 | 22.1 | 14.9 |
| Proc. Amer. Math. Soc. | 12 | 4200 | 5.3 | 13.3 | 10 | 17.9 | 14.6 |
| Proc. London Math. Soc. (3) | 6 | 1632 | 7.5 | 9 | 6 | 15 | 12 |
| Publ. Math. Inst. Hautes Etudes Sci. | 2 | 500 | 17.5 | 3.6 | 3.4 | 17.8 | 17.6 |
| Q. J. Math. | 4 | 512 | 6 | 7 | 1 | 15 | 6 |
| Quart. Appl. Math. | 4 | 800 | 3.6 | 8.1 | 5.3 | 20.2 | 16.8 |
| Results Math. | 8 | 800 | 3 | 3 | 1.5 | 2.5 | 1.5 |
| Rocky Mountain J. Math. | 6 | 2100 | 10 | 20 | 17 | 33 | 30 |
| Semigroup Forum | 6 | 1050 | 7 | 7 | 6 | 14 | 10 |
| SIAM J. Appl. Math. | 6 | 1800 | 9.2 | 6.7 | 3.7 | 18.2 | 12.9 |
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| SIAM Rev. | 4 | 800 | 12.4 | 10.8 | 9.8 | 23.2 | 22.2 |
| Theory Comput. Syst. | 8 | 1300 | 9 | 18 | 2 | 20 | 10 |
| Trans. Amer. Math. Soc. | 12 | 6600 | 7.8 | 21.7 | 17.9 | 30.2 | 25.3 |


| Journal (Print) | Number issues per Year | Approximate | 2007 Median Time (in Months) from: |  | Editor's Current Estimate of Waiting Time between Submission and Publication (in Months) |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Number Pages per Year | Submission to Final Acceptance | Acceptance to Final Publication |  |
| Ann. Appl. Probab. | 6 | 2400 | 5 | 14 | 14 |
| Mem. Amer. Math. Soc. | 6 | 3800 | 16.4 | 22.7 | 37.8 |


| Journal (Electronic) | Number of Articles Posted in 2007 | 2007 Median Time (in days) from: |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  | Submission to Final <br> Acceptance | Acceptance to Posting | Format(s) |
| Acta Math. Acad. Paedagog. Nyházi. (N.S.) www.emis.de/journals/AMAPN | 19 | 150 | 91 | pdf, ps |
| Appl. Math. E-Notes www.math.nthu.edu.tw/~amen/ | 36 | 180 | 180 | pdf |
| Cent. Eur. J. Math. www.versita.com/science/mathematics/cejm/ | 45 | 140 | 49 | pdf, ps, dvi, tex |
| Chic. J. Theoret. Comput. Sci. cjtcs.cs.uchicago.edu/ | 1 | 141 | 3 | pdf, ps, dvi, tex |
| Conform. Geom. Dyn. www.ams.org/journals/ecgd | 18 | 159 | 84 | pdf, ps, dvi |
| Differ. Geom. Dyn. Syst. www.mathem.pub.ro/dgds | 36 | 150 | 250 | pdf |
| Differ. Uravn. Protsessy Upr. www.math.spbu.ru/diffjournal/j/ru | 14 | 20 | 3 | pdf, tex, doc |
| Discrete Math. Theor. Comput. Science www.dmtcs.org/ | 20 | 290 | 20 | pdf, ps |
| Doc. Math. www.math.uni-bielefeld.de/documenta/ | 21 | 273 | 14 | pdf, ps, dvi |
| Electron. J. Combin. www.combinatorics.org/ | 108 | 182 | 11 | pdf, ps |
| Electron. J. Differential Equations ejde.math.unt.edu | 178 | 117 | 10 | html, pdf, ps, tex |
| Electron. J. Linear Algebra www.math.technion.ac.il/iic/ela | 38 | 174 | 14 | pdf |
| Electron. J. Qual. Theory Differ. Equ. www.math.u-szeged.hu/ejqtde/ | 30 | 150 | 10 | pdf, ps, dvi |
| Electron. Res. Announc. Math. Sci. http://www.math.psu.edu/era/ | 17 | 14 | 7 | pdf |
| Electron. Trans. Numer. Anal. etna.mcs.kent.edu/ | 25 | 273 | 156 | html, pdf, ps, dvi, tex, |
| ESAIM Control Optim. Calc. Var. www.esaim-journal.org/ | 67 | 248 | 400 | pdf, ps, html for metadata and references |
| ESAIM Probab. Stat. www.esaim-ps.org/ | 28 | 120 | 90 | pdf, ps, html for metadata and references |
| Integers www.integers-ejcnt.org | 102 | 175 | 14 | pdf, ps, dvi, tex, |
| J. Integer Seq. www.cs.uwaterloo.ca/journals/JIS/ | 77 | 128 | 1 | html, pdf, ps, dvi, tex, |
| JIPAM. J. Inequal. Pure Appl. Math jipam.vu.edu.au | 121 | 100 | 50 |  |
| LMS J. Comput. Math. www.lms.ac.uk/jcm | 18 | 175 | 47 | pdf, html (indexes, abstracts) |
| Lobachevskii J. Math. <br> www.maik.ru/cgi-perl/journal. pl?lang=eng\&name=lobjmat | 24 | 115 | 30 | html, pdf, ps, dvi |
| New York J. Math. nyjm.albany.edu/nyjm.html | 19 | 344 | 21 | pdf, ps, dvi |
| Numer. Funct. Anal. Optim. www.tandf.co.uk/01630563 | NR | 98 | 76 | pdf, tex, Word |


| Journal (Electronic) | Number of Articles Posted in 2007 | 2007 Median Time (in days) from: |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  | Submission to Final Acceptance | $\begin{gathered} \text { Acceptance } \\ \text { to } \\ \text { Posting } \end{gathered}$ | Format(s) |
| Represent. Theory www.ams.org/journals/ert | 9 | 273 | 48 | pdf, ps, dvi |
| Sém. Lothar. Combin. www.mat.univie.ac.at/~slc/ | 19 | 265 | 13 | pdf, ps, dvi, tex |
| SIAM J. Appl. Dyn. Syst. www.siam.org/journals/siads.php | 26 | 180 | 114 | pdf, BibTeX |
| Theory Appl. Categ. www.tac.mta.ca/tac/ | 27 | 151 | 11 | pdf, ps, dvi, html (TOC/ abstract only) |
| Theory of Comput. theoryofcomputing.org | 12 | 223 | 9 | pdf, ps, dvi, tex, html (for bibliography), article ps.zip and ps.gz |

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Apply to: Jan van Casteren, Secretary, University of Antwerp, Department of Mathematics, Middelheimlaan 1, B-2020 Antwerp, Belgium; email: bms@ulb.ac.be; email: jan.vancasteren@ua.ac.be; http://bms.ulb.ac.be.
Dues: 18 euros, payable to Belgian Mathematical Society, Campus Plaine, CP 218/01, Bld. du Triomphe, B-1050 Brussels, Belgium. Account number: 000-0641030-54 (IBAN : BE 4200006410 3054, BIC : BPOTBEB1).
Privileges: Membership includes a subscription to Bulletin of the Belgian Mathematical Society-Simon Stevin; newsletter.
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Apply to: Dr. Wolfgang Volk, Berliner Mathematische Gesellschaft, Schriftführer, Freie Universität Berlin, Institut für Mathematik, Sekretariat Frau B. Wengel, Arnimallee 3, 14195 Berlin, Germany; email: wolfgang. volk@berlin.de; http://www.mathematik.de/BMG/.
Dues: 10 euros, payable to Dr. Jörg Schmid-Kikuchi at the above address. IBAN : DE80 100200002530873 400, BIC : BEBEDEBBXXX.
Privileges: Sitzungsberichte der $B M G$ at reduced rate.
Officers: Rudolf Baierl (President), Gerhard Preuss (VicePresident), Jörg Schmid-Kikuchi (Treasurer), Wolfgang Volk (Secretary).

## Croatian Mathematical Society

Apply to: Dr. Renata Svedrec, Secretary, HMD, Department of Mathematics, Bijenička 30, 10000 Zagreb, Croatia; email: hmd@math.hr; http://www.math.hr/hmd.

Dues: U.S. \$10, payable to HMD, Zagrebačka banka d.d. Zagreb, 2500-03688780-IBAN: HR442360000-1101530802.
Privileges: Vjesnik HMD (in Croatian) and one of five journals edited by CMS free of charge. All publications of the CMS and all fees reduced by at least $25 \%$.
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Apply to: Gregory Makrides, 36 Stasinou Street, Suite 102, Strovolos 2003, Nicosia, Cyprus; email: cms@cms. org.cy.
Dues: U.S. \$20, payable to Cyprus Mathematical Society at the above address.
Privileges: Receive the annual periodical Mathematiko VEMA in Greek. Invitations to conferences organized in Cyprus and the Annual Summer Math School organized in Cyprus at the end of June.
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## Dansk Matematisk Forening (Danish Mathematical Society)

Address for mail: c/o President Vagn L. Hansen, Department of Mathematics, Building 303 S, Technical University of Denmark, DK-2800 Kongens Lyngby, Denmark; email: dmf@mathematics.dk/; http://www. mathematics.dk/.
Apply to: Please use the electronic form at http:// www.mathematics.dk/.
Dues: DKK 155, payable to Carsten L. Petersen, Treasurer, Department of Science, NSM, Roskilde University (RUC), Building 27.2, Universitetsvej 1, Postbox 260, DK-4000 Roskilde, Denmark.
Privileges: Mathematica Scandinavica (750 DKK per year), Nord. Mat. Tidss. (Normat) (320 SEK per year). Members of the American Mathematical Society do not have to join Dansk Matematisk Forening to obtain the journals. Subscription orders should be sent directly to the journals: Normat, NCM Göteborgs Université, Box 160, SE-405 30 Gothenburg, Sweden; Mathematica Scandinavica, Matematisk Institut, Aarhus Universitet, 8000 Aarhus C, Denmark. Members of the American Mathematical Society who join the Danish Mathematical Society as reciprocity members will receive the newsletter Matilde.
Officers: Vagn Lundsgaard Hansen (President), Poul Hjorth (Vice-President), Carsten Lunde Peterson (Treasurer), Poul Hjorth (Secretary).

## Deutsche Mathematiker-Vereinigung e.V. (DMV) (German Mathematical Society)

Apply to: Mrs. Roswitha Jahnke, DMV-Office, c/o WIAS,

Mohrenstr. 39, 10117 Berlin, Germany; email: dmv@wiasberlin.de; http://dmv.mathematik.de.
Dues: 23 euros, payable to Deutsche MathematikerVereinigung e.V. Volksbank Freiburg, Konto: 6955002, BLZ: 680900 00, IBAN: DE 666809000000069550 02, BIC: GENODE61FR1.
Privileges: Free subscription to: Mitteilungen der Deutschen Mathematiker-Vereinigung. Discounts on one of three publications: Jahresbericht der Deutschen Mathematiker-Vereinigung, Math. Semesterberichte, Journal für Mathematik-Didaktik. Discounted registration rates at DMV meetings.
Officers: Guenter M. Ziegler (President), Wolfgang Lueck (Vice-President), Juerg Kramer (Treasurer), Guenter Toerner (Secretary).

## Edinburgh Mathematical Society

Apply to: Dr. A. D. Gilbert, Honorary Secretary, Edinburgh Mathematical Society, James Clerk Maxwell Building, King's Buildings, Mayfield Road, Edinburgh EH9 3JZ, Scotland; email: edmathsoc@maths.ed.ac.uk; http://www.maths.ed.ac.uk/~ems/.
Dues: U.S. $\$ 20$ ( $£ 10$ sterling) without Society's proceedings, U.S. $\$ 50$ (£25 sterling) with Society’s proceedings, payable to the Honorary Secretary, as above.
Privileges: The Society's proceedings are available at a concessionary rate; see above.
Officers: C. M. Campbell (President), P. J. Davies (VicePresident), M. A. Youngson (Treasurer), A. D. Gilbert and T. H. Lenagan (Secretaries).

## European Mathematical Society

Apply to: Riitta Ulmanen, Department of Mathematics and Statistics, P.O. Box 68, University of Helsinki, F100014, Helsinki, Finland. email: ems-office@helsinki. fi; http://www.euro-math-soc.eu.
Dues: 44 euros, payable either via Web or to Riitta Ulmanen at the above address.
Privileges: An AMS member has a privilege to pay 44 euros instead of 88 euros and receive EMS Newsletter.
Officers: Ari Laptev (President), P. Exner and H. Holden (Vice-Presidents), Jouko Väänänen (Treasurer), Stephen Huggett (Secretary)

## Gesellschaft für Angewandte Mathematik und Mechanik e.V. (GAMM)*

Address for mail: V. Ulbricht, Institut für Festkörpermechanik, Technische Universität Dresden, 01062 Dresden, Germany; email: Gamm@mailbox.tu-dresden.de; http://www.gamm-eV.de.
Apply to: R. Kienzler, Universität Bremen, Fachbereich Produktionstechnik, Postfach 330440, 28334 Bremen, Germany.

Dues: 51 euros, payable to A. Frommer, Bergische Universität Wuppertal, Fachbereich C-Mathematik, 42097 Wuppertal, Germany.
Privileges: Regular publications of GAMM and participation in scientific meetings at a reduced rate.
Officers: R. Jeltsch (President), F. Pfeiffer (Vice-President), A. Frommer (Treasurer), V. Ulbricht (Secretary), R. Kienzler (Vice-Secretary).

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Apply to: Frances Goldman, Treasurer, Glasgow Mathematical Association, Department of Mathematics, University of Glasgow, Glasgow G12 8QW, United Kingdom; email: fhg@maths.gla.ac.uk; http://www.maths.gla. ac.uk/.
Dues: $£ 7$, payable to Glasgow Mathematical Association, at the above address.
Privileges: Glasgow Mathematical Journal at reduced rate (£45).
Officers: A. Craw (President), F. Goldman (Treasurer), L. Moon (Secretary).

## Hellenic (Greek) Mathematical Society*

Apply to: Hellenic Mathematical Society, 34, Panepistimiou Street, 10679 Athens, Greece; email: info@hms. gr; http://www.hms.gr/.
Dues: U.S. $\$ 20$ payable to Hellenic Mathematical Society at the above address.
Privileges: The Bulletin of HMS, News-Bulletin (Enimerosi), discounts that are available to all members.
Officers: Nikolaos Alexandris (President), George Dimakos and Dionysios Anapolitanos (Vice-Presidents), Evaggelos Eustathiou (Treasurer), Ioannis Tyrlis (Secretary).

## Icelandic Mathematical Society*

Address for mail: Icelandic Mathematical Society, Raunvisindastofnun Haskolans, Dunhaga 3, IS-107 Reykjavik, Iceland; email: kristjanj@simnet.is; http:// www. vedur.is/is/.
Apply to: Dr. Kristjän Jonasson at the above address.
Dues: U.S. \$12, payable to Dr. Hersir Sigurgeirsson at the above address.
Privileges: Reduced subscription rate on Mathematica Scandinavia and Nordisk matematisk Tidskrift (Normat); subscription orders should be sent directly to the journals.
Officers: Kristjän Jonasson (President), Hersir Sigurgeirsson (Treasurer), Fjola Run Björnsdóttir (Secretary).

## Irish Mathematical Society

Address for mail: Shane O'Rourke, Department of Mathematics, Bishopstown Campus, Cork Intitute of

Technology, Cork, Ireland; email: Shane.ORourke@cit. ie.
Apply to: Sinead Breen, St. Patrick's College, Drumcondra, Dublin 9, Ireland; email: sinead.breen@spd.dcu.ie.
Dues: U.S. $\$ 10$ (2008), $\$ 15$ (2009), payable to Irish Mathematical Society, Sinead Breen, RM. MOV30A, St. Patrick's College, Drumcondra, Dublin 9, Ireland.
Privileges: Free copy of the Bulletin of the Irish Mathematical Society (two times per year); free registration at IMS annual conference (September).
Officers: R. Higgs (President), J. Cruickshank (VicePresident), Sinead Breen (Treasurer), Shane O’Rourke (Secretary).

## János Bolyai Mathematical Society*

Apply to: Cecilia Kulcsár, Executive Director, János Bolyai Mathematical Society, Fö utca 68, H-1027 Budapest, Hungary; email: bjmt@renyi.hu.
Dues: Are voluntary but should minimally cover duplication and mailing costs; for reciprocity members (residing outside Hungary) suggested fee is $1 / 8$ of 1 percent of the member's net income, payable to Kereskedelmi ES Hitelbank P.T., Account Number 10200830-32310243. Sponsoring members pay at least U.S. $\$ 180$ or equivalent per year.
Privileges: Upon request, Matematikai Lapok (twice a year), Középiskolai Matematikai Lapok (monthly). If sufficient interest is expressed, a bulletin in English will be available. In addition, the JBMS is negotiating to obtain discounts for its reciprocity and sponsoring members on several serial publications and periodicals appearing in Hungary. Contact the JBMS secretary for more information regarding this and other privileges of membership.
Officers: Gyula Katona (President), Cecilia Kulcsár (Executive Director), György Lippner (Treasurer), András Recski (Secretary General), Tibor Jordán (Vice Secretary General).

## Jednota českých matematiků a fyziků (Union of Czech Mathematicians and Physicists)*

Apply to: Jan Kratochvíl, Union of Czech Mathematicians and Physicists, Žitná 25, 11710 Praha 1, Czech Republic; email: jcmf@math.cas.cz; http://www.jcmf.cz.
Dues: U.S. \$20, payable to Jan Obdržálek at the above address.
Privileges: (i) A discount of $20 \%$ in the conference fees for conferences, symposia, summer schools, and similar events organized (or coorganized) by the JČMF; (ii) newsletter.

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Address for mail: Secretary of JSMF, FMFI UK Pavilon F1, Mlynská dolina, 84248 Bratislava, Slovak Republic; email: JSMF@CENTER.FMPH.UNIBA.SK; http://www.uniba. sk/~jsmf.
Apply to: Hilda Draškovičová, FMFI UK, KATC, Mlynská dolina, 84248 Bratislava, Slovak Republic.
Dues: U.S. \$20, payable to Slovenská sporitel'ňa, Záhradnicka 93, 8000 Bratislava, Slovak Republic; č.u.: 101848-019/0900 IČO: 178705.
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Officers: Victor Bezak (President), Hilda Draškovičová (Vice-President), Edmund Dobročka (Treasurer), Imrich Morva (Secretary).

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Dues: 50 euros.
Privileges: Free periodical Nieuw Archief voor Wiskunde.
Officers: H. W. Broer (President), G. Vegter (VicePresident), S. Bhulai (Treasurer), R. van der Mei (Secretary).

## London Mathematical Society

Apply to: Miss Susan M. Oakes, London Mathematical Society, De Morgan House, 57-58 Russell Square, London WC1B 4HS, United Kingdom; email: membership@lms. ac.uk; http://www.lms.ac.uk/.
Dues: U.S. $\$ 43.50$ payable to London Mathematical Society at the above address.
Privileges: LMS Newsletter; reduced rates for the Bulletin, Journal, and Proceedings of the LMS; Nonlinearity; LMS Lecture Notes; LMS Student Texts; LMS Monographs. (Please write to the LMS for complete details.)
Officers: E. B. Davies (President), D. G. Larman and F. A. Rogers (Vice-Presidents), N. M. J. Woodhouse (Treasurer), P. R. Cooper (Executive Secretary).

## Mathematical Society of Serbia*

Apply to: Milica Babić, Mathematical Society of Serbia, Knez Mihailova 35/IV, p.p. 355, 11000 Belgrade, Serbia; email: info@dms.org.yu; http://www.dms.org.yu.
Dues: U.S. \$12, payable to DRUS̄TVO MATEMATIC̄ARA SRBIJE Acct. No. 250-6498-06, NACIONALNA S̄TEDIONICA. Privileges: Matematički Vesnik, Teaching of Mathematics. Officers: Branislav Popović (President), Zoran Kadelburg (Vice-President), Milica Babić (Treasurer), Biljana Babić (Secretary).

## Norsk Matematisk Forening (Norwegian Mathematical Society)*

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Dues: NOK 100, payable to Øyvind Solberg at the above address.
Privileges: All regular membership privileges, including the monthly newsletter Infomat.
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Apply to: Robert F. Tichy, Institut für Mathematik, Technische Universität Graz, Steyrergasse 30, A-8010 Graz, Austria; email: oemg@oemg.ac.at; http://www. oemg.ac.at/.
Dues: 20 euros, payable to ÖMG, Wiedner Hauptstr. 8, A-1040 Wien, Bank Austria-Creditanstalt, IBAN: AT 83 12000229 10389200, BIC: BKAUATWW.
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Apply to: Maciej Czarnecki, ZG PTM, ul. Śniadeckich 8, 00-956 Warszawa, Poland; email: zgptm@ptm.org.pl; http://www.ptm.org.pl.
Dues: U.S. \$22, payable to Polskie Towarzystwo Matematyczne, ul. Šniadeckich 8, 00-956 Warszawa, Poland, KREDYT BANK S.A., IBAN: PL 981500177712177008 43490000 , BIC: KRDBPL.
Privileges: Members receive one of the following five series of the publication Annales Societatis Mathematicae Polonae: Commentationes Mathematicae, Wiadomości Matematyczne (in Polish), Matematyka Stosowana (in Polish), Didactica Mathematicae (in Polish), Antiquitates Mathematicae (in Polish).
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Apply to: Pablo Fernández, Secretaria de la Real Sociedad Matemática Española, Facultad de Matematicas, Despacho 525, Universidad Complutense de Madrid, 28040 Madrid, Spain; email: secretaria@rsme.es; http://www.rsme. es.
Dues: 23,50 euros, payable to Real Sociedad Matemática Española at the above address.

Privileges: La Gaceta de la Real Sociedad Matemática Española (paper and Web access), 4 issues per year; Boletín de la RSME (electronic newsletter).
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Apply to: Carlos Castro (Secretary), Despacho 520, Facultad de Matematicas, Universidad Complutense, 28040 Madrid, Spain; email: info@sema.org.es; http: //www.sema.org.es.
Dues: 15 euros, payable to SEMA at the above address.
Privileges: Information concerning applied mathematics in Spain through Boletín de la SEMA, reduced inscription fee for activities sponsored by SEMA.
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Dues: 40 euros; reciprocity members and students: 20 euros, payable to the Sociedade Portuguesa de Matemática, at the address above.
Privileges: Each member receives the following publication of our Society free of charge: Boletim da Sociedade Portuguesa de Matemática and Gazeta de Matemática.
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## Societat Catalana de Matemàtiques*

Address for mail: Carrer del Carme 47, 08001, Barcelona, Spain; email: scm@iec.cat; email: nfuster@iec.cat; http://scm.iec.cat.
Apply to: Secretary, Catalan Mathematical Society, at the address above.
Dues: 16 euros, payable to the Societat Catalana de Matemàtiques.
Privileges: Butlletí de la Societat Catalana de Matemàtiques (two times per year) plus SCM/Notices (two times per year).
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## Societatea Matematicienilor din Romania*

Apply to: Horia I. Ene, Calea Grivitei 21, P. O. Box 1-764, 70700 Bucvharest, Romania.

Dues: U.S. \$10, payable to Societatea Matematicienilor din Romania at the address above.
Privileges: Reduced rates for participation in scientific conferences organized by SMR, Bulletin Mathématiques (four times per year) free.
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## Societatea de Ştiințe Matematice din România

Apply to: Radu Gologan, President, Str. Academiei, NR. 14, Sector 1, 010014, Bucureşti, Rômania; email: office@rms.unibuc.ro; http://www.rms.unibuc.ro.
Dues: U.S. $\$ 15 / \$ 30$ (see privileges below), payable to Societatea de Ştiințe Matematice din România, Account R008 RNCB 007600435732 0002, Banca Comerciala Romana, Filiala Sector 5, Bucuresti, Romania.
Privileges: For membership dues of U.S. \$30, free subscription to one of the Society's journals. When participating in the annual meetings of the Society, all AMS members are exempt from taxes.
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## Société Mathématique de France

Apply to: Société Mathématique de France, Attn. Claire Ropartz, Institut Henri Poincaré, 11 Rue Pierre et Marie Curie, F-75231 Paris cedex 05, France; email: smf@dma. ens.fr; http://smf.emath.fr/.
Dues: U. S. \$49, payable to the American Mathematical Society or SMF
Privileges: Bulletin, U.S. \$134; Memoires, U.S. \$137; Bulletin and Mémoires, U.S. \$310; Bulletin (version électronique seule), U.S. \$133; Astérisque, U.S. \$550; Histoire des Mathématiques, U.S. \$83; Histoire des Mathématiques (version électronique seule), U.S. \$63; Panoramas et Synthèses, U.S. \$99; Annales scientifiques de l'ENS, U.S. \$525.
Officers: St. Jaffard (President), L. Di Vizio, F. Germinet, M. Granger (Vice-Presidents), M. Vigue (Treasurer), P. Loidreau (Secretary).

## Société Mathématique du Luxembourg

Apply to: Norbert Poncin, Société Mathématique du Luxembourg, Université du Luxembourg, Campus Limpertsberg, 162A, Avenue de la Faïencerie, L-1511 Luxembourg, Luxembourg; email: norbert.poncin@uni.lu; http:// math.uni.lu/sml.
Dues: 20 euros (less discount), payable to Société Mathématique du Luxembourg at the above address.
Privileges: Discount on membership dues (same percent as for AMS); information concerning activities of the SML.

Officers: Norbert Poncin (President), Martin Schlichenmaier (Vice-President), Jean Schiltz (Treasurer), Jean-Luc Marichal (Secretary).

## Société de Mathématiques Appliquées et Industrielles (SMAI)

Apply to: Société de Mathématiques Appliquées et Industrielles (SMAI), Institut Henri Poincaré, 11 rue Pierre et Marie Curie, 75231 Paris cedex 05, France; email: smai@emath.fr; http://smai.emath.fr/.
Dues: 40 euros, payable to Société de Mathématiques Appliquées et Industrielles at the above address.
Privileges: Free subscription to the Society's bulletin, Matapli (magazine); lettre SMAI-INFO (regular electronic newsletter).
Officers: Denis Talay (President), Patrick Lascaux (VicePresidents), Robert Eymard (Treasurer), Serge Piperno (Secretary).

## Society of Associations of Mathematicians and Computer Scientists of Macedonia*

Apply to: Boro Piperevski, President SAMCSM, Pirinska B.B., 91000 Skopje, Macedonia.

Dues: $\$ 5$, payable to SDMI na MAKEDONIA, acct. 40120-678-10217, Pirinska B.B., 91000 Skopje, Macedonia.
Privileges: Receiving the Bulletin of SAMCSM and taking part in SAMCSM activities.
Officers: Boro Piperevski (President), Borko Ilievski (VicePresident), Kosta Miševski (Treasurer), Vasile Marčevski (Secretary).

## Society of Mathematicians, Physicists, and Astronomers of Slovenia*

Address for mail: DMFA, P.P. 2964, 1000 Ljubljana, Slovenia; email: tomaz.pisanski@fmf.uni-lj.si; http://www.dmfa.si/.
Apply to: Tomaž Pisanski at the above address.
Dues: SKB Banka D. D., Ajdovscina 4, SWIFT (BIC): SKBASI2X, IBAN: SI56 03100100001878
Privileges: Subscription to Obzornik za matematiko in fiziko (surface mail).
Officers: Zvonko Trontelj (President), Nada Razpet (Vice-President), Andreja Jaklič (Treasurer), Janez Krušič (Secretary).

## Suomen matemaattinen yhdistys (Finnish Mathematical Society)

Address for mail: Department of Mathematics and Statistics, P. O. Box 68 (Gustaf Hällströmin katu 2b), 00014 University of Helsinki, Finland; email: tadeas.priklopil@ helsinki.fi; http://www.math.helsinki.fi/~smy/ english/.

Apply to: Tadeas Priklopil, Secretary, at the above address.
Dues: 15 euros, payable to Jari Taskinen, Treasurer, at the above address.
Privileges: Arkhimedes (six issues per year) and Eukleides (newsletter), Mathematica Scandinavica at reduced price. Officers: Mats Gyllenberg (President), Marjatta Näätänen (Vice-President), Jari Taskinen (Treasurer), Tadeas Priklopil (Secretary).

## Svenska Matematikersamfundet

Address for mail: Nils Dencker, Matematikcentrum, Lund University, Box 118, SE-221 00 Lund, Sweden; email: dencker@math.lth.se;
http://www.matematikersamfundet.org.se.
Apply to: Milagros Izquierdo Barrios, MAI, Linköping University, SE-581 83 Linköping, Sweden.
Dues: 100 Swedish crowns, payable to Milagros Izquierdo Barrios at above address.
Privileges: Mathematica Scandinavia and Nordisk Matematisk Tidskrift at reduced rates. Newsletter (Utskicket) about the activities and meetings of the Society.
Officers: Nils Dencker (President), Tobias Ekholm (VicePresident), Milagros Izquierdo Barrios (Treasurer), Pavel Kurasov (Secretary).

## Swiss Mathematical Society

Address for mail: Swiss Mathematical Society, Department of Mathematics, University of Fribourg, Perolles, Chemin du musee 23, 1700 Fribourg, Switzerland; email: viktor.schroeder@math.uzh.ch; http://www.math.ch.
Apply to: Above address; email: norbert. hungerbuehler@ unifr.ch; http://www.math.ch.
Dues: 50 CHF or 34 EUR if residing in Switzerland, 25 CHF or 17 EUR if residing outside Switzerland, payable by check to SMS, Louise Wolf, P. O. Box 300, CH-1723 Marly 1, Switzerland or by bank transfer to "Credit Suisse (Switzerland) IBAN: 350483502658920000 0, BIC: CRESCHZZ80A.
Privileges: Commentarii Mathematici Helvetici (special price), Elemente der Mathematik (special price), Electronic Newsletter (free), information concerning activities of SMS.
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## Ukrainian Mathematical Society*

Apply to: A. S. Serdyuk, Institute of Mathematics, National Academy of Sciences, Ukraine, Tereschenkivskaja str., 3, 01601 Kyiv-4, Ukraine; email: sam@imath.kiev.ua. Dues: U.S. $\$ 30$, payable to N. A. Nazarenko at the above address.
Privileges: All privileges of a normal individual UMS member.

Officers: A. M. Samoilenko (President), M. L. Gorbachuk (Vice-President), N. A. Nazarenko (Treasurer), A. S. Serdyuk (Secretary).

## Union of Bulgarian Mathematicians*

Apply to: Sava Ivanov Grozdev, Secretary, Union of Bulgarian Mathematicians, Acad. G. Bonchev Str., Block 8, BG-1113 Sofia, Bulgaria.
Dues: 20 USD, payable to Union of Bulgarian Mathematicians, Account \#1100366612, BULBANK AD Central office, code 62196214.
Privileges: The right to attend all events organized by the UBM at reduced rate and to present papers at them, the right to attend other events in Bulgaria at a reduced rate, and the right to purchase all UMB editions at a reduced rate.
Officers: St. Dodunekov (President), I. Tonov, O. Mushkarov, R. Nikolaev (Vice Presidents).

## Unione Matematica Italiana

Apply to: Giuseppe Anichini, Segreteria dell'Unione Matematica Italiana, Dipartimento di Matematica, Piazza Porta S. Donato, 5, 40126 Bologna, Italy; email: umi@dm. unibo.it; http://umi.dm.unibo.it/.
Dues: 50 euros, payable to Unione Matematica Italiana. Privileges: Free Notiziario dell'UMI (10 issues a year), Rivista la Matematica nella Societa e nella cultura (ex Sez. A).

Officers: Franco Brezzi (President), Graziano Gentili (Vice-President), Barbara Lazzari (Treasurer), Giuseppe Anichini (Secretary).

## Middle East

## Iranian Mathematical Society*

Apply to: M. Shokouhi, Iranian Mathematical Society, P.O. Box 13145-418, Tehran, Iran; email: iranmath@ims.ir; http://www.ims.ir.
Dues: U.S. $\$ 45$ payable to Iranian Mathematical Society at the above address.
Privileges: Bulletin of the Iranian Mathematical Society (two issues per year in English), Farhang va Andisheh Riazi (two issues per year in Persian), Khabarnameh and Gozaresh (8 issues per year in Persian), and reduced rate for participation in the conferences and seminars organized by IMS.
Officers: A. R. Medghalchi (President), M. J. Mamayhani (Treasurer).

## Israel Mathematical Union (IMU)*

Address for mail: Israel Mathematical Union, Department of Mathematics, Ben Gurion University, Be'er Sheva

84105, Israel; email: imu@imu.org.il; http://www.imu. org.il
Apply to: Barak Weiss, Secretary, at the above address. Dues: 50 Israeli shekels for two years.
Privileges: Participation in meetings and all other privileges enjoyed by an ordinary member.
Officers: Michael Lin (President), Ilan Hirshberg (Treasurer), Barak Weiss (Secretary).

## Palestinian Society for Mathematical Sciences*

Address for mail: Mathematics Department, Birzeit University, P. O. Box 14, West Bank, Palestine.
Apply to: Fawzi Yagoub, Department of Mathematics and Computer Science, SUNY College at Fredonia, Fredonia, NY 14063.
Dues: U.S. \$30, payable to Fawzi Yagoub; see address above.
Privileges: Free issues of the PSMS Newsletter, 50\% reduction on all PSMS conference fees, $50 \%$ reduction on all PSMS publications.
Officers: Mohammad Al-Amleh (President); Mohammad Saleh, Tahseen Mughrabi (Vice-Presidents); Raghib Abu Saris, Nur edden Rabei, Mohammad El-Atrash, Taha Abu Kaf, Saber Elaydi (Members).

## Saudi Association for Mathematical Sciences*

Apply to: M. A. Alabdullatif, President, King Saud University, College of Science, P. O. Box 2455, Riyadh 11451, Saudi Arabia.
Dues: U.S. \$30, payable to Saudi Association for Mathematical Sciences at the above address.
Privileges: Reduction in membership fee from U.S. \$40 to U.S. $\$ 30$; proceedings of conferences, symposia, and seminars arranged by the Association.
Officers: M. A. Alabdullatif (President), A. Alshihah (Vice-President), M. A. Aseerj (Treasurer), M. S. Qutaifan (Secretary).

## South Pacific

## Australian Mathematical Society Inc.

Address for mail: Department of Mathematics, University of Queensland, Brisbane, Queensland 4072, Australia; email: Secretary@austms.org.au; http://www.austms. org.au/.
Apply to: The Business Manager, Australian Mathematical Society, Department of Mathematics, Australian National University, Canberra ACT 0200, Australia.
Dues: \$AUD 52 (in 2008), payable to the Australian Mathematical Society, c/o The Business Manager, at the above address.

Privileges: Complimentary issues of The Gazette (five issues in 2008), Journal AustMS-Pure Mathematics and Statistics (\$AUD 66), ANZIAM Journal (\$AUD 57), Bulletin of AustMS (\$AUD 63). Reduced price for volumes in Lecture Series and reduced registration at conferences sponsored by AustMS.
Officers: P. G. Hall (President); P. G. Taylor and S. O. Warnaar (Vice-Presidents); N. Joshi (Incoming President); A. Howe (Treasurer); E. J. Billington (Secretary).

## New Zealand Mathematical Society

Address for mail: New Zealand Mathematical Society, c/o Dr. Winston Sweatman (NZMS Secretary), Institute of Information and Mathematical Sciences, Massey University at Albany, Private Bag 102904, North Shore 0745, Auckland, New Zealand; email: w.sweatman@massey.ac.nz; http://www.math.waikato.ac.nz/NZMS/NZMS.html.
Apply to: Dr. John Shanks, Department of Mathematics and Statistics, University of Otago, P.O. Box 56, Dunedin, New Zealand.
Dues: NZ\$20 payable to Dr. John Shanks at above address.
Privileges: Newsletter of the NZMS (three per year).
Officers: Robert McLachlan (President), Gaven Martin (Vice-President), Tammy Smith (Treasurer), Winston Sweatman (Secretary).


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# Mathematics Calendar 

## November 2008

* 7-8 Prairie Analysis Seminar 2008, University of Kansas, Lawrence, Kansas.
Description: This seminar is the eighth in a sequence of yearly analysis meetings organized each fall by the Departments of Mathematics at the University of Kansas and Kansas State University. The goal is to provide an opportunity for scientific exchange and cooperation among analysts. There will be time allocated for short contributed talks by participants. Priority will be given to graduate and postdoctoral students and those in early stages of their careers.
Principal Lecturer: Eric Sawyer.
Invited Speakers: Xiaochun Li and Carlos Perez.
Organizers: Estela A. Gavosto, KU; Marianne Korten, KSU; Charles Moore, KSU; Rodolfo H. Torres, KU.
Information: http://www.math.ku.edu/conferences/ prairie/prairie08/; email: torres@math.ku.edu.
*9-14 22nd Large Installation System Administration Conference (LISA ‘08), North San Diego, California.
Description: The annual LISA conference is the meeting place of choice for system and network administrators. System administrators of all specialties and levels of expertise meet at LISA to exchange ideas, sharpen old skills, learn new techniques, debate current issues, and meet colleagues and friends.
Information: http://www.usenix.org/events/lisa08/; email: jpeterson@usenix.org.
*24-28 Expository Quantum Lecture Series 2 (EQuaLS2): "Foundations of Quantum Science \& Technology 2008", Institute for Math-
ematical Research, University Putra Malaysia, Serdang, Selangor Darul Ehsan, Malaysia.
Description: Expository Quantum Lecture Series (EQuaLS) is a series of lectures conducted by members of Laboratory of Computational Sciences \& Informatics, Institute for Mathematical Research and Physics Department, Faculty of Science. The main objective of this lecture series is to rapidly introduce and update researchers and students with the latest developments and techniques in quantum science and technology or related areas. This year's lecture series will be on "Foundations of Quantum Science \& Technology 2008".
Information: http://www.inform.upm.edu.my/equals2/; email: hisham@fsas.upm.edu.my.


## December 2008

* 29-31 VI International Symposium on Optimization and Statistics (ISOS-2008), Aligarh Muslim University, Aligarh, India.
Description: The aim of holding the symposium is to disseminate and highlight the current researches in all the branches of Statistics and Operations Research.
Enquiries: All the queries/correspondence regarding registration, abstract/paper submission, accommodation, travel etc. should be addressed to: Professor A. H. Khan, Director International Symposium 2008, Department of Statistics and Operations Research, Aligarh Muslim University, Aligarh-202 002, India; Phone: +91 5712701251 (Dept.), +91 5712720601 (Res.); Cell \#: + 919411047042 ; email: ahamidkhan@rediffmail.com; chairman.stats@gmail.com; or Professor M. J. Ahsan, Department of Statistics and Operations Research, Aligarh Muslim University, Aligarh-202 002, India; Cell \#:

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 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. 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/.
+919897356448; email: mjahsan2001@yahoo.co.in; http:// www. amu.ac.in/shared/sublinkimages/isos2008.pdf.
January 2009

* 1-June 30 Research Program on Mathematical Biology: Modelling and Differential Equations: An i-MATH activity, Centre de Recerca Matemática, Bellaterra, Spain.
Information: http://www.crm.cat/Research/0809/ MathematicalBiology/.

February 2009

* 1-July 15 Research Programme on Harmonic Analysis, Geometric Measure Theory and Quasiconformal Mappings: An i-MATH activity, Centre de Recerca Matem $\dagger$ mática, Bellaterra, Spain.
Information: http://www.crm.cat/Research/0809/ Harmonic/.
*3-7 30th Linz Seminar on Fuzzy Set Theory, Bildungszentrum St. Magdalena, Linz, Austria.
Description: The 30th Linz Seminar is devoted to the theme "The Legacy of 30 Seminars: Where Do We Stand and Where Do We Go?". Different to previous years, the scope of the seminar does not restrict to a single sub-topic of fuzzy set theory. Instead, the goal is to view fuzzy set theory and the past and future contributions of the Linz seminars from additional perspectives. We want to determine the state of the art achieved within fuzzy set theory, to ask for the impacts on other fields (of mathematics and applications), and to discuss their future research directions and applications.
Information: http://www.flll.jku.at/research/linz2009/ index.html; email: fabrizio.durante@jku.at.
* 16-20 Workshop on Complex Geometry, University of Adelaide, Australia.
Speakers: N. Buchdahl, M. Eastwood, P. Ebenfelt, V. Ejov, F. Forstneric, R. Gover, A. Harris, A. Isaev, F. Larusson, C. LeBrun (to be confirmed), A. Neeman, G. Schmalz.

Organizers: N. Buchdahl, M. Eastwood, F. Larusson.
Information: There is no formal registration process or fee, but please let the organizers know if you plan to attend the workshop. There are still slots available for additional speakers. Limited financial support is available. Please contact the organizers by October 15, 2008, if you are interested; http://maths.adelaide.edu.au/~flarusson/ workshop.html; email: finnur.larusson@adelaide.edu.au.

## March 2009

* 22-26 SETIT 2009: The Fifth International Conference on Sciences of Electronic, Technologies of Information and Telecommunications, Hammamet, Tunisia.
Sponsor: SETIT2009 is technically co-sponsored by IEEE.
Information: You can find more details in: http://www. setit. rnu.tn.
May 2009
* 7-9 8th Mississippi State: UAB Conference on Differential Equations and Computational Simulations, Mississippi State University, Mississippi State, Mississippi.
Description: This Conference will provide a joint forum where academia and industry can exchange research ideas involving theoretical and applied developments in differential equations and computational simulations.
Deadline: The deadline for pre-registration and submitting abstracts is March 31, 2009.
Principal Speakers: Douglas Arnold, University of Minnesota; Peter Bates, Michigan State University; Jack Benek, Wright-Patterson Air Force Base; Alfonso Castro, Harvey Mudd College; Pavel Drabek, University of West Bohemia, Czech Republic; Gisele Goldstein, University of Memphis; Philip Maini, University of Oxford, United Kingdom; Scott Morton, Eglin Air Force Base; Tinsley Oden, University of Texas at Austin; Stanley Osher, University of California at Los Angeles; Peter Polacik, University of Minnesota; Jere Segrest, University of Alabama at Birmingham; Allen Tannenbaum, Georgia Institute of Technology; Theresa Windus, Ames Lab, U.S. Department of Energy. Organizers: Ratnasingham Shivaji and Bharat Soni.

Information: http://www.msstate.edu/dept/math/events/ de.conf/de2009/; email: shivaji@ra.msstate.edu.

* 11-15 Workshop and Advanced Course on Deterministic and Stochastic Modelling in Computational Neuroscience and other Biological Topics, Barcelona, Spain.
Information: http://www. crm. cat.
* 12-14 7th International Symposium on Hysteresis Modeling and Micromagnetics (HMM-2009), Gaithersburg, Maryland.
Information: The symposium website is: http://www. metallurgy.nist.gov/magnet/hmm2009/.
June 2009
* 15-18 The 5th International Conference "Dynamical Systems and Applications", "Ovidius" University of Constantza, Constantza, Romania.
Information: http://www.univ-ovidius.ro/faculties/ civil\%5Feng/conferinta\%20iunie\%202009/Home.html; email: gherghinacristina@yahoo.com.
* 15-19 Conference on Harmonic Analysis, Geometric Measure Theory and Quasiconformal Mappings, Barcelona, Spain.
Information: http://www.crm.cat.
*21-27 Eighth International Conference on Symmetry in Nonlinear Mathematical Physics, Institute of Mathematics, National Academy of Sciences of Ukraine, Kyiv (Kiev), Ukraine.
Topics: To be discussed at this conference include: Geometrical methods in mathematical physics, Lie theory and differential equations, classical and quantum integrable systems, dynamical systems and chaos, exactly and quasi-exactly solvable models, Lie groups and algebras, representation theory, orthogonal polynomials and special functions, quantum algebras, quantum groups and noncommutative geometry, supersymmetry and supergravity, strings and branes, cosmology and quantum gravity.
Information: http://www.imath.kiev.ua/~appmath/conf. html; email: vaneeva@imath.kiev.ua.
July 2009
*20-24 AIP (Applied Inverse Problems), Vienna, Austria.
Description: AIP is a well-established conference series dealing with all aspects of inverse problems.
Information: See http://aip.disi.unige.it/;
*27-30 The Society for Mathematical Biology Annual Meeting, University of British Columbia, Vancouver, Canada.
Description: The annual meeting of the Society for Mathematical Biology highlights a broad spectrum of cutting-edge research on the interface between mathematics and biology.
Information: http://www.math.ubc.ca/Research/MathBio/ SMB2009/; email: cytryn@math.ubc.ca.


## September 2009

* 15-18 Bogolyubov Kyiv Conference: "Modern Problems of Theoretical and Mathematical Physics", Bogolyubov Institute for Theoretical Physics, Kyiv, Ukraine.
Description: The National Academy of Sciences of Ukraine, the Bogolyubov Institute for Theoretical Physics and the Institute of Mathematics organize the Bogolyubov Kyiv Conference: "Modern Problems of Theoretical and Mathematical Physics" on the occasion of the 100th anniversary of Nikolai Bogolyubov.
Topics: Mathematical methods in theoretical physics, Particles and quantum field theory, Statistical physics and kinetic theory, Nuclei theory and nuclear reactions, Solid-state theory.
Information: http://www.bitp.kiev.ua/bogolyubov2009/; email: bogolyubov2009@bitp.kiev.ua.


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## Algebra and Algebraic Geometry

CONTEMPORARY MATHEMATICS


## Representation Theory of Real Reductive Lie Groups

James Arthur, University of Toronto, ON, Canada, Wilfried Schmid, Harvard University, Cambridge, MA, and Peter E. Trapa, University of Utah, Salt Lake City, UT, Editors

The representation theory of real reductive groups is still incomplete, in spite of much progress made thus far. The papers in this volume were presented at the AMS-IMS-SIAM Joint Summer Research Conference "Representation Theory of Real Reductive Lie Groups" held in Snowbird, Utah in June 2006, with the aim of elucidating the problems that remain, as well as explaining what tools have recently become available to solve them. They represent a significant improvement in the exposition of some of the most important (and often least accessible) aspects of the literature.
This volume will be of interest to graduate students working in the harmonic analysis and representation theory of Lie groups. It will also appeal to experts working in closely related fields.
Contents: J. Adams, Guide to the Atlas software: Computational representation theory of real reductive groups; J. Arthur, Problems for real groups; D. Barbasch, D. Ciubotaru, and A. Pantano, Unitarizable minimal principal series of reductive groups; B. Casselman, Computations in real tori; W. Hoffmann, Weighted orbital integrals; J.-P. Labesse, Introduction to endoscopy; D. Shelstad, Tempered endoscopy for real groups I: Geometric transfer with canonical factors.
Contemporary Mathematics, Volume 472
November 2008, 246 pages, Softcover, ISBN: 978-0-8218-4366-6, LC 2008024593, 2000 Mathematics Subject Classification: 22E15, 22E30, 22E45, 22E46, 22E47, 22E50, 20G05, AMS members US\$63, List US\$79, Order code CONM/472


# Representations of Shifted Yangians and Finite $W$-algebras 

Jonathan Brundan and Alexander Kleshchev, University of Oregon, Eugene, OR

Contents: Introduction; Shifted Yangians; Finite $W$-algebras; Dual canonical bases; Highest weight theory; Verma modules; Standard modules; Character formulae; Notation; Bibliography.
Memoirs of the American Mathematical Society, Volume 196, Number 918

November 2008, 107 pages, Softcover, ISBN: 978-0-8218-42164, LC 2008030300, 2000 Mathematics Subject Classification: 17B37, 17B10, Individual member US\$38, List US\$63, Institutional member US\$50, Order code MEMO/196/918

## Analysis



## The Topological Dynamics of Ellis Actions

Ethan Akin, City College, CUNY, New York, NY, Joseph Auslander, University of Maryland, College Park, MD, and Eli Glasner, Tel Aviv University, Israel

Contents: Introduction; Semigroups, monoids and their actions; Ellis semigroups and Ellis actions; Continuity conditions; Applications using ideals; Classical dynamical systems; Classical actions: The group case; Classical actions: The Abelian case; Iterations of continuous maps; Table; Bibliography; Index.
Memoirs of the American Mathematical Society, Volume 195, Number 913

August 2008, 152 pages, Softcover, ISBN: 978-0-8218-4188-4, LC 2008021012, 2000 Mathematics Subject Classification: 20M20, 37B05, 37B20, 54H20, Individual member US\$41, List US\$69, Institutional member US\$55, Order code MEMO/195/913


> Long-Time Behavior of Second Order Evolution Equations with Nonlinear Damping

Igor Chueshov, Kharkov University, Ukraine, and Irena Lasiecka, University of Virginia, Charlottesville, VA

Contents: Introduction; Abstract results on global attractors; Existence of compact global attractors for evolutions of the second order in time; Properties of global attractors for evolutions of the second order in time; Semilinear wave equation with a nonlinear dissipation; Von Karman evolutions with a nonlinear dissipation; Other models from continuum mechanics; Bibliography; Index.

Memoirs of the American Mathematical Society, Volume 195, Number 912

August 2008, 183 pages, Softcover, ISBN: 978-0-8218-4187-7, LC 2008020750, 2000 Mathematics Subject Classification: 37L30; 34G20, 47H20, Individual member US\$44, List US\$74, Institutional member US\$59, Order code MEMO/195/912


> Special Functions and Orthogonal Polynomials

Diego Dominici, State University of New York at New Paltz, NY, and Robert S. Maier, University of Arizona, Tucson, AZ, Editors

This volume contains fourteen articles that represent the AMS Special Session on Special Functions and Orthogonal Polynomials, held in Tucson, Arizona in April of 2007. It gives an overview of the modern field of special functions with all major subfields represented, including: applications to algebraic geometry, asymptotic analysis, conformal mapping, differential equations, elliptic functions, fractional calculus, hypergeometric and $q$-hypergeometric series, nonlinear waves, number theory, symbolic and numerical evaluation of integrals, and theta functions. A few articles are expository, with extensive bibliographies, but all contain original research.
This book is intended for pure and applied mathematicians who are interested in recent developments in the theory of special functions. It covers a wide range of active areas of research and demonstrates the vitality of the field.
Contents: C. Balderrama and W. O. Urbina R., Fractional integration and fractional differentiation for $d$-dimensional Jacobi expansions; K. G. Boreskov, A. V. Turbiner, and J. C. López Vieyra, Sutherland-type trigonometric models, trigonometric invariants, and multivariate polynomials; R. P. Boyer and
W. M. Y. Goh, Polynomials associated with partitions: Asymptotics and zeros; S. Chakravarty and Y. Kodama, A generating function for the $N$-soliton solutions of the Kadomtsev-Petviashvili II equation; P. A. Clarkson, Asymptotics of the second Painlevé equation; M. W. Coffey, Evaluation of certain Mellin transformations in terms of the trigamma and polygamma functions; D. Crowdy and J. Marshall, Conformal maps to generalized quadrature domains; Á Elbert and M. E. Muldoon, Approximations for zeros of Hermite functions; H. Kazi and E. Neuman, Inequalities and bounds for elliptic integrals II; R. S. Maier, P-symbols, Heun identities, and ${ }_{3} F_{2}$ identities; D. Manna and V. H. Moll, An iterative method for numerical integration of rational functions; M. J. Schlosser, A Taylor expansion theorem for an elliptic extension of the Askey-Wilson operator; S. H. Son, Ramanujan's symmetric theta functions in his lost notebook; V. Varlamov, Integral representations for products of Airy functions and their fractional derivatives.
Contemporary Mathematics, Volume 471
November 2008, 218 pages, Softcover, ISBN: 978-0-8218-4650-6, LC 2008022201, 2000 Mathematics Subject Classification: 33-06, AMS members US\$55, List US\$69, Order code CONM/471


> The Mapping Class Group from the Viewpoint of Measure Equivalence Theory

Yoshikata Kida, Kyoto University, Japan, and Tohoku University, Sendai, Japan

Contents: Introduction; Property A for the curve complex; Amenability for the actions of the mapping class group on the boundary of the curve complex; Indecomposability of equivalence relations generated by the mapping class group; Classification of the mapping class groups in terms of measure equivalence I; Classification of the mapping class groups in terms of measure equivalence II; Appendix A. Amenability of a group action; Appendix B. Measurability of the map associating image measures; Appendix C. Exactness of the mapping class group; Appendix D. The cost and $\ell^{2}$-Betti numbers of the mapping class group; Appendix E. A group-theoretic argument for Chapter 5; Bibliography; Index.
Memoirs of the American Mathematical Society, Volume 196, Number 916
November 2008, 190 pages, Softcover, ISBN: 978-0-8218-4196-9, LC 2008030042, 2000 Mathematics Subject Classification: 20F38, 37A20, Individual member US\$44, List US\$74, Institutional member US\$59, Order code MEMO/196/916

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Eigenvalues and Completeness for Regular and Simply Irregular Two-Point Differential Operators

approximate solutions; The app determinant: Classification; Asymptotic expansion of solutions; The characteristic determinant; The Green's function; The eigenvalues for $n$ even; The eigenvalues for $n$ odd; Completeness of the generalized eigenfunctions; The case $L=T$, degenerate irregular examples; Unsolved problems; Appendix; Bibliography; Index.

Memoirs of the American Mathematical Society, Volume 195, Number 911

August 2008, 177 pages, Softcover, ISBN: 978-0-8218-4171-6, LC 2008020748, 2000 Mathematics Subject Classification: 34L10, 34L20; 47E05, Individual member US\$43, List US\$71, Institutional member US\$57, Order code MEMO/195/911


> Operator Algebras and Geometry

Hitoshi Moriyoshi, Keio University, Yokohama, Japan, and Toshikazu Natsume, Nagoya Institute of Technology, Japan

In the early 1980's topologists and geometers for the first time came across unfamiliar words like $C^{*}$-algebras and von Neumann algebras through the discovery of new knot invariants (by V. F. R. Jones) or through a remarkable result on the relationship between characteristic classes of foliations and the types of certain von Neumann algebras. During the following two decades, a great deal of progress was achieved in studying the interaction between geometry and analysis, in particular in noncommutative geometry and mathematical physics. The present book provides an overview of operator algebra theory and an introduction to basic tools used in noncommutative geometry. The book concludes with applications of operator algebras to Atiyah-Singer type index theorems. The purpose of the book is to convey an outline and general idea of operator algebra theory, to some extent focusing on examples.
The book is aimed at researchers and graduate students working in differential topology, differential geometry, and global analysis who are interested in learning about operator algebras.
Contents: $C^{*}$-algebras; $K$-theory; $K K$-theory; Von Neumann algebras; Cyclic cohomology; Quantizations and index theory; Foliation index theorems; References; Index.

Translations of Mathematical Monographs, Volume 237
December 2008, approximately 159 pages, Hardcover, ISBN: 978-0-8218-3947-8, LC 2008029381, 2000 Mathematics Subject Classification: 46L87, 46L80; 46L05, 46L10, AMS members US\$55, List US\$69, Order code MMONO/237

## MEMOIRS <br> Anesten wationatisel socity

Degree Theory for
Operators of Monotone
Type and Nonlinear Elliptic Equations with Inequality Constraints
$\qquad$ Nikolaos S. Papageorgiou Vasile Staicu (2) University, Athens, OH, Nikolaos S. Papageorgiou, National Technical University, Athens, Greece, and Vasile Staicu, University of Aveiro, Portugal

Contents: Introduction; Mathematical background; Degree theoretic results; Variational-hemivariational inequalities; Hemivariational inequalities with an asymmetric subdifferential; Bibliography.
Memoirs of the American Mathematical Society, Volume 196, Number 915

November 2008, 70 pages, Softcover, ISBN: 978-0-8218-41921, LC 2008030040, 2000 Mathematics Subject Classification: 35J85, 35J60, Individual member US\$35, List US\$59, Institutional member US\$47, Order code MEMO/196/915

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Proceedings of Symposia in
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Perspectives in
Partial Differential
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Analysis and Applications
A Volume in Honor of
Nladimir G. Maz'y's's 70th Birthday
Dorina Mitrea
Martus Mitrea
Edtors
4. American Mathematical Sociely
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Perspectives in Partial Differential Equations, Harmonic Analysis and Applications

A Volume in Honor of Vladimir G. Maz'ya's 70th Birthday

Dorina Mitrea and Marius Mitrea, University of Missouri, Columbia, MO, Editors

V. G. Maz'ya is widely regarded as a truly outstanding mathematician whose work spans 50 years and covers many areas of mathematical analysis.
This volume contains a unique collection of papers contributed on the occasion of Maz' ya's 70th birthday by a distinguished group of experts of international stature in the fields of Harmonic Analysis, Partial Differential Equations, Function Theory, Spectral Analysis, and History of Mathematics, reflecting the state of the art in these areas, in which Maz' ya himself has made some of his most significant contributions.

Contents: N. Arcozzi, R. Rochberg, and E. Sawyer, Capacity, Carleson measures, boundary convergence, and exceptional sets; J. Bourgain, On the absence of dynamical localization in higher dimensional random Schrödinger operators; H. Brezis and J. Van Schaftingen, Circulation integrals and critical Sobolev spaces: Problems of optimal constants; L. Capogna, N. Garofalo,
and D.-M. Nhieu, Mutual absolute continuity of harmonic and surface measures for Hörmander type operators; L. Gårding, Soviet-Russian and Swedish mathematical contacts after the war. A personal account; F. Gesztesy and M. Mitrea, Generalized Robin boundary conditions, Robin-to-Dirichlet maps, and Krein-type resolvent formulas for Schrödinger operators on bounded Lipschitz domains; S. Hofmann, A local Tb theorem for square functions; J.-P. Kahane, Partial differential equations, trigonometric series, and the concept of function around 1800: A brief story about Lagrange and Fourier; C. E. Kenig, Quantitative unique continuation, logarithmic convexity of Gaussian means and Hardy's uncertainty principle; J. L. Lewis, N. Lundström, and K. Nyström, Boundary Harnack inequalities for operators of $p$-Laplace type in Reifenberg flat domains; M. Lilli and J. F. Toland, Waves on a steady stream with vorticity; F. Nazarov and A. Volberg, On analytic capacity of portions of continuum and a question of T. Murai; B. Simon, The Christoffel-Darboux kernel; M. E. Taylor, A saint-Venant principle for Lipschitz cylinders; H. Triebel, Wavelets in function spaces; I. E. Verbitsky, Weighted norm inequalities with positive and indefinite weights; M. Venouziou and G. C. Verchota, The mixed problem for harmonic functions in polyhedra of $\mathbb{R}^{3}$.
Proceedings of Symposia in Pure Mathematics, Volume 79
November 2008, approximately 432 pages, Hardcover, ISBN: 978-0-8218-4424-3, 2000 Mathematics Subject Classification: 01A50, 26D10, 31B15, 34L40, 42B25, 46-06, 46E35, 35J25, 35Q53, 74J15, AMS members US\$76, List US\$95, Order code PSPUM/79


## The Stable Manifold

 Theorem for Semilinear Stochastic Evolution Equations and Stochastic Partial Differential EquationsSalah-Eldin A. Mohammed, Southern Illinois University at Carbondale, IL, Tusheng Zhang, University of Manchester, England, and Huaizhong Zhao, Loughborough University, Leicestershire, England

Contents: Introduction; Part 1. The stochastic semiflow: Basic concepts; Flows and cocycles of semilinear see's; Semilinear spde's: Lipschitz nonlinearity; Semilinear spde's: Non-Lipschitz nonlinearity; Part 2. Existence of stable and unstable manifolds: Hyperbolicity of a stationary trajectory; The nonlinear ergodic theorem; Proof of the local stable manifold theorem; The local stable manifold theorem for see's and spde's; Acknowledgments; Bibliography.
Memoirs of the American Mathematical Society, Volume 196, Number 917

November 2008, 105 pages, Softcover, ISBN: 978-0-8218-4250-8, LC 2008030290, 2000 Mathematics Subject Classification: 60H10, 60H20; 60H25, Individual member US\$38, List US\$63, Institutional member US\$50, Order code MEMO/196/917


# Bernoulli FreeBoundary Problems 

E. Shargorodsky, King's College, London, England, and J. F. Toland, University of Bath, England

Contents: Introduction; Bernoulli free boundaries; Type-(I) problems; Proofs of main results; Appendix A. Auxiliary results; Bibliography; Index.
Memoirs of the American Mathematical Society, Volume 196, Number 914

November 2008, 70 pages, Softcover, ISBN: 978-0-8218-4189-1, LC 2008030033, 2000 Mathematics Subject Classification: 35R35, 76B07; 35Q15, Individual member US\$35, List US\$59, Institutional member US\$47, Order code MEMO/196/914


Spectral Theory of Differential Operators M. Sh. Birman 80th
Anniversary Collection
T. Suslina, St. Petersburg State University, Russia, and D. Yafaev, Université de Rennes I, France, Editors

This volume is dedicated to the eightieth birthday of Professor M. Sh. Birman. It contains original articles in spectral and scattering theory of differential operators, in particular, Schrödinger operators, and in homogenization theory. All articles are written by members of M. Sh. Birman's research group who are affiliated with different universities all over the world. A specific feature of the majority of the papers is a combination of traditional methods with new modern ideas.
Contents: M. Solomyak and T. Suslina, On the scientific work of M. Sh. Birman in 1998-2007; T. Suslina and D. Yafaev, Continuation of the list of publications of M. Sh. Birman; M. Sh. Birman, Perturbations of the continuous spectrum of a singular elliptic operator by varying the boundary and the boundary conditions; V. S. Buslaev and S. B. Levin, Asymptotic behavior of the eigenfunctions of many-particle Schrödinger operator. I. One-dimensional particles; M. N. Demchenko and N. D. Filonov, Spectral asymptotics of the Maxwell operator on Lipschitz manifolds with boundary; R. L. Frank and A. Laptev, Spectral inequalities for Schrödinger operators with surface potentials; L. Friedlander and M. Solomyak, On the spectrum of the Dirichlet Laplacian in a narrow infinite strip; A. Laptev and A. V. Sobolev, Hardy inequalities for simply connected planar domains; E. Korotyaev and A. Kutsenko, Lyapunov functions of periodic matrix-valued Jacobi operators; A. Pushnitski, The spectral flow, the Fredholm index, and the spectral shift function; G. Raikov, On the spectrum of a translationally invariant Pauli operator; G. Rozenblum and A. V. Sobolev, Discrete spectrum distribution of the Landau operator perturbed by an expanding electric potential; Y. Safarov, On the comparison of the Dirichlet and Neumann counting functions; O. Safronov, Absolutely continuous spectrum of multi-dimensional Schrödinger operators
with slowly decaying potentials; R. Shterenberg, On discrete spectrum of the perturbed periodic magnetic Schrödinger operator with degenerate lower edge of the spectrum; T. A. Suslina, Homogenization of periodic second order differential operators including first order terms; T. Weidl, Improved Berezin-Li-Yau inequalities with a remainder term; D. R. Yafaev, Spectral and scattering theory of fourth order differential operators.
American Mathematical Society Translations-Series 2 (Advances in the Mathematical Sciences), Volume 225
December 2008, approximately 298 pages, Hardcover, ISBN: 978-0-8218-4738-1, LC 91-640741, 2000 Mathematics Subject Classification: 47-06, 47F05; 81-06, AMS members US\$87, List US\$109, Order code TRANS2/225

## General and Interdisciplinary



A Decade of the Berkeley Math Circle The American Experience, Volume I

Zvezdelina Stankova, Mills College, Oakland, CA, and University of California, Berkeley, and Tom Rike, Oakland, CA, Editors

Many mathematicians have been drawn to mathematics through their experience with math circles: extracurricular programs exposing teenage students to advanced mathematical topics and a myriad of problem-solving techniques and inspiring in them a lifelong love for mathematics. Founded in 1998, the Berkeley Math Circle (BMC) is a pioneering model of a U.S. math circle, aspiring to prepare our best young minds for their future roles as mathematics leaders. Over the last decade, 50 instructors-from university professors to high school teachers to business tycoons-have shared their passion for mathematics by delivering more than 320 BMC sessions full of mathematical challenges and wonders.
Based on a dozen of these sessions, this book encompasses a wide variety of enticing mathematical topics: from inversion in the plane to circle geometry; from combinatorics to Rubik's cube and abstract algebra; from number theory to mass point theory; from complex numbers to game theory via invariants and monovariants. The treatments of these subjects encompass every significant method of proof and emphasize ways of thinking and reasoning via 100 problem-solving techniques. Also featured are 300 problems, ranging from beginner to intermediate level, with occasional peaks of advanced problems and even some open questions.
The book presents possible paths to studying mathematics and inevitably falling in love with it, via teaching two important skills: thinking creatively while still "obeying the rules," and making connections between problems, ideas, and theories. The book encourages you to apply the newly acquired knowledge to problems and guides you along the way, but rarely gives you ready answers. "Learning from our own mistakes" often occurs through discussions of non-proofs and common problem-solving pitfalls. The reader has to commit to mastering the new theories and techniques by "getting your hands dirty" with the problems, going back and reviewing
necessary problem-solving techniques and theory, and persistently moving forward in the book. The mathematical world is huge: you'll never know everything, but you'll learn where to find things, how to connect and use them. The rewards will be substantial.
Titles in this series are co-published with the Mathematical Sciences Research Institute (MSRI).
Contents: Inversion in the plane. Part I; Combinatorics. Part I; Rubik's cube. Part I; Number theory. Part I: Remainders, divisibility, congruences and more; A few words about proofs. Part I; Mathematical induction; Mass point geometry; More on proofs. Part II; Complex numbers. Part I; Stomp. Games with invariants; Favorite problems at BMC. Part I: Circle geometry; Monovariants. Part I: Mansion walks and frog migrations; Epilogue; Symbols and notation; Abbreviations; Biographical data; Bibliography; Credits; Index.
MSRI Mathematical Circles Library, Volume 1
December 2008, approximately 332 pages, Softcover, ISBN: 978-0-8218-4683-4, LC 2008030521, 2000 Mathematics Subject Classification: 00-01, 00A07; 00A08, AMS members US\$39, List US\$49, Order code MCL/1

## Geometry and Topology



## The Geometry of Heisenberg Groups

With Applications in Signal Theory, Optics, Quantization, and Field Quantization
Ernst Binz and Sonja Pods, University of Mannheim, Germany

The three-dimensional Heisenberg group, being the simplest non-commutative Lie group, appears prominently in various applications of mathematics. The goal of this book is to present basic geometric and algebraic properties of the Heisenberg group and its relation to other important mathematical structures (the skew field of quaternions, symplectic structures, and representations) and to describe some of its applications. In particular, the authors address such subjects as well as signal analysis and processing, geometric optics, and quantization. In each case, the authors present necessary details of the applied topic being considered.
With no prerequisites beyond the standard mathematical curriculum, this book manages to encompass a large variety of topics being easily accessible in its fundamentals. It can be useful to students and researchers working in mathematics and in applied mathematics.
Contents: The skew field of quaternions; Elements of the geometry of $S^{3}$, Hopf bundles and spin representations; Internal variables of singularity free vector fields in a Euclidean space; Isomorphism classes, Chern classes and homotopy classes of singularity free vector fields in three-space; Heisenberg algebras, Heisenberg groups, Minkowski metrics, Jordan algebras and SL(2, © ; ; The Heisenberg group and natural $C *$-algebras of a vector field in

3-space; The Schrödinger representation and the metaplectic representation; The Heisenberg group-A basic geometric background of signal analysis and geometric optics; Quantization of quadratic polynomials; Field theoretic Weyl quantization of a vector field in 3 -space; Thermodynamics, geometry and the Heisenberg group by Serge Preston; Bibliography; Index.
Mathematical Surveys and Monographs, Volume 151
December 2008, approximately 284 pages, Hardcover, ISBN: 978-0-8218-4495-3, LC 2008030289, 2000 Mathematics Subject Classification: 22B05, 22E70, 43A40, 43A65, 46L05, 46L65, 53D55, 57R25, 78A05, 80M99, AMS members US\$68, List US\$85, Order code SURV/151


> Discrete Differential Geometry Integrable Structure

Alexander I. Bobenko, Technische Universität Berlin, Germany, and Yuri B. Suris, Technische Universität München, Garching bei München, Germany

An emerging field of discrete differential geometry aims at the development of discrete equivalents of notions and methods of classical differential geometry. The latter appears as a limit of a refinement of the discretization. Current interest in discrete differential geometry derives not only from its importance in pure mathematics but also from its applications in computer graphics, theoretical physics, architecture, and numerics. Rather unexpectedly, the very basic structures of discrete differential geometry turn out to be related to the theory of integrable systems. One of the main goals of this book is to reveal this integrable structure of discrete differential geometry.
For a given smooth geometry one can suggest many different discretizations. Which one is the best? This book answers this question by providing fundamental discretization principles and applying them to numerous concrete problems. It turns out that intelligent theoretical discretizations are distinguished also by their good performance in applications.
The intended audience of this book is threefold. It is a textbook on discrete differential geometry and integrable systems suitable for a one semester graduate course. On the other hand, it is addressed to specialists in geometry and mathematical physics. It reflects the recent progress in discrete differential geometry and contains many original results. The third group of readers at which this book is targeted is formed by specialists in geometry processing, computer graphics, architectural design, numerical simulations, and animation. They may find here answers to the question "How do we discretize differential geometry?" arising in their specific field.
Prerequisites for reading this book include standard undergraduate background (calculus and linear algebra). No knowledge of differential geometry is expected, although some familiarity with curves and surfaces can be helpful.
This item will also be of interest to those working in applications.
Contents: Classical differential geometry; Discretization principles. Multidimensional nets; Discretization principles. Nets in quadrics; Special classes of discrete surfaces; Approximation; Consistency as integrability; Discrete complex analysis. Linear theory; Discrete
complex analysis. Integrable circle patterns; Foundations; Solutions of selected exercises; Bibliography; Notations; Index.

Graduate Studies in Mathematics, Volume 98
January 2009, approximately 401 pages, Hardcover, ISBN: 978-0-8218-4700-8, 2000 Mathematics Subject Classification: 53-01, 53-02; 51Axx, 51Bxx, 53Axx, 37Kxx, 39A12, 52C26, AMS members US\$55, List US\$69, Order code GSM/98


## Lessons in Geometry

## I. Plane Geometry

## Jacques Hadamard

This is a book in the tradition of Euclidean synthetic geometry written by one of the twentieth century's great mathematicians. The original audience was pre-college teachers, but it is useful as well to gifted high school students and college students, in particular, to mathematics majors interested in geometry from a more advanced standpoint. The text starts where Euclid starts, and covers all the basics of plane Euclidean geometry. But this text does much more. It is at once pleasingly classic and surprisingly modern. The problems (more than 450 of them) are well-suited to exploration using the modern tools of dynamic geometry software. For this reason, the present edition includes a CD of dynamic solutions to select problems, created using Texas Instruments' TI-Nspire ${ }^{\mathrm{TM}}$ Learning Software. The TI-Nspire ${ }^{\mathrm{TM}}$ documents demonstrate connections among problems and-through the free trial software included on the CD-will allow the reader to explore and interact with Hadamard's Geometry in new ways. The material also includes introductions to several advanced topics. The exposition is spare, giving only the minimal background needed for a student to explore these topics. Much of the value of the book lies in the problems, whose solutions open worlds to the engaged reader.
And so this book is in the Socratic tradition, as well as the Euclidean, in that it demands of the reader both engagement and interaction. A forthcoming companion volume that includes solutions, extensions, and classroom activities related to the problems can only begin to open the treasures offered by this work. We are just fortunate that one of the greatest mathematical minds of recent times has made this effort to show to readers some of the opportunities that the intellectual tradition of Euclidean geometry has to offer.
TI-Nspire ${ }^{\mathrm{TM}}$ is a trademark of Texas Instruments.
Contents: Introduction; On the straight line; On the circle; On similarity; Complements to book III; On areas; On the methods of geometry; On Euclid's postulate; On the problem of tangent circles; On the notion of area; Miscellaneous problems and problems proposed in various contests; Malfatti's problem.

December 2008, approximately 339 pages, Hardcover, ISBN: 978-0-8218-4367-3, LC 2008030263, 2000 Mathematics Subject Classification: 01A73, 51-01; 51-03, AMS members US\$47, List US\$59, Order code MBK/57


Topology of Tiling Spaces

Lorenzo Sadun, University of Texas, Austin, TX

Aperiodic tilings are interesting to mathematicians and scientists for both theoretical and practical reasons. The serious study of aperiodic tilings began as a solution to a problem in logic. Simpler aperiodic tilings eventually revealed hidden "symmetries" that were previously considered impossible, while the tilings themselves were quite striking.
The discovery of quasicrystals showed that such aperiodicity actually occurs in nature and led to advances in materials science. Many properties of aperiodic tilings can be discerned by studying one tiling at a time. However, by studying families of tilings, further properties are revealed. This broader study naturally leads to the topology of tiling spaces.
This book is an introduction to the topology of tiling spaces, with a target audience of graduate students who wish to learn about the interface of topology with aperiodic order. It isn't a comprehensive and cross-referenced tome about everything having to do with tilings, which would be too big, too hard to read, and far too hard to write! Rather, it is a review of the explosion of recent work on tiling spaces as inverse limits, on the cohomology of tiling spaces, on substitution tilings and the role of rotations, and on tilings that do not have finite local complexity. Powerful computational techniques have been developed, as have new ways of thinking about tiling spaces.
The text contains a generous supply of examples and exercises.
Contents: Basic notions; Tiling spaces and inverse limits; Cohomology of tilings spaces; Relaxing the rules I: Rotations; Pattern-equivariant cohomology; Tricks of the trade; Relaxing the rules II: Tilings without finite local complexity; Solutions to selected exercises; Bibliography.
University Lecture Series, Volume 46
October 2008, 118 pages, Softcover, ISBN: 978-0-8218-4727-5, LC 2008029389, 2000 Mathematics Subject Classification: 52C22, 5502, 52C23, 55N99, 55N05, AMS members US\$23, List US\$29, Order code ULECT/46


## Stationary and Time Dependent Gross-Pitaevskii Equations

Alberto Farina, Université de Picardie J. Verne, Amiens, France, and Jean-Claude Saut, University of Paris-Sud, Orsay, France, Editors

This volume is based on a thematic program on the Gross-Pitaevskii equation which was held at the Wolfgang Pauli Institute in Vienna in 2006. The program consisted of two workshops and a one-week Summer School.

The Gross-Pitaevskii equation, an example of a defocusing nonlinear Schrödinger equation, is a model for phenomena such as the Bose-Einstein condensation of ultra cold atomic gases, the superfluidity of Helium II, or the "dark solitons" of Nonlinear Optics. Many interesting and difficult mathematical questions associated with the Gross-Pitaevskii equation, linked for instance to the nontrivial boundary conditions at infinity, arise naturally from its modeling aspects.
The articles in this volume review some of the recent developments in the theory of the Gross-Pitaevskii equation. In particular the following aspects are considered: modeling of superfluidity and Bose-Einstein condensation, the Cauchy problem, the semi-classical limit, scattering theory, existence and properties of coherent traveling structures, and numerical simulations.
Contents: W. Bao, Analysis and efficient computation for the dynamics of two-component Bose-Einstein condensates; N. G. Berloff, Quantised vortices, travelling coherent structures and superfluid turbulence; F. Béthuel, P. Gravejat, and J.-C. Saut, Existence and properties of travelling waves for the Gross-Pitaevskii equation; R. Carles, On the semi-classical limit for the nonlinear Schrödinger equation; P. Gérard, The Gross-Pitaevskii equation in the energy space; K. Nakanishi, Scattering theory for the Gross-Pitaevskii equation; D. E. Pelinovsky and P. Kevrekidis, Periodic oscillations of dark solitons in parabolic potentials.
Contemporary Mathematics, Volume 473
December 2008, 180 pages, Softcover, ISBN: 978-0-8218-4357-4, LC 2008024618, 2000 Mathematics Subject Classification: 35Q55, 35Q40, 35Q60, 37K40, 35J60, AMS members US\$47, List US\$59, Order code CONM/473

## MEMOIRS <br> oathematical society

A Proof of Alon's
Second Eigenvalue
Conjecture and
Related Problems standard trace method; Background and terminology; Tangles; Walk sums and new types; The selective trace; Ramanujan functions; An expansion for some selective traces; Selective traces in graphs with (without) tangles; Strongly irreducible traces; A sidestepping lemma; Magnification theorem; Finishing the $\mathcal{G}_{n, d}$ proof; Finishing the proofs of the main theorems; Closing remarks; Glossary; Bibliography.

Memoirs of the American Mathematical Society, Volume 195, Number 910

August 2008, 100 pages, Softcover, ISBN: 978-0-8218-4280-5, LC 2008020746, 2000 Mathematics Subject Classification: 68R10, 05C50, Individual member US\$37, List US\$62, Institutional member US\$50, Order code MEMO/195/910

## New AMS-Distributed Publications

## Analysis



## Infinitesimal

Isospectral Deformations of the Grassmannian of

Jacques Gasqui, Université Joseph Fourier, Saint-Martin d'Heres, France, and Hubert Goldschmidt, Columbia

University, New York, NY
The authors study the real Grassmannian $G_{n, n}^{\mathbb{R}}$ of $n$-planes in $\mathbb{R}^{2 n}$, with $n \geq 3$, and its reduced space. The latter is the irreducible symmetric space $\bar{G}_{n, n}^{\mathbb{R}}$, which is the quotient of the space $G_{n, n}^{\mathbb{R}}$ under the action of its isometry which sends a $n$-plane into its orthogonal complement. One of the main results of this monograph asserts that the irreducible symmetric space $\bar{G}_{3,3}^{\mathbb{R}}$ possesses non-trivial infinitesimal isospectral deformations; it provides the first example of an irreducible reduced symmetric space which admits such
deformations. The authors also give a criterion for the exactness of a form of degree one on $\bar{G}_{n, n}^{\mathbb{R}}$ in terms of a Radon transform.
This item will also be of interest to those working in geometry and topology.

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: Introduction; Symmetric spaces of compact type and the Guillemin condition; Invariant symmetric forms on symmetric spaces; The real Grassmannians; The Stiefel manifolds and the real Grassmannians; Functions and forms of degree one on the real Grassmannians; Isospectral deformations of the real Grassmannian of 3-planes in $\mathbb{R}^{6}$; Forms of degree one; A family of polynomials; Exactness of the forms of degree one; Branching laws; The special Lagrangian Grassmannian $S U(4) / S O(4)$; The complex quadric of dimension three; Bibliography.

Mémoires de la Société Mathématique de France, Number 108
August 2008, 92 pages, Softcover, ISBN: 978-2-85629-232-7, 2000 Mathematics Subject Classification: 44A12, 53C35, 58A10, 58J53, Individual member US\$34, List US\$38, Order code SMFMEM/108


# Function Spaces and 

 Wavelets on Domains Hans Triebel, University of Jena,Germany

Wavelets have emerged as an important tool in analyzing functions containing discontinuities and sharp spikes. They were developed independently in the fields of mathematics, quantum physics, electrical engineering, and seismic geology. Interchanges between these fields during the last ten years have led to many new wavelet applications such as image compression, turbulence, human vision, radar, earthquake prediction, and pure mathematics applications such as solving partial differential equations.

This book develops a theory of wavelet bases and wavelet frames for function spaces on various types of domains. Starting with the usual spaces on Euclidean spaces and their periodic counterparts, the exposition moves on to so-called thick domains (including Lipschitz domains and snowflake domains). Specifically, wavelet expansions and extensions to corresponding spaces on Euclidean $n$-spaces are developed. Finally, spaces on smooth and cellular domains and related manifolds are treated.

Although the presentation relies on the recent theory of function spaces, basic notation and classical results are repeated in order to make the text self-contained.

This book is addressed to two types of readers: researchers in the theory of function spaces who are interested in wavelets as new effective building blocks for functions and scientists who wish to use wavelet bases in classical function spaces for various applications. Adapted to the second type of reader, the preface contains a guide on where to find basic definitions and key assertions.

A publication of the European Mathematical Society (EMS). Distributed within the Americas by the American Mathematical Society.

Contents: Spaces on $\mathbb{R}^{n}$ and $\mathbb{T}^{n}$; Spaces on arbitrary domains; Spaces on thick domains; The extension problem; Spaces on smooth domains and manifolds; Complements; Bibliography; Symbols; Index.

EMS Tracts in Mathematics, Volume 7
August 2008, 265 pages, Hardcover, ISBN: 978-3-03719-019-7, 2000 Mathematics Subject Classification: 46-02, 46E35, 42C40, 42B35, 28A80, AMS members US\$62, List US\$78, Order code EMSTM/7

## Applications



# Tractability of Multivariate Problems 

Volume I: Linear Information

Erich Novak, University of Jena, Germany, and Henryk Woźniakowski, Columbia University, New York, NY

Multivariate problems occur in many applications. These problems are defined on spaces of $d$-variate functions and $d$ can be huge-in the hundreds or even in the thousands. Some high-dimensional problems can be solved efficiently to within $\varepsilon$, i.e., the cost increases polynomially in $\varepsilon^{-1}$ and $d$. However, there are many multivariate problems for which even the minimal cost increases exponentially in $d$. This exponential dependence on $d$ is called intractability or the curse of dimensionality.
This is the first volume of a three-volume set comprising a comprehensive study of the tractability of multivariate problems. It is devoted to tractability in the case of algorithms using linear information and develops the theory for multivariate problems in various settings: worst case, average case, randomized and probabilistic. A problem is tractable if its minimal cost is not exponential in $\varepsilon^{-1}$ and $d$. There are various notions of tractability, depending on how we measure the lack of exponential dependence. For example, a problem is polynomially tractable if its minimal cost is polynomial in $\varepsilon^{-1}$ and $d$. The study of tractability was initiated about 15 years ago. This is the first and only research monograph on this subject.
Many multivariate problems suffer from the curse of dimensionality when they are defined over classical (unweighted) spaces. In this case, all variables and groups of variables play the same role, which causes the minimal cost to be exponential in $d$. But many practically important problems are solved today for huge $d$ in a reasonable time. One of the most intriguing challenges of the theory is to understand why this is possible. Multivariate problems may become weakly tractable, polynomially tractable or even strongly polynomially tractable if they are defined over weighted spaces with properly decaying weights. One of the main purposes of this book is to study weighted spaces and obtain necessary and sufficient conditions on weights for various notions of tractability.
The book is of interest for researchers working in computational mathematics, especially in approximation of high-dimensional problems. It may be also suitable for graduate courses and seminars. The text concludes with a list of thirty open problems that can be good candidates for future tractability research.

A publication of the European Mathematical Society (EMS). Distributed within the Americas by the American Mathematical Society.
Contents: Overview; Motivation for tractability studies; Twelve examples; Basic concepts and survey of IBC results; Worst case setting; Average case setting; Randomized setting; Generalized tractability; Appendices; Bibliography; Index.

EMS Tracts in Mathematics, Volume 6
August 2008, 395 pages, Hardcover, ISBN: 978-3-03719-026-5, 2000 Mathematics Subject Classification: 65-02, 65Y20, 68Q17, 68Q25, 41A63, 46E22, 28C20, 46E30, AMS members US\$78, List US\$98, Order code EMSTM/6

## Geometry and Topology

## Surveys in Differential Geometry, Volume XI

Metric and Comparison Geometry

Jeffrey Cheeger, New York University-Courant Institute, NY, and Karsten Grove, University of Maryland, College Park, MD, Editors

The works included in this volume, edited by Jeffrey Cheeger and Karsten Grove, treat important recent developments in metric geometry and comparison geometry. Both these areas are vital and expanding components of modern geometry.
A publication of International Press. Distributed worldwide by the American Mathematical Society.
Contents: X. Rong, Collapsed manifolds with bounded sectional curvature and applications; B. Wilking, Nonnegatively and positively curved manifolds; W. Ziller, Examples of manifolds with non-negative sectional curvature; V. Kapovitch, Perelman's stability theorem; A. Petrunin, Semiconcave functions in Alexandrov's geometry; G. Wei, Manifolds with a lower Ricci curvature bound; J. Lott, Optimal transport and Ricci curvature for metric-measure spaces; J. Rosenberg, Manifolds of positive scalar curvature: A progress report; S. Buyalo and V. Schroeder, Spaces of curvature bounded above; F. T. Farrell, L. E. Jones, and P. Ontaneda, Negative curvature and exotic topology.

## International Press

October 2007, 347 pages, Hardcover, ISBN: 978-1-57146-117-9, 2000 Mathematics Subject Classification: 53C20, 53C21, 53C23, 51F99, 51K05, 51K10, AMS members US\$68, List US\$85, Order code INPR/70

## Survey In Differential Geometry, Volume X

Essays in Geometry in Memory of S.-S. Chern

Shing-Tung Yau, Harvard University, Cambridge, MA, Editor

This volume includes lectures on geometry and topology related to the works of the late and venerated S.-S. Chern. The lectures were
presented at the 2005 Journal of Differential Geometry conference at Harvard University.

A publication of International Press. Distributed worldwide by the American Mathematical Society.

Contents: B. Dai, C.-L. Terng, and K. Uhlenbeck, On the space-time monopole equation; V. Guillemin, S. Sternberg, and J. Weitsman, The Erhardt function for symbols; K. Liu, Recent results on the moduli spaces of Riemann surfaces; W. Meeks, Applications of minimal surfaces to the topology of three-manifolds; V. Moncrief, An integral equation for spacetime curvature in general relativity; A. Nietzke and C. Vafa, Topological strings and their physical applications; R. P. Thomas, Notes on GIT and symplectic reduction for bundles and varieties; S.-T. Yau, Perspectives on geometric analysis; S.-W. Zhang, Distributions in algebraic dynamics.

## International Press

November 2006, 430 pages, Hardcover, ISBN: 978-1-57146-116-2, 2000 Mathematics Subject Classification: 03-02, AMS members US\$76, List US\$95, Order code INPR/69

## Number Theory



Les Six Opérations de Grothendieck et le Formalisme des Cycles Évanescents dans le Monde Motivique (II)

## Joseph Ayoub, Université Paris

 13, CNRS, FranceThis second volume contains chapters 3 and 4 of the author's study of the functoriality of the stable homotopy categories of schemes. In the previous volume, he concentrated on the six operations $f^{*}$, $f_{*}, f_{!}, f^{!},-\otimes-$ and $\underline{\operatorname{Hom}}(-,-)$, their constructibility and exactness.
This volume begins with the construction of the nearby motive functors $\Psi_{f}$ which are the analogue of the nearby cycles functors, well-known in étale cohomology. The author then extends the vanishing cycles formalism to these functors. In particular, he computes the effect of the functor $\Psi_{f}$ in the case where $f$ has semi-stable reduction. He also shows that $\Psi_{f}$ preserves constructible motives and commutes with external tensor product and duality. He then defines a monodromy operator and proves that this operator is nilpotent.

The last chapter, which is of a different nature than the previous ones, recalls in full detail the construction of the stable homotopy category of $S$-schemes.
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: La théorie des foncteurs cycles proches dans un cadre motivique; La construction de 2-foncteurs homotopiques stables; Bibliographie.

Astérisque, Number 315
October 2007, 362 pages, Softcover, ISBN: 978-2-85629-245-7, 2000 Mathematics Subject Classification: 14-02, 14C25, 14F20, 14F35, 14F42, 18A40, 18F10, 18F20, 18F25, 18G55, 19E15, Individual member US\$105, List US\$117, Order code AST/315


# Classified Advertisements 

# Positions available, items for sale, services available, and more 

## CALIFORNIA

CALIFORNIA INSTITUTE OF
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Mathematics Department
Olga Taussky and John Todd
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Description: Appointments are for three years. There are three terms in the Caltech academic year, and instructors are expected to teach one course in all but two terms of the total appointment. These two terms will be devoted to research. During the summer months there are no duties except research.

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000107

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Description: There are three terms in the Caltech academic year. The fellow is expected to teach one course in two terms each year, and is expected to be in residence even during terms when not teaching. The initial appointment is for three years with an additional three-year terminal extension expected.
Eligibility: Offered to a candidate within six years of having received the Ph.D. who shows strong research promise in one of the areas in which Caltech's mathematics faculty is currently active
Deadline: January 1, 2009.
Application information: Please apply online at: http://mathjobs.org. To avoid duplication of paperwork, your application will also be considered for an Olga Taussky and John Todd Instructorship and a Harry Bateman Research Instructorship.
Caltech is an Affirmative Action/Equal Opportunity Employer. Women, minorities, veterans, and disabled persons are encouraged to apply.

000108

## CALIFORNIA INSTITUTE OF <br> TECHNOLOGY Mathematics Department Harry Bateman Research Instructorships in Mathematics

Description: Appointments are for two years. The academic year runs from approximately October 1 to June 1. Instructors are expected to teach one course per quarter for the full academic year and to devote the rest of their time to research. During the summer months there are no duties except research.
Eligibility: Open to persons who have recently received their doctorates in mathematics.
Deadline: January 1, 2009.
Application information: Please apply online at: http://mathjobs.org. To avoid duplication of paperwork, your application may also be considered for an Olga Taussky and John Todd Instructorship.
Caltech is an Affirmative Action/Equal Opportunity Employer. Women, minorities, veterans, and disabled persons are encouraged to apply.

## UNIVERSITY OF CALIFORNIA AT BERKELEY Berkeley, CA 94720 Department of Mathematics Tenured or Tenure-Track Positions

Pending budget approval, we invite applications for two positions effective July

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 2008 rate is $\$ 110$ per inch or fraction thereof on a single column (oneinch 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: December 2008 issue-October 1, 2008; January 2009 issue-October 28, 2008; February 2009
issue-November 26, 2008; March 2009 issue-December 29, 2008; April 2009 issue-January 29, 2009; May 2009-February 27, 2009.
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 c1assads@ams.org. AMS location for express delivery packages is 201 Charles Street, Providence, Rhode Island 20904. Advertisers will be billed upon publication.

1, 2009, at either the tenure-track (assistant professor) or tenured (associate or full professor) level, in pure or applied mathematics. Tenure-track applicants are expected to have demonstrated outstanding research potential, normally including major contributions beyond the doctoral dissertation. Such applicants are requested to submit an application on-line via http://www.mathjobs.org and the application should contain the AMS cover sheet, a resume, a list of publications, and a research statement. Applicants should ask three people to submit letters of evaluation through http://mathjobs. org. It is the responsibility of the tenuretrack applicants to make sure that letters of evaluation are sent. All letters of evaluation are subject to Berkeley campus policies on confidentiality of letters of evaluation, a summary of which can be found at http://math.berkeley.edu/ employmencacademic.htm7.

Tenure applicants are expected to demonstrate leadership in research. They are requested to apply on-line via http:// mathjobs.org and to submit the AMS cover sheet, a curriculum vitae, a list of publications, and the names and addresses of three references. Applicants should indicate whether they are applying for an associate professor or a full professor position. The department will assume responsibility to solicit letters of evaluation and will provide evaluators with a copy of the summary of policies on confidentiality of letters of evaluation.

Non-electronic applications for tenuretrack and tenure positions can be sent to the Vice Chair for Faculty Affairs at the above address. They should contain the materials specified above.

Applications for both tenure-track and tenure applications must be submitted on http://mathjobs.org or postmarked by December 1, 2008. Applications submitted or postmarked after the deadline will not be considered. The University of California is an Equal Opportunity, Affirmative Action Employer.

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## UNIVERSITY OF CALIFORNIA AT BERKELEY Berkeley, CA 94720 Department of Mathematics Charles B. Morrey Jr. Assistant Professorships

We invite applications for these special (non-tenure-track) positions effective July 1, 2009. The terms of these appointments may range from two to three years. Applicants should have a recent Ph.D., or the equivalent, in an area of pure or applied mathematics.

The applications must be submitted online via http://www.mathjobs.org and should include the AMS Cover Sheet and supporting documentation (cover letter, resume, publication list, research statement, and
possibly a teaching statement). Applicants should ask three people to submit letters of evaluations via http://mathjobs. org. All letters of evaluation are subject to Berkeley campus policies on confidentiality of letters of evaluation, a summary of which can be found at: http://math. berke1ey.edu/employmentacademic. htm 1 . Applications must be submitted by December 1, 2008. Applications submitted after the deadline will not be considered. The University of California is an Equal Opportunity, Affirmative Action Employer.

000122

## UNIVERSITY OF CALIFORNIA AT BERKELEY Berkeley, CA 94720 Department of Mathematics Temporary Postdoctoral Positions

Several temporary positions beginning in fall 2009 are anticipated for new and recent Ph.D.'s in pure or applied mathematics. The terms of these appointments may range from one to three years. Applicants for NSF or other postdoctoral fellowships are encouraged to apply for these positions. Mathematicians whose research interests are close to those of regular department members will be given some preference.
The applications must be submitted online via http://www.mathjobs.org and should include the AMS Cover Sheet and supporting documentation (cover letter, resume, publication list, research statement, and possibly a teaching statement). Applicants should ask three people to submit letters of evaluation via http:// mathjobs.org. All letters of evaluation are subject to Berkeley campus policies on confidentiality of letters of evaluation, a summary of which can be found at: http://math.berke1ey.edu/employmenCacademic.htm1. Applications must be submitted by December 1, 2008. Applications submitted after the deadline will not be considered. The University of California is an Equal Opportunity, Affirmative Action Employer.

000123

## UNIVERSITY OF CALIFORNIA, DAVIS Faculty Positions in Mathematics

The Department of Mathematics at the University of California, Davis, is soliciting applications for a tenure-track assistant professor position starting July 1, 2009.
The department has identified the following priority areas: geometry and probability, but outstanding candidates in all areas of mathematics may be considered. Minimum qualifications for these positions include a Ph.D. degree or its equivalent in the mathematical sciences and great promise in research and teaching. Duties include mathematical research,
undergraduate and graduate teaching, and departmental and university service. Additional information about the department may be found at: http://math. ucdavis. edu/. Our postal address is Department of Mathematics, University of California, One Shields Avenue, Davis, CA 956168633. Applications will be accepted until the position is filled. To guarantee full consideration, the application should be received by November 30, 2008. To apply: submit the AMS Cover Sheet and supporting documentation electronically through http://www.mathjobs.org/. UC Davis is an Affirmative Action/Equal Employment Opportunity Employer and is dedicated to recruiting a diverse faculty community. We welcome all qualified applicants to apply, including women, minorities, individuals with disabilities and veterans.

## UNIVERSITY OF CALIFORNIA, DAVIS Postdoc Positions in Mathematics

The Department of Mathematics at the University of California, Davis, is soliciting applications for a few postdoctoral positions starting July 1, 2009. The areas of specialization are open. To be considered for the Arthur J. Krener Assistant Professor position, the department seeks applicants with excellent research potential in areas of faculty interest and effective teaching skills. Applicants are required to have completed their Ph.D. by the time of their appointment, but no earlier than July 1,2005 . The annual salary of this position is US $\$ 52,350$. The teaching load is three quarter-long courses. Arthur J. Krener appointments are renewable for a total of up to three years, assuming satisfactory performance in research and teaching.
Applicants for the VIGRE Fellow position must be U.S. citizens, nationals, or permanent residents and have received their Ph.D. no earlier than January 1, 2008. Applicants in all research areas are encouraged to apply. The current annual salary for VIGRE Fellows is US $\$ 59,456$. The teaching load is three quarter-long courses. VIGRE Fellow appointments are renewable for a total of up to three years, assuming satisfactory performance in research and teaching. Additional information about the department may be found at: http://math.ucdavis. edu/. Our postal address is Department of Mathematics, University of California, One Shields Avenue, Davis, CA 956168633. Applications will be accepted until the positions are filled. To guarantee full consideration, the application should be received by November 30, 2008. To apply: submit the AMS Cover Sheet and supporting documentation electronically through http://www.mathjobs.org/. UC Davis is an Affirmative Action/Equal Employment Opportunity Employer and is dedicated to recruiting a diverse faculty community. We welcome all qualified applicants to
apply, including women, minorities, individuals with disabilities and veterans.

000104

## UNIVERSITY OF CALIFORNIA, LOS ANGELES <br> Department of Mathematics Faculty Positions <br> Academic Year 2009-2010

The Department of Mathematics, subject to administrative approval, expects to make several tenure-track/tenure appointments in a wide range of possible fields. We also plan to make temporary and visiting appointments in the following categories 2-5. Depending on the level, candidates must give evidence of potential or demonstrated distinction in scholarship and teaching.
(1) Tenure-Track/Tenured Faculty Positions. Salary is commensurate with level of experience.
(2) E. R. Hedrick Assistant Professorships. Salary is US\$61,200 and appointments are for three years. The teaching load is four quarter courses per year.
(3) Computational and Applied Mathematics (CAM) Assistant Professorships. Salary is US\$61,200, and appointments are for three years. The teaching load is normally reduced to two or three quarter courses per year by research funding as available.
(4) Program in Computing (PIC) Assistant Adjunct Professorships. Salary is US $\$ 65,500$. Applicants for these positions must show very strong promise in teaching and research in an area related to computing. The teaching load is four one-quarter programming courses each year and one seminar every two years. Initial appointments are for one year and possibly longer, up to a maximum service of four years.
(5) Assistant Adjunct Professorships and Research Postdocs. Normally appointments are for one year, with the possibility of renewal. Strong research and teaching background required. The salary range is US $\$ 56,400-\$ 59,500$. The teaching load for adjuncts is five quarter courses per year.

If you wish to be considered for any of these positions you must submit an application and supporting documentation electronically via http://www.mathjobs. org.

For fullest consideration, all application materials should must be submitted on or before December 12, 2008. Ph.D is required for all positions.

UCLA and the Department of Mathematics have a strong commitment to the achievement of excellence in teaching and research and diversity among its faculty and staff. The University of California is an Equal Opportunity/Affirmative Action Employer. The University of California asks that applicants complete the Equal Opportunity Employer survey for Letters and Science, at the following URL: http://cis.ucla.edu/
facultysurvey. Under Federal law, the University of California may employ only individuals who are legally authorized to work in the United States as established by providing documents specified in the Immigration Reform and Control Act of 1986.

000043

## UNIVERSITY OF CALIFORNIA, LOS ANGELES Institute for Pure and Applied Mathematics

The Institute for Pure and Applied Mathematics (IPAM) at UCLA is seeking a second Associate Director (AD), to begin a twoyear appointment on July 1, 2009. The AD is expected to be an active and established research mathematician or scientist in a related field, with experience in conference organization. The primary responsibility of the AD will be running individual programs in coordination with the organizing committees. More information on IPAM's programs can be found at: http://www. ipam.uc7a.edu. The selected candidate will be encouraged to continue his or her personal research program within the context of the responsibilities to the institute. For a detailed job description and application instructions, go to: http:// www.ipam.ucla.edu/jobopenings/ |assocdirector.aspx|. Applications will receive fullest consideration if received by February 1, 2009, but we will accept applications as long as the position remains open. UCLA is an Equal Opportunity/Affirmative Action Employer.

000090

## UNIVERSITY OF CALIFORNIA, SAN DIEGO

Stefan E. Warschawski Assistant Professorship

The Department of Mathematics at the University of California, San Diego, is seeking two outstanding candidates for a special three-year assistant professorship, the S. E. Warschawski Assistant Professorship, pending funding approval. We encourage applications in any area of pure mathematics, applied US $\$ 53,200$. This is a three-year nonrenewable appointment.
Applicants should possess a recent Ph.D. degree (received no earlier than 2006) in mathematics or expect to receive one prior to July 2009. Candidates should have excellent teaching skills and excellent research potential. Candidates with teaching and research interests compatible with current faculty are sought. To receive full consideration, applications should be submitted online through http://www. mathjobs.org/ by December 1, 2008. For further instructions and information,
see http://math.ucsd.edu/about/ lemployment/faculty|.

In compliance with the Immigration Reform and Control Act of 1986, individuals offered employment by the University of California will be required to show documentation to prove identity and authorization to work in the United States before hiring can occur. UCSD is an Equal Opportunity/Affirmative Action Employer with a strong institutional commitment to the achievement of diversity among its faculty and staff.

All applications should include the following items:

## * 3 Reference Letters

(Writers should upload their reference letters to http://mathjobs.org or send them under separate cover; at least one letter should address teaching experience in some depth.)

* 1 Cover Letter
* 1 Curriculum Vitae
* 1 Publications List
* 1 Research Statement
* 1 Teaching Statement, and optionally a statement about contributions to diversity.


## UNIVERSITY OF CALIFORNIA, SAN DIEGO <br> Department of Mathematics Tenure Track/Tenured Positions

The Department of Mathematics at the University of California, San Diego, is seeking outstanding candidates to fill approximately 6 tenure-track/tenured positions to start July 2009, pending funding approval. We encourage applications from any area of pure mathematics, applied mathematics, or statistics. The level for the large majority of these positions is at the assistant professor level, however, one or two positions are available for distinguished mathematicians with exceptional research records of the highest caliber.
Applicants for all positions must possess a Ph.D. and should have outstanding accomplishments in both research and teaching. Level of appointment will be based on qualifications with appropriate salary per UC pay scales. To receive full consideration, applications should be submitted online through http://www. mathjobs.org/ by November 2, 2008. For further instructions and information, see http://www.math.ucsd.edu/about/ employment/faculty.

In compliance with the Immigration Reform and Control Act of 1986, individuals offered employment by the University of California will be required to show documentation to prove identity and authorization to work in the United States before hiring can occur. UCSD is an Equal Opportunity/Affirmative Action Employer with a strong institutional commitment
to the achievement of diversity among its faculty and staff.

All applications should include the following items:

* 3 Reference Letters
(Writers should upload their reference letters to http://mathjobs.org or send them under separate cover; at least one letter should address teaching experience in some depth.)
* 1 Cover Letter
* 1 Curriculum Vitae
* 1 Publications List
* 1 Research Statement
* 1 Teaching Statement, and optionally a statement about contributions to diversity.

000092

## CONNECTICUT

## FAIRFIELD UNIVERSITY Department of Mathematics and Computer Science

The Department of Mathematics and Computer Science at Fairfield University invites applications for one tenure-track position in mathematics, at the rank of assistant professor, to begin in September 2009. We seek a highly qualified candidate with a commitment to and demonstrated excellence in teaching, and strong evidence of research potential. A doctorate in mathematics is required. The teaching load is 3 courses/ 9 credit hours per semester and consists primarily of courses at the undergraduate level. The successful candidate will be expected to teach a wide variety of courses from elementary calculus and statistics to graduate level courses; in particular, Fairfield University's core curriculum includes two semesters of mathematics for all undergraduates.

Fairfield University, the Jesuit University of Southern New England, is a comprehensive university with about 3,200 undergraduates and a strong emphasis on liberal arts education. The department has an active faculty of 14 full-time tenured or tenure-track members. We offer a BS and an MS in mathematics, as well as a BS in computer science. The MS program is an evening program and attracts students from various walks of life - secondary school teachers, eventual Ph.D. candidates, and people working in industry, among others.

Fairfield offers competitive salaries and compensation benefits. The picturesque campus is located on Long Island Sound in southwestern Connecticut, about 50 miles from New York City. Fairfield is an Affirmative Action/Equal Opportunity Employer. For more information see the department web page at: http://www. fairfie1d.edu/macs_index.htm1. Applicants should send a letter of application, a curriculum vitae, teaching and research statements, and three letters of recommendation commenting on the
applicant's experience and promise as a teacher and scholar, to Matt Coleman, Chair of the Department of Mathematics and Computer Science, Fairfield University, 1073 N. Benson Rd., Fairfield CT $06824-5195$. Full consideration will be given to complete applications received by December 12, 2008. We will be interviewing at the Joint Mathematics Meetings in Washington DC, January 5-8, 2009. Please let us know if you will be attending.

000102

## YALE UNIVERSITY J. Willard Gibb Assistant Professorships in Mathematics 2009-2010

The Gibbs Assistant Professorships are intended primarily for men and women who received the Ph.D. degree and show definite promise in research in pure or applied mathematics. Appointments are for three years. The salary will be at least US $\$ 68,000$. Each recipient of a Gibbs Assistant Professorship will be given a moving allowance based on the distance to be moved.
The teaching load for Gibbs Assistant Professors will be kept light, so as to allow ample time for research. This will consist of three one-semester courses per year. Part of the duties may consist of a one-semester course at the graduate level in the general area of the instructor's research. Inquiries and applications should be addressed to: email: gibbs.committee@ math.yale.edu or to:

The Gibbs Committee
Department of Mathematics
Yale University
P.O. Box 208283

New Haven, Connecticut 06520-8283 Applications and supporting material must be received by January 1, 2009. Offers are expected to be made in early February. Yale University is an Affirmative Action/Equal Opportunity Employer. Applications from women and underrepresented minority scholars are especially encouraged.

000089

## GEORGIA

## GEORGIA INSTITUTE OF TECHNOLOGY School of Mathematics

The School of Mathematics at Georgia Tech is continuing an ambitious faculty recruitment program begun five years ago. During the past five years, fifteen appointments were made, including four tenured appointments, two at the full professor level and two at the associate professor level. Building on past successes, this recruiting effort is intended to make rapid advances in the scope and quality of our research and graduate education
programs. Candidates will be considered at all ranks, with priority given to those candidates who (1) bring exceptional quality research credentials to Georgia Tech; (2) complement existing strengths in the School of Mathematics; (3) reinforce bridges to programs in engineering and the physical, computing, and life sciences; (4) have strong potential for external funding; and (5) have a demonstrated commitment to high quality teaching at both the undergraduate and graduate levels. Consistent with these priorities, candidates will be considered in all areas of pure and applied mathematics and statistics. Applications should consist of a curriculum vitae, including a list of publications; summary of future research plans; and at least three letters of reference. Applications should also include evidence of teaching skills. Applications should preferably be electronically submitted directly to: http://www.mathjobs.org. If a candidate cannot submit an application electronically, then it may be sent to the Hiring Committee, School of Mathematics, Georgia Institute of Technology, Atlanta, GA, 30332-0160. Candidates for Associate and full professor positions should also submit a statement outlining their vision for service as a senior faculty member at Georgia Tech. Review of applications will begin in October 2008, and the roster of candidates being considered will be updated on a continual basis. Georgia Tech, an institution of the University System of Georgia, is an Equal Opportunity/Affirmative Action Employer.

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## ILLINOIS

## UNIVERSITY OF CHICAGO Department of Mathematics

The University of Chicago Department of Mathematics invites applications for the following positions:

1. L. E. Dickson Instructor: This is open to mathematicians who have recently completed or will soon complete a doctorate in mathematics or a closely related field, and whose work shows remarkable promise in mathematical research and teaching. The appointment typically is for two years, with the possibility of renewal for a third year. The teaching obligation is up to four one-quarter courses per year. For applicants who are U.S. citizens or permanent residents, there is the possibility of reduced teaching and resources for summer support and travel from the department's VIGRE grant.
2. Assistant Professor: This is open to mathematicians who are further along in their careers, typically two or three years past the doctorate. These positions are intended for mathematicians whose work has been of outstandingly high caliber. Appointees are expected to have the potential to become leading figures in their fields. The appointment is generally for
three years, with a teaching obligation of three one-quarter courses per year.
Applicants will be considered for any of the positions above which seem appropriate. Complete applications consist of (a) a cover letter, (b) a curriculum vitae, (c) three or more letters of reference, at least one of which addresses teaching ability, and (d) a description of previous research and plans for future mathematical research. Applicants are strongly encouraged to include information related to their teaching experience, such as a teaching statement or evaluations from courses previously taught, as well as an AMS cover sheet. If you have applied for an NSF Mathematical Sciences Postdoctoral Fellowship, please include that information in your application, and let us know how you plan to use it if awarded.

Applications must be submitted online through http://www.mathjobs.org. Questions may be directed to: apptsec@math.uchicago.edu. We will begin screening applications on December 1, 2008. Screening will continue until all available positions are filled. The University of Chicago is an Equal Opportunity/ Affirmative Action Employer.

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## INDIANA

## UNIVERSITY OF NOTRE DAME, NOTRE DAME, IN 46556 Department of Mathematics Notre Dame Instructorship in Mathematics

The Department of Mathematics of the University of Notre Dame invites applications from recent doctorates for the position of Notre Dame Instructor in Mathematics. Candidates in any specialty compatible with the research interests of the department will be considered. The teaching load and salary will be competitive with those of distinguished instructorships at other AMS Group I universities. This position is for a term of three years beginning August 22, 2009; it is not renewable and is not tenure-track. Applications, including a curriculum vitae and a completed AMS standard cover sheet, should be filed through MathJobs (http://www. MathJobs.org). Applicants should also arrange for at least three letters of recommendation to be submitted through the http://MathJobs system. These letters should address the applicant's research accomplishments and supply evidence that the applicant has the ability to communicate articulately and teach effectively. Notre Dame is an Equal Opportunity Employer, and we particularly welcome applications from women and minority candidates. The evaluation of candidates will begin December 1, 2008. Information about the department is available at: http://math.nd.edu.

000095

## KENTUCKY

## UNIVERSITY OF LOUISVILLE Department of Mathematics

The Department of Mathematics at the University of Louisville anticipates filling three tenure-track positions at the assistant professor level beginning fall 2009. Preference will be given to applicants in applied or computational areas of algebra, combinatorics and probability, but qualified applicants in other areas strengthening the department's Ph.D. program in applied and industrial mathematics and complementing existing strengths will be considered. The department currently has 26 tenured/tenure-track faculty members and the typical teaching load is two courses per semester.
The minimum qualifications for these positions include a Ph.D. degree, or its equivalent, in the mathematical sciences. Applicants with demonstrated strengths in research and teaching are encouraged to apply. The expectations include that the successful applicant will contribute fully to research and both undergraduate and graduate instruction.
Review of applications will begin December 12, 2008. Applicants must apply online at http://www. louisville.edu/ jobs: for the algebra position use Job ID \# 23107; for the combinatorics position use Job ID \# 23126, and for the probability position use Job ID \# 23127; only your CV must be submitted electronically. In addition, the following items need to be mailed in hardcopy to the address below: (1) cover letter with the job ID number, summary of research and of teaching interests; (2) the AMS Standard Coversheet; and (3) a hard copy of your curriculum vitae. Please indicate whether you are going to attend the AMS Annual Joint Meeting in Washington, DC, in your cover letter. Also, please arrange to have at least three letters of recommendation which discuss at length your research and teaching qualifications, sent to:

## Search Committee

Department of Mathematics
University of Louisville
Louisville, KY 40292.
The University of Louisville is an Affirmative Action, Equal Opportunity, Americans with Disabilities Employer, committed to diversity and in that spirit, seeks applications from a broad variety of candidates.
For more information about the position or institution please see: http://www. math. louisville.edu.

## MARYLAND

## JOHNS HOPKINS UNIVERSITY Department of Mathematics Full Professor

The Department of Mathematics invites applications for one or more positions at the associate professor or full professor level in general areas of analysis, algebra, topology, number theory, and mathematical physics beginning fall 2009 or later.

To submit your applications go to: http://www.mathjobs.org/jobs/jhu. Applicants are strongly advised to submit their other materials electronically at this site.

If you do not have computer access, you may mail your application directly to: Appointments Committee, Department of Mathematics, Johns Hopkins University, 404 Krieger Hall, Baltimore, MD 21218. Application should include a vita, at least four letters of recommendation of which one specifically comments on teaching, and a description of current and planned research. Write to cpoole@jhu.edu for questions concerning these positions. Applications received by November 17, 2008, will be given priority. The Johns Hopkins University is an Affirmative Action/Equal Opportunity Employer. Minorities and women candidates are encouraged to apply.

## 000045

## JOHNS HOPKINS UNIVERSITY Department of Mathematics Non-Tenure-Track J. J. Sylvester Assistant Professor 2008 Advertising

Subject to availability of resources and administrative approval, the Department of Mathematics solicits applications for non-tenure-track assistant professor positions beginning fall 2009.
The J. J. Sylvester Assistant Professorship is a three-year position offered to recent Ph.D.'s with outstanding research potential. Candidates in all areas of pure mathematics, including analysis, mathematical physics, geometric analysis, complex and algebraic geometry, number theory, and topology are encouraged to apply. The teaching load is three courses per academic year.
To submit your applications go to: http://www.mathjobs.org/jobs/jhu. Applicants are strongly advised to submit their other materials electronically at this site.

If you do not have computer access, you may mail your application directly to: Appointments Committee, Department of Mathematics, Johns Hopkins University, 404 Krieger Hall, Baltimore, MD 21218. Application should include a vita, at least four letters of recommendation of which one specifically comments on teaching, and a description of current and planned
research. Write to cpoole@jhu.edu for questions concerning these positions. Applications received by November 17, 2008, will be given priority. The Johns Hopkins University is an Affirmative Action/Equal Opportunity Employer. Minorities and women candidates are encouraged to apply.

000046

## MASSACHUSETTS

## BOSTON COLLEGE <br> Department of Mathematics <br> Tenure-Track Positions in Number Theory and in Geometry/Topology

The Department of Mathematics at Boston College invites applications for two ten-ure-track positions at the level of assistant professor beginning in September 2009, one in number theory and the second in geometry/topology. In exceptional cases, a higher level appointment may be considered. The teaching load for each position is three semester courses per year.
Requirements include a Ph.D. or equivalent in mathematics awarded in 2007 or earlier, a record of strong research combined with outstanding research potential, and demonstrated excellence in teaching mathematics.

A completed application should contain a cover letter, a description of research plans, a statement of teaching philosophy, curriculum vitae, and at least four letters of recommendation. One or more of the letters of recommendation should directly comment on the candidate's teaching credentials.
Applications completed no later than December 1, 2008, will be assured our fullest consideration. Please submit all application materials through http:// mathjobs.org. If necessary, printed materials may otherwise be sent to:

Chair, Search Committee in Number Theory
(resp. in Geometry/Topology)
Department of Mathematics
Boston College
Chestnut Hill, MA 02467-3806
Applicants may learn more about the department, its faculty and its programs at http://www.bc.edu/math. Electronic inquiries concerning these positions may be directed to math-search-nt@bc.edu or math-search-gt@bc.edu. Boston College is an Affirmative Action/Equal Opportunity Employer. Applications from women, minorities, and individuals with disabilities are encouraged.

000060

## MASSACHUSETTS INSTITUTE OF TECHNOLOGY Department of Mathematics

The Mathematics Department at MIT is seeking to fill positions at the level of assistant professor or higher for September 2009. Appointments are based on exceptional research contributions in pure mathematics. Appointees will be expected to fulfill teaching duties and pursue their own research program. Ph.D. required by employment start date. We request that applications and other materials, including (a) curriculum vitae, (b) research description, and (c) three letters of recommendation be submitted online at http://www. mathjobs.org. Applications should be complete by December 1, 2008, to receive full consideration. We request that your reference letters be submitted by reviewers online via http://mathjobs. We will also accept recommendations sent as PDF attachments to pure@math.mit.edu, or in hardcopy mailed to: Pure Mathematics Committee, Room 2-345, Department of Mathematics, MIT, 77 Massachusetts Ave., Cambridge, MA 02139-4307. Please do not mail or email duplicates of items already submitted via mathjobs.

MIT is an Equal Opportunity, Affirmative Action Employer.

000073

## MASSACHUSETTS INSTITUTE OF TECHNOLOGY Department of Mathematics C.L.E. Moore Instructorships in Mathematics

These positions for September 2009 are open to mathematicians who show definite promise in research. Applicants with Ph.D.'s after June 2008 are strongly preferred. Appointees will be expected to fulfill teaching duties and pursue their own research program. We request that applications and other materials, including (a) curriculum vitae, (b) research description, and (c) three letters of recommendation, be submitted online at http://www. mathjobs.org. Applications should be complete by December 1, 2008, to receive full consideration. We request that your letters of reference be submitted by the reviewers online via http://mathjobs. We will also accept recommendations either as PDF attachments sent to: pure@ math.mit.edu, or as paper copies mailed to: Pure Mathematics Committee, Room 2-345, Department of Mathematics, MIT, 77 Massachusetts Ave., Cambridge, MA 02139-4307. Please do not mail or email duplicates of items already submitted via mathjobs.

MIT is an Equal Opportunity, Affirmative Action Employer.

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## MASSACHUSETTS INSTITUTE OF TECHNOLOGY Department of Mathematics Applied Mathematics

The applied mathematics group at MIT is seeking to fill combined teaching and research positions at the level of instructor, assistant professor or higher, beginning September 2009. Ph.D. required by employment start date. Appointments are mainly based on exceptional research qualifications. Candidates in all areas of applied mathematics, including physical applied mathematics, computational molecular biology, numerical analysis, scientific computation, and theoretical computer science will be considered. Current activities of the group include: combinatorics, operations research, theory of algorithms, numerical analysis, astrophysics, condensed matter physics, computational physics, fluid dynamics, geophysics, nonlinear waves, theoretical and computational molecular biology, material sciences, quantum computing and quantum field theory, but new hiring may involve other areas as well. We request that applications and other materials, including (a) curriculum vitae, (b) research description, and (c) three letters of recommendation be submitted online at: http://www.mathjobs.org, preferably well in advance of our deadline of January 1, 2009, since we will begin our deliberations in December. We request that your reference letters be submitted by reviewers online via http://mathjobs. We will also accept recommendations sent as PDF attachments to: applied@ math. mit. edu, or in hardcopy mailed to: Applied Mathematics Committee, Room 2-345, Department of Mathematics, MIT, 77 Massachusetts Ave., Cambridge, MA 02139-4307. Please do not mail or email duplicates of items already submitted via mathjobs.

MIT is an Equal Opportunity, Affirmative Action Employer.

000075

## MASSACHUSETTS INSTITUTE OF TECHNOLOGY <br> Department of Mathematics Statistics

The Department of Mathematics at MIT is seeking to fill combined teaching and research positions at the level of instructor, assistant professor or higher in STATISTICS or APPLIED PROBABILITY beginning September 2009. Appointments are mainly based on exceptional research qualifications. Ph.D. required by employment start date. We request that applications and other materials, including (a) curriculum vitae, (b) research description, and (c) three letters of recommendation be submitted online at: http://www. mathjobs.org. Applications should be complete by January 1, 2009, to receive full consideration. We request that your
reference letters be submitted by review ers online via http://mathjobs. We will also accept recommendations sent as PDF attachments to: statistics@math.mit. edu, or in hardcopy mailed to: Committee on Statistics, Room 2-345, Department of Mathematics, MIT, 77 Massachusetts Ave., Cambridge, MA 02139-4307. Please do not mail or email duplicates of items already submitted via mathjobs.

MIT is an Equal Opportunity, Affirmative Action Employer

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## WILLIAMS COLLEGE Mathematics \& Statistics

The Williams College Department of Mathematics and Statistics invites applications for one tenure-track position in mathematics, beginning fall 2009, at the rank of assistant professor (in an exceptional case, a more advanced appointment may be considered). We are seeking a highly qualified candidate who has demonstrated excellence in teaching and research, and who will have a Ph.D. by the time of appointment.

Williams College is a private, coeducational, residential, highly selective liberal arts college with an undergraduate enrollment of approximately 2,000 students. The teaching load is two courses per 12week semester and a winter term course every other January. In addition to excellence in teaching, an active and successful research program is expected.

Applicants are asked to supply a vita and have three letters of recommendation on teaching and research sent. Teaching and research statements are also welcome. Applications may be made online (http://www.mathjobs.org/jobs). Alternately, application materials and letters of recommendation may be sent to Olga R. Beaver, Chair of the Hiring Committee, Department of Mathematics and Statistics, Williams College, Williamstown, MA 01267. Evaluation of applications will begin on or after November 15 and will continue until the position is filled. For more information on the Department of Mathematics and Statistics, please visit http://www.williams.edu/ |Mathematics|.

Williams College is committed to building and supporting a diverse population of faculty, staff and students, to fostering a varied and inclusive curriculum, and to providing a welcoming intellectual environment for all. As an EEO/AA Employer, Williams encourages applications from all backgrounds. To learn more about Williams College, please visit http://www. williams.edu.

000048

## MICHIGAN

## MICHIGAN STATE UNIVERSITY Department of Mathematics

The Department of Mathematics expects to have 3 tenure-track positions available, beginning in the fall of 2009. Successful candidates will primarily be appointed at the rank of assistant professor, but truly outstanding applicants for appointment at a higher rank will be considered. Excellence is essential in both research and teaching, and it is preferred that the successful candidates will have some experience beyond the Ph.D. Among the open positions one is designated for interdisciplinary applied math/mathematical biology. The rest are available to outstanding applications in all mathematical research areas. Application materials should be submitted electronically through the AMS website http://mathjobs.org and should consist of at least four letters of references, curriculum vitae, a statement of teaching philosophy and experience, evidence of teaching excellence, and a statement of current and future research plans. Applications are considered on a continuing basis but candidates are urged to apply by November 15, 2008.

000112

## MICHIGAN TECHNOLOGICAL UNIVERSITY Department of Mathematical Sciences Tenure-track Position in Numerical Analysis

Applications are invited for a tenure-track faculty position in numerical analysis. Expertise in the design and analysis of algorithms for solving partial differential equations is preferred, but other areas of numerical analysis will be considered. Appointment is anticipated at the rank of assistant professor, although highly qualified candidates may be considered for appointment at the rank of associate professor.
The Department of Mathematical Sciences offers BS, MS, and Ph.D. programs. Current faculty have expertise in CFD and fluid mechanics, mathematical modeling in biology, inverse problems, and materials science, as well as discrete mathematics and statistics. Faculty are expected to have an active research program, seek external funding, and provide excellent teaching. Teaching loads are very competitive.
The position starts August 17, 2009, and candidates must complete all requirements for the Ph.D. in mathematics or a related field by that date. Review of applications will begin December 15, 2008; candidates applying by that date are assured full consideration. Interested candidates should send a vita and three letters of recommendation (at least one of which addresses teaching), a description of
proposed research program, and a statement of teaching interests to:

Search Committee
Numerical Analysis Position
Department of Mathematical Sciences
Michigan Technological University
1400 Townsend Drive
Houghton, MI 49931-1295
or to mathdept@mtu. edu (electronic submissions in PDF format are encouraged).
Michigan Technological University is an Equal Opportunity Educational Institution/Equal Opportunity Employer/Affirmative Action Employer.

## MICHIGAN TECHNOLOGICAL UNIVERSITY Department of Mathematical Sciences Tenure-track Position in Algebraic Number Theory

Applications are invited for a tenuretrack faculty position in algebraic number theory. The successful candidate will have a research program that includes significant applications to cryptography, coding theory, design theory, or graph theory. Appointment is anticipated at the rank of assistant professor, although highly qualified candidates may be considered for appointment at the rank of associate professor.
The Department of Mathematical Sciences offers BS, MS, and Ph.D. programs. Current faculty have expertise in coding theory, design theory, and commutative algebra, as well as applied mathematics and statistics. Faculty are expected to have an active research program, seek external funding, and provide excellent teaching. Teaching loads are very competitive.
The position starts August 17, 2009, and candidates must complete all requirements for the Ph.D. in mathematics or a related field by that date. Review of applications will begin December 15, 2008; candidates applying by that date are assured full consideration. Interested candidates should send a vita, three letters of recommendation (at least one of which addresses teaching), a description of proposed research program, and a statement of teaching interests to:

## Search Committee

Number Theory Position
Department of Mathematical Sciences
Michigan Technological University
1400 Townsend Drive
Houghton, MI 49931-1295
or to mathdept@mtu. edu (electronic submissions in PDF format are encouraged).
Michigan Technological University is an Equal Opportunity Educational Institution/Equal Opportunity Employer/Affirmative Action Employer.

000125

## MICHIGAN TECHNOLOGICAL UNIVERSITY <br> Department of Mathematical Sciences <br> Tenure-track Position(s) in Statistical Genetics

Applications are invited for one or more tenure-track faculty positions in statistical genetics. The successful candidate(s) will join an active research group (five faculty, ten graduate students, and one postdoc) using statistical techniques to determine the genetic basis of complex diseases. Appointment is anticipated at the rank of assistant professor, although highly qualified candidates may be considered for appointment at the rank of associate professor.

The Department of Mathematical Sciences offers BS, MS, and Ph.D. programs. In addition to those working in statistical genetics, current faculty have expertise in wildlife statistics, probability, discrete mathematics, and applied mathematics. Faculty are expected to have an active research program, seek external funding, and provide excellent teaching. Teaching loads are very competitive.

The position starts August 17, 2009, and candidates must complete all requirements for the Ph.D. in statistics or a related field by that date. Review of applications will begin December 1, 2008; candidates applying by that date are assured full consideration. Interested candidates should send a vita, three letters of recommendation (at least one of which addresses teaching), a description of proposed research program, and a statement of teaching interests to:

## Search Committee

## Statistical Genetics Position

Department of Mathematical Sciences
Michigan Technological University 1400 Townsend Drive
Houghton, MI 49931-1295
or to mathdept@mtu. edu (electronic submissions in PDF format are encouraged).

Michigan Technological University is an Equal Opportunity Educational Institution.

000124

## WAYNE STATE UNIVERSITY Department of Mathematics

Pending authorization, the Department of Mathematics invites applications for a possible tenure-track position commencing in fall 2009. Applications should include a signed, detailed vita; description of current research interests; and four letters of recommendation, one of which should address teaching. Solid evidence of teaching at the undergraduate level is preferred to a statement of teaching philosophy. There is also a possibility of a visiting position for the 2009-2010 academic year. A Ph.D. in mathematics and a strong interest in research and teaching
are required for all positions. Applications received by December 1, 2008 will be given priority. Wayne State University - People working together to provide quality service. Applicants must apply online at: http://jobs.wayne.edu. For further information, please consult the department's website: http://www.math. wayne.edu.
Wayne State University is an Equal Opportunity/Affirmative Action Employer. Women and members of underrepresented minority groups are especially encouraged to apply.

000099

## MINNESOTA

## UNIVERSITY OF MINNESOTA

## Dunham Jackson Assistant Professor

This is a three-year appointment from fall semester 2009 through spring semester 2012, with a teaching load of 3 one-semester courses per academic year. Outstanding research and teaching abilities are required. Preference will be given to applicants whose research interests are compatible with those of the school. Applicants should have received or expect to receive a Ph.D. in mathematics no earlier than Jan. 1, 2008, and no later than August 25, 2009. Salary is competitive. For full consideration, applications and all supporting materials must be submitted electronically through http://www. mathjobs.org by December 1, 2008. Applications received after the deadline will be considered as positions remain. No paper submission is needed unless the candidate is unable to submit electronically, in which case letters may be sent to the following address:

Peter J. Olver
Professor and Head, School of Mathematics
University of Minnesota
127 Vincent Hall,
206 Church Street S.E.
Minneapolis, MN 55455
email: mathsrch@tc.umn.edu
Applicants must include the following: Cover letter, curriculum vitae, at least 4 letters of recommendation, one of which should address teaching ability, description of research and a teaching statement. Reference letter writers should be asked to submit their letters online through http://mathjobs.org. If they are unable to do so, they may send their letters to the above mentioned address. In addition to your MathJobs application, the University of Minnesota requires all applicants to register at the website http://employment.umn.edu. At this site you should first click on the link "Search Positions". Enter Requisition Number 157121. When the job listing appears click the "View" link in the Position Title field and then the button "Apply for this Posting". At this point you will be prompted to "Fill out a
new Application". In your application, you should enter your name and optional demographic information. It is not necessary to fill out your complete contact information or to submit your other application material to this site.
The University of Minnesota is an Equal Opportunity Employer/Educator.

000081

## UNIVERSITY OF MINNESOTA School of Mathematics

The School of Mathematics of the University of Minnesota is seeking outstanding candidates for 2-3 tenured or tenure-track faculty positions starting fall semester 2009. Candidates should have a Ph.D. or equivalent degree in mathematics or a closely related field and excellent records in both research and teaching.
For full consideration, applications and all supporting materials must be submitted electronically through http://www. mathjobs.org by December 1, 2008. Applications received after the deadline will be considered as positions remain. No paper submission is needed unless the candidate is unable to submit electronically, in which case letters should be sent to the following address:

Peter J. Olver, Professor and Head
School of Mathematics
University of Minnesota
127 Vincent Hall
206 Church Street S.E.
Minneapolis, MN 55455

## email: mathsrch@tc.umn.edu

Applicants must include the following: Cover letter, curriculum vitae, at least 4 letters of recommendation, one of which should address teaching ability, and a research and teaching statement. Reference letter writers should be asked to submit their letters online through http://mathjobs.org. If they are unable to do so, they may send their letters to the above mentioned address. In addition to your MathJobs application, the University of Minnesota requires all applicants to register at the website http://employment.umn.edu. At this site you should first click on the link "Search Positions". Enter Requisition Number 157121 for tenure-track positions and 157113 for tenured positions.
When the job listing appears click the "View" link in the Position Title field and then the button "Apply for this Posting". At this point you will be prompted to "Fill out a new Application". In your application, you should enter your name and optional demographic information. It is not necessary to fill out your complete contact information or to submit your other application material to this site.
The University of Minnesota is an Equal Opportunity Employer/Educator.

000082

## NEW HAMPSHIRE

DARTMOUTH COLLEGE John Wesley Young Research Instructorship

The John Wesley Young Instructorship is a postdoctoral, two- to three-year appointment intended for promising Ph.D. graduates with strong interests in both research and teaching and whose research interests overlap a department member's. Current research areas include applied mathematics, combinatorics, geometry, logic, non-commutative geometry, number theory, operator algebras, probability, set theory and topology. Instructors teach four ten-week courses distributed over three terms, though one of these terms in residence may be free of teaching. The assignments normally include introductory, advanced undergraduate, and graduate courses. Instructors usually teach at least one course in their own specialty. This appointment is for 26 months with a monthly salary of US $\$ 4,833$ and a possible 12 month renewal. Salary includes two-month research stipend for Instructors in residence during two of the three summer months. To be eligible for a 2009-2011 Instructorship, candidate must be able to complete all requirements for the Ph.D. degree before September 2009. Applications may be obtained at http:// www.math.dartmouth.edu/recruiting/ or http://www.mathjobs.org. Position ID: 237-JWY. General inquiries can be directed to Annette Luce, Department of Mathematics, Dartmouth College, 6188 Kemeny Hall, Hanover, New Hampshire 03755-3551. At least one referee should comment on applicant's teaching ability; at least two referees should write about applicant's research ability. Applications received by January 5, 2009, receive first consideration; applications will be accepted until position is filled. Dartmouth College is committed to diversity and strongly encourages applications from women and minorities.

000078

## NEW JERSEY

## INSTITUTE FOR ADVANCED STUDY School of Mathematics

The School of Mathematics has a limited number of memberships, some with financial support, for research in mathematics and computer science at the Institute during the 2009-2010 academic year. Candidates must have given evidence of ability in research comparable at least with that expected for the Ph.D. degree.

During the academic year of 2009-2010, Enrico Bombieri of the school and Peter Sarnak of Princeton University/Institute for Advanced Study will lead a program on analytic number theory. The program will have an emphasis on analytic aspects, and
particular topics that will be covered include the distribution of prime numbers, sieves, L functions, special sequences as well as additive and combinatorial methods, exponential sums, spectral analysis and modular forms.
Minicourses explaining some of the basic methods and tools connected with these topics will be held towards the beginning of each term, and a weekly seminar will take place on Tuesday afternoons. A week-long workshop highlighting recent developments connected with the program will be held in the spring.

Recently the school has established the von Neumann Early Career Fellowships. Six of these fellowships will be available for the 2009-2010 academic year. To be eligible for the von Neumann Fellowships, applicants should be at least 5 years following the receipt of their Ph.D. but not yet eligible to receive their first paid sabbatical.

The Veblen Research Instructorship is a three-year position which the School of Mathematics and the Department of Mathematics at Princeton University established in 1998. Three-year instructorships will be offered each year to candidates in pure and applied mathematics who have received their Ph.D. within the last three years. The first and third year of the instructorship will be spent at Princeton University and will carry regular teaching responsibilities. The second year will be spent at the Institute and dedicated to independent research of the instructor's choice.

Application materials may be requested from Applications, School of Mathematics, Institute for Advanced Study, Einstein Drive, Princeton, NJ 08540; email: applications@math.ias.edu. Application forms may be downloaded via a Web connection to: http://www.math.ias. edu. Application deadline is December 1.
The Institute for Advanced Study is committed to diversity and strongly encourages applications from women and minorities.

000054

## RUTGERS UNIVERSITY, CAMDEN Department of Mathematical Sciences Joseph and Loretta Lopez Endowed Chair in Mathematics

Applications and nominations are invited for the Joseph and Loretta Lopez Chair in Mathematics. The department seeks a distinguished scholar in mathematics with international reputation, well-established research and teaching record, and demonstrated ability to generate external funding. This endowed chair is the first at the Camden Campus of Rutgers University. It is a tenured faculty position and the chair is for a 5 -year renewable term. The holder of this chair will be a senior faculty member and a vigorous participant in the research, instruction, and service work of
the Department of Mathematical Sciences. The holder will also be expected to play a vital role in the recently established Center for Computational and Integrative Biology. Applicants must demonstrate evidence of interest in the areas of mathematical and/or computational biology.
The appointment will commence on September 1, 2009. The salary and startup funds are highly competitive and negotiable. The department will begin reviewing applications on December 17 and continue its review until the position is filled. Applications should be sent to:

Professor Gabor Toth, Chair, Search Committee, Department of Mathematical Sciences, Rutgers University, Camden, Camden, New Jersey, 08102.

Applicants should also arrange for at least four letters of recommendation to be sent. Rutgers University, Camden, is an Affirmative Action/Equal Opportunity Employer and encourages applications from women and minority-group members.

000077

## THE COLLEGE OF NEW JERSEY Department of Mathematics and Statistics <br> Tenure-Track Position in Mathematics Education

The Department of Mathematics and Statistics at The College of New Jersey invites applicants for a tenure-track assistant professor in mathematics education, starting August 2009. We seek broadly trained candidates who have potential to contribute collaboratively to interdisciplinary curricular and scholarly efforts within the School of Education and at the college. A doctorate in mathematics education, mathematics, or statistics, with a strong background and interest in K -12 mathematics education, are required. The successful candidate will teach mathematics methods and content courses, supervise student teachers, and conduct research in mathematics education. Typical teaching load is 2 to 3 courses per semester. To apply, candidates should submit a letter of application highlighting their interest and qualifications; current curriculum vitae; statement of teaching philosophy; statement of research objectives; copies of graduate and undergraduate transcripts; and have three letters of recommendation sent to: Math Education Search, Department of Mathematics and Statistics, The College of New Jersey, P.O. Box 7718, Ewing, NJ, 08628-0718. Review of applications will begin October 15, 2008, and will continue until the position is filled. For further information about our program, please visit: http://www.tcnj. edu/~mathstat/. To enrich education through diversity, TCNJ is an Affirmative Action/Equal Opportunity Employer. Women and members of underrepresented groups are encouraged to apply.

000118

## THE COLLEGE OF NEW JERSEY Department of Mathematics and Statistics Tenure-track Position in Applied Mathematics

The Department of Mathematics and Statistics at The College of New Jersey invites applicants for a tenure-track assistant or associate professor in applied mathematics, starting August 2009. We seek broadly trained candidates who have potential to contribute collaboratively to interdisciplinary curricular and scholarly efforts within the School of Science and at the college. A Ph.D. in mathematics or applied mathematics and a broad background in mathematics are required. The successful candidate will teach several required core mathematics courses and have the opportunity to develop an upper-level course in area of specialty. Typical teaching load is 2 to 3 courses per semester. Specific research area in applied mathematics is open. To apply, candidates should submit a letter of application highlighting their interest and qualifications; current curriculum vitae; statement of teaching philosophy; statement of research objectives; copies of graduate and undergraduate transcripts; and have three letters of recommendation sent to: Applied Math Search, Department of Mathematics and Statistics, The College of New Jersey, P.O. Box 7718, Ewing, NJ 08628-0718. Review of applications will begin October 15, 2008, and will continue until January 30, 2009. To enrich education through diversity, TCNJ is an Affirmative Action/Equal Opportunity Employer. For further information about our program, please visit: http://www. tcnj.edu/~mathstat//

000119

## NEW YORK

## FORDHAM UNIVERSITY Department of Mathematics

The Mathematics Department of Fordham University invites applications for a tenure track position starting in the fall of 2009. An active and productive research program and a record of success in undergraduate teaching are essential. We are interested in specialties that give promise of leading to research collaborations with our faculty, including areas of computational and applied mathematics. Expertise in applications of mathematics to other disciplines is a plus. Further details may be found at: http://www.fordham.edu/ mathematics/TenureTrack.pdf. Address inquiries by email to: mathematics@ fordham.edu.

Applications must be submitted online through http://MathJobs.Org at: http://www.mathjobs.org/jobs/
fordham and should include a cover letter, a curriculum vitae; research and teaching statements; and four letters of recommendation, at least one of which addresses teaching experience. In exceptional circumstances, letters of recommendation only may be mailed to: Hiring Committee, Mathematics Department, Fordham University, 441 E. Fordham Rd., Bronx, NY 10458. To receive fullest consideration, applications should be complete by November 1st, but applications will be reviewed until the position is filled.
Fordham is an independent Catholic university in the Jesuit tradition that welcomes applications from men and women of all backgrounds. Fordham is an EO/AA employer.

000100

## NORTH CAROLINA

## WAKE FOREST UNIVERSITY

 Department of MathematicsApplications are invited for two tenuretrack positions in mathematics at the assistant professor level beginning August 2009. We seek highly qualified candidates who have a commitment to excellence in both teaching and research. A Ph.D. in mathematics or a related area is required. Candidates with research interests in number theory, combinatorics, or algebra will receive first consideration. The department has 20 members and offers both a B.A. and a B.S. in mathematics, with an optional concentration in statistics, and a B.S. in each of mathematical business and mathematical economics. The department has a graduate program offering an M.A. in mathematics. A complete application will include a letter of application, curriculum vitae, teaching statement, research statement, graduate transcripts and three letters of recommendation. Applicants are encouraged to post materials electronically at: http:// www.mathjobs.org. Hard copy can be sent to Stephen Robinson, Wake Forest University, Department of Mathematics, P.O. Box 7388, Winston-Salem, NC 27109. (sbr@wfu.edu, http://www.math.wfu. edu) AA/EO Employer.

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## OHIO

## CASE WESTERN RESERVE UNIVERSITY Department of Mathematics

The Department of Mathematics at Case Western Reserve University anticipates at least one new tenure-track position (rank open, junior preferred). Applications are encouraged from any area of mathematics. Preference will be given to candidates in the areas of algebra, broadly construed. Algebra-related fields may include, but are not limited to, algebraic geometry,
algebraic topology, number theory, operator algebras, group representation theory, and combinatorics. Exceptional candidates in other areas of mathematics will also be considered. Above the rank of assistant professor, a strong publication record is required. Candidates should hold a Ph.D. in mathematics by the time of appointment, demonstrated teaching experience, and a publication record appropriate to rank. The normal teaching load is two courses per semester.
Candidates should submit a letter of application, curriculum vitae and arrange for three letters of recommendation to be submitted directly. In addition, a statement of teaching philosophy and experience, evidence of teaching excellence, and a statement of current and future research plans should be included as part of the application dossier. All application materials should be submitted electronically through the AMS website http:// mathjobs.org or mailed to:

Faculty Search
Department of Mathematics
Case Western Reserve University
10900 Euclid Avenue
Cleveland, OH 44106
More detailed information regarding the department may be found on the website: http://www.cwru.edu/artsci/math/. Women and minority candidates are encouraged to apply. Case Western Reserve University is supportive of the needs of dual career couples and is an Equal Opportunity /Affirmative Action Employer. The application process will continue until the position is filled but interested applicants are encouraged to apply by November 15, 2008, when the review process will begin.
Case Western Reserve University is located in the attractive University Circle cultural district of Cleveland Ohio, home of the internationally famous Cleveland Orchestra, the Cleveland Museum of Art, the Cleveland Institute of Music, the Cleveland Institute of Art. Within a fivemile radius of campus are the nation's second largest theater district; multiple professional sports teams; a wide range of musical, artistic, and culinary venues; and numerous, diverse communities in which to live.
Items to be submitted through http:// mathjobs.org.

* Cover Letter
* Curriculum Vitae
* Research Statement
* Teaching Statement
* Publication List
* 3 Reference Letters (submitted directly by writers)


## CASE WESTERN RESERVE UNIVERSITY Department of Mathematics

The Department of Mathematics at Case Western Reserve University anticipates
at least one new tenure-track (rank open, junior preferred). Applications are encouraged from any area of applied, computational, or interdisciplinary mathematics. Preference will be given to candidates with interest in the areas of life sciences and energy research. Exceptional candidates in other areas of applied and computational mathematics will also be considered. Above the rank of assistant professor, a strong publication record is required. Candidates should hold a Ph.D. in mathematics or a related field by the time of appointment, demonstrated teaching experience, and a publication record appropriate to rank. The normal teaching load is two courses per semester.

Candidates should submit a letter of application, curriculum vitae, and arrange for three letters of recommendation to be submitted directly. In addition, a statement of teaching philosophy and experience, evidence of teaching excellence, and a statement of current and future research plans should be included as part of the application. All application materials should be submitted electronically through the AMS website http://mathjobs.org or mailed to:

## Faculty Search <br> Department of Mathematics <br> Case Western Reserve University <br> 10900 Euclid Avenue <br> Cleveland, OH 44106

More detailed information regarding the department may be found on our website: http://www.cwru.edu/artsci/math/. Women and minority candidates are encouraged to apply. Case Western Reserve University is supportive of the needs of dual career couples and is an Equal Opportunity /Affirmative Action Employer. The application process will continue until the position is filled but interested applicants are encouraged to apply by November 15, 2008, when the review process will begin.

Case Western Reserve University is located in the University Circle cultural district of Cleveland, Ohio, home of the internationally-famous Cleveland Orchestra, the Cleveland Museum of Art, the Cleveland Institute of Music, the Cleveland Institute of Art. Within a five-mile radius of campus are the nation's second largest theater district; multiple professional sports teams; a wide range of musical, artistic, and culinary venues; and numerous, diverse communities in which to live.
Items to be submitted for the application:

* Cover Letter
* Curriculum Vitae
* Research Statement
* Teaching Statement
* Publication List
* 3 Reference Letters (submitted directly by writers)

000128

## UNIVERSITY OF DAYTON Department of Mathematics

Applications are invited for a tenure-track position in the Department of Mathematics at the assistant professor level starting in August 2009. Candidates must have a Ph.D. in mathematics. Applicants must have a strong commitment to research, and the potential to become an effective teacher. Responsibilities include developing and maintaining a research agenda, teaching a broad range of mathematics courses, advising, and curriculum development. The applicant will also be expected to participate in directing undergraduate students working on research projects and to work with students from diverse backgrounds. We are open to all areas of research, but fundamental areas such as algebra, number theory, topology, and set theory will receive special attention.
The selection process begins December 9, 2008. To receive full consideration, all materials must be received by January 12, 2009. A complete application consists of a resume, three letters of recommendation, a statement of research agenda, a statement of teaching philosophy and an unofficial graduate school transcript. Both teaching abilities and research abilities should be addressed in the letters of recommendation. Please include an e-mail address in your correspondence.
We strongly encourage applicants to submit materials through http://MathJobs.org. Applications can also be sent directly to: Dr. Robert Gorton, Chair of the Mathematics Search Committee, Department of Mathematics, University of Dayton, Dayton, OH 45469-2316. Contact the search committee at: Robert.Gorton@ notes.udayton.edu.
Obtain further information at: http:// campus.udayton.edu/~mathdept.
The University of Dayton, a comprehensive Catholic University founded by the Society of Mary in 1850, is an Equal Opportunity/Affirmative Action Employer. Women, minorities, individuals with disabilities and veterans are strongly encouraged to apply. The University of Dayton is firmly committed to the principle of diversity.

000101

## OKLAHOMA

## OKLAHOMA STATE UNIVERSITY Department of Mathematics

Applications are invited for two tenuretrack faculty positions beginning fall 2009. Applicants should have obtained a doctoral degree, have outstanding research potential, and be committed to excellence in undergraduate and graduate education. Research experience beyond the doctorate is preferred. The department encourages applications from individuals with research interest close to
that of a permanent faculty member; in particular, we encourage applications from individuals interested in research in mathematics education. Applicants in mathematics education should have, in addition to a doctoral degree, coursework equivalent to at least that of a master's degree in mathematics and be conducting research in secondary or college-level mathematics education. Especially wellqualified applicants may be considered for appointment at the rank of associate professor. All applicants should use the AMS http://mathjobs.org site to submit a curriculum vita, abstracts of completed research, and a statement regarding teaching experience, and have 4 letters of recommendation uploaded. One letter of recommendation should appraise the applicant's teaching experience and abilities. Applicants should use the AMS standardized form, Academic Employment in Mathematics: Application Cover Sheet, and indicate their subject area using the AMS subject classification numbers. Full consideration will be given to applications received by December 1, 2008. Additional information may be found at: http://www.math.okstate. edu/faculty_openings or by writing to the address below. Oklahoma State University is located in Stillwater in north central Oklahoma, about one hour by car from either Tulsa or Oklahoma City. The department boasts a dynamic faculty with 31 tenured or tenure-track members and 3 postdocs engaged in mathematics research and education. An active Ph.D. program, support for colloquium and other visitors, as well as involvement of undergraduates in early research experiences, create a lively atmosphere in the department. The department has received national recognition for the faculty's contributions to mathematical research and education. More information on the department is available at: http://www. math.okstate.edu/. Oklahoma State University is an AA/EEO/E-Verify employer committed to diversity. OSU-Stillwater is a tobacco-free campus. Appointment Committee Chair Dept. of Math/401 Math Sciences Oklahoma State University Stillwater, Ok 74077-1058

000113

## OREGON

## LINFIELD COLLEGE Department of Mathematics

Applications are invited for a tenure-track position in mathematics at the assistant professor rank, to begin fall 2009, pending budget approval. Candidates must have a Ph.D. In mathematics, applied mathematics, or statistics by August 15, 2009. Further information, including application requirements, is available at: http://www. 1 infie1d.edu/ |humanresources/teaching.php|. Applications received by December 1, 2008, will
receive full consideration. Women and members of minority groups are especially encouraged to apply.

000117

## PENNSYLVANIA

## BRYN MAWR COLLEGE

Department of Mathematics
The Department of Mathematics invites applications for a continuing non-tenure track position of Math Program Coordinator to begin July 1, 2009. The position is a three-year appointment. It can be renewed for multiple terms. An MA/MS in Mathematics is required, though a Ph.D. in mathematics is preferred. We are seeking an enthusiastic individual with excellent teaching, communication, and administrative skills. The successful candidate will work with our department to provide our students with a comfortable transition from high school to college, will encourage them to pursue mathematics beyond the elementary level, and will coordinate departmental organizations and activities. Applicants must share our dedication to opening young women's minds to mathematics while enhancing their abilities to think both deeply and broadly. See http://www.brynmawr.edu/math for a more detailed description of the department and the position.

Applicants with excellent teaching and administrative skills should arrange to have a cover letter, a curriculum vita, a statement of teaching interests and philosophy, a list of mathematics courses taken and taught, official undergraduate and graduate transcripts, and at least three reference letters sent to: Search Committee, Department of Mathematics, Bryn Mawr College, 101 N. Merion Avenue, Bryn Mawr, PA 19010-2899.

Applications may also be submitted online through http://mathjobs.org. Applications should be complete by December 15, 2008.

Located in suburban Philadelphia, Bryn Mawr College is a highly selective liberal arts college for women who share an intense intellectual commitment, a selfdirected and purposeful vision of their lives, and a desire to make meaningful contributions to the world. Bryn Mawr comprises an undergraduate college with 1,200 students, as well as coeducational graduate schools in some humanities, sciences, and social work. The College participates in a consortium together with Haverford and Swarthmore Colleges and the University of Pennsylvania. Bryn Mawr College is an Equal Opportunity, Affirmative Action Employer. Minority candidates and women are especially encouraged to apply.

000111

## PENN STATE UNIVERSITY Department of Mathematics

Penn State York invites applications for a tenure-track assistant professor of mathematics position. Teach undergraduate math courses, primarily the first two years of college mathematics (pre-calculus, techniques of Calculus I; Calculus I, II, and III, linear algebra, and differential equations; 18 credits per year). Assignments may include day, evening, and Saturday classes. Research and service expected. Ph.D. in pure or applied mathematics is required by time of appointment. Evidence of potential for excellent teaching, research and publication in high-quality journals, and professional growth is expected. To learn more about the campus and Penn State, visit: http://www.psu. edu/ur/cmpcol1.htm1. To learn more about the position and how to apply, visit: http://www.psu.jobs/Search/ |Opportunities.html| and follow the "Faculty" link. AA/EOE.

000126

## UNIVERSITY OF PITTSBURGH Mathematics Department Representation Theory/Algebraic Geometry/ Number Theory/Combinatorics

The Mathematics Department of the University of Pittsburgh invites applications for two tenure-track or tenured positions in representation theory/algebraic geometry/number theory/combinatorics to begin in the fall term 2009, pending budgetary approval. The appointments are at the assistant professor level or above, depending on the credentials of the applicant. A Ph.D. in mathematical sciences is required. We seek excellence in teaching and research so applicants should demonstrate substantial research accomplishment and dedication to teaching. Send a vita, three letters of recommendation, a research statement and evidence of teaching accomplishments electronically through http://www.mathjobs. org. If the candidate is unable to submit electronically, materials may be sent to: Search Committee in Algebra, Department of Mathematics, University of Pittsburgh, Pittsburgh, PA 15260. Review of completed files will begin on November 30, 2008, and continue until the position is filled. The University of Pittsburgh is an Affirmative Action, Equal Opportunity Employer. Women and members of minority groups underrepresented in academia are especially encouraged to apply.

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## UNIVERSITY OF PITTSBURGH <br> Mathematics Department Non-Tenure Stream Positions in Mathematics

The Mathematics Department of the University of Pittsburgh invites applications for two non-tenure-stream positions to begin in the fall term 2009, pending budgetary approval. A Ph.D. in mathematical sciences is preferred and at least a Master's degree in mathematical sciences is required. The appointments are at the assistant instructor level or above, depending on the credentials of the applicant. We seek excellence in teaching and potential for collaboration in the research activities of the department. Send a vitae, three letters of recommendation, and a teaching portfolio including a statement of teaching philosophy, sample course syllabi and assignments, and evaluations of teaching by students or supervisors, electronically through http://www. mathjobs.org. If the candidate is unable to submit electronically, materials may be sent to: NTS Search Committee, Department of Mathematics, University of Pittsburgh, Pittsburgh, PA 15260. Review of completed files will begin on December 15,2008 , and continue until the position is filled. The University of Pittsburgh is an Affirmative Action, Equal Opportunity Employer. Women and members of minority groups underrepresented in academia are especially encouraged to apply.

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## UNIVERSITY OF PITTSBURGH Mathematics Department Scientific Computing/Numerical Analysis

The Mathematics Department of the University of Pittsburgh invites applications for a tenure-track or tenured position in scientific computing/numerical analysis to begin in the fall term 2009, pending budgetary approval. The appointment is at the assistant professor or the associate Professor level, depending on the credentials of the applicant. A Ph.D. in mathematical sciences is required. We seek excellence in teaching and research so applicants should demonstrate substantial research accomplishment and dedication to teaching. Submit a vita, three letters of recommendation, a research statement and evidence of teaching accomplishments electronically through http:// www.mathjobs.org. If the candidate is unable to submit electronically, materials may be sent to: Search Committee in Scientific Computing/Numerical Analysis, Department of Mathematics, University of Pittsburgh, Pittsburgh, PA 15260. Review of completed files will begin on November 30, 2008, and continue until the position is filled. The University of Pittsburgh is an Affirmative Action, Equal Opportunity Employer. Women and members of minority
groups underrepresented in academia are especially encouraged to apply.

## UNIVERSITY OF PITTSBURGH Mathematics Department Topology/Geometry

The Mathematics Department of the University of Pittsburgh invites applications for a tenure-track position in topology/ geometry to begin in the fall term 2009, pending budgetary approval. The appointment is at the assistant professor level. A Ph.D. in Mathematical Sciences is required. We seek excellence in teaching and research so applicants should demonstrate substantial research accomplishment and dedication to teaching. Submit a vita, three letters of recommendation, a research statement and evidence of teaching accomplishments electronically through http://www.mathjobs. org. If the candidate is unable to submit electronically, materials may be sent to: Search Committee in Topology/Geometry, Department of Mathematics, University of Pittsburgh, Pittsburgh, PA 15260. Review of completed files will begin on November 30, 2008, and continue until the position is filled. The University of Pittsburgh is an Affirmative Action, Equal Opportunity Employer. Women and members of minority groups underrepresented in academia are especially encouraged to apply.

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## VILLANOVA UNIVERSITY <br> Department of Mathematical Sciences Assistant Professor

The Department of Mathematical Sciences invites applications for a tenure-track position at the assistant professor level starting August 2009. A Ph.D. in one of the mathematical sciences or near completion of the doctorate is required. All areas of mathematical sciences will be considered. Send application letter, graduate school transcripts, CV, and three letters of recommendation to: Dr. Douglas Norton, Chair, Dept. of Mathematical Sciences, Villanova University, Villanova, PA 19085. Villanova is a Catholic university sponsored by the Augustinian order. An AA/EEO Employer, Villanova seeks a diverse faculty committed to scholarship, service, and especially teaching, who understand, respect, and can contribute to the university's mission and values. Review of applications begins $12 / 1 / 2008$ and continues until the position is filled. Please see the department homepage at http://www.villanova. edu/artsci/mathematics.

## RHODE ISLAND

## BROWN UNIVERSITY Department of Mathematics

J. D. Tamarkin Assistant Professorship: One three-year non-tenured non-renewable appointment, beginning July 1, 2009. The teaching load is one course one semester, and two courses the other semester and consists of courses of more than routine interest. Candidates are required to have received a Ph.D. degree or equivalent by the start of their appointment, and they may have up to three years of prior academic and/or postdoctoral research experience.
Applicants should have strong research potential and a commitment to teaching. Field of research should be consonant with the current research interests of the department.
For full consideration, applicants must submit a curriculum vitae, an AMS Standard Cover Sheet and three letters of recommendation by December 1, 2008. Please submit all application materials on line at http://www.mathjobs.org.
If necessary, inquiries and materials can be addressed to: Junior Search Committee, Department of Mathematics, Box 1917, Brown University, Providence, RI 02912. Email inquiries should be addressed to: juniorsearch@math.brown.edu.
Brown University is an Equal Opportunity/Affirmative Action Employer and encourages applications from women and minorities.

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## TENNESSEE

## VANDERBILT UNIVERSITY Department of Mathematics Tenure-Track or Tenured Faculty Positions

The Department of Mathematics at Vanderbilt University invites applications for at least one position at the tenure-track or tenured level beginning fall 2009. Exceptional candidates from any area of pure or applied mathematics are encouraged to apply, but priority will be given to applicants in the research areas of the department or number theory and algebraic geometry. The department especially encourages applications from women and minorities.
We are looking for individuals with an outstanding record in research and demonstrated excellence in teaching. Salaries are competitive and are based on credentials. Qualified candidates should submit their application materials electronically through the AMS website http://MathJobs.org via the URL http://www.mathjobs.org/jobs. Al-
ternatively, application materials may be sent to:

Faculty Hiring Committee
Vanderbilt University
Department of Mathematics
1326 Stevenson Center
Nashville, TN 37240.
These materials should include a letter of application, a curriculum vitae, a publication list, a description of current and planned research, at least four letters of recommendation, and the AMS Cover Sheet. One of the letters must discuss the applicant's teaching qualifications. Reference letter writers should be asked to submit their letters online through http:// mathjobs.org. Senior applicants should also include five names of suggested reviewers. Evaluation of the applications will commence on December 1, 2008, and continue until the positions are filled. For information about the Department of Mathematics at Vanderbilt University, please consult the web at: http://www. math. vanderbilt.edu/.
Vanderbilt is an Equal Employment Opportunity/Affirmative Action Employer.

000097

## VANDERBILT UNIVERSITY <br> Department of Mathematics Non Tenure-Track Assistant Professor Positions

We invite applications for several visiting and non-tenure-track assistant professor positions in the research areas of the Mathematics Department beginning fall 2009. These positions will have variable terms but most will be three-year appointments with a 2-2 teaching load. Two of these appointments will be special non-tenure-track assistant professorships with a 1-1 teaching load and a stipend to support research.
We are looking for individuals with outstanding research potential and a strong commitment to excellence in teaching. Preference will be given to recent doctorates. Submit your application and supporting materials electronically through the AMS website http://MathJobs.org via the URL http://www.mathjobs.org/ jobs. Alternatively, application materials may be sent to:

NTT Appointments Committee
Vanderbilt University
Department of Mathematics
1326 Stevenson Center
Nashville, TN 37240.
These materials should include a letter of application, a curriculum vitae, a publication list, a research statement, four letters of recommendation and the AMS Cover Sheet. One of the letters must discuss the applicant's teaching qualifications. Reference letter writers should be asked to submit their letters online through http:// mathjobs.org. Evaluation of the applications will commence on December 1, 2008, and continue until the positions are filled.

For information about the Department of Mathematics at Vanderbilt University, please consult the web at: http://www. math. vanderbilt.edu/.
Vanderbilt is an Equal Employment Opportunity/Affirmative Action Employer. Women and minorities are especially invited to apply.

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## TEXAS

## TEXAS A\&M UNIVERSITY The Department of Mathematics

The Department of Mathematics anticipates several openings for tenured, ten-ure-eligible, and visiting faculty positions beginning fall 2009. The field is open, but we particularly seek applications from individuals whose mathematical interests would augment and build upon existing strengths both within the Mathematics Department as well as other departments in the university. Salary, teaching loads, and start-up funds are competitive. For a tenured position the applicant should have an outstanding research reputation and would be expected to fill a leadership role in the department. An established research program, including success in attracting external funding and supervision of graduate students, and a demonstrated ability and interest in teaching are required. Informal inquiries are welcome. For an assistant professorship, we seek strong research potential and evidence of excellence in teaching. Research productivity beyond the doctoral dissertation will normally be expected. We also have several visiting positions available. Our Visiting Assistant Professor positions are three-year appointments and carry a three course per year teaching load. They are intended for those who have recently received their Ph.D., and preference will be given to mathematicians whose research interests are close to those of our regular faculty members. Senior Visiting Positions may be for a semester or one-year period. A complete dossier should be received by December 15, 2008. Early applications are encouraged since the department will start the review process in October 2008. Applicants should send the completed "AMS Application Cover Sheet", a vita, a summary statement of research and teaching experience; and arrange to have letters of recommendation sent to: Faculty Hiring, Department of Mathematics, Texas A\&M University, College Station, Texas 77843-3368. Further information can be obtained from: http://www. math.tamu. edu/hiring.

Texas A\&M University is an Equal Opportunity Employer. The university is dedicated to the goal of building a culturally diverse and pluralistic faculty and staff committed to teaching and working in a multicultural environment and strongly encourages applications from women, minorities, individuals with disabilities,
and veterans. The university is responsive to the needs of dual career couples.

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## Texas A\&M University Department of Mathematics IAMCS-KAUST Postdoctoral Fellowships

The Institute for Applied Mathematics and Computational Science (IAMCS) at Texas A\&M University is pleased to invite applications for its IAMCS-KAUST Postdoctoral Fellowships.
IAMCS is an interdisciplinary research institute at Texas A\&M University recently named as one of the four inaugural King Abdullah University of Science and Technology (KAUST) Global Research Partner Centers. Its core members number more than two dozen faculty from the fields of mathematics, statistics, computer science, and engineering.

Fostering collaboration and interdisciplinary research anchored in the mathematical sciences are at the heart of IAMCS's mission. To that end, IAMCS emphasizes among its activities annual research themes. Its first two annual themes are Computational Earth Science and Computational Material Science and Engineering. IAMCS postdoctoral candidates should have demonstrated interest and involvement in interdisciplinary research, and successful candidates will be encouraged to participate in the annual theme activities and to establish research collaborations exploring theme year topics. Moreover, each fellow will be invited to establish collaborations with KAUST faculty, postdocs, and students as well as all of the KAUST Global Research Partner institutions and individual investigators. This offers an unprecedented opportunity for postdoctoral fellows to join a remarkable network of leading research institutions and eminent scholars assembled through the KAUST GRP program.

KAUST is a new graduate research university being rapidly developed by the Kingdom of Saudi Arabia at a site along the Red Sea a short distance north of Jeddah. When it opens in September 2009, it will offer world class, state-of-the-art research and instructional facilities supporting its core research and graduate programs in earth sciences, materials science and engineering, biosciences, and applied mathematics and computational science. A key element in KAUST's development as a premier graduate research university is its Global Research Partnership (GRP) program. The GRP consists of its Academic Excellence Alliance Partners, Research Center Partners, and Individual Research Scholar Partners.

The IAMCS-KAUST Postdoctoral Fellowships at Texas A\&M University are twoyear appointments with the possibility of extension to a third year. The fellowship stipend is US $\$ 50 \mathrm{~K}$ over 12 months plus fringe benefits. Interested individuals should submit their application materials
(CV, research statement, and three letters of recommendation) to the email address: email: KAUST@tamu. edu by December 15, 2008. IAMCS intends to select up to four IAMCS-KAUST Fellows.

Texas A\&M University is an Equal Opportunity Employer. The university is dedicated to the goal of building a culturally diverse pluralistic faculty and staff committed to teaching and working in a multicultural environment and strongly encourages applications from women, minorities, and individuals with disabilities.

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## UNIVERSITY OF TEXAS AT DALLAS Department of Mathematical Sciences Department Head

The University of Texas at Dallas seeks a distinguished scientist to head its Department of Mathematical Sciences and enhance its national and international stature. A Ph.D. in mathematics, applied mathematics, statistics, or related field is required together with a proven record of scholarly research commensurate with tenure at the full professor level. The successful candidate will have a multidisciplinary research emphasis and will present a vision for the future of the department and clear evidence of leadership potential. The position represents an unusual opportunity to shape a mathematics department for the future in an expanding, research-oriented university with strong science, engineering, and management emphases. Salary will be commensurate with qualifications and experience.

The department maintains strong undergraduate and graduate degree programs in mathematics, applied mathematics, statistics, and bioinformatics and computational biology, and expects to add M.S. and Ph.D. degree programs in actuarial mathematics and biostatistics in the near future.

The university is located in the rapidly growing and increasingly cosmopolitan suburbs of North Dallas amid one of the largest and most vibrant concentrations of high technology, multi-national corporations in the nation, including a substantial energy sector. For more information, visit: http://www.utda1las.edu.

Inquiries may be addressed to:
Dr. Raimund Ober, Professor, Chair of the Search Committee, ober@ $\backslash$ break utda11as.edu; Dr. Michael Baron, Professor, mbaron@utda11as.edu; Dr. Mieczyslaw K. Dabkowski, Assistant Professor, mdab@ utdallas.edu; Dr. Sam Efromovich, Endowed Professor, efrom@utda11as.edu; Dr. Robert Hilborn, Professor \& Department Head, rhi1born@utda11as. edu; Dr. David Lewis, Senior Lecturer II, d1ewis@
utdallas.edu; Dr. Viswanath Ramakrishna, Professor, vish@utdallas.edu.

Review of applications will begin December 15, 2008, and will continue until the position is filled. The successful candidate will fill the position effective August 2009, although other arrangements are negotiable.

Candidates should submit a complete resume or curriculum vitae, a statement of research interests, a letter describing his/her vision for the development of the department, and the contact information (names, addresses, telephone numbers, and email) for five professional references. Electronic applications may be submitted via http://go.utda11as.edu/ |facultyjobs| and are highly encouraged. The electronic process will allow candidates to upload documents into a secure space directly from their computers. Emailed materials will not be accepted. Indication of gender and ethnic origin for affirmative action statistical purposes is requested as part of the application process but is not required for consideration.

Alternatively, application materials may be mailed to:

Academic Search \#20096
The University of Texas at Dallas
Mail Station AD 42, Room MP 2.228
800 West Campbell Road
Richardson, Texas 75080-3021
U.S.A.

The University of Texas at Dallas is an Equal Opportunity/Affirmative Action University and encourages applications from candidates who would enhance the diversity of the university's faculty and administration.

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## UTAH

## UNIVERSITY OF UTAH Department of Mathematics

The Department of Mathematics at the University of Utah invites applications for the following positions: Full-time ten-ure-track or tenured appointments at the level of assistant, associate, or full professor in all areas of mathematics. Special consideration will be given to candidates in the area of statistics. Three-year Scott, Wylie, Burgess, and VIGRE Assistant Professorships, including Dual VIGRE Post Doctoral positions, depending on funding availability. Three-year Post Doctoral positions with the NSF-NIGMS grant on the Formation and Function of Physiological Gels. Please see our website at: http:// www.math. utah.edu/positions for information regarding available positions, application requirements, and deadlines. Applications must be completed through the website http://www.mathjobs.org. The University of Utah is an Equal Opportunity, Affirmative Action Employer and encourages applications from women and
minorities, and provides reasonable accommodation to the known disabilities of applicants and employees. The University of Utah values candidates who have experience working in settings with students from diverse backgrounds, and possess a strong commitment to improving access to higher education for historically underrepresented students.

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## WASHINGTON

## PACIFIC LUTHERAN UNIVERSITY Department of Mathematics

We seek to fill two tenure-track assistant professorships, one in mathematics and one in statistics, beginning September 2009. PLU is a comprehensive university offering a curriculum integrating the liberal arts and professional programs. A Ph.D. or doctoral degree in mathematics, statistics or a related field is required, as is evidence of exemplary teaching. For further information visit our website at: http://www.plu.edu/employment. AA/EOE.

000110

## UNIVERSITY OF WASHINGTON Department of Mathematics

Applications are invited for a non-tenuretrack acting assistant professor position. The appointment is for a period of up to three years to begin in September 2009. Applicants are required to have a Ph.D. by the starting date, and to be highly qualified for undergraduate and graduate teaching and independent research.

Applications should include the American Mathematical Society's Cover Sheet for Academic Employment, a curriculum vitae, statements of research and teaching interests, and three letters of recommendation. We prefer applications and supporting materials to be submitted electronically via http://www.mathjobs. org. Application materials may also be mailed to: Appointments Committee Chair (AAP position), Department of Mathematics, Box 354350, University of Washington, Seattle, WA 98195-4350. Priority will be given to applicants whose complete applications, including recommendations, are received by December 15, 2008.

The University of Washington is building a culturally diverse faculty and strongly encourages applications from female and minority candidates. The University is an Equal Opportunity/Affirmative Action Employer.

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## WISCONSIN

## UNIVERSITY OF WISCONSIN-MILWAUKEE Department of Mathematical Sciences Milwaukee, WI 53201-0413

The Department of Mathematical Sciences, University of Wisconsin-Milwaukee (UWM), invites applications to fill a faculty position at the assistant or associate professor level in mathematical sciences. Starting date is August 2009. We seek an outstanding researcher in computational mathematics. Candidates must have, or expect to complete by August 2009, a Ph.D. or equivalent in mathematics or a closely related field. Members of our computational math group work in numerical partial differential equations, high performance scientific computing, multiscale modeling and analysis, and mathematical biology. Expertise in these fields and experience related to interdisciplinary research are especially welcome.

Candidates for this position must have a strong research record and a demonstrated commitment to teaching excellence. Responsibilities include development of a vigorous, collaborative, externally funded research program, teaching two courses per semester, and taking active roles in the undergraduate, Masters, and Doctoral programs. A competitive compensation, benefits, and research start-up package is provided. More information is available at: http://www.math.uwm.edu/.

Applications must be completed online at: http://www.jobs.uwm.edu/app1icants/Centra1?quickFind=50739. In addition, applicants must arrange to have three letters of recommendation (at least one should address the candidate's teaching abilities) sent to the chairperson at: adbe11@uwm.edu or at the above address. Review of applications will start December 1,2008 , and continue until the position is filled. UW-Milwaukee is an AA/EEO employer.

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## CANADA

## UNIVERSITY OF BRITISH COLUMBIA Department of Mathematics Tenured position and Deputy Director of PIMS

Applications are invited for a position as tenured associate or full professor of mathematics at UBC and for a term of 5 years as deputy director of PIMS. Applicants must have an outstanding record of scientific accomplishment in an area consistent with the research interests of the Mathematics Department, as described in http://www.math.ubc.ca/Research/ index. shtm7.

The applicant should demonstrate strong evidence of leadership and excellent communication and organizational
skills; there is some preference for prior administrative experience.

Departmental responsibilities:
The successful applicant is expected to pursue a vigorous research program and have a strong commitment to the educational mission of the department.
Institute responsibilities:
The Deputy Director of PIMS will act as the PIMS-UBC site director and assist the PIMS Director in several aspects of her/his tasks, in particular with the development and implementation of scientific policies and the adjudication process of the scientific programmes, as well as supervision of the organization of scientific activities and supervision of the preparation of grant proposals.
The salary will be commensurate with experience and research record.

Applicants are strongly encouraged to apply online as described at: http:// www.math.ubc.ca/Dept/deptJobs. shtm7<br>\#App7y.

Alternatively, applicants may send a current CV including a list of publications, statement of research and teaching interests, and should arrange for three letters of recommendation to be sent directly to:

Chair, Departmental Committee on
Appointments,
Department of Mathematics
University of British Columbia
\#121-1984 Mathematics Road
Vancouver, B.C. Canada V6T 1 Z2
In order to ensure full consideration, applications should be received by December 1, 2008.

The University of British Columbia hires on the basis of merit and is committed to employment equity. We encourage all qualified persons to apply; however Canadian citizens and permanent residents will be given priority.

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## ENGLAND

## University of Warwick <br> Department of Mathematics <br> Postdoctoral Fellowships in Geometric Analysis (2 posts)

Fixed term contracts: 36 months and 28 months, commencing October 2009. More information on the group at: http:// www.warwick.ac.uk/~maseq. See job reference: 59718-108 at: http://www. warwick.ac.uk/go/jobs/research. Closing Date: December 3, 2008. The university values diversity.

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## ISRAEL

## WEIZMANN INSTITUTE OF SCIENCE

## Department of Mathematics

A number of fellowships for postdoctoral research in the fields of mathematics, applied mathematics and computer science, as well as a number of interdisciplinary areas including bioinformatics, neurosciences, computer vision and robotics will be offered by the Weizmann Institute of Science. The deadlines for the submission of applications are January 5 and May 15, 2009. Additional information and application forms are available on the website: http://www.weizmann. ac.il/feinberg or by writing to Postdoctoral Fellowship Program, Feinberg Graduate School, The Weizmann Institute of Science, Rehovot 76100, Israel; Fax: 972-8-934-4114.

000106

## SINGAPORE

## NATIONAL UNIVERSITY OF SINGAPORE Department of Mathematics

The Department of Mathematics at the National University of Singapore (NUS) invites applications for tenured, tenuretrack and visiting (including postdoctoral) positions at all levels, beginning in August 2009.

NUS is a research intensive university that provides quality undergraduate and graduate education. The Department of Mathematics, which is one of the largest in the university, has about 70 faculty members and teaching staff whose expertise cover major areas of contemporary mathematical research.
We seek promising scholars and established mathematicians with outstanding track records in any field of pure and applied mathematics. The department offers internationally competitive salaries with start-up grants for research. The teaching load is particularly light for young scholars, in an environment conducive to research with ample opportunities for career development.
The department is particularly interested in, but not restricted to consider-
ing, applicants specializing in any of the following areas:

* Geometric analysis, algebraic geometry, number theory and automorphic forms, and probability
* Computational biology, medical imaging, computational materials science and nanoscience

Application materials should be sent to Search Committee via email (as PDF files) to: search@math.nus.edu.sg.
Please include the following supporting documentation in the application:

1. an American Mathematical Society Standard Cover Sheet;
2. a detailed CV including publications list;
3. a statement (max. of 3 pages) of research accomplishments and plan;
4. a statement (max. of 2 pages) of teaching philosophy and methodology. Please attach evaluation on teaching from faculty members or students of your current institution, where applicable;
5. at least three letters of recommendation including one which indicates the candidate's effectiveness and commitment in teaching. Please ask your referees to send their letters directly to: search@ math. nus. edu.sg. Enquiries may also be sent to this email address.

Review process will begin on 15 October, and will continue until positions are filled.

For further information about the department, please visit http://www.math. nus.edu.sg.

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## TAIWAN

## NATIONAL CHUNG CHENG UNIVERSITY Department of Mathematics Regular and Visiting Positions

The Department of Mathematics invites applications for regular and visiting positions at either the level of assistant professor or above effective August 1, 2009.

Applications are invited in all areas of mathematics. Global analysis, differential equations and statistics are among the priorities. A degree of Ph.D. is required. Applicants should send a complete curriculum vitae, three letters of reference, transcripts (if necessary), and a professional statement describing their philosophy about both teaching and research. Applications received by January 31, 2009, will be given full consideration. Send all materials to Dr. Ching-An Wang, Chair, Department of Mathematics, National Chung Cheng University, Ming-Hsiung, Chia-Yi, Taiwan, R.O.C., 62117.

Additonal departmental information is available on our website, http://www. math. ccu.edu.tw; fax:886-5-272-0497; email: director@math.ccu.edu.tw.

000105

# Meetings \& Conferences of the AMS 

IMPORTANTINFORMATION REGARDING MEETINGSPROGRAMS: AMS Sectional Meeting programs do not appear in the print version of the Notices. However, comprehensive and continually updated meeting and programinformation with links to the abstract for each talk can be found on the AMS website. Seehttp://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.

## Kalamazoo, Michigan

## Western Michigan University

October 17-19, 2008
Friday - Sunday

## Meeting \#1043

Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of Notices: August 2008
Program first available on AMS website: September 4, 2008
Program issue of electronic Notices: October 2008
Issue of Abstracts: Volume 29, Issue 4

## Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: Expired
The scientific information listed below may be dated. For the latest information, see www.ams.org/amsmtgs/ sectional.htm1.

## Invited Addresses

M. Carme Calderer, University of Minnesota, Title to be announced.

Alexandru Ionescu, University of Wisconsin, Global Schrodinger maps: Small data in the critical Sobolev spaces.

Boris S. Mordukhovich, Wayne State University, Variational analysis: New trends and applications.

David Nadler, Northwestern University, Representation theory via topological field theory.

## Special Sessions

Affine Algebraic Geometry, Shreeram Abhyankar, Purdue University, Anthony J. Crachiola, Saginaw Valley State University, and Leonid G. Makar-Limanov, Wayne State University.

Computation in Modular Representation Theory and Cohomology, Christopher P. Bendel, University of Wiscon-
sin-Stout, Terrell L. Hodge, Western Michigan University, Brian J. Parshall, University of Virginia, and Cornelius Pillen, University of South Alabama.

Computational Group Theory, Luise-Charlotte Kappe, State University of New York Binghamton, Arturo Magidin, University of Louisiana-Lafayette, and Robert F. Morse, University of Evansville.

Graph Labeling, Graph Coloring, and Topological Graph Theory, Arthur T. White, Western Michigan University, and David L. Craft, Muskingum College.

Homotopy Theory, Michele Intermont, Kalamazoo College, and John R. Martino and Jeffrey A. Strom, Western Michigan University.

Linear Codes Over Rings and Modules, Steven T. Dougherty, University of Scranton, and Jay A. Wood, Western Michigan University.

Mathematical Finance, Qiji J. Zhu, Western Michigan University, and George Yin, Wayne State University.

Mathematical Knowledge for Teaching, Kate Kline and Christine Browning, Western Michigan University.

Nonlinear Analysis and Applications, S. P. Singh, University of Western Ontario, Bruce B. Watson, Memorial University, and Mahi Singh, University of Western Ontario.

Optimization/Midwest Optimization Seminar, Jay S. Treiman and Yuri Ledyaev, Western Michigan University, and Ilya Shvartsman, Penn State Harrisburg.

Quasigroups, Loops, and Nonassociative Division Algebras, Clifton E. Ealy Jr. and David Richter, Western Michigan University, and Petr Vojtechovsky, University of Denver.

Representations of Real and P-adic Lie Groups, Alessandra Pantano, University of California Irvine, Annegret Paul, Western Michigan University, and Susana Alicia Salamanca-Riba, New Mexico State University.

Topological Field Theory, David Nadler, Northwestern University.

Variational Analysis and its Applications, Yuri Ledyaev and Jay S. Treiman, Western Michigan University, Ilya Shvartsman, Penn State Harrisburg, and Qiji J. Zhu, Western Michigan University.

## Huntsville, Alabama

University of Alabama, Huntsville

October 24-26, 2008
Friday - Sunday

## Meeting \#1044

Southeastern Section
Associate secretary: Matthew Miller
Announcement issue of Notices: August 2008
Program first available on AMS website: September 11, 2008
Program issue of electronic Notices: October 2008
Issue of Abstracts: Volume 29, Issue 4

## Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: Expired
The scientific information listed below may be dated. For the latest information, see www.ams.org/amsmtgs/ sectional.htm1.

## Invited Addresses

Mark Behrens, Massachusetts Institute of Technology, Congruences amongst modular forms and the stable homotopy groups of spheres.

Anthony M. Bloch, University of Michigan, Ann Arbor, Variational principles and nonholonomic dynamics.

Roberto Camassa, University of North Carolina, Chapel Hill, Spinning rods, microfluidics, and propulsion by cillia in biological systems.

Mark V. Sapir, Vanderbilt University, Geometry of groups, random walks, and polynomial maps over finite fields.

## Special Sessions

Applications of PDEs and ODEs (in honor of Karen Ames), Suzanne M. Lenhart and Philip W. Schaefer, University of Tennessee, Knoxville.

Applications of Topology to Dynamical Systems, John C. Mayer and Lex G. Oversteegen, University of Alabama at Birmingham.

Applied Probability, Moonyu Park and Boris Kunin, University of Alabama in Huntsville.

Dynamics and Applications of Differential Equations, Wenzhang Huang and Shangbing Ai, University of Alabama in Huntsville, and Weishi Liu, University of Kansas.

Gaussian Analysis and Stochastic Partial Differential Equations, Davar Khoshnevisan, University of Utah, and Dongsheng Wu, University of Alabama in Huntsville.

Geometric Mechanics, Control, and Integrability, Anthony M. Bloch, University of Michigan, Ann Arbor, and Dmitry Zenkov, North Carolina State University.

Graph Decompositions, Robert A. Beeler and Robert B. Gardner, East Tennessee State University.

Graph Theory, Peter J. Slater and Grant Zhang, University of Alabama in Huntsville.

Homotopy Theory and Algebraic Topology, Mark Behrens, Massachusetts Institute of Technology, and Michael Hill, University of Virginia.

Inverse Limits and Their Applications, Judy A. Kennedy, Lamar University.

Mathematical Biology: Modeling, Analysis, and Simulations, Jia Li, University of Alabama in Huntsville, Azmy S. Ackleh, University of Louisiana at Lafayette, and Maia Martcheva, University of Florida.

Nonlinear Operator Theory and Partial Differential Equations, Claudio H. Morales, University of Alabama in Huntsville, and Pei-Kee Lin, University of Memphis.

Probability on Discrete and Algebraic Structures, Kyle T. Siegrist, University of Alabama in Huntsville.

Random Matrices, Leonard N. Choup, University of Alabama in Huntsville, and Jack Silverstein, North Carolina State University.

Set-Theoretic Topology, Gary Gruenhage, Auburn University, and Peter J. Nyikos and Robert M. Stephenson Jr, University of South Carolina.

## Shanghai, People's Republic of China

Fudan University

December 17-21, 2008
Wednesday - Sunday

## Meeting \#1045

First Joint International Meeting Between the AMS and the Shanghai Mathematical Society
Associate secretary: Susan J. Friedlander
Announcement issue of Notices: June 2008
Program first available on AMS website: Not applicable Program issue of electronic Notices: Not applicable Issue of Abstracts: Not applicable

## Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Not applicable
For abstracts: October 31, 2008
The scientific information listed below may be dated. For the latest information, see www.ams.org/amsmtgs/ internmtgs.htm7.

## Invited Addresses

Robert J. Bryant, University of California Berkeley, Title to be announced.
L. Craig Evans, University of California Berkeley, Title to be announced.

Zhi-Ming Ma, Chinese Academy of Sciences, Title to be announced.

Richard Schoen, Stanford University, Title to be announced.

Xiaoping Yuan, Fudan University, Title to be announced.

Weiping Zhang, Chern Institute, Title to be announced.

## Special Sessions

Biomathematics: Newly Developed Applied Mathematics and New Mathematics Arising from Biosciences, Banghe Li, Chinese Academy of Sciences, Reinhard C. Laubenbacher, Virginia Bioinformatics Institute, and Jianjun Paul Tian, College of William and Mary.

Combinatorics and Discrete Dynamical Systems, Reinhard C. Laubenbacher, Virginia Bioinformatics Institute, Klaus Sutner, Carnegie Mellon University, and Yaokun Wu, Shanghai Jiao Tong University.

Differential Geometry and Its Applications, Jianguo Cao, University of Notre Dame, and Yu Xin Dong, Fudan University.

Dynamical Systems Arising in Ecology and Biology, Qishao Lu, Beijing University of Aeronautics \& Astronautics, and Zhaosheng Feng, University of Texas-Pan American.

Elliptic and Parabolic Nonlinear Partial Differential Equations, Changfeng Gui, University of Connecticut, and Feng Zhou, East China Normal University.

Harmonic Analysis and Partial Differential Equations with Applications, Yong Ding, Beijing Normal University, Guo-Zhen Lu, Wayne State University, and Shanzhen Lu, Beijing Normal University.

Integrable System and Its Applications, En-Gui Fan, Fudan University, Sen-Yue Lou, Shanghai Jiao Tong University and Ningbo University, and Zhi-Jun Qiao, University of Texas-Pan American.

Integral and Convex Geometric Analysis, Deane Yang, Polytechnic University, and Jiazu Zhou, Southwest University.

Lie Algebras, Vertex Operator Algebras and Related Topics, Hu Nai Hong, East China Normal University, and Yi-Zhi Huang, Rutgers University.

Nonlinear Systems of Conservation Laws and Related Topics, Gui-Qiang Chen, Northwestern University, and Shuxing Chen and Yi Zhou, Fudan University.

Optimization and Its Application, Shu-Cherng Fang, North Carolina State University, and Xuexiang Huang, Fudan University.

Quantum Algebras and Related Topics, Naihuan N. Jing, North Carolina State University, Quanshui Wu, Fudan University, and James J. Zhang, University of Washington.

Recent Developments in Nonlinear Dispersive Wave Theory, Jerry Bona, University of Illinois at Chicago, Bo Ling Guo, Institute of Applied Physics and Computational Mathematics, Shu Ming Sun, Virginia Polytech Institute and State University, and Bingyu Zhang, University of Cincinnati.

Representation of Algebras and Groups, Birge K. Huis-gen-Zimmermann, University of California Santa Barbara,

Jie Xiao, Tsinghua University, Jiping Zhang, Beijing University, and Pu Zhang, Shanghai Jiao Tong University.

Several Complex Variables and Applications, Siqi Fu, Rutgers University, Min Ru, University of Houston, and Zhihua Chen, Tongji University.

Several Topics in Banach Space Theory, Gerard J. Buskes and Qingying Bu, University of Mississippi, and Lixin Cheng, Xiamen University.

Stochastic Analysis and Its Application, Jiangang Ying, Fudan University, and Zhenqing Chen, University of Washington.

Topics in Partial Differential Equations and Mathematical Control Theory, Xiaojun Huang, Rutgers University, Gengsheng Wang, Wuhan University of China, and Stephen S.-T. Yau, University of Illinois at Chicago.

## Washington, District of Columbia

## Marriott Wardman Park Hotel and Omni Shoreham Hotel

## January 5-8, 2009

Monday - Thursday

## Meeting \#1046

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: Bernard Russo
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: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: Expired

## Program Updates

## AMS Sessions

Because of the untimely death of Oded Schramm, the Gibbs Lecture will be given by Percy A. Deift, Courant Institute, on Integrable systems: A modern view, at 8:30 p.m. on Monday.

Speakers in the Current Events Bulletin session on Wednesday afternoon are Matthew J. Emerton, Northwestern University; Olga V. Holtz and Michael L. Hutchings,

University of California Berkeley; and Frank Sottile, Texas A\&M University.

Congressional Fellowship Session, Wednesday, 4:30 p.m.-6:30 p.m., organized by Samuel M. Rankin III, AMS. This session will describe the AMS Congressional Fellowship, administered by the American Association for the Advancement of Science (AAAS), and the fellowship's unique public policy learning experience. This fellowship demonstrates the value of science-government interaction by allowing the fellows to bring a technical background and external perspective to the decision-making process in Congress. Previous and current AMS-sponsored Congressional Fellows will give their perspectives on the fellowship to interested meeting participants in an effort to encourage applications for future fellowships.

## MAA Sessions

Presentations by Teaching Award Winners will be given by Michael J. Bardzell, Salisbury University; David Pengelley, New Mexico State University; and Vali Siadat, Richard J. Daley College; at 2:30 p.m. on Wednesday afternoon.

Invited Paper Session on The Beauty and Power of Number Theory, Wednesday, 1:00 p.m.-3:00 p.m., organized by Thomas Koshy, Framingham State College, and Thomas Moore, Bridgewater State College. This session features talks by George E. Andrews and Kristen Eisentrager, Pennsylvania State University, Carl Pomerance, Dartmouth University, and Ken Ono, University of Wis-consin-Madison.

Contributed Paper Session on Wavelets in Undergraduate Education, Tuesday afternoon, organized by Catherine Beneteau, University of South Florida; Caroline Haddad, SUNY Geneseo; David Ruch, Metropolitan State College of Denver; and Patrick Van Fleet, University of St. Thomas.

Math Club in a Box, Thursday, 1:00 p.m.-3:00 p.m., organized by Kay B. Somers, Moravian College, and Elizabeth Mayfield, Hood College. One of the recommendations of the Strategic Planning Group on Students is that the MAA offer support to student chapter advisors by making available "in-a-box" resources such as Jeopardy-in-a-box, Career-Day-in-a-box, Fun-Math-Games-in-a-box, Student-Fair-information-for-parents-and-students-in-a-box, Math-Volunteer-Ideas-in-a-box ... activities that advisors could easily carry out on their own campuses, with their own students. In some cases, we picture a literal box: something an advisor receives in the mail and opens to find a ready-made activity within. In other cases, participants may offer "virtual boxes". What would you put in such a box? What activity or resource would you contribute to this new collection of MAA Student Activity Boxes? We seek field-tested resources from faculty across the MAA to assist student chapter advisors and others who want to engage students in mathematics-related activities. These "boxes" could be used as part of a course, but more likely will involve activities intended to be completed outside the classroom. Proposals and questions regarding the session may be directed to Kay Somers, mekbs01@moravian. edu. The deadline for proposals is Friday, November 7, 2008. The session is sponsored by the MAA Committee on Undergraduate Student Activities and Chapters (CUSAC).

SIGMAA on Statistics Education Business Meeting, Tuesday, 5:45 p.m.-7:15 p.m.

SIGMAA on Research in Undergraduate Mathematics Education Business Meeting, Tuesday, 6:00 p.m.-7:30 p.m.

MAA Department Liaisons Meeting will take place on Monday, 9:30 a.m.-11:00 a.m.

## Other Organizations

Society for Industrial and Applied Mathematics
An Invited Address will be given by Kenneth M. Golden, University of Utah, on Mathematics of sea ice to help predict climate change on Tuesday, 11:10 a.m.-noon.

The following minisymposia are scheduled on the days indicated:

Mathematical Modeling of Natural Resources, organized by Catherine A. Roberts, College of the Holy Cross, Monday morning and afternoon;

Mathematical and Computational Challenges in Global Climate and Energy Processes, organized by Margot Gerritsen, Stanford University, Tuesday morning;

Graph Theory, organized by Stephen G. Hartke, University of Nebraska-Lincoln, Tuesday afternoon and Wednesday morning;

Polar Climate Modeling, organized by Kenneth M. Golden, University of Utah; and David M. Holland, Courant Institute of Mathematical Sciences-NYU; and moderated by Deborah L. Sulsky, University of New Mexico, Wednesday afternoon;

The Mathematics of Energy Conversion, Keith Promislow, Michigan State University; and

Education Minisymposium on Professional Development and Career Choices for Students, organized by William L. Briggs, University of Colorado at Denver, Thursday afternoon.

## Urbana, Illinois

## University of Illinois at Urbana-Champaign

March 27-29, 2009
Friday - Sunday

## Meeting \#1047

Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of Notices: January
Program first available on AMS website: February 12, 2009
Program issue of electronic Notices: March
Issue of Abstracts: To be announced

## Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: December 9, 2008
For abstracts: February 3, 2009

The scientific information listed below may be dated. For the latest information, see www.ams.org/amsmtgs/ sectional.htm7.

## Invited Addresses

Jeffrey C. Lagarias, University of Michigan, Title to be announced (Erdós Memorial Lecture).

Jacob Lurie, Massachusetts Institute of Technology, Title to be announced.

Gilles Pisier, Texas A\&M University, Title to be announced.

Akshay Venkatesh, New York University-Courant Institute, Title to be announced.

## Special Sessions

Algebra, Geometry and Combinatorics (Code: SS 10A), Rinat Kedem, University of Illinois at Urbana-Champaign, and Alexander T. Yong, University of Minnesota.

Algebraic Methods in Statistics and Probability (Code: SS 3A), Marlos A. G. Viana, University of Illinois at Chicago.

Complex Dynamics and Value Distribution (Code: SS 11A), Aimo Hinkkanen and Joseph B. Miles, University of Illinois at Urbana-Champaign.

Concrete Aspects of Real Positive Polynomials (Code: SS 20A), Victoria Powers, Emory University, and Bruce Reznick, University of Illinois at Urbana-Champaign.

Differential Geometry and Its Applications (Code: SS 16A), Stephanie B. Alexander, University of Illinois at Urbana-Champaign, and Jianguo Cao, University of Notre Dame.

Geometric Function Theory and Analysis on Metric Spaces (Code: SS 6A), Sergiy Merenkov, Jeremy Taylor Tyson, and Jang-Mei Wu, University of Illinois at UrbanaChampaign.

Geometric Group Theory (Code: SS 2A), Sergei V. Ivanov, Ilya Kapovich, Igor Mineyev, and Paul E. Schupp, University of Illinois at Urbana-Champaign.

Graph Theory (Code: SS 4A), Alexander V. Kostochka and Douglas B. West, University of Illinois at UrbanaChampaign.

Holomorphic and CR Mappings (Code: SS 9A), John P. D'Angelo, Jiri Lebl, and Alex Tumanov, University of Illinois at Urbana-Champaign.

Hyperbolic Geometry and Teichmuller Theory (Code: SS 18A), Jason Deblois, University of Illinois at Chicago, Richard P. Kent, IV, Brown University, and Christopher J. Leininger, University of Illinois at Urbana-Champaign.

Local and Homological Methods in Commutative Algebra (Code: SS 13A), Florian Enescu, Georgia State University, and Sandra Spiroff, University of Mississippi.

Mathematical Visualization (Code: SS 7A), George K. Francis, University of Illinois at Urbana-Champaign, Louis H. Kauffman, University of Illinois at Chicago, Dennis Martin Roseman, University of Iowa, and Andrew J. Hanson, Indiana University.

Number Theory in the Spirit of Erdós (Code: SS 14A), Kevin Ford and A. J. Hildebrand, University of Illinois at Urbana-Champaign.

Operator Algebras and Operator Spaces (Code: SS 8A), Zhong-Jin Ruan, Florin P. Boca, and Marius Junge, University of Illinois at Urbana-Champaign.

Probabilistic and Extremal Combinatorics (Code: SS 5A), Jozsef Balogh and Zoltan Furedi, University of Illinois at Urbana-Champaign.

The Interface Between Number Theory and Dynamical Systems (Code: SS 17A), Florin Boca, University of Illinois at Urbana-Champaign, Jeffrey Lagarias, University of Michigan, and Kenneth Stolarsky, University of Illinois at Urbana-Champaign.

Time, Scale and Frequency Methods in Harmonic Analysis (Code: SS 15A), Richard S. Laugesen, University of Illinois at Urbana-Champaign, and Darrin M. Speegle, St. Louis University.

Topological Dynamics and Ergodic Theory (Code: SS 19A), Alica Miller, University of Louisville, and Joseph Rosenblatt, University of Illinois at Urbana-Champaign.

Topological Field Theories, Representation Theory, and Algebraic Geometry (Code: SS 12A), Thomas Nevins, University of Illinois at Urbana-Champaign, and David Ben-Zvi, University of Texas at Austin.
$q$-Series and Partitions (Code: SS 1A), Bruce Berndt, University of Illinois at Urbana-Champaign, and Ae Ja Yee, Pennsylvania State University.

## Raleigh, North Carolina

## North Carolina State University

## April 4-5, 2009

Saturday - Sunday

## Meeting \#1048

Southeastern Section
Associate secretary: Matthew Miller
Announcement issue of Notices: January 2009
Program first available on AMS website: February 19, 2009
Program issue of electronic Notices: April 2009
Issue of Abstracts: To be announced

## Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: December 16, 2008
For abstracts: February 10, 2009
The scientific information listed below may be dated. For the latest information, see www.ams.org/amsmtgs/ sectional.htm7.

## Invited Addresses

Nathan Dunfield, University of Illinois at UrbanaChampaign, Surfaces in finite covers of 3-manifolds: The Virtual Haken Conjecture.

Reinhard C. Laubenbacher, Virginia Bioinformatics Institute, Algebraic models in systems biology.

Jonathan C. Mattingly, Duke University, Stochastically forced fluid equations: Transfer between scales and ergodicity.

Raman Parimala, Emory University, Title to be announced.

## Special Sessions

Advancements in Turbulent Flow Modeling and Computation (Code: SS 8A), Leo G. Rebholz, Clemson University, and Traian Iliescu, Virginia Polytechnic Institute and State University.

Applications of Algebraic and Geometric Combinatorics (Code: SS 2A), Seth M. Sullivant, Harvard University, and Carla D. Savage, North Carolina State University.

Brauer Groups, Quadratic Forms, Algebraic Groups, and Lie Algebras (Code: SS 12A), Eric S. Brussel and Skip Garibaldi, Emory University.

Computational Methods in Lie Theory (Code: SS 10A), Eric Sommers, University of Massachusetts, Amherst, and Molly Fenn, North Carolina State University.

Enumerative Geometry and Related Topics (Code: SS 7A), Richard L. Rimanyi, University of North Carolina, Chapel Hill, and Leonardo C. Mihalcea, Duke University.

Galois module theory and Hopf algebras (Code: SS 13A), Robert G. Underwood, Auburn University Montgomery, and James E. Carter, College of Charleston.

Geometry of Differential Equations (Code: SS 9A), Thomas A. Ivey, College of Charleston, and Irina A. Kogan, North Carolina State University.

Homotopical Algebra with Applications to Mathematical Physics (Code: SS 3A), Thomas J. Lada, North Carolina State University, and Jim Stasheff, University of North Carolina, Chapel Hill.

Kac-Moody Algebras, Vertex Algebras, Quantum Groups, and Applications (Code: SS 1A), Bojko N. Bakalov, Kailash C. Misra, and Naihuan N. Jing, North Carolina State University.

Low Dimensional Topology and Geometry (Code: SS 4A), Nathan M. Dunfield, University of Illinois at UrbanaChampaign, John B. Etnyre, Georgia Institute of Technology, and Lenhard Ng, Duke University.

Mathematics of Immunology and Infectious Diseases (Code: SS 14A), Stanca M. Ciupe, Duke University.

Nonlinear Dynamics and Control (Code: SS 11A), Anthony M. Bloch, University of Michigan, Ann Arbor, and Dmitry Zenkov, North Carolina State University.

Recent Advances in Symbolic Algebra and Analysis (Code: SS 5A), Michael F. Singer and Agnes Szanto, North Carolina State University.

Rings, Algebras, and Varieties in Combinatorics (Code: SS 6A), Patricia Hersh, North Carolina State University, Christian Lenart, SUNY Albany, and Nathan Reading, North Carolina State University.

## Worcester,

 MassachusettsWorcester Polytechnic Institute

## April 25-26, 2009

Saturday - Sunday

## Meeting \#1050

Eastern Section
Associate secretary: Steven H. Weintraub
Announcement issue of Notices: February 2009
Program first available on AMS website: March 12, 2009
Program issue of electronic Notices: April 2009
Issue of Abstracts: To be announced

## Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: January 6, 2009
For abstracts: March 3, 2009
The scientific information listed below may be dated. For the latest information, see www.ams.org/amsmtgs/ sectiona1.htm7.

## Invited Addresses

Octav Cornea, Université de Montréal, Title to be announced.

Fengbo Hang, Courant Institute of New York University, Title to be announced.

Umberto Mosco, Worcester Polytechnic Institute, Title to be announced.

Kevin Whyte, University of Illinois at Chicago, Title to be announced.

## Special Sessions

Discrete Geometry and Combinatorics (Code: SS 5A), Egon Schulte, Northeastern University, and Brigitte Servatius, Worcester Polytechnic Institute.

Number Theory (Code: SS 4A), John T. Cullinan, Bard College, and Siman Wong, University of Massachusetts, Amherst.

Quasi-Static and Dynamic Evolution in Fracture Mechanics (Code: SS 6A), Christopher J. Larsen, Worcester Polytechnic Institute.

Symplectic and Contact Topology (Code: SS 1A), Peter Albers, Courant Institute of Mathematical Sciences, and Basak Gurel, Université de Montréal.

The Mathematics of Climate Change (Code: SS 3A), Catherine A. Roberts, College of the Holy Cross, Mary Lou Zeeman, Bowdoin College, and Gareth E. Roberts, College of the Holy Cross.

Topological Robotics (Code: SS 2A), Li Han and Lee N. Rudolph, Clark University.

## San Francisco, California

## San Francisco State University

April 25-26, 2009
Saturday - Sunday

## Meeting \#1049

Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of Notices: February 2009
Program first available on AMS website: March 12, 2009
Program issue of electronic Notices: April 2009
Issue of Abstracts: To be announced

## Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: January 6, 2009
For abstracts: March 3, 2009
The scientific information listed below may be dated. For the latest information, see www.ams.org/amsmtgs/ sectional.htm1.

## Invited Addresses

Yehuda Shalom, University of California Los Angeles, Title to be announced.

Roman Vershynin, University of California Davis, Title to be announced.

Karen Vogtmann, Cornell University, Title to be announced.

Efim Zelmanov, University of California Los Angeles, Title to be announced.

## Special Sessions

Advances in the Theory of Integer Linear Optimization and its Extensions (Code: SS 7A), Mathias Koppe and Peter Malkin, University of California Davis.

Banach Algebras, Topological Algebras and Abstract Harmonic Analysis (Code: SS 1A), Thomas V. Tonev, University of Montana-Missoula, and Fereidoun Ghahramani, University of Manitoba.

Concentration Inequalities (Code: SS 3A), Sourav Chatterjee, University of California Berkeley, and Roman Vershynin, University of California Davis.

Geometry and Topology of Orbifolds (Code: SS 6A), Elizabeth Stanhope, Lewis \& Clark University, and Joseph E. Borzellino, California State University San Luis Obispo.

Nonlinear Dispersive Equations (Code: SS 4A), Sebastian Herr, University of California Berkeley, and Jeremy L. Marzuola, Columbia University.
$Q$-Series and Partitions (Code: SS 5A), Neville Robbins, San Francisco State University.

Recent Progress in Geometric Group Theory (Code: SS 2A), Seonhee Lim and Anne Thomas, Cornell University.

# Waco, Texas 

Baylor University

October 16-18,2009
Friday - Sunday

## Meeting \#1051

Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of Notices: August 2009
Program first available on AMS website: September 3, 2009
Program issue of electronic Notices: October 2009
Issue of Abstracts: To be announced

## Deadlines

For organizers: March 17, 2009
For consideration of contributed papers in Special Sessions: June 30, 2009
For abstracts: August 25, 2009
The scientific information listed below may be dated. For the latest information, see www.ams.org/amsmtgs/ sectional.htm1.

## Invited Addresses

David Ben-Zvi, University of Texas at Austin, Title to be announced.

Alexander A. Kiselev, University of Wisconsin, Title to be announced.

Michael C. Reed, Duke University, Title to be announced.

Igor Rodnianski, Princeton University, Title to be announced.

## Special Sessions

Commutative Algebra: Module and Ideal Theory (Code: SS 4A), Lars W. Christensen, Texas Tech University, Louiza Fouli, University of Texas at Austin, and David Jorgensen, University of Texas at Arlington.

Dynamic Equations on Time Scales: Analysis and Applications (Code: SS 1A), John M. Davis, Ian A. Gravagne, and Robert J. Marks, Baylor University.

Mathematical Models of Neuronal and Metabolic Mechanisms (Code: SS 3A), Janet Best, Ohio State University, and Michael Reed, Duke University.

Numerical Solutions of Singular or Perturbed Partial Differential Equation Problems with Applications (Code: SS 2A), Peter Moore, Southern Methodist University, and Qin Sheng, Baylor University.

Topological Methods for Boundary Value Problems for Ordinary Differential Equations (Code: SS 5A), Richard Avery, Dakota State University, Paul W. Eloe, University of Dayton, and Johnny Henderson, Baylor University.

## University Park, Pennsylvania

Pennsylvania State University

October 24-25, 2009
Saturday - Sunday

## Meeting \#1052

## Eastern Section

Associate secretary: Steven H. Weintraub
Announcement issue of Notices: August 2009
Program first available on AMS website: September 10, 2009
Program issue of electronic Notices: October 2009
Issue of Abstracts: To be announced

## Deadlines

For organizers: March 24, 2009
For consideration of contributed papers in Special Sessions: July 7, 2009
For abstracts: September 1, 2009

## Boca Raton, Florida

## Florida Atlantic University

October 30 - November 1, 2009
Friday - Sunday

## Meeting \#1053

Southeastern Section
Associate secretary: Matthew Miller
Announcement issue of Notices: August 2009
Program first available on AMS website: September 17, 2009
Program issue of electronic Notices: October 2009
Issue of Abstracts: To be announced

## Deadlines

For organizers: March 30, 2009
For consideration of contributed papers in Special Sessions: July 14, 2009
For abstracts: September 8, 2009
The scientific information listed below may be dated. For the latest information, see www.ams.org/amsmtgs/ sectional.htm1.

## Invited Addresses

Spyros Alexakis, Princeton University, Title to be announced.

Kai-Uwe Bux, University of Virginia, Title to be announced.

Dino J. Lorenzini, University of Georgia, Title to be announced.

Eduardo D. Sontag, Rutgers University, Title to be announced.

## Special Sessions

Concentration, Functional Inequalities, and Isoperimetry (Code: SS 2A), Mario Milman, Florida Atlantic University, Christian Houdre, Georgia Institute of Technology, and Emanuel Milman, Institute for Advanced Study.

Constructive Mathematics (Code: SS 1A), Robert Lubarsky, Fred Richman, and Martin Solomon, Florida Atlantic University.

## Riverside, California

## University of California

November 7-8, 2009
Saturday - Sunday

## Meeting \#1054

Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of Notices: September 2009
Program first available on AMS website: September 24, 2009
Program issue of electronic Notices: November 2009
Issue of Abstracts: To be announced

## Deadlines

For organizers: April 6, 2009
For consideration of contributed papers in Special Sessions: July 21, 2009
For abstracts: September 15, 2009

The scientific information listed below may be dated. For the latest information, see www.ams.org/amsmtgs/ sectional.htm1.

## Special Sessions

Algebraic Geometry (Code: SS 1A), Christopher Hacon, University of Utah, and Ziv Ran, University of California Riverside.

History and Philosophy of Mathematics (Code: SS 4A), Shawnee L. McMurran, California State University San Bernardino, and James J. Tattersall, Providence College.

Noncommutative Geometry (Code: SS 2A), Vasiliy Dolgushev and Wee Liang Gan, University of California Riverside.

Representation Theory (Code: SS 3A), Vyjayanthi Chari, Wee Liang Gan, and Jacob Greenstein, University of California Riverside.

## San Francisco, California

## Moscone Center West and the San Francisco Marriott

## January 13-16, 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

## Lexington, Kentucky

University of Kentucky
March 27-28, 2010
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 28, 2009
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

## St. Paul, Minnesota

## Macalester College

April 10-11,2010
Saturday - 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 10, 2009
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

## Albuquerque, New Mexico

University of New Mexico

## April 17-18, 2010

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 17, 2009
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

## Berkeley, California

## University of California at Berkeley

June 2-5, 2010
Wednesday - Saturday
Eighth Joint International Meeting of the AMS and the Sociedad Matemática Mexicana.
Associate secretary: Susan J. Friedlander
Announcement issue of Notices: February 2010
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

## Notre Dame, Indiana

## Notre Dame University

September 18-19, 2010
Saturday - 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: February 19, 2010
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

## Los Angeles, California <br> University of California Los Angeles

## October 9-10, 2010

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 10, 2010
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

[^14]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 <br> 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: 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: April 1, 2012
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

## Baltimore, Maryland

## Baltimore Convention Center

## January 15-18,2014

Wednesday - Saturday
Joint Mathematics Meetings, including the 120th Annual Meeting of the AMS, 97th 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, with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).
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: April 1, 2013
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

## San Antonio, Texas

## Henry B. Gonzalez Convention Center and Grand Hyatt San Antonio

## January 10-13,2015

Saturday - Tuesday
Joint Mathematics Meetings, including the 121st Annual Meeting of the AMS, 98th 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 of Symbolic Logic, with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).
Associate secretary: Steven H. Weintraub
Announcement issue of Notices: October 2014

Program first available on AMS website: To be announced
Program issue of electronic Notices: January 2015
Issue of Abstracts: To be announced

## Deadlines

For organizers: April 1, 2014
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

## Correction

The following information pertaining to the Short Course (Quantum Computation and Quantum Information) being given in Washington, DC, at the Joint Meetings in January 2009, is being reprinted from page 1163 of the October 2008 issue of the Notices. Some of the mathematical notation was incorrectly transcribed by a computer program. The Notices regrets this error.

## Riemannian Geometry of Quantum Computation

## Howard Brandt, U. S. Army Research Laboratory

An introduction is given to some recent developments in the differential geometry of quantum computation for which the quantum evolution is described by the special unitary unimodular group in $2^{n}$ dimensions, $S U\left(2^{n}\right)$. Using the Lie algebra $\operatorname{su}\left(2^{n}\right)$, detailed derivations are given of a useful Riemannian geometry of $S U\left(2^{n}\right)$, including the connection and the geodesic equation for minimal complexity quantum computations. Examples of some solutions to the geodesic equation are elaborated.

## References

[1] M. A. Nielsen and I. L. Chuang, Quantum Information and Computation, Cambridge University Press, 2000.
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[4] M. A. Naimark and A. I. Stern, Theory of Group Representations, Springer-Verlag, New York (1982).
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[6] Walter Pfeifer, The Lie Algebras su(N), Birkhäuser, Basel, 2003.
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[8] Bo-Yu Hou and Bo-Yuan Hou, Differential Geometry for Physicists, World Scientific, Singapore, 1997.
[9] H. E. Brandt, "Qubit Devices" in Quantum Computation, AMS Short Course, S. J. Lomonaco, ed., Proc. Symp. Appl. Math. 59, Amer. Math. Soc., Providence, RI, 2000.
[10] S. J. Lomonaco and H. E. Brandt, eds., Quantum computation and information, Contemp. Math. 305, Amer. Math. Soc., Providence, RI, 2000.

Name

> (please write name as you would like it to appear on your badge)

Mailing Address $\qquad$

Telephone $\qquad$ Fax: $\qquad$
In case of emergency (for you) at the meeting, call: Day \# $\qquad$ Evening \#: $\qquad$ $\checkmark$ all that apply. First column is eligible for member registration fee
Email Address
(Acknowledgment of this registration will be sent to the email address given here, unless you
(Acknowledgment of this registration will be sent to the email addr
check this box: Send by U.S. Mail $\square$ )

| $\square$ AMS | $\square A S A$ |
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| $\square M A A$ | $\square A W M$ |
| $\square A S L$ | $\square N A M$ |
| $\square C M S$ | $\square Y M N$ |
| $\square S I A M$ |  |

Affiliation for badge
Nonmathematician guest badge name
(please note charge below)


Membership

$$
\begin{aligned}
& \text { check this box: Send by U.S. Mail } \square \text { ) } \\
&
\end{aligned}
$$

$\square$ I DO NOT want my program and badge to be mailed to me on 12/12/08. (Materials will be mailed unless you check this box.)

- SIAM


## Registration Fees

| Joint Meetings | by Dec 15 | at mtg | Subtotal |
| :---: | :---: | :---: | :---: |
| - Member AMS, ASL, CMS, MAA, SIAM | US \$216 | US \$282 |  |
| - Nonmember | US \$335 | US \$435 |  |
| - Graduate Student | US \$ 44 | US \$ 54 |  |
| $\square$ Undergraduate Student | US \$ 30 | US \$ 40 |  |
| - High School Student | US \$ 5 | US \$ 10 |  |
| - Unemployed | US \$ 43 | US \$ 53 |  |
| - Temporarily Employed | US \$174 | US \$202 |  |
| - Developing Countries Special Rate | US \$ 43 | US \$ 53 |  |
| - Emeritus Member of AMS or MAA | US \$ 43 | US \$ 53 |  |
| - High School Teacher | US \$ 43 | US \$ 53 |  |
| - Librarian | US \$ 43 | US \$ 53 |  |
| - Nonmathematician Guest | US \$ 15 | US \$ 15 |  |
|  |  | \$ |  |

AMS Short Course: Quantum Computation and Quantum Information (1/3-1/4)

| Member of AMS or MAA | US \$ 96 | US \$130 |
| :--- | :---: | :---: |
| Nonmember | US \$130 | US \$160 |
| Student, Unemployed, Emeritus | US \$44 | US \$ 65 |
|  |  | $\$$ |

MAA Short Course: Data Mining \& New Trends in Teaching Statistics. (1/3-1/4)

| Member of MAA or AMS | US \$125 | US \$140 |
| :--- | :--- | :--- |
| Nonmember | US \$175 | US \$190 |
| Student, Unemployed, Emeritus | US \$ 50 | US \$ 60 |

## MAA Minicourses (see listing in text)

I would like to attend: One Minicourse Two Minicourses
Please enroll me in MAA Minicourse(s) \#___ and/or \#_ In order of preference, my alternatives are: \#____ and/or \#____ Price: US \$60 for each minicourse.
(For more than 2 minicourses call or email the MMSB.)
\$ $\qquad$

## Employment Center

Applicant résumé forms and employer job listing forms can be found at www.ams.org/emp-reg/

- Employer—Quiet Area Table (2 interviewers) US \$250 US \$330
- Employer—Additional Quiet Area Table US \$100 N/A
- Employer- Committee Table (3-6 interviewers) US \$350 US \$425

Employer- Curtained Booth (1-3 interviewers) US \$425 N/A
I Applicant US \$ 25 US \$40
\$

US \$ 50 N/A

- Graduate School Fair Table


## Events with Tickets

| MER Banquet (1/6) | US $\$ 53.00$ | \#___Regular | \#____Veg | \#___Kosher |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| NAM Banquet (1/7) | US $\$ 52.00$ | \#___Regular | \#____Veg | \#___Kosher |
| AMS Banquet (1/8) | US $\$ 52.50$ | \#___Regular | \#____Veg | \#___Kosher |

Luncheon for Jim Tattersall (1/8) US \$36.00 \#___Reg \#___Veg \#___Kosher

## Other Events

- Graduate Student/First Time Attendee Reception (1/5) (no charge)

Total for Registrations and Events \$
\$
Registration for the Joint Meetings is not required for the Short Courses, but it is required for the Minicourses and the Employment Center.

## Payment

Registration \& Event Total (total from column on left) \$
Hotel Deposit (only if paying by check)
\$
\$ $\qquad$

Total Amount To Be Paid
\$
(Note: A US $\$ 5$ processing fee will be charged for each returned check or invalid credit card. Debit cards are not accepted.)

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- Check. Make checks payable to the AMS. Checks drawn on foreign banks must be in equivalent foreign currency at current exchange rates.
- Credit Card. VISA, MasterCard, AMEX, Discover (no others accepted)

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Exp. date: $\qquad$ Zipcode of credit card billing address:

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## Other Information

Mathematical Reviews field of interest \#
How did you hear about this meeting? Check one: Colleague(s) Notices $\square$ Focus Internet
This is my first Joint Mathematics Meetings.
I am a mathematics department chair.

- For planning purposes for the MAA Two-year College Reception, please check if you are a faculty member at a two-year college.
I I would like to receive promotions for future JMM meetings.
- Please do not include my name on any promotional mailing list. $\square$ Please $\checkmark$ this box if you have a disability requiring special services. Mail to:

Mathematics Meetings Service Bureau (MMSB) P. O. Box 6887

Providence, RI 02940-6887 Fax: 401-455-4004
Questions/changes call: 401-455-4143 or 1-800-321-4267 x4143; mmsb@ams.org

## Deadlines Please register by the following dates for:

Résumés/job descriptions printed in the Winter Lists
To be eligible for the complimentary room drawing: For housing reservations, badges/programs mailed: For housing changes/cancellations through MMSB:

Oct. 22, 2008
Oct. 31, 2008

For advance registration for the Joint Meetings, Employment
Center, Short Courses, MAA Minicourses, \& Tickets: Dec. 15, 2008
For 50\% refund on banquets, cancel by:
For $50 \%$ refund on advance registration, Minicourses \&
Short Courses, cancel by:
Dec. 30, 2008*
*no refunds after this date

## Washington DC Joint Mathematics Meetings Hotel Reservations




 reverse of form) or a credit card guarantee. The Hilton will charge credit cards for the first night deposit immediately upon receipt of reservations.

- Deposit enclosed (see front of form)


## Date and Time of Arrival

Name of Other Room Occupant
Name of Other Room Occupant

* Please note: Hilton 1 and Hilton 2 rooms are identical.

$$
\begin{array}{ll}
\text { Arrival Date } & \text { Departure Date } \\
\text { Arrival Date } & \text { Departure Date }
\end{array}
$$ I I plan to share a room with

$$
\begin{aligned}
& \text { redit card Card Number } \\
& \text { Date and Time of Departure }
\end{aligned}
$$

Exp. Date
Child (give age(s)


## Special Housing Requests:

Email confirmations (no paper) will be sent by the Marriott and the Hilton. (The Omni will not send confirmations.) Please provide your email address for Marriott \& Hilton confirmations:

If you are not making a reservation, please check off one of the following:

- I plan to make a reservation at a later date.

I will be making my own reservations at a hotel not listed. Name of hotel: I I live in the area or will be staying privately with family or friends.
 I have disabilities as defined by the ADA that require a sleeping room that is accessible to the physically challenged. My needs are: - Other requests:

I am a member of a hotel frequent-travel club and would like to receive appropriate credit.
The hotel chain and card number are:

## Meetings and Conferences of the AMS

## Associate Secretaries of the AMS

Western Section: Michel L. Lapidus, Department of Mathematics, University of California, Surge Bldg., Riverside, CA 92521-0135; e-mail: 1apidus@math.ucr.edu; telephone: 951-827-5910.

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Southeastern Section: Matthew Miller, Department of Mathematics, University of South Carolina, Columbia, SC 29208-0001, e-mail: mi11er@math.sc.edu; telephone: 803-777-3690.

2009 Washington, DC, Meeting: Bernard Russo, Department of Mathematics, University of California, Irvine, CA 92697-3875, e-mail: brusso@math.uci .edu; telephone: 949-824-5505.

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:

## 2008

October 17-19
October 24-26
December 17-21

2009
January 5-8
March 27-29
April 4-5
April 25-26
April 25-26
Oct. 16-18
Oct. 24-25

Oct. 30-Nov. 1
Nov. 7-8

2010
January 13-16
March 27-28
April 10-11
April 17-18
June 2-5

Kalamazoo, Michigan p. 1346
Huntsville, Alabama
p. 1347

Shanghai, People's
Republic of China
p. 1347

Washington, DC p. 1348
Annual Meeting
Urbana, Illinois
p. 1349

Raleigh, North Carolina p. 1350
Worcester, Massachusetts p. 1351
San Francisco, California p. 1352
Waco, Texas
University Park, Pennsylvania
p. 1352
p. 1353

Boca Raton, Florida p. 1353
Riverside, California
p. 1353

San Francisco, California p. 1354
Annual Meeting
Lexington, Kentucky p. 1354
St. Paul, Minnesota p. 1354
Albuquerque, New Mexico p. 1354
Berkeley, California p. 1354

| September 18-19 <br> October 9-10 | Notre Dame, Indiana <br> Los Angeles, California | p. 1355 <br> p. 1355 |
| :--- | :--- | :--- |
| $\mathbf{2 0 1 1}$ <br> January 5-8 | New Orleans, Louisiana <br> Annual Meeting | p. 1355 |
| $\mathbf{2 0 1 2}$ | Banuary 4-7 | Boston, Massachusetts <br> Annual Meeting |
| $\mathbf{2 0 1 3}$ p. 1355 <br> January 9-12 San Diego, California <br> Annual Meeting <br> 2014 <br> January 15-18 Baltimore, Maryland <br> Annual Meeting <br> 2015 p. 1355 <br> January 10-13 San Antonio, Texas <br> Annual Meeting | p. 1356 |  |

## Important Information Regarding AMS Meetings

Potential organizers, speakers, and hosts should refer to page 95 in the January 2008 issue of the Notices for general information regarding participation in AMS meetings and conferences.


#### Abstract

s 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 similarily coded material (such as accent marks in text) must be typeset in LATFX. Visit http://www.ams.org/cgi-bin/ abstracts/abstract.p7 Questions about abstracts 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.


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- Reviewed by Hong You Wu,

Mathematical Reviews, Issue 2001d
2008. DVD. Springer VideoMATH

ISBN 978-3-540-24041-9 - \$49.95

## Variational Methods in Imaging

O. Scherzer, M. Grasmair, H. Grossauer, M. Haltmeier, F. Lenzen, University of Innsbruck, Innsbruck, Austria
This book focuses on variational methods in imaging. The presentation is mathematically rigorous and covers a detailed treatment of the approach from an inverse problems point of view. Many numerical examples accompany the theory throughout the text. It can serve as a main text in courses in image processing or as a supplemental text for courses on regularization and inverse problems at the graduate level.
2009. Approx. 335 p. 72 illus. (Applied Mathematical Sciences, Volume 167) Hardcover
ISBN 978-0-387-30931-6 \$79.95

## Applied Delay Differential Equations

T. Erneux, Université Libre de Bruxelles, Belgium
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2009. X, 202 p. (Surveys and Tutorials in the Applied Mathematical Sciences, Volume 3) Softcover
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- approx. $\$ 39.95$


## Stochastic Calculus for Fractional Brownian Motion and Applications

F. Biagini, LMU München, Germany; Y. Hu, University of Kansas, Lawrence, KS, USA; University of Oslo, Norway; B. Øksendal, University of Oslo, Norway; T. Zhang, University of Manchester, UK

The purpose of this book is to present a comprehensive account of the different definitions of stochastic integration for fBm, and to give applications of the resulting theory. Particular emphasis is placed on studying the relations between the different approaches.
2008. XII, 332 p. (Probabilty and Its Applications) Hardcover ISBN 978-1-85233-996-8 - \$99.00

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L. Grafakos, University of Missouri, Columbia, MO, USA

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## Modern Fourier Analysis

L. Grafakos, University of Missouri, Columbia, MO, USA

2nd ed. 2008. Approx. 520 p. 27 illus. (Graduate Texts in Mathematics, Volume 250) Hardcover ISBN 978-0-387-09433-5

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The primary goal of these two volumes is to present the theoretical foundation of the field of Euclidean Harmonic analysis. The original edition was published as a single volume, but due to its size, scope, and the addition of new material, the second edition consists of two volumes. The present edition contains a new chapter on timefrequency analysis and the CarlesonHunt theorem. The first volume contains the classical topics such as Interpolation, Fourier Series, the Fourier Transform, Maximal Functions, Singular Integrals, and Littlewood-Paley Theory. The second volume contains more recent topics such as Function Spaces, Atomic Decompositions, Singular Integrals of Nonconvolution Type, and Weighted Inequalities.

[^15]
[^0]:    ${ }^{1}$ Editor's Note: See "Citation statistics: An IMU report", Notices, September 2008.

[^1]:    Douglas N. Arnold is McKnight Presidential Professor of Mathematics at the University of Minnesota. His email address is arnold@umn.edu.
    Jonathan Rogness is assistant professor of mathematics at the University of Minnesota. His email address is rogness@umn.edu.

[^2]:    Contact the AMS: I-800-32I-4AMS (4267), in the U. S. and Canada, or I-40I-455-4000 (worldwide); fax: I-40I-455-4046; email: cust-serv@ams.org. American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294 USA

[^3]:    David Corfield is lecturer in philosophy at the University of Kent at Canterbury. His email address is d.corfield@ kent.ac.uk.

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    Joseph A. Gallian is professor of mathematics and statistics at the University of Minnesota, Duluth. His email address is jga11ian@d.umn.edu.
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    Janet E. Mertz is professor of oncology at the McArdle Laboratory for Cancer Research, University of Wisconsin School of Medicine and Public Health, Madison. Her email address is mertz@oncology.wisc.edu.

[^5]:    ${ }^{1}$ Data not determined for Hong Kong and Singapore, other countries with median team ranks among the top 34.
    ${ }^{2}$ Data for pre-1988 years are incomplete.

[^6]:    James W. Maxwell is AMS associate executive director for special projects. His email address is jwm@ams.org.

[^7]:    Daniel S. Silver is professor of mathematics at the University of South Alabama, Mobile. His email address is silver@jaguar1.usoutha1.edu.

[^8]:    It is said in Nature that U. U. [Unseen Universe] is germinating into some higher form. If you think of extending the collection of hymns given in the

[^9]:    1 New doctoral hires are individuals who have held a doctorate for less than one year at the time of hiring.

[^10]:    1 Standard errors reported as zero reflect rounding of values that are less than 500.

[^11]:    1 Underrepresented minorities includes any person having origins within the categories American Indian or Alaska Native, Black or African American, Hispanic or Latino, and Native Hawaiian or Other Pacific Islander.
    2 Numbers in this column reflect corrections of those previously reported. For further information visit our website at http://www.ams.org/employment/surveyreports.html

[^12]:    $1_{\text {Research-Doctorate Programs in the United States: Continuity and Change, }}$ edited by Marvin L. Goldberger, Brendan A. Maher, and Pamela Ebert Flattau, National Academy Press, Washington, DC, 1995.
    ${ }^{2}$ These findings were published in An Assessment of Research-Doctorate Programs in the United States: Mathematical and Physical Sciences, edited by Lyle V. Jones, Gardner Lindzey, and Porter E. Coggeshall, National Academy Press, Washington, DC, 1982. The information on mathematics, statistics, and computer science was presented in digest form in the April 1983 issue of the Notices, pages 257-67, and an analysis of the classifications was given in the June 1983 Notices, pages 392-3.

[^13]:    "This is a wonderful book. The content is overwhelming. Every practicing mathematician, everyone who uses mathematics, and everyone who is interested in mathematics must have a copy of their own."—Simon A. Levin, Princeton University
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[^14]:    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: Steven H. Weintraub
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