ISSN 0002-9920 (print)
ISSN 1088-9477 (online)

# Notices

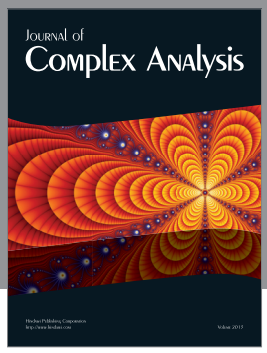
## of the American Mathematical Society

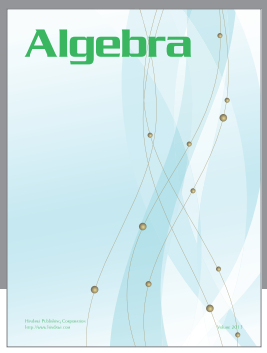
October 2013 Volume 60, Number 9

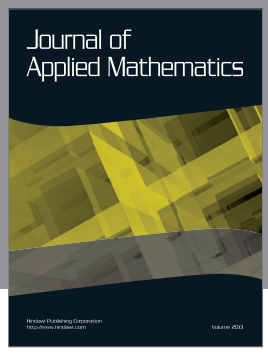


125th Anniversary
AMS
American Mathematical Society

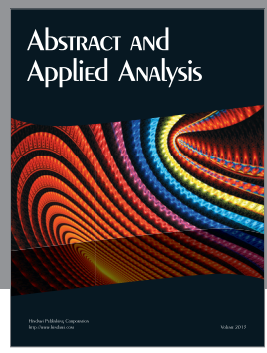
*About the cover: JMM 2014 in Baltimore (see pages 1153 and 1225)*

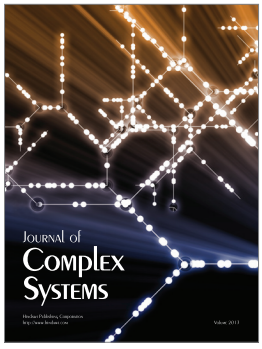


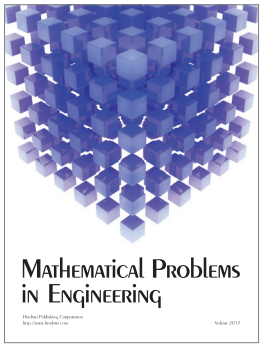



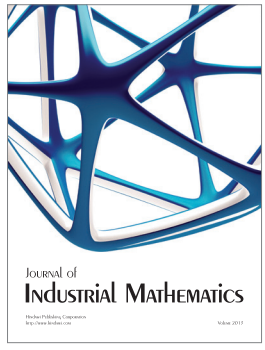


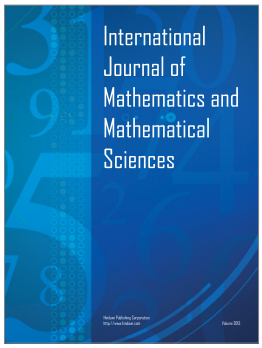


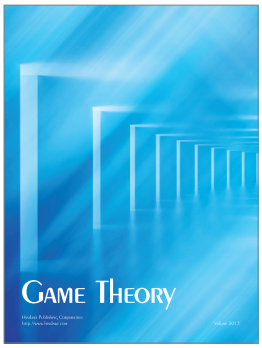





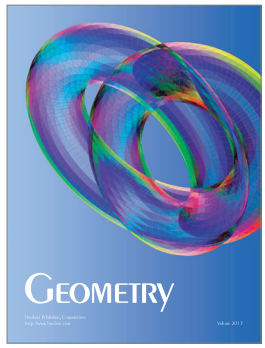


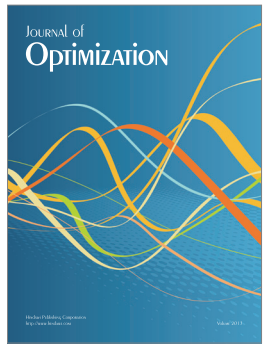



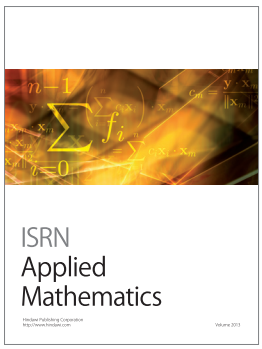



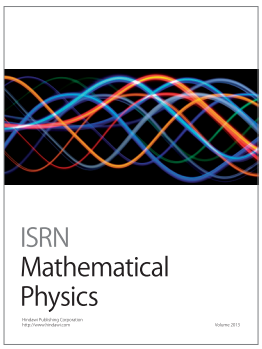



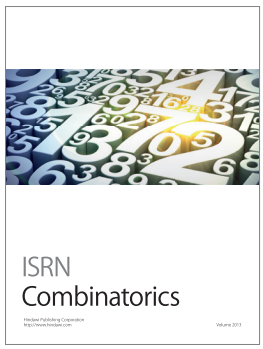


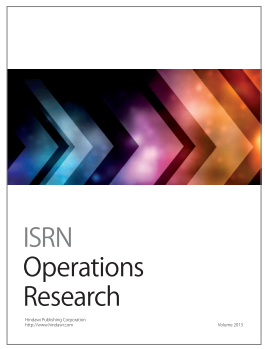


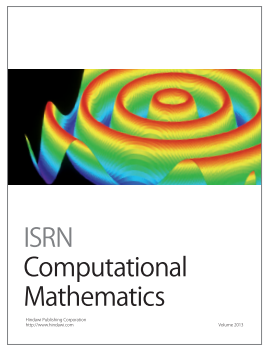



# Call for applications

## Academic year 2014-2015

The Fondation mathématique Jacques Hadamard (FMJH) and the Fondation Sciences Mathématiques de Paris (FSMP) are pleased to offer the following opportunities, located in Paris area, to outstanding scientists and excellent students:

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Procedures of applications are available online

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**The call for applications begins in October 2013**

**Contact**
FMJH: contact@fondation-hadamard.fr
FSMP: contact@fsmp.fr

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FSMP Fondation Sciences Mathématiques de Paris

INSTITUTE FOR PURE AND APPLIED MATHEMATICS

Los Angeles, California

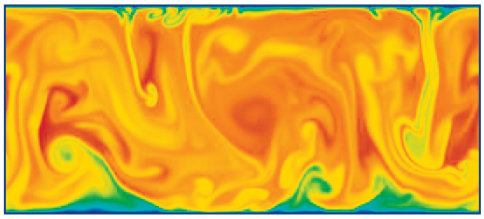


Image courtesy of David Goluskin

# MATHEMATICS OF TURBULENCE

September 8 – December 12, 2014

**ORGANIZING COMMITTEE: Charlie Doering** (University of Michigan), **Gregory Eyink** (Johns Hopkins University), **Pascale Garaud** (UC Santa Cruz), **Michael Jolly** (Indiana University), **Keith Julien** (University of Colorado), **Beverley McKeon** (Caltech)

## Scientific Overview

Turbulence is perhaps the primary paradigm of complex nonlinear multi-scale dynamics. It is ubiquitous in fluid flows and plays a major role in problems ranging from the determination of drag coefficients and heat and mass transfer rates in engineering applications, to important dynamical processes in environmental science, ocean and atmosphere dynamics, geophysics, and astrophysics. Understanding turbulent mixing and transport of heat, mass, and momentum remains an important open challenge for 21st century physics and mathematics.

This IPAM program is centered on fundamental issues in mathematical fluid dynamics, scientific computation, and applications including rigorous and reliable mathematical estimates of physically important quantities for solutions of the partial differential equations that are believed, in many situations, to accurately model the essential physical phenomena.

## Workshop Schedule

- Mathematics of Turbulence Tutorials. September 9 - 12, 2014.
- Workshop I: Mathematical Analysis of Turbulence. September 29 - October 3, 2014.
- Workshop II: Turbulent Transport and Mixing. October 13 - 17, 2014.
- Workshop III: Geophysical and Astrophysical Turbulence. October 27 - 31, 2014.
- Workshop IV: Turbulence in Engineering Applications. November 17 - 21, 2014.
- Culminating Workshop at Lake Arrowhead Conference Center (by invitation only), December 7 – 12, 2014.

## Participation

This program will bring together physicists, engineers, analysts, and applied mathematicians to share problems, insights, results and solutions. Enhancing communications across these traditional disciplinary boundaries is a central goal of the program.

Full and partial support for long-term participants is available. We are especially interested in applicants who intend to participate in the entire program (September 8 – December 12, 2014), but will consider applications for shorter periods. Funding is available for participants at all academic levels, though recent PhDs, graduate students, and researchers in the early stages of their careers are especially encouraged to apply. Encouraging the careers of women and minority mathematicians and scientists is an important component of IPAM's mission and we welcome their applications. More information and an application is available online.

## www.ipam.ucla.edu/programs/mt2014

NSF UCLA *IPAM is an NSF funded institute*

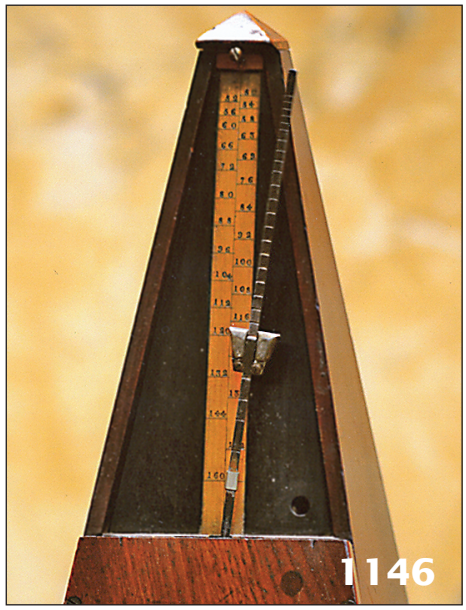
Institute for Pure & Applied Mathematics IPAM University of California, Los Angeles

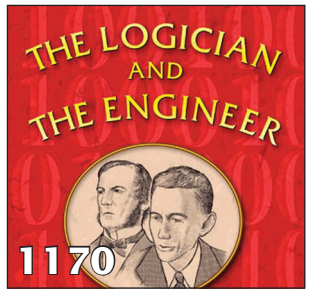
# Notices

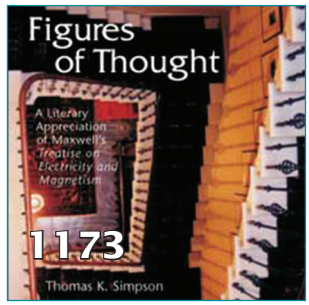
of the American Mathematical Society

October 2013




We celebrate the arrival of fall in the October issue with an article about the accuracy of Beethoven's metronome. This is accompanied by a piece on mathematical authority, agency, and voice in the teaching process. And there is a more mathematical item about Voevodsky's univalence axiom in homotopy theory. Finally, Kenneth A. Ross writes of his experience creating elementary analysis courses in the 1960s.

*—Steven G. Krantz, Editor*

## Features

# Notices

of the American Mathematical Society

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[*Notices of the American Mathematical Society* (ISSN 0002-9920) is published monthly except bimonthly in June/July by the American Mathematical Society at 201 Charles Street, Providence, RI 02904-2294 USA, GST No. 12189 2046 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, RI 02940-6248 USA.] Publication here of the Society's street address and the other information in brackets above is a technical requirement of the U.S. Postal Service. Tel: 401-455-4000, email: `notices@ams.org`.





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# Departments



# From the AMS Secretary

The American Mathematical Society presents

## The AMS Einstein Public Lecture in Mathematics

# Jon Kleinberg

Cornell University Photography

Tisch University Professor, Cornell University

## Bursts, Cascades, and Hot Spots:
### A Glimpse of Some Online Social Phenomena at Global Scales

**Saturday, October 19, 2013**
5 p.m. Graham Chapel
Washington University in St. Louis
Reception afterwards in Holmes Lounge

As an increasing amount of social interaction moves online, it becomes possible to study phenomena that were once essentially invisible: how our social networks are organized, how groups of people come together and attract new members, and how information spreads through society. With computational and mathematical ideas, we can begin to map the rich social landscape that emerges, filled with "hot spots" of collective attention, and behaviors that cascade through our networks of social connections.

Joe Angeles/WUSTL Photos

Jon Kleinberg is a leader in the effort to understand modern entities such as the World Wide Web and online social networks. He has received many awards and honors including a MacArthur "Genius" Grant and election to the National Academy of Sciences. Famous not only for his research, Kleinberg is also celebrated for his ability to explain his insightful results to anyone, regardless of their expertise.

Courtesy of Jon Kleinberg

Sponsored by the American Mathematical Society.
Hosted by the Department of Mathematics at Washington University in St. Louis.
This event is part of the AMS 2013 Fall Central Sectional Meeting, October 18-20.

**www.ams.org/meetings/sectional/2204_events.html**

125th Anniversary
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*Photo courtesy of PROMYS*

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The Epsilon Fund provides scholarships and other support for summer mathematics programs for talented youths across the United States.

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# The Public Face of Mathematics

I wish to encourage all AMS members to become active in promoting mathematics to the public. This can be accomplished in many ways: e.g., writing for a local newspaper about your favorite mathematics, organizing local mathematics festivals or competitions, helping local schools or clubs, or contacting your local congressional representative and offering your availability to try to answer any questions they may have pertaining to mathematics. These are just a few examples of ways to promote mathematics. No action is too insignificant. If you do not know where to begin, a discussion of how to effectively promote mathematics is starting to take place, and we hope AMS members can join in and contribute at any level (see more information below). Recent attacks in the news indicate that the perception of mathematics outside our community is increasingly negative and it is at risk of becoming politicized, with funding and support of mathematics at risk of suffering further.

Just in the past year you can read in popular magazines and newspapers that mathematics is not useful in the workplace ("Here's How Little Math Americans Actually Use at Work, *The Atlantic*, April 24, 2013); that mathematics is likely not essential for scientific success and is responsible for the loss of many young scientists ("Great Scientist ≠ Good at Math", *The Wall Street Journal*, April 5, 2013); that mathematics is an unnecessary ordeal, "an onerous stumbling block for all kinds of students" ("Is Algebra Necessary?", *New York Times*, opinion published July 28, 2012). Especially disturbing is the recent official report of the President's Council of Advisors on Science and Technology (PCAST E2E report, February 2012, http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-engage-to-excel-final_feb.pdf), which recommends "college mathematics teaching and curricula developed and taught by faculty from mathematics-intensive disciplines other than mathematics, including physics, engineering, and computer science ;" i.e., university mathematicians cannot be trusted to teach their own subject. Thus, it is not the quality of the attacks received, but their quantity and frequency and the lack of a regular countervoice that are of concern.

You may say there is nothing to worry about, that these negative articles are passing opinions, and that the public and policymakers will not dare listen to or act on these propositions. You can also say that these negative attacks are not new and have no political agenda behind them. Nevertheless, there is evidence that public discourse about science can make a quick change for the worse. In the past decade we have seen an alarming decline in the acceptance of scientific evidence and the scientific method. Consider for example our current political debate about climate change and global warming. Back in the late 1980s and early 1990s, conservative politicians like Reagan and Thatcher called for action to combat climate change, but today many politicians fear nothing of saying that "science is inconclusive" when in fact the majority of experts do agree we humans are affecting our environment.

Another example that underlines how mathematical topics can quickly run into politics and become the target of attacks or restriction is that of statistical methods that can be used to adjust or improve imperfect census counts. Politicians do not recognize them as valid and block their application, with the consequence that errors in the U.S. census persist despite existing ways to improve the accuracy of counts objectively. Can the actions of politicians and public opinion influence the situation we have now? I believe the answer is "yes". For example, see how quickly politicians began pressuring universities to use online courses or the recent introduction of legislation that could change the grant review system at NSF (see, e.g., http://news.sciencemag.org/scienceinsider/HQRA13_001_xml.pdf).

Several mathematicians are already publishing positive articles about mathematics and responding to the attacks (to name a few: see, e.g., Bryna Kra's article at http://chronicle.com/article/Mathematics-1000-Years-Old/139943/; the columns by Jordan Ellenberg and Ed Frenkel in *Slate,* http://www.slate.com/authors.jordan_ellenberg.html, http://www.slate.com/authors.edward_frenkel.html; or *The Huffington Post* columns by Jonathan Borwein and David H. Bailey, http://www.huffingtonpost.com/david-h-bailey/), but more needs to be done, and not everything has to be done through newspaper editorials. For example, there is a need to engage the public directly through mathematical events such as public lectures, demonstrations, or exhibits (some great examples include the public lectures sponsored by the mathematical institutes or the outreach to students and teachers done by math circles and math teachers' circles).

In response to the need for more positive publicity of mathematics, there will be a panel, sponsored jointly by the AMS Committee on Education and the AMS Committee on Science Policy, to discuss effective ways to reach the public and policymakers. The panel, The Public Face of Mathematics, will take place at the upcoming Joint Mathematics Meetings in Baltimore, Friday, January 17, 2014, from 2:30 p.m. to 4:00 p.m. Please join the conversation. As Congressman Jerry McNerney wrote in the May 2013 *Notices,* "The community will not continue to innovate without a concerted effort to make sure that the field of mathematics remains a priority for institutions that support research."

*—Jesús A. De Loera,*
*Professor of Mathematics*
*University of California, Davis*
deloera@math.ucdavis.edu

DOI: http://dx.doi.org/10.1090/noti1047

# Letters to the Editor

## Plundering the Russian Academy of Sciences

The project of reforming the Russian Academy of Sciences (RAS) was suggested in June 2013 by the Russian "Duma" without discussion with Russian scientists. It appears as a sudden attack. The project implies the expropriation of property of the RAS, elimination of the RAS, and creation of a new organization with the same name but with new staff and new regulations.

From my point of view, such a "reform" should be qualified as the liquidation of the RAS, the plundering of properties of the RAS, and the plundering of the name of the RAS.

I think the RAS deserved serious criticism but not liquidation. Such a liquidation would be a big step toward the total destruction of any science in Russia.

Corruption has created serious problems for science in Russia. The revolution in and disintegration of Russia are predicted for "this year" by many authors. Such predictions have appeared again and again over the past several years, so I cannot qualify them as scientific, but I accept that there are reasons behind these predictions. The observed destruction of science in Russia is one of these reasons.

I do not ask colleagues to save the RAS nor to save science in Russia; I doubt if they can be saved. I would only suggest that at least mathematicians use the correct terminology to describe what is happening with science in Russia at the beginning of the twenty-first century.

In support of my point of view, I suggest the following links:

http://www.mi.ras.ru/index.php?c=ref

http://mizugadro.mydns.jp/t/index.php/About_RAS_reform

http://mizugadro.mydns.jp/t/index.php/Against_the_RAS_reform

http://mizugadro.mydns.jp/t/index.php/RAS_reform

http://samlib.ru/k/kuznecow_d_j/saveras.shtml

*—Dmitrii Kouznetsov*
*Institute for Laser Science, University of Electro Communication, Japan*
dima@ils.uec.ac.jp

(Received July 17, 2013)

## Evidence-Based Teaching Practices

I applaud Professor Reys's efforts to improve the teaching of undergraduate math ["Getting Evidence-Based Teaching Practices into Mathematics Departments: Blueprint or Fantasy?", by Robert Reys, *Notices*, August 2013]. Let me pass on a couple of thoughts based on forty years of undergraduate teaching experience.

The term "evidence-based" worries me. A distinguished professor of education once said to me that there were no reliable statistics in education. Of course he was exaggerating, but it is true that one should be very careful about statistical evaluations of teaching. And, in the absence of good statistics, it is not clear what one would mean by "evidence".

Professor Reys mentions "inquiry-based learning". He also mentions the PCAST [President's Council of Advisors on Science and Technology] report calling for "1 million more college graduates in STEM fields." It seems to me the thrust of the PCAST report is that STEM [science, technology, engineering, and mathematics] should be spelled STEm; i.e., there should be less math, and what math there is should be geared to practical applications, principally computers. I worry that, if we try to combine the slower, deeper, inquiry-based approach with the more efficient "industrial" methods which will be required to produce 1 million more STEm graduates, the result will be a train wreck.

Two final thoughts. Firstly, when I started teaching more than forty years ago at Princeton, all the senior faculty except one taught undergraduate courses. Gradually over the years, institutions started hiring specialized faculty to do undergraduate teaching, so now many senior faculty don't teach undergraduates at all. (I do not know what the situation is now at Princeton. Perhaps things there are as they were in 1971 when I arrived.) Secondly, despite what I just said, I think math continues to put more thought and effort into undergraduate teaching than any other science. Unlike other sciences, the high demand for calculus and other undergraduate level teaching means that we can (and we do) live with only a fraction of the government support available to physics or biology. We should be proud of that independence.

*Spencer Bloch*
*University of Chicago (retired)*
bloch@math.uchicago.edu

(Received August 4, 2013)

## Remark on a Quartic Algorithm

Performing one step of the algorithm mentioned on page 845 of the August 2013 issue of the *Notices* as follows

$$x_0 = \text{some initial approximation of } \sqrt{q}$$

$$0 \le n \Rightarrow a_n = \frac{q - x_n^2}{2x_n} \quad \text{and} \quad x_{n+1} = x_n + a_n - \frac{a_n^2}{2(x_n + a_n)}$$

(which yields a sequence $(x_n)_{n=0}^{\infty}$ converging quartically to $\sqrt{q}$) is equivalent to—but is less computationally efficient than—performing two steps of (the quadratically convergent) Newton's method as follows.

$$x_0 = \text{some initial approximation of } \sqrt{q} \quad (\text{in fact any } x_0 \in (0, \infty))$$

$$1 \le n \Rightarrow x_n = (x_{n-1} + q/x_{n-1})/2$$

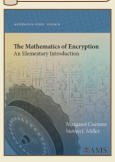
*—Dan Jurca*
*California State University, East Bay*
dan.jurca@csueastbay.edu

(Received August 6, 2013)

# It's a Mathematical World

The fascinating world of mathematics is constantly at work around us, manifesting in our lives as both the art of pure thought and a universally applicable science. From probability theory to healthcare modelling, modern cryptography to oceanography, the titles below showcase the elegance and functionality of mathematics in the world at large.

## The Mathematics of Encryption



### An Elementary Introduction

**Margaret Cozzens**, *DIMACS, Rutgers University, Piscataway, NJ*, and **Steven J. Miller**, *Williams College, Williamstown, MA*

This book provides a historical and mathematical tour of cryptography, from classical ciphers to quantum cryptography. The authors introduce just enough mathematics to explore modern encryption methods, with nothing more than basic algebra and some elementary number theory being necessary. Unlike many books in the field, this book is aimed at a general liberal arts student, but without losing mathematical completeness.

**Mathematical World**, Volume 29; 2013; 332 pages; Softcover; ISBN: 978-0-8218-8321-1; List US$49; AMS members US$39.20; Order code MAWRLD/29

## Mathematical Methods in Immunology

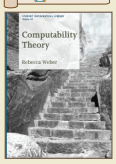
**Jerome K. Percus**, *Courant Institute of Mathematics, New York, NY, and Department of Physics, New York University, NY*

The complexity of the mammalian adaptive immune system calls for its encapsulation by mathematical models, and this book aims at the associated description and analysis. In the process, it introduces tools that should be in the armory of any current or aspiring applied mathematician, in the context of, arguably, the most effective system nature has devised to protect an organism from its manifold invisible enemies.

Titles in this series are co-published with the Courant Institute of Mathematical Sciences at New York University.

**Courant Lecture Notes**, Volume 23; 2011; 111 pages; Softcover; ISBN: 978-0-8218-7556-8; List US$32; AMS members US$25.60; Order code CLN/23

## Computability Theory

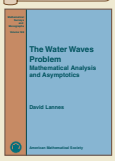


**Rebecca Weber**, *Dartmouth College, Hanover, NH*

What can we compute—even with unlimited resources? Are computations necessarily drastically limited, not just in practice, but theoretically? In this new book, Rebecca Weber addresses these questions, which lie at the heart of computability theory. The reader will gain a firm grounding in the fundamentals of the subject as well as an overview of currently active areas of research. Filled with ample examples, exercises, and extensive explanations, this book is suitable as both a textbook or for independent study with few prerequisites.

**Student Mathematical Library**, Volume 62; 2012; 203 pages; Softcover; ISBN: 978-0-8218-7392-2; List US$37; AMS members US$29.60; Order code STML/62

## The Water Waves Problem



### Mathematical Analysis and Asymptotics

**David Lannes**, *Ecole Normale Supérieure et CNRS, Paris, France*

In spite of recent intense activity surrounding the water waves equations, there exists no self-contained reference dealing with the basic theory of these equations. The present volume admirably fills this gap in the literature by proposing a simple and robust framework that allows readers to address important issues raised by the water waves equations.

**Mathematical Surveys and Monographs**, Volume 188; 2013; 321 pages; Hardcover; ISBN: 978-0-8218-9470-5; List US$98; AMS members US$78.40; Order code SURV/188

## Modelling in Healthcare

The Complex Systems Modelling Group (CSMG), *The IRMACS Center, Simon Fraser University, Burnaby, BC, Canada*

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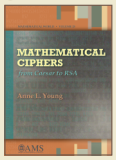
*— Timothy G. Buchman, Ph.D., M.D., FACS, FCCM*

2010; 218 pages; Hardcover; ISBN: 978-0-8218-4969-9; List US$69; AMS members US$55.20; Order code MBK/74

## Mathematical Ciphers



### From Caesar to RSA

**Anne L. Young**, *Loyola College in Maryland, Baltimore, MD*

This historical look at the use of ciphers to encode messages carries great relevance with today's emphasis on information security. Anne L. Young keeps the analysis focused on the cipher, bringing in mathematical theory when needed. The text culminates with discussion of the RSA cipher to protect information on the Internet. JavaScript programs are available to assist with exercises at the end of each chapter.

**Mathematical World**, Volume 25; 2006; 159 pages; Softcover; ISBN: 978-0-8218-3730-6; List US$30; AMS members US$24; Order code MAWRLD/25

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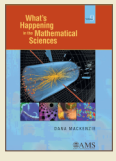
**Student Mathematical Library**, Volume 57; 2011; 237 pages; Softcover; ISBN: 978-0-8218-5261-3; List US$42; AMS members US$33.60; Order code STML/57

## What's Happening in the Mathematical Sciences, Volume 9



**Dana Mackenzie**

This book looks at some highlights of the most recent developments in pure and applied mathematics. These include the mathematics behind stories that made headlines, as well as fascinating mathematical vignettes that never made it into the newspapers. Topics covered in this volume include the mathematics surrounding natural and manmade disasters, such as the 2009 H1N1 outbreak and the 2011 tsunami in Japan, as well as developments in the pure mathematical realm, including the 2012 solutions to the Willmore and Lawson Conjectures. The stories in this book invite the reader into the exciting world of modern mathematics, which teems with the thrill of discovery and the anticipation of what is still to come.

**What's Happening in the Mathematical Sciences**, Volume 9; 2013; 127 pages; Softcover; ISBN: 978-0-8218-8739-4; List US$25; AMS members US$20; Order code HAPPENING/9

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# Was Something Wrong with Beethoven's Metronome?

*Sture Forsén, Harry B. Gray, L. K. Olof Lindgren, and Shirley B. Gray*

Mathematicians and scientists seldom rest easy when the numbers are not right. The search for understanding is never far from mind. In many ways, this is why mathematics is so much fun. Similarly, conductors and musicians, who immediately recognize wrong notes, are perplexed by Beethoven's metronome markings. Some of his tempo markings, even on many of his most popular classics, have been considered so fast as to be impossible to play. What is the problem? Why?

The pianist and musicologist Peter Stadlen (1910–1996), who devoted many years to studies of Beethoven's markings, regarded sixty-six out of a total of 135 important markings as absurdly fast and thus possibly wrong [1], [2]. Indeed, many if not most of Beethoven's markings have been ignored by latter day conductors and recording artists. This situation is all the more puzzling since Beethoven himself was a strong proponent of the metronome and took the instrument to heart when it first came into his hands about 1816. He even expressed satisfaction that finally his intentions as to the tempi in his more important compositions would be made generally known.

The literature on the subject is enormous. However, this article will focus on the salient features of the early metronomes as seen through the eyes of a scientist, engineer, or mathematician. We investigate their early history, how they were constructed, and their mechanical properties. We investigate possible sources of error as to why Beethoven may not have been able to correctly note reliable and transferable time measures. We hope to demonstrate that there are possible mathematical explanations for the "curious" tempo markings—explanations that hitherto have not been considered except perhaps by Stadlen, who even went so far as to locate Beethoven's own metronome.

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DOI: http://dx.doi.org/10.1090/noti1044

## Musical Notation and Tempo Indications in Beethoven's Lifetime

The musical notation used in European classical music—the five-line staff indicating pitch and notes of different appearance, whole notes, half notes, quarter notes, etc., to indicate the relative length of a tone within a time interval such as the "beat" or the "bar"—was essentially in widespread use by the end of the seventeenth century [3]. What was lacking in these early days was a universal way of indicating the tempo. *Relative* tempi could be used. There was the Italian system, still in use, with expressive words that run the gamut from fast to slow, proceeding from *prestissimo* all the way through *vivace*, *allegro*, to *adagio* and the sluggish *larghissimo*. There was, and is, also the German equivalent, again from fast to slow, going from *schnell*, perhaps preceded with an

amplifying *sehr*, towards *sehr langsam*. Of course there is the French as well. The verbal way of marking tempi gives considerable freedom to the performing musician and thus a certain amount of artistic latitude to adapt to the current moment. Nevertheless, a number of composers, performing artists, and conductors were not satisfied with the lack of precision. In fact, already in the early years of the seventeenth century, the human pulse was used for timing. It is reported that the pulse was taken as eighty beats/minute—which seems somewhat high but may reflect the level of stress of performing artists. Also, the use of clocks was proposed by Henry Purcell in the late seventeenth century, and then there were devices based on the properties of simple pendulums.

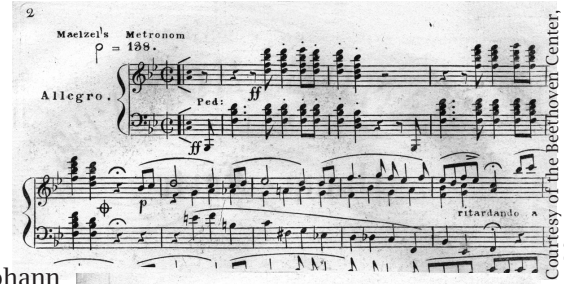
The study of the period of a simple pendulum is associated with the great Italian scientist Galileo. In Pisa he is thought to have experimented with a piece of string, fixed at one end and with a weight at the other. First, a pendulum is independent of the mass of the weight for a constant length of the string, and secondly, the square of the period of time varies directly with the length of the string. Galileo's results were eventually put into use for musical timekeeping. Perhaps the first was the French flutist and musicologist Etienne Louliè at the end of the seventeenth century. His device was rather unwieldy—it is reported to have been nearly two meters (approximately six feet) tall and obviously not very mobile. But his basic design was gradually refined by others who equipped a clockworks device to keep the pendulum swinging and also added a graduated scale by which the length of the string with the weight could be both altered and measured. A drawing of a pendulum instrument, i.e., the *metromètre*, designed ca. 1730 by Count D'Ons-en-Bray is reproduced in an article by Thomas Y. Levin [4]. Unwieldy as they must have been, the pendulum-based timekeeping instruments seem to have been in use well into the nineteenth century for want of a simpler alternative. Readers may want to compare the metromètre with Huygens's-pendulum clock (1673) [5].

But a "quantum jump" in the history of musical timekeeping was not far ahead. In Amsterdam in 1812 Dietrich Nikolaus Winkel (1780–1826) was experimenting with pendulums. He made the discovery that a special variant of a pendulum, in this case a thin wooden or metal beam some 15–20 cm in length and onto which weights could be attached, behaved in an interesting way. If the beam was able to swing freely around a pivot and two weights were attached to the beam, one on either side of the pivot, the pendulum would beat a steady time. Furthermore, with proper adjustment of the position and mass of the weights, it would beat either slow tempi, which previously had required very long single weight pendulums, or very fast tempi if the weights were moved toward the pivot. The principle of the metronome was born. Readers may picture the new invention as an augmented application of the Archimedean Law of the Lever.

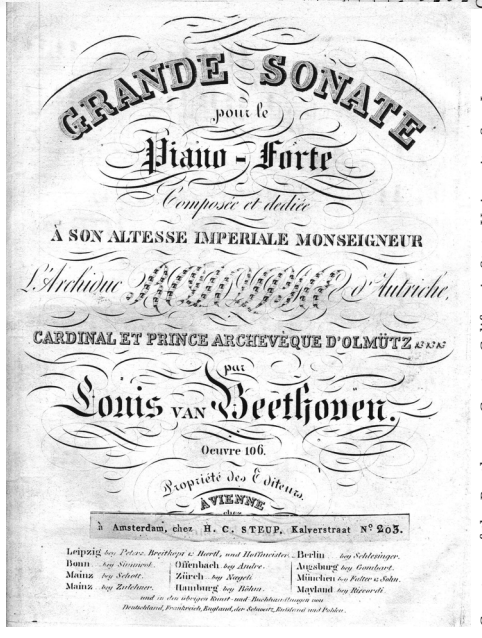
Winkel must have realized the double pendulum principle could be applied to musical timekeeping. But there was obviously more to be done before the idea could be transformed into an easy-to-use instrument. Winkel spent a few years experimenting with his ideas. Finally, in August of 1815 he described his new invention in the *Reports of the Netherlands Academy of Sciences* where it also received extensive praise in a commentary. Though published, Winkel was soon to meet his nemesis. Winkel was no businessman for he had not patented his invention. He was soon approached by an enterprising man from Vienna who was something of a ruthless entrepreneur, a man named Mälzel.

### The Multitalented Herr Mälzel

Johann Nepomuk Mälzel (1772–1838) was quite an interesting character. He was born in Regensburg where his father was a skillful organ builder. Young Johann turned out to have considerable musical talent. At the age of fourteen he was already regarded as one of the best piano players in the city. But he was also a most gifted mechanical engineer. At the age of twenty he established himself in Vienna and eventually gained access to a mechanical workshop in the famous Stein factory, producer of one of the pianoforte instruments that Beethoven favored. Mälzel was seemingly not without a well-developed taste for publicity. Moreover, his talent was in constructing musical automatons, devices that appealed greatly to the public at that time. A recent investigation reveals that he may in fact have copied



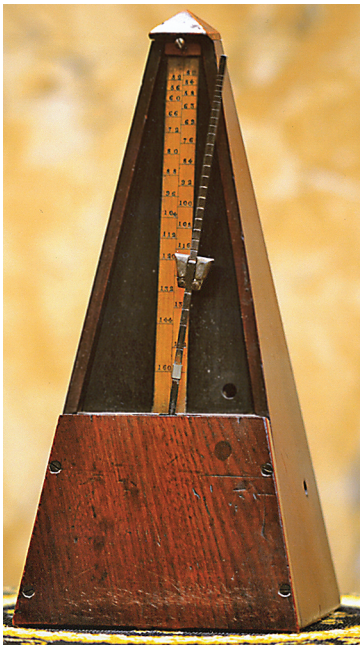

Courtesy of the Beethoven Center, California State University, San Jose.




Courtesy of the Beethoven Center, California State University, San Jose.

inventions by others, changing them slightly and then claiming that they were his own. One of his most famous mechanical constructions was the remarkable *panharmonicon* that could imitate all instruments in a military band—even gun shots! It was actuated by a bellow. The notes played were determined by pins attached to a large rotating wooden cylinder, much like in old barrel-organs. The amazing "device" was demonstrated not only in Vienna but also in Paris where he sold his first instrument in 1807. It caught the eye of Luigi Cherubini who wrote a composition named *Echo* for the panharmonicon. It is indeed sad that the only copy of the panharmonicon, which for many years was kept at the *Landesgewerbemuseum* in Stuttgart, was destroyed in a bomb raid in 1942.

Mälzel's reputation as somewhat of a mechanical wizard grew and in 1808 he received the title *Hofkammermaschinist*, a title that translates as court or royal machinist. He came in contact with Beethoven, who sought help for his increasing hearing loss. Mälzel constructed several ear trumpets for him, some still on display at the Beethoven Haus in Bonn. During Beethoven's visit to Mälzel's workshop, the problem of musical timekeeping was almost certainly discussed, and Mälzel apparently started working on the issue [6]. It appears that in 1813 he actually made some kind of timekeeping device, a "chronometer", possibly based on an earlier design by G. E. Stöckler. In June of the same year Mälzel also suggested to Beethoven that he write a symphony to celebrate the Duke of Wellington's recent victory over Napoleon's troops at Vitoria in Spain, and he added that the composition should be arranged for the panharmonicon. Beethoven agreed and, as was his habit, outlined the composition. The collaboration ended in a bitter conflict between the two. Mälzel considered himself the rightful owner of the final work although the panharmonicon version was eventually abandoned and the composition rewritten by Beethoven for a symphony orchestra and first performed in this form in December of 1813. Beethoven dismissed Mälzel's claims and instigated legal action against him.



Courtesy of the Beethoven Center, California State University, San Jose.

Chess players will be interested to know that in later life Mälzel purchased a remarkable chess playing automaton designed in 1770 by Baron Wolfgang von Kampelen. This automaton was generally known as "The Turk" after the dress of the almost life-sized doll that moved the chess pieces. Although seemingly run by an intricate mechanical assembly of cog-wheels and rods, it actually hid a human player in a way that escaped even the most inquisitive skeptics. Mälzel successfully toured with the Turk, who did beat most opponents, Napoleon among them, all over Europe. Later he toured the United States where, however, the human involvement inside the Turk was accidentally exposed. Mälzel, who became a wealthy man, died in 1838 of an overdose of alcohol on a ship in the harbor of LaGuaira, Venezuela. The Turk eventually ended its days in 1854 when it was destroyed by fire at the National Theater in Philadelphia. Both Wikipedia and the magician James Randi have described how the public was fooled into accepting the idea that no human could possibly be hidden inside [7].

But now back to the invention of the double pendulum by Dietrich Winkel in Amsterdam. News traveled fast even in the early part of the nineteenth century. Mälzel had obtained some information on Winkel's invention as early as 1812. It is even possible that the two had briefly met that year. But after the publication of Winkel's invention in August of 1815, Mälzel hurried to Amsterdam, met with Winkel, inspected the new "metronome" and realized its superiority over his own timekeeping devices. He offered Winkel money to buy the right to sell the device under his own name. Not surprisingly, Winkel refused.

Intellectual property rights were rarely enforced in those days, so Mälzel went back to Vienna, made a copy of Winkel's instrument, added a graded scale to the oscillating beam on the side of the movable weight, took the copy to Paris, and saw to it that "his"—Mälzel's—invention was patented there and later also in London and Vienna. He even set up a small factory, Mälzel & Cie, in Paris for the production of "his" metronomes.

In 1817 Winkel became fully aware of Mälzel's activities and he was understandably upset. He instigated proceedings against Mälzel for the obvious theft. The Netherlands Academy of Sciences was involved as arbitrator and ruled in Winkel's favor. To no avail, Winkel had been scooped. The metronome factory in Paris was up and running. Metronomes soon became very popular. Mälzel was regarded as the true inventor and the abbreviation "MM" for "Mälzel's Metronome" was commonly placed before metronome measures in printed sheets of music.

## Beethoven and Mälzel's Metronome

The first metronomes based on Winkel's double pendulum principles from Mälzel's Paris factory should have become available in early 1816. It is thus possible that Beethoven was presented with a copy around this time, perhaps as a gesture of peace from Mälzel, who must have realized that Beethoven's approval of the instrument would be good for business. Not much is mentioned about the metronome in Beethoven's letters in 1816, perhaps due to the master's preoccupation with pressing family matters. His brother Caspar Carl died of tuberculosis in November 1815, leaving behind a nine-year-old son, Karl. Beethoven made every effort to become the sole guardian of his young nephew, to the point of taking the case to court in opposition to Karl's mother, Johanna. The legal battle went on for more than four years, causing considerable emotional strain on young Karl [8].

It is reported that in 1816 Beethoven was so preoccupied by these legal dealings that he stopped composing. But from 1817 onward the metronome was indeed on his mind. At that time he wrote Hofrath von Mosel, "So far as I am myself concerned, I have long purposed giving up those inconsistent terms 'allegro', 'andante', 'adagio', and 'presto'; and Mälzel's metronome furnishes us with the best opportunity of doing so" [9]. Later, his ninth symphony, in addition to his earlier symphonies, was marked with metronome measures. After a report from a performance of its popularity in Berlin, he wrote to his publisher Schott, "I have received letters from Berlin informing me that the first performance of the ninth symphony was received with enthusiastic applause, which I attribute largely to the metronome markings" [10]. Surprisingly, Beethoven only gave metronome markings to one of his piano sonatas, Op. 106, also called the *Hammerklavier sonata*. Here the first movement, an allegro, is marked one hundred thirty-eight beats per minute for the half note, which is extraordinarily fast. The great pianist Wilhelm Kempff made some rather harsh comments on this marking in his set of recordings of the later piano sonatas, "The erroneous (sic!) metronome markings can easily lead to this regal movement being robbed of its radiant majesty."

Assuming Beethoven had one of Mälzel's metronomes in his possession by 1817, he probably could not hear the "clicks" of the repetitive beat as he was suffering from approaching deafness at that time. But, of course, he could *see* the oscillating beam. So what could possibly have caused him to indicate the fast tempi throughout that so puzzled subsequent generations of musicians? Have present-day musicians tried to make his compositions more "romantic" than the master intended or else given up as being technically too difficult?

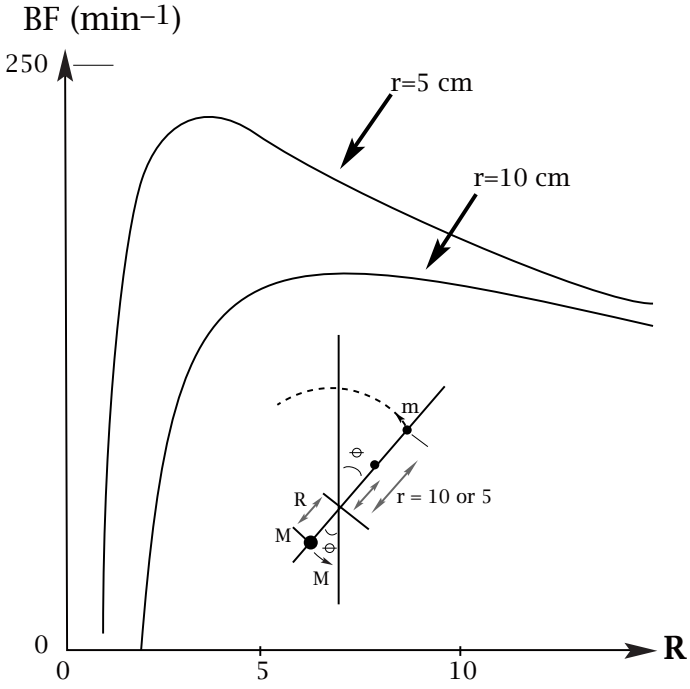



**Figure 1. The beat frequency, BF, of a metronome as a function of the distance R of the heavy weight ($M$=40 g) from the pivot axis at two fixed positions of the movable weight: r= 5 cm and r= 10 cm. As is evident, the beat frequency will be extremely sensitive to a small change in the position of the heavy weight—in particular for small values of r.**

The beat rate was indicated by gradations on the oscillating beam. Beethoven's eyesight was not the best. He could have read the wrong numbers. On the other hand, he often had help from his nephew Karl, who may not have had vision problems. Then there is the connection between the beat rate and the note length: a beat rate of "60" could refer to the length of a whole note, a half note, or a quarter note, and the tempo of the music changes accordingly. A beat rate of 60 for a whole note becomes 120 for a half note. Accidentally removing the stem from the sign of the half note would seemingly double the tempo. Could copy errors have been the culprit?

We should also consider psychological factors. Different humans may have slightly different "internal clocks". A tempo regarded as fast for one person may be less so for another. We suppose that internal clocks have a tendency to run slower with age in most humans, one notable exception being Toscanini's, whose clock seemed famously to never lose time.

But one must also consider reports that Beethoven's metronome on occasion was out of

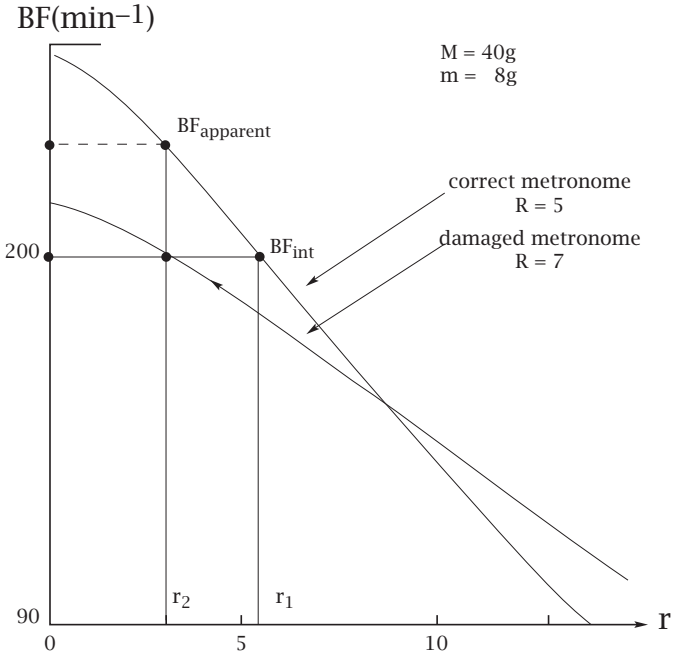



**Figure 2. The beat frequency, BF, of a metronome as a function of the distance r from the pivot axis of the movable weight ($m$ = 8 g) . The heavy weight ($M$= 40 g) is assumed to be at the distance R= 5 cm from the pivot axis for the correct, factory-calibrated metronome and at the distance R= 7 cm for the damaged metronome. The damaged metronome will beat slower than indicated by the factory-engraved markings for a calibrated and correct metronome when r is less than 8 cm, while it will go faster than the engraved markings at r larger than 8 cm. Thus when r < 8 cm, $\mathbf{BF}_{\mathbf{damaged}} < \mathbf{BF}_{\mathbf{correct}}$; when r = 8 cm, $\mathbf{BF}_{\mathbf{damaged}} = \mathbf{BF}_{\mathbf{correct}}$; when r > 8 cm, $\mathbf{BF}_{\mathbf{damaged}} > \mathbf{BF}_{\mathbf{correct}}$.**

order. In an April 1819 letter to his friend and copyist Ferdinand Ries at the Fitzwilliam Museum in Cambridge, Beethoven states that he cannot yet send Ries the tempi for his sonata Op. 106 *because his metronome is broken* [11]. Beethoven was very irritated and upset, perhaps from symptoms of lead poisoning, a condition he may have had according to studies at the Argonne National Laboratory [12]. Could Beethoven on occasion have dropped the metronome on the floor or could he have used more than one metronome in his last ten years?

Peter Stadlen is reported to have found Beethoven's metronome after a long search. This particular specimen was among the property auctioned off by his surviving nephew Karl after his uncle's death. To Stadlen's disappointment the heavy weight was gone, perhaps an indication that the early metronomes from Mälzel's factory did not have rugged, shock-proof construction.

## Dynamical Properties of the Metronome

Finally, we take a closer look at the dynamical properties of the mechanical double pendulum metronome and, in particular, determine if its performance is sensitive to the position of the supposedly fixed heavy weight with respect to the pivot. (See the text below on the derivation of the equations of motion.)

The final result for the oscillation frequency $\Omega$ of a Winkel-type double pendulum is as follows:

$$\Omega = \left[ \frac{g(M\mathrm{R} - m\mathrm{r})}{(M\mathrm{R}^2 + m\mathrm{r}^2)} \right]^{1/2}. \tag{1}$$

Here $M$ is the mass of the heavier fixed weight beneath the pivot along with its distance R to the pivot axis. Correspondingly, $m$ is the mass of the movable weight at distance r above the pivot point. The lighter weight and its distance are what musicians can see, while the heavier weight is usually hidden in the base of the cabinet. Also, $g$ is the acceleration due to gravity (9.81 m/sec$^2$). But $\Omega$ is not the same as the beat frequency in "clicks per minute" of the metronome (**BF**). As can be seen in the derivation, the beat frequency **BF** is related to $\Omega$ by the ratio

$$\mathbf{BF} = 60\Omega/\pi. \tag{2}$$

The equations are valid under the assumption that there is no friction or drag, the masses are point masses, and the amplitude of the oscillations around the vertical position is small. The last assumption is not severe as the beat frequency would not deviate much from the above expression for relatively large amplitudes; however, the correct equations would be far more complex and nonlinear. Please note that **BF** is the limit when r goes to zero, and it is independent of the mass of the two weights as determined by R, or rather $1/\sqrt{\mathrm{R}}$, which is a consequence of $m$ being located on the pivot axis with the double pendulum beating like a simple pendulum.

Equation (1) gives us an opportunity to investigate the sensitivity of the metronome frequency to a change in parameters. For any particular metronome we can assume that both $M$ and $m$ are fixed at the factory by the manufacturer. The value of R for the heavy weight is also likely to be set at the factory in order to make the metronome beat at the correct frequency when the moving weight is put at the corresponding grading on the oscillating beam. But what if an error had been made? Perhaps the heavy weight was attached to the beam in such a way that it actually could slide—move—from its original position. Suppose the metronome accidentally fell to the floor or was otherwise damaged. We could investigate what the consequences would be. But first, just for curiosity's sake, let us look at how the beat frequency of a metronome in clicks

per minute, **BF**, will depend on the position of the **heavy weight** in relationship to the lighter weight at a fixed distance. In other words, suppose only the location of the heavy weight $M$ is changed.

We now turn to numerical results. Although we have searched extensively, we have not found the actual values of the parameters $M$, $m$, and R that Beethoven used to obtain his tempo markings. Over a limited parametric space, however, the results are not sensitive to the values picked. For the sake of argument, let's assume $M = 40$ grams at distance R = 5 cm for the heavier weight and $m = 8$ at distance r = 10 for the upper weight. (See Figure 1.) We note that the beat frequency **BF** of a metronome is extremely sensitive to the position of the heavy weight if the distance R is less than about 3–4 cm and **BF** goes to zero at R = 1 cm and r = 5 cm. At the latter distances the two weights exactly balance each other with the cross product being (40)(1) = (8)(5). Under these conditions the metronome beam would rotate freely like a balanced propeller if there were no physical constraints. For r =10 this condition is met when R = 2; i.e., (40)(2) = (8)(10). As illustrated in Figure 1, the heavy weight should not be placed too close to the pivot as it is important to minimize the effects of small changes in its position. But it is also evident that, for R values larger than those at the maxima in the arcs of the curves, shifts in the position of the heavy weight toward larger distances from the pivot will result in **BF** shifts to smaller values. This effect is particularly striking when the movable weight is close to the pivot, i.e., in the region of fast tempi of the metronome!

Finally, let us look at what would happen if the metronome were somehow damaged by a shift in the heavy weight from its calibrated factory position. We consider two cases. First we will assume that the heavy weight is moved such that it is a longer distance ($R_{Beethoven}$) from the pivot, a situation that could occur if the metronome fell to the floor in an upright position. (We hope that Herr Ludwig, as he rests in heaven, will forgive us for the notation ($R_{Beethoven}$).) If we take ($R_{Beethoven}$) to be 7 cm and assume that the original factory position was 5 cm, the result is shown in Figure 2. For fast tempi (**BF** axis), the damaged metronome will go **slower** than indicated by the factory calibration. At a medium value of r we reach a point where the factory gradations happen to be correct, but for slow tempi (see R) the damaged metronome always will go **faster** than predicted by calibrations.

In the second case let us assume the heavy weight is moved to a position closer to the pivot than its original factory location, perhaps because the metronome had accidentally fallen to the floor with its top down. In Figure 3 the results are displayed for a case in which the factory position

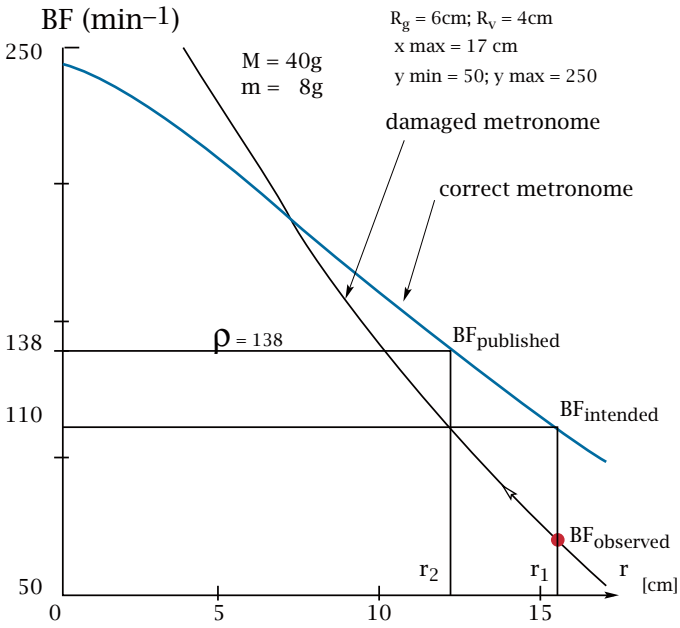



**Figure 3. The beat frequency, BF, of a metronome as a function of the distance r from the pivot axis of the movable weight ($m$ = 8 g). The heavy weight ($M$ = 40 g) is assumed to be at the distance, R= 6 cm from the pivot axis for the correct, factory-calibrated metronome and at the distance R= 4 cm for the damaged metronome. Beethoven puts the movable weight on his metronome to correspond to the marking BF =110 ( i.e., $BF_{int}$ in Figure 3) but, somewhat puzzled perhaps, finds that the visibly observed BF seems far too slow, around seventy to eighty or so, i.e., the BF of the damaged metronome curve at the setting $r_1$ (the point indicated by $BF_{obs}$.]**

of the heavy weight is 6 cm from the pivot (R = 6 cm) and the distance after an accident is R = 4 cm. We note by looking at Figure 1 that, in the region of small values of R, even a small change in position will have a major effect on the metronome's beat frequency. Other sets of parameters produce even greater changes.

Could these results explain Beethoven's "absurdly fast" metronome markings? We should note that, if the same model is applied in the region of slow tempi (see Figure 2), the printed markings would result in somewhat **slower** beat frequencies on the damaged metronome than intended by the master.

Let's envision the following *hypothetical scenario* (cf. Figures 1–3). Unknown to him, the metronome Beethoven is working with is damaged in the sense that the heavy weight hidden by the wooden case has been displaced. Assume Beethoven puts the movable weight on his metronome to correspond to the marking of approximately **BF** =110 (i.e.,

$\mathbf{BF}_{\text{intended}}$ in Figure 3). Somewhat puzzled perhaps, he finds the visibly observed **BF** seems far too slow, around 70 to 80, i.e., the **BF** of the damaged metronome curve at the setting $r_1$ (the point indicated as $\mathbf{BF}_{\text{observed}}$). The markings on the metronome beam with the light movable weight that he can clearly see **do not** correspond to his desired **BF**. Beethoven, dissatisfied with the slow movement of the visible metronome beam, then moves the weight until he is satisfied with the much higher **BF**.

Today we know very little about who actually helped the master with the practical details of proceeding from his raw, hardly legible, handwritten sheets of music, but we are very sure that a **BF** = 138 was published ($p$=138). (See Figure 3.) A latter day pianist intending to perform the *Hammerklavier* sonata looks at the printed sheet of music marked a "half-note = 138," sets a correctly calibrated metronome, and mutters, "incredibly fast"—very fast indeed! Our *scenario* provides an explanation for Beethoven's "fast tempi problem", if indeed there is one.

How could Beethoven not note the occasional odd behavior of his metronome? A thorough account by Peter Stadlen gives the impression that the master was not entirely comfortable with the new device, most especially in the process of converting from beat frequencies to actual tempi markings for half-notes, quarter-notes, etc. [13]. Obviously, it would be very helpful if we knew more about the actual design of his metronome(s). We suggest that one or more of the devices could have been damaged, perhaps accidentally during one of his well-known violent temper tantrums. Whatever the case, our mathematical analysis shows that a damaged double pendulum metronome could indeed yield tempi consistent with Beethoven's markings.

*Arguably this is a bold hypothesis. Perhaps someone else was involved in the procedure—Beethoven's eyesight was not always the best.*

### Derivation: Equations of Motion for a Double Pendulum for the Type Used in Mechanical Metronomes.

Consider the following model of the double pendulum:

We will assume that the beam oscillates around the pivot without any friction and also that the mass of the beam can be ignored in comparison to that of the two weights. The total energy $E$ of the oscillating pendulum is a sum of its potential energy $V$ and its kinetic energy $T$.

The kinetic energy may be written

$$T = \frac{1}{2}m(v_m)^2 + \frac{1}{2}M(v_M)^2 \tag{3}$$

where $v_m$ and $v_M$ are the velocity of the light and heavy masses, respectively, in the direction of their motions. Now

$$v_m = \frac{d(S_m)}{dt} \quad \text{where } (s_m) = \mathrm{r}\sin\Theta,$$
$$v_M = \frac{d(S_M)}{dt} \quad \text{where } (s_M) = \mathrm{R}\sin\Theta.$$

For small values of $\Theta$ we have $\sin\Theta = \Theta$ (in radians). Thus

$$s_m = \mathrm{r}\Theta \quad \text{and} \quad s_M = \mathrm{R}\Theta.$$

The velocities $v$ are then

$$v_m = \mathrm{r}\frac{d\Theta}{dt} = \mathrm{r}\dot{\Theta} \quad \text{and} \quad (v_m)^2 = \mathrm{r}^2\dot{\Theta}^2,$$
$$v_M = R\frac{d\Theta}{dt} = \mathrm{R}\dot{\Theta} \quad \text{and} \quad (v_M)^2 = \mathrm{R}^2\dot{\Theta}^2.$$

The kinetic energy of the double pendulum is thus

$$T = \frac{1}{2}\left[m\mathrm{r}^2\dot{\Theta}^2 + M\mathrm{R}^2\dot{\Theta}^2\right]. \tag{4}$$

Now let us consider the potential energy $V$ with respect to the axis of the pivot:

$$V = gm\mathrm{r}\cos\Theta - gM\mathrm{R}\cos\Theta, \tag{5}$$

where $g$ is the acceleration due to gravity. Again assuming small angles of oscillation when $\sin\Theta = \Theta$ and since $\sin^2\Theta + \cos^2\Theta = 1$, we can replace $\cos\Theta$ with $(1-\Theta^2)^{\frac{1}{2}}$. The potential energy $V$ then becomes

$$V = g[m\mathrm{r} - M\mathrm{R}](1-\Theta^2)^{\frac{1}{2}}. \tag{6}$$

But, if the double pendulum moves without friction, then the total energy $E$ is constant and the time derivative will be zero:

$$\frac{dE}{dt} = 0.$$

Let us for the sake of clarity take the time derivatives of $T$ and $V$ separately:

$$\frac{dT}{dt} = \frac{1}{2}\left[m\mathrm{r}^2 2]\dot{\Theta}\ddot{\Theta} + M\mathrm{R}^2 2\dot{\Theta}\ddot{\Theta}\right] \tag{7}$$
$$= \left[m\mathrm{r}^2 + M\mathrm{R}^2\right]\dot{\Theta}\ddot{\Theta}$$

where $\ddot{\Theta} = \frac{d^2\Theta}{dt^2}$.

Now consider the time derivative of the potential energy for small oscillations:

$$\frac{dV}{dt} = \frac{d}{dt}[g[m\mathrm{r} - M\mathrm{R}](1-\Theta^2)^{\frac{1}{2}}].$$

Note that

$$\frac{d\sqrt{(1-\Theta^2}}{dt} = \frac{1}{2}\left(\frac{-2\Theta\dot{\Theta}}{\sqrt{(1-\Theta^2)}}\right) \approx -\Theta\dot{\Theta} \text{ for small } \Theta.$$

Continuing,

$$\frac{dV}{dt} = g(M\mathrm{R} - m\mathrm{r})\Theta\dot{\Theta},$$

and since $\dfrac{dE}{dt} = \dfrac{d}{dt}[T+V] = 0$,

$$(m\mathrm{r}^2 + M\mathrm{R}^2)\dot{\Theta}\ddot{\Theta} + g(M\mathrm{R} - m\mathrm{r})\Theta\dot{\Theta} = 0. \tag{8}$$

We can eliminate $\dot{\Theta}$ since $\dot{\Theta} = 0$ does not give anything, and we are left with

$$\ddot{\Theta} + g\left[\frac{(M\mathrm{R} - m\mathrm{r})}{(m\mathrm{r}^2 + M\mathrm{R}^2)}\right]\Theta = 0. \tag{9}$$

This is a differential equation of the type

$$\frac{d^2x}{dt^2} + a^2x = 0$$

with the solution

$$x(t) = (x_0)\cos(ax + a),$$

and if we introduce

$$\Omega = \left[\frac{g(M\mathrm{R} - m\mathrm{r})}{M\mathrm{R}^2 + m\mathrm{r}^2)}\right]^{\frac{1}{2}},$$

the solution to equation (9) is

$$(\Theta(t) = (\Theta_0)\cos(\Omega t + \Omega).$$

Let us check to see if this expression yields the same for a simple pendulum if we put $m = 0$. We have

$$\Omega = \left[g\left(\frac{M\mathrm{R}}{M\mathrm{R}^2}\right)\right]^{\frac{1}{2}} = \left[\frac{g}{\mathrm{R}}\right]^{\frac{1}{2}},$$

$\Theta(t) = \cos[(g/\mathrm{R})t]$, and thus the oscillation frequency is $\Omega = (g/\mathrm{R})$, or the correct equation for small amplitude oscillations. We note that $\Omega$ is in fact the oscillation also for our double pendulum!

How do we relate $\Omega$ to the beat frequency of the metronome? The period of any type of pendulum is the time it takes to swing from one starting position and back to that position again. But this corresponds to **two "clicks"** of the metronome—it clicks at every turning point of the oscillating beam! Therefore, to go from pendulum period $(P = 2\pi/\Omega)$ to beat frequency "**BF**" in "clicks per minute" we have

$$\mathbf{BF} = \mathbf{60}\Omega/\pi.$$

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### About the Cover

Baltimore, MD, is the location of the 2014 Joint Mathematics Meetings. Pictured on the cover is a nighttime view of the Baltimore Inner Harbor.

One item of interest in Baltimore for mathematicians is that the Walters Museum was the site of work on the Archimedes Codex. In response to a query of ours, however, Nancy Zinn, deputy director at the Museum, reports that the codex is no longer there. She says further:

"Since the completion of our analysis and conservation of the manuscript, the codex has been returned to its owner, and is no longer on deposit at the museum. However … the owner has agreed to our request for the palimpsest to be on view at the Huntington Library in San Marino, CA, from March 15 to June 8, 2014. This will be the third, and final, venue for the exhibition 'Lost and Found: The Secrets of Archimedes'. It is unlikely that the codex will ever be displayed publicly again."

A complete report about the palimpsest can be found at

http://archimedespalimpsest.org/

*—Bill Casselman*
*Graphics Editor*
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# Teaching Mathematics with Women in Mind

*Jessica M. Deshler and Elizabeth A. Burroughs*

We both work at institutions that have been awarded NSF ADVANCE grants. ADVANCE is a program that aims to develop systematic approaches to supporting academic women in science, technology, engineering, and mathematics (STEM) disciplines. ADVANCE looks at universities and asks, "What support can universities provide to help women faculty members thrive in STEM?" We took that question to heart and asked ourselves, "What support can we provide in our undergraduate mathematics classrooms to help women students thrive in mathematics?"

We decided to take a hard look in the mirror. This meant examining our own approaches to teaching and confronting the limits of our own education and preparation. Trained as mathematicians, we found our preparation for understanding how gender affects undergraduate mathematics classroom environments lacking. We turned to resources from psychology, sociology, and women's and gender studies to better understand our own teaching. Our personal goal—it might not be yours—is to understand how gender bias influences our mathematics teaching and to explore concrete steps we can take to reduce the effects of that bias.

We've asked ourselves why our classrooms should look different from the classrooms in which we were undergraduate students. After all, we are both women who were successful undergraduate mathematics majors and went on to earn Ph.D.'s in mathematics. Call it survivor's guilt: we both know that we were able to "fit in" in mathematics when many other women could not. We could say, "Other women should do what we did and learn to fit in." Instead, we are asking, "What should we do differently as mathematics instructors so that more women, who wouldn't otherwise be successful, will be and will persist in the study of our subject?"

We have to make a few stipulations. First, we believe teaching can be taught. Though trained as applied mathematicians, we both now do research in and teach mathematics education. Our work in mathematics education is guided by the belief that great teaching can be taught. This is contrary to what popular culture has us believe: often teachers are characterized as "born to teach." Sometimes great teachers believe it too. There is something to that—in the absence of preparation for teaching, there are those who will become better because they experiment, reflect, and revise their own teaching. They do this on their own and end up keeping the best of their experiments and learning from the ineffective ones. We don't mean to diminish the greatness of those who have figured out how to become great teachers on their own; we want to understand what they do in classrooms and teach others to do the same. As we explore changes to make in a classroom to be responsive to gender, we are thinking of explicit teaching choices.

Second, we believe there is inherent good in giving more people access to undergraduate mathematics. This is a value we stipulate. You might not share that value, but if that's the case, then you and we are aiming at different things. We've thought a lot about what kinds of good come from access to mathematics, and we believe that what might resonate most with our students is the access to fulfilling, higher-paying jobs that comes with advanced technological knowledge. Some may argue that this is not why we teach mathematics, but it

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DOI: http://dx.doi.org/10.1090/noti1042

is certainly why many of our students are taking mathematics classes. The mathematics classes we teach are populated with students who are taking the course because it is required by their major, because someone has decided what amount of mathematics they will need to know to be successful in their academic program (and ultimately in a career in their chosen field). Dudley [11] suggests that we "be a little less insistent that mathematics is essential for earning a living" and argues that texts such as *Everybody Counts* [26] overestimate the necessity of mathematics (and skills in algebra) for everyday life and work. He uses the telephone Yellow Pages headings of Janitor Service, Janitor's Equipment and Supplies, Jewelers, and others to support his point. We take the point of view that we are preparing students for career aspirations above and beyond those used in his example. The majority of students in calculus courses have chosen career paths where calculus is accepted as necessary or at the very least helpful. We therefore need to consider how to facilitate a greater understanding among students in our classes.

Finally, we are not psychologists, sociologists, or gender theorists. We are thinking about these issues on a very practical level—that of mathematics professors. But, to understand the practical, we've found we have to consider the theoretical. And we understand that our social scientist colleagues have something to tell mathematicians about how to teach mathematics. Indulge us—this article might take you out of your comfort zone and talk about some nonmathematical theoretical ideas that we think have an influence on choices we make when teaching mathematics.

## The Scenario

Consider the following: you are teaching an upper-level undergraduate mathematics course with about thirty students. Roughly one third of the students are women, and throughout the semester you notice that these women are some of your best students. In fact, none of the worst students are women. A careless analysis of this situation might lead you to believe that there is no gender disparity in undergraduate mathematics courses at your institution and, in fact, women seem to be advantaged, so you can focus on making your instruction as engaging as possible so all of your students will benefit. A more careful analysis would expose the selection bias inherent in your single classroom situation: your sample only includes those students who were successful enough in prior courses to be enrolled in an upper-level course. If there is no gender bias, then you should expect women to be proportionally represented throughout the grade distribution; instead, the lack of women in the mid-to-low performance range might indicate that women are being screened out of advanced undergraduate mathematics when men of similar performance levels are not [5]. Such a scenario is a call to all of us who teach mathematics to undergraduates to pay attention to issues of equity.

## What Are We Teaching Our Students?

Students in undergraduate mathematics courses are generally exposed to a breadth and depth of mathematical content. In recent years a focus on conceptual understanding has led to a curriculum reform movement in mathematics across all school levels, a movement that is focused on conceptual rather than procedural understanding of mathematics. Conceptual understanding is one of five components of mathematical proficiency for children identified by the National Research Council [25], and researchers have called for a priority on conceptual learning in higher education in general [20]. While true for mathematics and higher education independently, this has been especially true for their intersection in the reform of undergraduate mathematics. Specifically, calculus has been at the center of a reform movement since the 1980s and is seen by many in higher education as a gateway to STEM majors, since success in this course is a requirement for entry into many STEM programs.

What are absent from this mathematical experience (and reform movements), however, are explicit discussions with students about the opportunities they'll have when they've taken more mathematics content courses. Undergraduate students do not have a chance to examine how mathematical knowledge translates into social and economic power by increased access to careers that are influential or high paying. Psychologists call this the "utility value" of mathematics. This utility value is often overlooked [18] despite the fact that researchers have called for students to obtain a cultural awareness of the significance of mathematics in the larger worlds of science and society [2]. Instructors of undergraduate mathematics can facilitate this awareness by incorporating this utility perspective into courses. Indeed, engineering has had great success with such a curriculum overhaul; incorporating examples and demonstrations that contextualize and draw the social and community connections for students has been shown to enhance performance and interest of both male and female engineering students [6].

We recently tried out a classroom activity as a way to promote an awareness of the utility value of mathematics. An instructor of a Calculus I course at one of our institutions introduced the utility value of mathematics to show students how the calculus concepts they were learning can be used to address societal problems. The instructor prepared a short presentation (four slides) describing the uses of mathematics beyond what students may normally think about when in a mathematics class. On this day in class, students

saw how mathematics is applied in political science (in the effect of weighted voting, coalitions and bloc voting, particularly timely given the U.S. presidential election at that time), national security (how disease spreads, bioterrorism, screening airline passengers, disaster response), and issues of social justice (in economic models for poverty-stricken nations). Each example presented came from a scholarly article to show students how researchers in these fields use mathematics, specifically the calculus they were studying in class, to address these problems. In addition to telling the students how calculus can be used in fields that might appeal to them, students were asked to take part in increasing their awareness through one homework assignment. They had to find, read, and summarize a scholarly article demonstrating calculus applied to a problem in their major academic fields over the course of one week. Through statements students made in their written summaries (e.g., "I never knew calculus could be applied to biology"), we were able to see a clear increase in utility-value awareness in this class from even just one assignment.

## What Else Can We Do?

Beyond developing curriculum related to utility value, we've also considered teaching practices which help our students set appropriate classroom behaviors. We aren't talking about listing classroom rules on the syllabus; we wanted to have students develop classroom habits that we would consider mathematically productive. We looked into feminist teaching and encountered the ideas of authority, agency, and voice. We've been thinking about what those ideas mean in a context that is mathematical. This article describes our interpretation of how undergraduate classrooms can reflect mathematical authority, mathematical agency, and mathematical voice as ways to encourage all students, with the specific aim of engaging more female students to persist in mathematical study.

We're concerned with understanding how the issues of authority, agency, and voice are present in a classroom where the academic topic is mathematics. We want to know: what does it mean to have mathematical authority, mathematical agency, or mathematical voice? We consider where our students find authority in the mathematics classroom. Is the source internal or external? Is it the instructor? Or is it the mathematics? Do our students act as agents for themselves, taking action where appropriate? Do they exercise a voice in the classroom, speaking from an authentic, individual perspective rather than being limited to repeating the ideas of others? One thing to keep in mind is that social scientists confer academic meaning on the terms *authority, agency*, and *voice* in a way that is related to the common English connotation of the words but is not identical to it (think of the precision that mathematicians invoke when using the words *similar, random*, or *equal*). In what follows, we try to offer our interpretation of the academic use of those words.

## Mathematical Authority

We suggest that it is most natural for mathematicians to understand the teaching construct of authority because the discipline of mathematics rests on a structure that is internally derived and verified. Educational and social theorists define different types of authority, including traditional authority (a right to command and a duty to obey) [35] and professional authority (based on expertise needed to achieve aims) [3]. Though classrooms might rely on these (and other) authority structures, mathematicians themselves recognize in doing mathematics that it is mathematical reasoning and the verification of that reasoning that characterizes the discipline. Then what characterizes classrooms where the authority structure reflects the premise of mathematical authority?

Despite efforts in collaborative learning, many students still view their instructors or their textbooks as the final authority on mathematical correctness [29]. In fact, it is easy for mathematics instructors to take this point of view as well, since they are the experts in the subject matter. Instructors need to instill in students an understanding of the authority inherent in the discipline. This, however, is easier said than done, and for many of us the attempt is familiar territory. We try to have discussions encouraging students to work out problems on their own or with classmates before seeking instructor intervention, yet still hear "I'll just wait for the professor to do it" as we walk away.

There is a need for instructors to develop methods of promoting self-reliance in students or risk perpetuating a culture in which students are unable or unwilling to solve mathematical problems (or conduct themselves in mathematical situations) without access to expert knowledge. If our students are relying on us to provide the authority in the classroom (instead of relying on the mathematics), then it is natural for us to conclude that either the students think themselves unable to do the mathematics or the students are able but unwilling. Students in the first group—those who don't believe they are capable of doing the mathematics—will feel they need to mimic the instructor. Those in the second group—unwilling to try—may believe the instructor is the expert and should be mimicked.

The first group of students does not believe they can do mathematics regardless of the effort they put in. They consider themselves outside a marked group [7] of people who have mathematical ability. Considering themselves outside this group, they

are merely able to reproduce the mathematics of others but not able to engage with the mathematics in a meaningful way. They see themselves only as copiers of others' mathematics [21] and are therefore unable to see where mathematics fits into the world around them. They will likely be unable to function in a mathematical situation outside the classroom without expert knowledge as a resource.

The second group, students who think simply mimicking their instructor's mathematical processes is acceptable, does not see the need to understand mathematics, because they have an expert mathematician in the classroom. Their inability to see mathematics beyond the classroom places them in the same situation as the students in the first group—unable to function in a mathematical situation without expert knowledge as a resource. We suggest that mathematicians teaching undergraduate courses consider whether their classroom approach encourages students to find mathematical authority from an external expert or from within mathematics itself. One way to foster a reliance on the internal authority of mathematics and promote agency and voice among students is through focusing on appropriate use of group work. Collaborative groups, as a pedagogical tool, allow students to express themselves mathematically, and women in particular have shown positive reactions to collaborative learning [32]. By participating in groups, students can practice developing their own voice and agency; they can learn to put their own mathematical ideas forward to peers and validate their reasoning.

An instructor at one of our institutions recently attempted to use video self-modeling (VSM) to reinforce effective group work practices among calculus students to promote the constructs described above. VSM is the activity of watching and learning from one's own positive behavior [4]. Group work is an integral part of the course, though getting students to "buy in" to group work and step away from the traditional lecture format of a mathematics class is sometimes difficult. (It should be noted that several of the group work activities used in this project are research-based supplemental curriculum materials which were implemented several years prior and the instructor was experienced in facilitating the activity.) VSM has been used in educational and psychological research to reinforce positive behaviors since the 1970s.

Prior to attempting the VSM activity, the instructor engaged the students first in small group discussions, then a whole class discussion around a series of questions designed to help them identify effective group work behaviors and discuss their attitudes toward collaborative work in a mathematics class.

During a later class, while working on a group-work activity (though not one of the activities common to all classes), three groups of students were videotaped. The instructor's plan was to sift through the three videos to find a short clip where students were modeling the behaviors they previously described as effective (things like sharing responsibility for the group's work, discussing mathematics in a way that builds on other students' contributions). However, in the 42 minutes of videotaping, the instructor was unable to find even a 30-second video segment in which students were, in fact, displaying the desired behaviors.

Instead, the instructor created the desired video clip with graduate teaching assistants portraying students while working through the activities. The teaching assistants were familiar enough with the mathematical content of the tasks that they were able to focus on modeling the desired behaviors. This is the video the instructor eventually used in her video-modeling intervention. After watching the video, the undergraduate students had a productive discussion about how to engage in groups. Informal reports from the instructor are that this activity did help the students in their collaborative work for the remainder of the semester.

## Mathematical Agency

The psychological construct of agency is, we propose, less obvious to mathematicians than that of authority. In considering agency, theorists consider an individual's ability to take action for him- or herself. We refer to the common definition of agency: the capacity to act or exert power. Researchers have called for mathematics educators to provide students with "tools to analyze and act upon issues important in their lives, in their communities, and to society in general" [14, p. xxi]. We have thought about how to interpret agency in mathematics classrooms and have found the ideas of mindset and motivation are those we can best understand and enact.

**Mindset for Learning.** Psychologists refer to an individual's mindset as the underlying beliefs about intelligence or ability that the individual holds. Mindsets are generally classified into two categories: a fixed mindset or a growth mindset. The fixed mindset, sometimes called an entity view, is characterized by the belief that intelligence or ability is fixed and a person either has the intelligence or ability or does not. The growth mindset, sometimes called an incremental view, is characterized by the belief that a person's intelligence or ability is malleable and changes with effort [12].

Psychologist Carol Dweck [12] has identified three features of learners with a growth mindset. Those with a growth mindset are focused not on high scores or grades but on learning; they believe that the amount of effort is what determines achievement; and they tend to use positive strategies when they face difficulty, such as changing problem-solving approaches.

There is evidence that shows that providing learners with a growth mindset can positively impact learning outcomes in mathematics and science. In a study of college chemistry courses, Grant and Dweck [17] studied how growth or fixed mindsets affected grades in this difficult course. They found, among other things, that growth mindset students were better able to recover from a setback (a low exam score) than fixed mindset students. They also found that mindset had a gender dimension: of those with a fixed mindset, men outperformed women. But with a growth mindset, women and men were statistically level.

Specific to mathematics, Good, Rattan, and Dweck [15] studied the mindsets of females in college calculus and found that women with a growth mindset were less susceptible to negative stereotypes and indicated a feeling that they "belong" in math, more so than women with a fixed mindset. Other studies by these authors [16] have shown that describing "math geniuses" as people who love and work at mathematics rather than as born geniuses provides students with a growth mindset about mathematics. In another study, Dar-Nimrod and Heine [8] found that females who are exposed to the idea that differences in mathematics are due to experience rather than genetics perform better on a mathematics performance task.

This research indicates that it is important to address students' mindsets in the classroom if the classroom goal is to develop critical thinking skills with respect to mathematics in more students. Instructors can provide students with the tools to understand and adopt a growth mindset. Perhaps this can be achieved by extending some of the strategies suggested for teaching children to have a growth mindset to higher education and by showcasing mathematicians (including women mathematicians) as hard workers. Alternatively, mathematics instructors providing students with examples (in the mathematics classroom) of how mindset can affect performance in other fields can provide a model of the relationship between the two (performance and mindset) and further a belief in growth mindset.

During a recent calculus class, a graduate instructor at one of our institutions attempted this by providing real-world examples during a classroom discussion to illustrate to the students how much of an impact our own thoughts can have on our performance. They listened to excerpts from stories in sports where positive thinking led to record breaking, among other things. Both strategies are relatively simple to implement and are well received by students in general.

## Motivation in Mathematics

Within the academic discipline of psychology there is a subfield that is concerned primarily with motivation. It is not the purpose of this section to elucidate all of the subtleties included in a rich knowledge of that field. Rather, this brief discussion is meant to provide an overview of motivation that will enable the mathematician or mathematics educator to be aware of the most widely agreed-upon impacts of the psychology of motivation in the mathematics classroom. To some psychologists, agency is considered a subconcept of the concept of motivation. We freely admit that we understand these concepts only through a layperson's view. With this as our lens, we choose to characterize attention to motivation as a way to promote agency within students in a classroom.

Key concepts in educational psychology that relate to motivation (in its academic usage) are goals, interest, and motivation (common English usage). According to Murphy and Alexander [22], who analyzed psychology literature for definitions in motivation, a goal is generally defined as that which students wish to achieve; an interest is the process "by which the underlying needs or desires of learners are energized;" and motivation is a process involved in the direction, intensity, and persistence of behavior [22, p. 28].

Students who are "goal-oriented" may have a specific goal as their aim. This may be a performance goal (earning a high grade or avoiding a failing grade), a mastery goal (to learn the material), a social goal (to fit in with peers, the teacher, or some other social community), or a work-avoidance goal (doing as little work as possible). There has been recent interest among research psychologists in refining this structure used to categorize goals [13], but the four categories suggested here can aid the mathematician's understanding of students' goals. It is often easiest in classroom settings to appreciate the student who has a mastery goal, and it can be frustrating to deal with students who have a work-avoidance goal. Students with performance goals might consider themselves "good" students; instructors who understand the difference between performance goal-oriented and mastery goal-oriented students may find opportunities to engage the performance goal-oriented students in activities that display the value of concept mastery. Classrooms that acknowledge students' social goals may find strategies to structure the classroom environment around a shared mathematical community.

*Interest* can be categorized as individual or situational interest. Students may have individual interest, which means that they have developed an interest in specific classroom material that comes from their prior interactions with or knowledge about the subject, or students may have situational interest, an interest that is more malleable and context dependent. It may be beneficial for teachers to focus instruction on situational interest in an attempt to embed ideas that can become individual interest [28].

Students may be motivated intrinsically, which is a feature that comes from the task in and of itself, or extrinsically, meaning they are performing the task to get some benefit or meet some other goal that is peripheral to the activity itself. Instructors who choose mathematics tasks that are relevant to students' interests may have more success tapping into students' intrinsic motivation [9].

Both of the strategies that we've discussed earlier, focusing on meaningful problems in the curriculum and explaining the utility value of mathematics to students, are ways we've tried to address motivation in classrooms.

## Mathematical Voice

The idea of voice is the hardest for us to get a handle on. Sometimes it is hard for us to understand the distinction between some ideas that social scientists present related to voice and those related to agency or authority. Rather than focusing our energy on understanding those distinctions that seem far outside our expertise, we have tried to understand what new ideas are encompassed within voice that we haven't yet explored. We propose that there are two aspects of mathematical voice that should be understood in relation to undergraduate mathematics: voice in the classroom and voice in society.

In one respect, a classroom that allows students mathematical voice is one in which students are literally speaking. But the idea of voice goes deeper than this. A classroom that attends to mathematical voice provides all students the opportunity and expectation to be engaged in the intellectual content of the classroom. This involves instructors using strategies that ensure all students are called on or share ideas vocally in an equitable way but also uses written assignments as ways to engage students' voices. Many of the issues of this aspect of voice overlap issues of mathematical authority and agency that have been previously discussed. A second aspect of mathematical voice is an understanding of what it means to have a mathematical voice in society at large. To understand that perspective, we found ourselves examining the sociological construct of privilege.

We think of privilege as a special advantage granted to a person or group of people not always deserved or earned. Privileged people in the United States tend to be male, white, middle or upper class, heterosexual, and physically and mentally able [24]. People in privileged groups are generally unaware of the advantages they obtain simply by belonging to this class based on their race, ethnicity, gender, or socio-economic status.

People of color or lower economic status are usually not afforded the same advantages as those in a privileged group. Researchers have shown that mathematics education has afforded privilege to some students while limiting opportunities for others, and trends in mathematics achievement continue to persist along racial, ethnic, gender, and socio-economic status among students [30], [31]. In addition to privilege affecting the type, quality, or level of mathematics education received by students, the level of mathematics education received by students will affect their future privilege in the access it gives them to career choices. This cyclic relationship between privilege and mathematics education in our society is one which we try to recognize in class.

It is difficult to balance the advantages afforded to those with privilege and those without, even in the relatively small and controlled environments of the classroom. As such, we don't have good suggestions or even examples of what we've tried. As a first step, we suggest that mathematics instructors seek to notice the ways that privilege emerges in the classroom environment: who talks more in class or who has stronger prerequisite skills, for example. Perhaps with greater awareness we can find ways to address this issue more concretely.

## Discussion

Our personal purpose in understanding the constructs of authority, agency, and voice in mathematics is to attempt to address the gap between the numbers of women and men who pursue mathematics careers, and we began by inspecting our own classrooms. The transition between high school and college is a critical time when many young women turn away from STEM career paths. Only half as many female first-year students plan to pursue STEM majors as their male counterparts [27], and of those who do major in STEM, women leave these majors at the same rate as men [33].

Current literature investigating why there are so few women in STEM reveals the following three themes: (1) the existence of perceived gender differences (the continued notion that men are mathematically innately superior and therefore better suited to careers in STEM), (2) the lack of interest in STEM by women, and (3) the influence of the STEM workplace environment [1]. Recently, researchers have also identified a lack of focus on the communal and social values that a STEM career affords as another possible deterrent to women's participation [10]. We suspect the lack of knowledge of the social value of STEM careers greatly contributes to the lack of interest in STEM by women.

Given these three influences, namely, the persistent lack of women in STEM majors and careers, the trend toward mathematics instruction that is both conceptual and attentive to societal issues, and the recognition of the value of including women's perspectives in creating a sense of belonging, we suspect that an understanding of the issues of authority, agency, and voice is a first step and a

critical foundation towards creating classrooms that foster a sense of belonging among women.

Mathematical knowledge is an instrument of economic potential for individuals in society. The U.S. Department of Labor projected that, in 2012, nine out of ten of the fastest growing occupations will require preparation in mathematics or science [34]. Additionally, careers that require this type of preparation equip degree recipients with higher earning power. For example, in 2012 the average starting salary for a bachelor's degree recipient entering non-STEM fields was much lower than recipients of degrees in STEM fields [23]. In particular, women in science and engineering tended to earn more than women in other sectors of the workforce. A recently published analysis of gender differences in mathematics performance at the K–12 level found evidence to support the hypothesis that socio-cultural factors in environment result in the observable differences in boys' and girls' performance in mathematics [19] and concluded that "eliminating gender discrimination in pay and employment opportunities could be part of a win-win formula for producing an adequate supply of future workers with high-level competence in mathematics" (p. 19).

These societal factors illustrate the importance of engaging women in mathematics in their undergraduate careers. We propose that teaching that attends to mathematical authority, mathematical agency, and mathematical voice will help all students, including women, as a way to address the STEM pipeline problem at the early undergraduate level.

## Acknowledgment

Partial support for this work was provided by the National Science Foundation's ADVANCE IT Program under award HRD-1007978. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

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# Voevodsky's Univalence Axiom in Homotopy Type Theory

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The Institute for Advanced Study in Princeton is hosting a special program during the academic year 2012–2013 on a new research theme that is based on recently discovered connections between homotopy theory, a branch of algebraic topology, and type theory, a branch of mathematical logic and theoretical computer science. In this brief paper our goal is to take a glance at these developments. For those readers who would like to learn more about them, we recommend a number of references throughout.

**Type theory** was invented by Bertrand Russell [20], but it was first developed as a rigorous formal system by Alonzo Church [3], [4], [5]. It now has numerous applications in computer science, especially in the theory of programming languages [19]. Per Martin-Löf [15], [11], [13], [14], among others, developed a generalization of Church's system which is now usually called dependent, constructive, or simply **Martin–Löf type theory**; this is the system that we consider here. It was originally intended as a rigorous framework for constructive mathematics.

In type theory objects are classified using a primitive notion of *type*, similar to the data types used in programming languages. As in programming languages, these elaborately structured types can be used to express detailed specifications of the objects classified, giving rise to principles of reasoning about them. To take a simple example, the objects of a product type $A \times B$ are known to be of the form $\langle a, b\rangle$, and so one automatically knows how to form them and how to decompose them. This aspect of type theory has led to its extensive use in verifying the correctness of computer programs. Type theories also form the basis of modern computer proof assistants, which are used for formalizing mathematics and verifying the correctness of formalized proofs. For example, the powerful Coq proof assistant [6] has recently been used to formalize and verify the correctness of the proof of the celebrated Feit-Thompson odd order theorem [7].

One problem with understanding type theory from a mathematical point of view, however, has always been that the basic concept of *type* is unlike that of *set* in ways that have been hard to make precise. This difficulty has now been solved by the idea of regarding types not as strange sets (perhaps constructed without using classical logic) but as spaces, regarded from the perspective of homotopy theory.

In **homotopy theory** one is concerned with spaces and continuous mappings between them, up to homotopy; a *homotopy* between a pair of continuous maps $f\colon X \to Y$ and $g\colon X \to Y$ is a continuous map $H\colon X \times [0,1] \to Y$ satisfying $H(x,0) = f(x)$ and $H(x,1) = g(x)$. The homotopy $H$ may be thought of as a "continuous deformation" of $f$ into $g$. The spaces $X$ and $Y$ are said to be *homotopy equivalent*, $X \simeq Y$, if there are continuous maps going back and forth, the composites of which are homotopical to the respective identity mappings, i.e., if they are isomorphic "up to

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DOI: http://dx.doi.org/10.1090/noti1043

homotopy". Homotopy equivalent spaces have the same algebraic invariants (e.g., homology, or the fundamental group) and are said to have the same *homotopy type*.

**Homotopy type theory** is a new field of mathematics which interprets type theory from a homotopical perspective. In homotopy type theory, one regards the types as spaces, or homotopy types, and the logical constructions (such as the product $A \times B$) as homotopy-invariant constructions on spaces. In this way, one is able to manipulate spaces directly, without first having to develop point-set topology or even define the real numbers. Homotopy type theory is connected to several topics of interest in modern algebraic topology, such as $\infty$-groupoids and Quillen model structures (see [18]); we will only mention one simple example below, namely the homotopy groups of spheres.

To briefly explain the homotopical perspective of types, consider the basic concept of type theory, namely that the *term* $a$ is of *type* $A$, which is written

$$a : A.$$

This expression is traditionally thought of as akin to "$a$ is an element of the set $A$". However, in homotopy type theory we think of it instead as "$a$ is a point of the space $A$". Similarly, every term $f : A \to B$ is regarded as a continuous function from the space $A$ to the space $B$.

This perspective clarifies features of type theory which were puzzling from the perspective of types as sets, for instance, that one can have nontrivial types $X$ such that $(X \to X) \cong X + 1$. But the key new idea of the homotopy interpretation is that the logical notion of identity $a = b$ of two objects $a, b : A$ of the same type $A$ can be understood as the existence of a path $p : a \rightsquigarrow b$ from point $a$ to point $b$ in the space $A$. This also means that two functions $f, g : A \to B$ are identical just in case they are homotopic, since a homotopy is just a family of paths $p_x : f(x) \rightsquigarrow g(x)$ in $B$, one for each $x : A$. In type theory, for every type $A$ there is a (formerly somewhat mysterious) type $\mathtt{Id}_A$ of identities between objects of $A$; in homotopy type theory, this is just the *path space* $A^I$ of all continuous maps $I \to A$ from the unit interval. (See [2], [1], [18].)

At around the same time that Awodey and Warren advanced the idea of homotopy type theory, Voevodsky showed how to model type theory using Kan simplicial sets, a familiar setting for classical homotopy theory, thus arriving independently at essentially the same idea around 2005. Both were inspired by the prior work of Hofmann and Streicher, who had constructed a model of type theory using groupoids [9].

Voevodsky, moreover, recognized that this simplicial interpretation satisfies a further crucial property, which he termed *univalence* and which is not usually assumed in type theory. Adding univalence to type theory in the form of a new axiom has far-reaching consequences, many of which are natural, simplifying, and compelling. The **Univalence Axiom** thus further strengthens the homotopical view of type theory since it holds in the simplicial model but fails in the view of types as sets.

The basic idea of the Univalence Axiom can be explained as follows. In type theory, one can have a universe $\mathcal{U}$, the terms of which are themselves types, $A : \mathcal{U}$, etc. Of course, we do not have $\mathcal{U} : \mathcal{U}$, so only some types are terms of $\mathcal{U}$—call these the *small* types. Like any type, $\mathcal{U}$ has an identity type $\mathtt{Id}_{\mathcal{U}}$, which expresses the identity relation $A = B$ among small types. Thinking of types as spaces, $\mathcal{U}$ is a space, the points of which are spaces. To understand its identity type, we must ask, "What is a path $p : A \rightsquigarrow B$ between spaces in $\mathcal{U}$?" The Univalence Axiom says that such paths correspond to homotopy equivalences $A \simeq B$, as explained above (the actual notion of equivalence required is slightly different). A bit more precisely, given any (small) types $A$ and $B$, in addition to the type $\mathtt{Id}_{\mathcal{U}}(A, B)$ of identities between $A$ and $B$ there is the type $\mathtt{Eq}(A, B)$ of equivalences from $A$ to $B$. Since the identity map on any object is an equivalence, there is a canonical map,

$$\mathtt{Id}_{\mathcal{U}}(A, B) \to \mathtt{Eq}(A, B).$$

The Univalence Axiom states that this map is itself an equivalence. At the risk of oversimplifying, we can state this succinctly as

**Univalence Axiom:** $(A = B) \simeq (A \simeq B)$.

In other words, identity is equivalent to equivalence.

From the homotopical point of view, this says that the universe $\mathcal{U}$ is something like a classifying space for (small) homotopy types, which is a practical and natural assumption. From the logical point of view, however, it is revolutionary: it says that isomorphic things can be identified! Mathematicians are, of course, used to identifying isomorphic structures in practice, but they generally do so with a wink, knowing that the identification is not "officially" justified by foundations. But in this new foundational scheme, not only are such structures formally identified, but the different ways in which such identifications may be made themselves form a structure that one can (and should!) take into account.

Part of the appeal of homotopy type theory with the Univalence Axiom is the many interesting connections it reveals between logic and homotopy. Another remarkable aspect is that it can be carried out in a **computer proof assistant** since type theory exhibits such good computational properties (see [21], [8] on the use of computer proof assistants

in general). In practical terms, this means that it is possible to use the powerful, currently available proof assistants based on type theory, like the Coq system, to develop mathematics involving homotopy theory, to verify the correctness of proofs, and even to provide some degree of automation of proofs.

To give just one example, in homotopy type theory one can directly define the $n$-dimensional sphere $S^n$ as a type, with its associated principles of reasoning. Moreover, for any type $A$ one can define the homotopy groups $\pi_n(A)$, again in a very direct way in terms of the identity type $\mathtt{Id}_A$ explained above. One can then reason directly in type theory, using the principles associated with these constructions, and prove, for example, that $\pi_n(S^n) = \mathbb{Z}$ for $n \geq 1$ (as has recently been done by G. Brunerie and D. Licata at the Institute for Advanced Study, using the Univalence Axiom in an essential way). Finally, the proof can be formalized in a proof assistant and verified by a computer. In this way, one not only has new methods of proof in classical homotopy theory, but indeed ones which provide associated computational tools.

Voevodsky has christened this combination of homotopy type theory with the Univalence Axiom, implemented on a computer proof assistant, the **Univalent Foundations** program. It can be regarded as a new foundation for mathematics in general, not just for homotopy theory, as Voevodsky has shown by developing an extensive code library of formalized mathematics in this setting. Moreover, he is promoting more interaction between pure mathematicians and the developers of such proof assistants, as is occurring in the special year on Univalent Foundations at the Institute for Advanced Study.

For those interested in contributing to this new kind of mathematics, it may be encouraging to know that there are many interesting open questions. The most pressing of them is perhaps the "constructivity" of the Univalence Axiom itself, conjectured by Voevodsky in [23]. It concerns the effect of adding the Univalence Axiom on the computational behavior of the system of type theory and thus on the existing proof assistants. Another major direction, of course, is the further formalization of classical results and current mathematical research in the univalent setting. We expect that it will eventually be possible to formalize large amounts of modern mathematics in this setting and that doing so will give rise to both theoretical insights and good numerical algorithms (extracted from code in a proof assistant).

In this direction, together with Voevodsky, the last two authors are working on an approach to the theory of integrable systems (using the new notion of $p$-adic integrable system as a test case) in the univalent setting. A preliminary treatment in the construction of the $p$–adic numbers is given in [17]. One of Voevodsky's goals (as we understand it) is that, in a not too distant future, mathematicians will be able to verify the correctness of their own papers by working within the system of univalent foundations formalized in a proof assistant and that doing so will become natural even for pure mathematicians (the same way that most mathematicians now typeset their own papers in TEX). We believe that this aspect of the univalent foundations program distinguishes it from other approaches to foundations by providing a practical utility for the working mathematician.

Our goal in this announcement has been to give a brief and intentionally superficial glimpse of two closely related recent developments: homotopy type theory and Voevodsky's univalent foundations program. Since these subjects are still developing quite rapidly, the current literature tends to be rather specialized and accessible mainly to those with prior knowledge of homotopy theory and logic. One exception is the survey article [18], which goes into much greater depth than the present article, while still being intended for a general mathematical readership; it also contains an introduction to the use of the Coq proof assistant in the univalent setting. A complete exposition of the current state of the art in homotopy type theory is available in the form of a book which was jointly authored by the participants of the IAS special year and is freely available at [10]. See also [1], and [23].

## Acknowledgments

We thank the Institute for Advanced Study for the excellent resources which have been made available to the authors during the preparation of this article. We thank Thierry Coquand, Dan Grayson, and Vladimir Voevodsky for useful discussions on the topic of this paper, and we thank the referees for helpful suggestions. Awodey is partly supported by NSF Grant DMS-1001191 and AFOSR Grant 11NL035, and was supported by the Friends of the Institute for Advanced Study and the Charles Simonyi Endowment. Pelayo is partly supported by NSF CAREER Grant DMS-1055897, NSF Grant DMS-0635607, and Spain Ministry of Science Grant Sev-2011-0087. Warren is supported by the Oswald Veblen Fund.

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# WHAT IS . . .

# the Leech Lattice?

*Chuanming Zong*

The *Leech lattice* is a magical structure in twenty-four-dimensional Euclidean space $\mathbb{E}^{24}$ that was inspired by Golay's error-correcting code $\mathcal{G}_{24}$. The magic of the Leech lattice led Conway to the discovery of the three *sporadic simple groups*: $Co_1$, $Co_2$, and $Co_3$. Also magically, the Leech lattice provides the optimal kissing configuration for the 24-dimensional unit ball as well as the densest *lattice ball packing* in $\mathbb{E}^{24}$.

Data in digital systems are typically stored, transmitted, and processed in binary codewords. If a single codeword is in error, the message is garbled or the computation spoiled. Starting in the 1940s, scientists searched for coding systems that could detect and even correct errors.

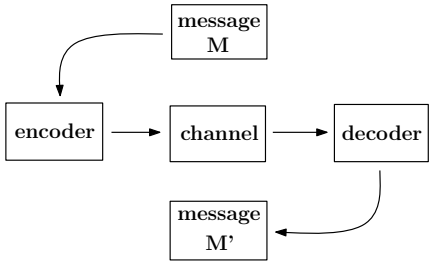


**Figure 1. The data transmission process.**

In 1947 R. Hamming discovered the first binary error-correcting code, $\mathcal{H}_7$, which is generated by four vectors, $(1,1,0,1,0,0,0)$, $(0,1,1,0,1,0,0)$, $(0,0,1,1,0,1,0)$ and $(0,0,0,1,1,0,1)$, over $\mathbb{Z}_2$. The *Hamming distance* between two codewords is the number of their different entries. The minimal Hamming distance of the code above is four, and therefore this code can detect and correct single-bit errors.

Let $\mathbf{w}_1$ denote the binary 23-tuple $(1,1,0,0,0,1,1,1,0,1,0,1,0,0,0,0,0,0,0,0,0,0,0)$. If we write the final entry, 0, first, followed by the other 22 entries, we get the first cyclic shift of $\mathbf{w}_1$: $(0,1,1,0,0,0,1,1,1,0,1,0,1,0,0,0,0,0,0,0,0,0,0,0)$. The next cyclic shift is $(0,0,1,1,0,0,0,1,1,1,0,1,0,1,0,0,0,0,0,0,0,0,0,0)$, and so on. Then $\mathbf{w}_1$ and its cyclic shifts generate a binary code, the *Golay code* $\mathcal{G}_{23}$, which was discovered by M. J. E. Golay in 1949. The minimal Hamming distance of this code is seven, and therefore it can detect and correct three-bit errors. This code has $2^{12} = 4096$ codewords. By adding a parity check to each codeword of $\mathcal{G}_{23}$, we get the *extended Golay code* $\mathcal{G}_{24}$. The minimal Hamming distance of $\mathcal{G}_{24}$ is eight.

The philosophy of error-correcting codes—to design codes with both large minimal Hamming distances and large numbers of codewords—is related to ball packings with large packing densities. In 1965 J. Leech constructed a twenty-four-dimensional lattice $\Lambda$ by lifting the extended Golay code $\mathcal{G}_{24}$ from $\mathbb{Z}_2^{24}$ to $\mathbb{Z}^{24}$ and restricting the sum of the coordinates to zero modulo 4. Here an $n$-dimensional *lattice* is the set of all linear combinations of $n$ linearly independent vectors over $\mathbb{Z}$. In 1967 Leech realized that there are big holes in $\Lambda$. Filling those holes doubles the density and produces a remarkable lattice, $\Lambda_{24}$, the Leech lattice. For convenience, we say a vector $(v_1, v_2, \ldots, v_n)$ has shape $(a^j, b^k, \ldots)$ if $v_i = a$ for $j$ entries, $v_i = b$ for $k$ entries, etc. In fact, the Leech lattice can be generated by all vectors of the shape

$$\tfrac{1}{\sqrt{8}}(\mp 3, \pm 1^{23}),$$

where the $\mp 3$ can be in any position and the upper signs are taken on a set of coordinates where a codeword of $\mathcal{G}_{24}$ is one.

The Leech lattice has 196,560 shortest vectors of length two: 97,152 of them have shape $(0^{16}, \pm 2^8)$; 98,304 of them have shape $(\pm 1^{23}, \pm 3)$; and 1,104 of them have shape $(0^{22}, \pm 4^2)$. One might therefore conjecture that $\Lambda_{24}$ has a large *symmetry group*. In 1968 J. H. Conway determined this group, $Co_0$. It is generated by six elements and has order

$$|Co_0| = 2^{22}3^9 5^4 7^2 11 \cdot 13 \cdot 23.$$

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DOI: http://dx.doi.org/10.1090/noti1045

More surprisingly, he discovered three new sporadic[1] simple groups, $Co_1$, $Co_2$, and $Co_3$, as subgroups of $Co_0$, where

$$|Co_1| = 2^{21}3^9 5^4 7^2 11 \cdot 13 \cdot 23,$$

$$|Co_2| = 2^{18}3^6 5^3 7 \cdot 11 \cdot 23,$$

and

$$|Co_3| = 2^{10}3^7 5^3 7 \cdot 11 \cdot 23.$$

Let $B^n$ denote the $n$-dimensional unit ball centered at the origin, that is,

$$B^n = \{\mathbf{x} \in \mathbb{E}^n : \ |\mathbf{x}| \le 1\};$$

let $\tau(B^n)$ denote its *kissing number* (the maximal number of nonoverlapping unit balls that can simultaneously touch $B^n$ at its boundary); and let $\tau^*(B^n)$ denote its *lattice kissing number*. Since the length of the shortest vectors in $\Lambda_{24}$ is two, $B^{24}+\Lambda_{24}$ is a lattice ball packing. Therefore we have

$$\tau(B^{24}) \ge \tau^*(B^{24}) \ge 196560. \tag{1}$$

Let $A(n, \theta)$ denote the maximal number of points on the surface of $B^n$ with minimal spherical separation $\theta$. Clearly we have

$$\tau(B^n) = A(n, \pi/3).$$

For $k = 0, 1, 2, \ldots$, let $P_k^{\alpha,\beta}(t)$ denote the *Jacobi polynomial* of degree $k$, where $\alpha > -1$ and $\beta > -1$ are two parameters. These polynomials form an orthogonal basis for the space of all polynomials. In the 1970s P. Delsarte et al. discovered the following criterion: *Write* $\alpha = (n-3)/2$. *If*

$$f(t) = \sum_{i=0}^{k} f_i P_i^{\alpha,\alpha}(t)$$

*is a real polynomial such that* $f_0 > 0$, $f_i \ge 0$ *for* $i = 1, 2, \ldots, k$, *and* $f(t) \le 0$ *for* $-1 \le t \le \cos\theta$, *then*

$$A(n, \theta) \le \frac{f(1)}{f_0}. \tag{2}$$

In 1978 V. I. Levenštein, A. M. Odlyzko, and N. J. A. Sloane constructed such a polynomial $f(t)$ for $n = 24$ and surprisingly obtained

$$\tau(B^{24}) = A(24, \pi/3) \le 196560. \tag{3}$$

Then (1) and (3) together yield

$$\tau(B^{24}) = \tau^*(B^{24}) = 196560.$$

Moreover, as was shown by E. Bannai and N. J. A. Sloane in 1981, the local kissing configuration of $B^{24} + \Lambda_{24}$ is the only optimal one for $\tau(B^{24})$, up to isometry.

The problem of optimizing the upper bound in (2) is unsolved in general and appears to be difficult. However, there are simple choices of $f(t)$ that exactly solve the kissing number problem in both $\mathbb{E}^8$ and $\mathbb{E}^{24}$. Perhaps the mystery lurking in the background is the uniqueness of the optimal configurations.

Let $\delta(B^n)$ and $\delta^*(B^n)$ denote the densities of the densest packings and the densest lattice packings of $B^n$ respectively. It can be verified that the determinant of $\Lambda_{24}$ is one and therefore the packing density of $B^{24} + \Lambda_{24}$ is $\pi^{12}/12!$. Thus we have

$$\delta(B^{24}) \ge \delta^*(B^{24}) \ge \frac{\pi^{12}}{12!}.$$

For a real function $f(\mathbf{x})$ defined on $\mathbb{E}^n$ we define

$$\hat{f}(\mathbf{y}) = \int_{\mathbb{E}^n} f(\mathbf{x}) e^{2\pi i \langle \mathbf{y}, \mathbf{x} \rangle} d\mathbf{x},$$

where $\langle \mathbf{y}, \mathbf{x} \rangle$ is the inner product of $\mathbf{y}$ and $\mathbf{x}$, and $i = \sqrt{-1}$. If there is a positive constant $\mu$ such that both $|f(\mathbf{x})|$ and $|\hat{f}(\mathbf{x})|$ are bounded above by a constant times $(1 + |\mathbf{x}|)^{-n-\mu}$, we say $f(\mathbf{x})$ is *admissible*.

In 2003 H. Cohn and N. D. Elkies proved the following criterion: *Suppose* $f(\mathbf{x})$ *is an admissible function defined on* $\mathbb{E}^n$ *that satisfies:*
1. $f(\mathbf{o}) = \hat{f}(\mathbf{o})$,
2. $f(\mathbf{x}) \le 0$ *whenever* $|\mathbf{x}| \ge r$, *and*
3. $\hat{f}(\mathbf{x}) \ge 0$ *for all* $\mathbf{x} \in \mathbb{E}^n$.

*Then we have*

$$\delta(B^n) \le \frac{\pi^{n/2}}{(n/2)!} \left(\frac{r}{2}\right)^n.$$

Actually, this is a Euclidean analog of (2). Based on this result, in 2009 H. Cohn and A. Kumar proved

$$\frac{\pi^{12}}{12!} \le \delta(B^{24}) \le \left(1 + 1.65 \cdot 10^{-30}\right) \cdot \frac{\pi^{12}}{12!} \tag{4}$$

and

$$\delta^*(B^{24}) = \frac{\pi^{12}}{12!}.$$

This time, up to symmetry, the Leech lattice again is the only optimal 24-dimensional lattice for $\delta^*(B^{24})$. Doubtless, given (4), everybody will bet on

$$\delta(B^{24}) = \frac{\pi^{12}}{12!}.$$


## Acknowledgments

This work is supported by 973 Programs 2013CB834201 and 2011CB302401, the National Natural Science Foundation of China (grant No. 11071003), and the Chang Jiang Scholars Program of China. I am grateful to the referee for helpful comments.


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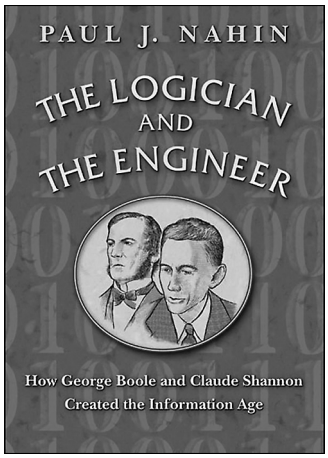


# The Logician and the Engineer

*Reviewed by Martin Davis*

**The Logician and the Engineer**
*Paul J. Nahin*
*Princeton University Press, 2013, US$16.55, 248 pages*
*ISBN-13: 978-0691151007*

Claude Shannon was my boss when I had a summer job at Bell Labs in Murray Hill, New Jersey, in 1953. Bell Labs in those years had a management that encouraged researchers to follow their own interests. Returning to Bell Labs from a year as a visiting professor at Harvard and MIT, computer scientist Ed Moore wrote, marveling at the pressures to which academic researchers were subject in contrast to his "industrial ivory tower". The combination of brilliant scientists and this laissez-faire management style certainly paid off, with, for example, seven Nobel Prizes in physics and two Turing Awards in computer science. Among the innovations credited to Bell Labs researchers are the transistor and the laser, the UNIX operating system and the C programming language, and Shannon's own information theory.

One day during that summer Shannon brought his unicycle to work and rode it down the long corridors as people poured out of the laboratories, shops, and offices. He rode it right into an elevator to repeat the performance on another floor. The same spirit of fun permeated some of his projects. In his office he proudly pointed to a desk calculator he called Throback I, which did arithmetic using Roman numerals. His "mouse" that solved mazes received national publicity. Another amusing incident that occurred that summer involved the game "matching pennies". In this game, in each round the two players, A and B, each secretly choose one of the bits 0 or 1. Player A wins if the bits chosen are the same; otherwise B wins. The fun started when one of the engineers, D. W. Hagelbarger, showed us a device he had built to play this game that did a good job of defeating people who didn't know the algorithm it was implementing. Perhaps a week later, Shannon had his own, much smaller, gadget to play the same game using a different algorithm. One afternoon we all stood around as the two machines were connected to play each other, with the results being tabulated. Shannon's machine won handily.

The logical operations that underlay Shannon's gadgets were implemented using electric *relays* (electric switches that are turned on and off by an electric current, producing a magnetic field). AT&T's telephone network was largely built of these sturdy elements. Shannon's extremely influential 1938 MIT master's thesis showed how Boolean algebra could be used to design circuits that carry out any desired logical operations. This thesis changed logical design of electric circuits from an art to routine engineering practice. It is said that Shannon explained this breakthrough as due simply to his happening to know about both Boolean algebra and circuit design. Of course, the crucial step was the realization that the abstract mathematics of logical reasoning and the practical issues of circuit design could be related. Nahin has made the coming together of these distinct strands the focal point of this book, which concerns the lives and work of the two pioneers George Boole and Claude Shannon.

Paul J. Nahin, an electrical engineer who obviously loves mathematics, has written a number of

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DOI: http://dx.doi.org/10.1090/noti1046

books on mathematical subjects that are addressed to a rather general public. He writes in an easy, genial style which, however, makes no effort to avoid technical matters. He certainly ignores the maxim that mathematical formulas scare away potential readers. For example, his charming book *Dr. Euler's Fabulous Formula*,[1] in the course of a long proof that $\pi^2$ is irrational, includes the formula

$$R(x) = \frac{1}{n!}\int_0^x (x-s)^n e^s s^n ds.$$

Nahin will begin a book by telling a prospective reader exactly what he expects her/him to know. For example, he writes that a prospective reader of his book on Euler's formula "should have the mathematical background equivalent to what a beginning third year college undergraduate in an engineering or physics program of study will have completed." In the case of the book being reviewed, he asks for much less in the way of mathematical preparation: algebra, including matrix multiplication. But he also expects readers to know Ohm's Law and Kirchhoff's Laws for electric circuits and how to compute the resistance of a pair of resistors in parallel. Nahin completes his prerequisite section by challenging the reader to follow a proof of a result from a paper by Claude Shannon with coauthor Hagelbarger (of the penny-matching machine).

George Boole (1815–1864) was born into the impoverished family of an English cobbler. In addition to showing how certain kinds of logical reasoning can be treated as a branch of algebra,[2] Boole wrote a paper that may be regarded as founding the theory of invariants, which was so important in nineteenth-century mathematics. He also worked on differential operators and the calculus of finite differences. He was entirely self-educated, later claiming he had chosen mainly mathematics books to study as a money-saving measure because they take longer to finish. The British rigid class system had no real way to deal with a genius like Boole who emerged from the lower middle classes. The problem was solved by exporting Boole to Ireland, where he was appointed to a professorship at a new university that had been founded in Cork. There he prospered, had a happy marriage, but died of pneumonia when he was only forty-nine years old.

Claude Shannon (1916–2001) was born into a relatively well-to-do Michigan family. His mathematical interests were nurtured by his sister, Catherine, six years his elder, who eventually became a mathematics professor at North Central College in Naperville, Illinois—after obtaining her master's degree in mathematics at the University of Michigan. Although he was to become a highly innovative world-class mathematician, even as a child Claude's passion for making things work led him to do such things as building a radio and a radio-controlled model boat. Shannon's master's thesis in electrical engineering, in which he made the crucial connection between Boolean algebra and switching circuits, was written at MIT under the supervision of Vannevar Bush, who recognized his ability. Shannon had been working with Bush's differential analyzer as his research assistant. Arguably, this analog computer was more powerful than the digital electromechanical large-scale calculators being built at Harvard in the 1930s.

Shannon's 1940 MIT Ph.D. was in mathematics, not engineering, but it was mathematics applied to genetics. After a postdoc year as a National Research Fellow at the Institute for Advanced Study in Princeton, Shannon accepted a position in the mathematics department at Bell Labs, where he was to remain for fifteen very fruitful years. The attack on Pearl Harbor came very soon after he joined the Labs, and he was heavily involved with war work. In 1943 Shannon and Alan Turing, in America for a brief visit, were able to discuss their common interest in cryptography. They also shared an expansive interest in the capabilities of the postwar computers that they expected would be developed. In particular, they discussed the problem of programming such a machine to play chess. Later, Shannon wrote a paper suggesting in outline an algorithm on which such a program might be based.

It was Shannon's attempt to understand the theoretical concepts underlying cryptography that led him to his most remarkable achievement: his development of *information theory* as a full-blown subject. He modeled communication between distant places as involving *messages* sent through a *channel*. A message was conceived of as a sequence of 0s and 1s, and Shannon defined the *information content* or *entropy* of such a message using a formula suggested by that for entropy in statistical thermodynamics. He also defined the *capacity* of a channel in terms of the rate at which data could flow through it. His main theorem showed that, in a suitable sense, data could always be encoded so as to make full use of channel

[1] *The formula in question is* $e^{it} = \cos t + i \sin t$.

[2] *Nahin is not always careful in offhand statements. For example, he says that "Boolean algebra…is also called mathematical logic." I was even more bothered by his statement that Shannon had shown that restricting a Turing machine to two symbols "in no way limits the power of what a Turing machine can do." But this is almost trivial. Shannon did something much more difficult: he showed that limiting a Turing machine to two* states *is no restriction in what it can do if sufficiently many symbols are available. The casual reader is not likely to be concerned with such matters.*

capacity. Of particular importance was Shannon's treatment of these matters in the context of a noisy channel. This work was the beginning of an important new field of study with theoretical and practical ramifications involving a number of researchers.

After presenting brief biographies of Boole and Shannon, Nahin introduces Boolean algebra as an algebra of classes and then goes on to show how it can also function as a propositional calculus. A number of logical puzzles are solved using Boolean algebra. Next we are shown how to use Boolean algebra to create switching circuits with electric relays as their basic component—Shannon's key insight. Here Nahin is forced to overstep his announced prerequisite. A pair of switches arranged in a parallel circuit will pass current if either (or both) is in the "on" position, thus implementing logical *or*. But when these switches are relays, turned on by an electric current, it is necessary to incorporate a device that permits current to flow in only one direction in order to avoid a short circuit in which the impulse backs up instead of moving forward. Such a device is called a diode[3] and nowadays is implemented in silicon (or similar materials) applying the techniques of solid state physics. Nahin attempts a rather rushed explanation that may not be easy for his readers to follow.

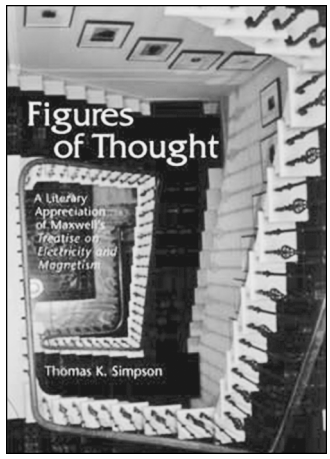
The rest of the book is a potpourri of very brief introductions to various topics: probability theory, error detection and correction, sequential machines capable of being in different "states", Turing machines with Rado's "busy beaver" unsolvable problem, countable and uncountable sets, and, finally, quantum computation.

Paul Nahin has brought together many fascinating things, always presented in a lively manner, usually with care, and with a real effort to provide clear, accurate explanations. This is a book that readers of the *Notices* may well recommend to first-year students or to other young people.

[3] *It is so called because, in the days of vacuum tube electronics, these devices were implemented as vacuum tubes containing just* two *electrodes.*

# Figures of Thought

*Reviewed by Brian Hayes*




**Figures of Thought: A Literary Appreciation of Maxwell's *Treatise on Electricity and Magnetism***
*Thomas K. Simpson*
*Green Lion Press, 2005*
*US$17.95, 169 pages*
*ISBN: 1-888009-31-6*

Mathematics has the most carefully curated literature in the entire world of learning. *Mathematical Reviews* and the *Zentralblatt für Mathematik* endeavor to catalogue, classify, and summarize every research publication in mathematics, even filling the occasional much-needed gap. But one thing that's *not* commonly done with the mathematical literature is to treat it as literature—to examine a piece of mathematical writing by the methods of literary scholarship and close textual analysis, the way a critic would explicate a poem.

Mathematical discourse is very different from poetry. The meaning of a poem is inextricably linked to the particular words that compose it. Mathematical truths, in contrast, are supposed to transcend the manner of their expression. Poems resist paraphrase and translation, but a theorem is a theorem, however you state it. As a measure of the distance between the two genres, consider the set of all badly written good poems. If this set is not empty, its members must be few and very peculiar. Badly written good mathematics, on the other hand, is all too common. (As for well-written bad mathematics: If your proof has a logical flaw, no amount of eloquent persiflage will redeem it.)

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DOI: http://dx.doi.org/10.1090/noti1041

In mathematics and the sciences, style and substance seem to be orthogonal variables—but on this point Thomas K. Simpson disagrees. Speaking of scientific works generally and with particular reference to James Clerk Maxwell's *Treatise on Electricity and Magnetism*, Simpson writes:

> It seems to be generally assumed that the literary and the scientific aspects of the work will factor, so to speak, and remain separable—thus the literary form will not bear significantly upon the scientific content. As it turns out, Maxwell in the *Treatise* is demonstrating precisely the opposite: so far from being divided, Maxwell's literary and scientific efforts are conjoined, in their aims as in their means.

Simpson's book *Figures of Thought* undertakes to support this claim through a literary and rhetorical examination of Maxwell's writing. The lit-crit approach to science is a novelty for most readers but not for Simpson. For many years he was a tutor at St. John's College, a school whose Great Books Program immerses students in original sources across the curriculum. He has been a student of Maxwell's work for fifty years.

### The Electrodynamic Wrestling Match

The *Treatise on Electricity and Magnetism* is a major landmark in physics, standing as Maxwell's last word on the subject; the first edition came out in 1873, and he was at work on a revision when he died (at age 48) in 1879. The book is also a minor milestone in mathematics, as it shows Maxwell and his contemporaries groping toward the system of ideas and notations that would soon become vector calculus. (Maxwell coined the terms *gradient* and *curl*; with a change of sign, his *convergence* operator became the *divergence*.)

The *Treatise* is one of those immense and encyclopedic Victorian testaments: two volumes, four parts, fifty-six chapters, 866 numbered articles, more than a thousand pages. I must confess that I had never read a word of it before taking up Simpson's commentary; what I knew of electrodynamics came from modern textbooks. Having now delved into the *Treatise*, I can report that it's not quite what I expected. It is not a summing up or a tidying up of Maxwell's earlier research papers on electromagnetic themes. It's a record of his ongoing wrestling match with problems he still finds challenging. It's science in progress and mathematics in the making.

Simpson's *Figures of Thought* covers only a small part of the *Treatise*, but it's the part of greatest interest to modern readers. We get a guided tour through the first nine chapters of Part IV, where electrical and magnetic phenomena are shown to be two aspects of a single concept: the electromagnetic field. Then we skip ahead to a later chapter that introduces the set of relations now known as Maxwell's equations.

Simpson's kind of literary analysis is not a critique of words and sentences or other aspects of small-scale prose style. As a matter of fact, there are few direct quotations of Maxwell's text. Instead the focus is on structure and rhetoric—on how Maxwell frames his arguments and tries to win the reader over to his views.

Simpson sees the *Treatise* as a drama in three acts, or as "a classic trilogy on the pattern of the *Oresteia*: opening with confidence, passing into darkness and confusion, but then emerging with a resolution that is new to the world and which could not have been foreseen at the outset." The drama has a hero: Michael Faraday, the unlettered, visionary genius of nineteenth-century British science, who intuited the relation between electricity and magnetism but resisted all urgings to put his discoveries in mathematical form. (Maxwell nonetheless eulogized Faraday as "a mathematician of a very high order.")

There's no real villain in the story, but there *is* a figure who serves as a dark shadow providing contrast for Faraday's brilliance. He is André-Marie Ampère, the French claimant to the title of founder of electrodynamics. "Embodied in the characters of Ampère and Faraday are not just two styles but two contrasting stances toward life itself: Ampère's imperious, dictating to nature; Faraday's modest, open, and sensitive to nature's voice."

The disagreements between these rivals were matters of substance as well as style. Ampère endeavored to explain electrical and magnetic phenomena with the kind of central force law that prevails in Newtonian gravitation. This action-at-a-distance scheme works well in the case of pointlike charged particles, where an electrostatic force proportional to $ee'/r^2$ is just like the Newtonian law $mm'/r^2$ (except that electric charge $e$ comes in negative and positive varieties whereas mass $m$ is always positive). The simplicity is lost, however, when the sources are no longer pointlike. When describing the force between two current-carrying loops of wire, Ampère becomes ensnared in a thicket of sines and cosines:

$$dF = \frac{ii'}{r^2}(\sin\theta \sin\theta' \cos\eta - \frac{1}{2}\cos\theta\cos\theta')\, ds\, ds'.$$

Here $i$ and $i'$ are the currents, $s$ and $s'$ are segments of the loops, and the angles $\theta$, $\theta'$ and $\eta$ define the relative orientation of the loops.[1]

Faraday had a different vision. Inspired by the patterns he observed when iron filings are sprinkled on a permanent magnet, he imagined "lines of force" extending throughout space. Two electric currents would interact not by means of direct forces transmitted through empty space but through the intermediary agency of electric and magnetic fields. Each current, magnet, or charge generates its own field and responds to the fields around it.

Act I of Simpson's three-part drama has Maxwell constructing a mathematical version of Faraday's lines of force—essentially a vector field, although modern notations and a few key concepts are lacking. The effort is a success, in the sense that the calculations based on the field concept correctly predict various experimental results. But Simpson calls it a "fragile victory" because the field is static; this version of the theory can accommodate only unvarying electric currents and magnetic fields.

With Act II, the drama turns to melodrama. This is "the darkest moment, the point of crisis." "We are in the dark wood of the *Treatise*," Simpson writes, evoking the *selva oscura* of Dante's *Inferno*. The source of all this consternation is Faraday's discovery of induction: A change in the current flowing through one circuit induces a momentary current in another nearby circuit. There is even self-induction, where the same circuit both generates and responds to the disturbance. Maxwell compares the effect to the momentum of water flowing in a garden hose, which resists changes in velocity. However, the analogy is imperfect because the effects of momentum in water "will be the same whether the hose is coiled or stretched in a straight line; but those of self-induction depend altogether on the configuration of the conductor."

Act III will eventually resolve this puzzle, but the ending is not one of those operatic climaxes where all the players suddenly drop their disguises,

[1] *I show the equation in the form given by Ampère. Simpson writes it* $(\cos\theta\cos\theta' \sin\eta - \frac{1}{2}\cos\theta\cos\theta')$. *I suspect this is a transcription error.*

lovers are reunited, and troublemakers promise to reform. Getting to a satisfactory theory takes seven dense chapters, including a long digression into the celestial mechanics of Joseph-Louis Lagrange. The key idea is to associate energy and momentum not with the current flowing through a wire but with the electric and magnetic fields that surround the wire. From this novelty we are led to an even more remarkable idea in the denouement: We can dispense with the hardware of wires and magnets altogether and watch as disembodied electric and magnetic fields act and react, then dance across the universe as light waves.

**Whodunit**

Simpson introduces his literary appreciation of Maxwell with this declaration:

> A scientific work evidences literary character when it is imbued with a vision or a goal towards which its parts are organized throughout. Achieving this organization is the business of the art of poetics, which teaches us that there must be a story line with a beginning, middle, and end.

Thus we are asked to believe that the three-act drama outlined above is something that Maxwell plotted out in advance, in the way that the author of a murder mystery knows who "done" it long before the reader begins to pick up clues. The *Treatise*, says Simpson, is "not simply a linear argument that deposits a result but a poetic work that prizes its beginnings in order to appreciate its conclusions."

This is not a view of Maxwell's authorial method and intent that I would have come to on my own, if I had been reading the *Treatise* without Simpson's guidance. My impression, for what it's worth, is that Maxwell is not working from a carefully constructed outline but rather is exploring ideas as they arise, testing how various pieces of the puzzle might fit together, starting over when a strategy doesn't work out. This impression of a tentative and *ad hoc* narrative becomes all the stronger when I draw back from the 150 pages that Simpson analyzes in detail and consider the rest of the *Treatise*, in which Maxwell reviews, digests, and attempts to formulate mathematical explanations for two centuries' worth of experimental findings.

I am not entirely alone in this opinion of Maxwell's aims and technique. C. W. F. Everitt, writing on Maxwell for the *Dictionary of Scientific Biography*, noted that Maxwell "gave the *Treatise* a loose-knit structure, organized on historical and experimental rather than deductive lines. Ideas are exhibited at different phases of growth in different places; different sections are developed independently, with gaps, inconsistencies, or even flat contradictions in argument. It is a studio rather than a finished work of art."

The question of rhetorical premeditation becomes particularly troubling in Simpson's Act II. The passage quoted above about the "dark wood" continues as follows:

> We are in the dark wood of the *Treatise*; and it is a sure sign of Maxwell's plan that he insists on leading us into it before he offers a way out. He might, after all, have structured the *Treatise* otherwise, in the manner of a linear textbook, marshaling a repertory of equations to yield the required result with no detour into aporia. That would have been the "direct" style, and it would have made far easier reading for Maxwell's contemporaries and for generations of students since. Maxwell's purpose, however, lies in another direction. He intends us, as readers, to experience this impasse the way Faraday experienced it.

It's not altogether a happy revelation that Maxwell would be so cavalier about the needs of those generations of students—especially since Simpson tells us that the *Treatise* was in fact meant to serve as a textbook for Cambridge students taking a new tripos examination in electricity and magnetism.

In spite of these misgivings, I have been grateful to have Simpson whispering in my ear as I've read the *Treatise*. For example, when Maxwell describes Ampère as "the Newton of electricity", I missed something crucial about the tone of voice. Although Maxwell is a genuine admirer of both Newton and Ampère, there's also an undertone of irony here, calling attention to Ampère's pomposity. Simpson supplies the missing smiley ;-) at the end of the sentence.

In a more extensive example, Simpson devotes several pages to Green's Theorem interpreted as a "figure of thought", a rhetorical device for expressing ideas about fields and flows. The very notion of viewing an equation as a rhetorical tool struck me as novel and provocative; more to the point, Simpson's discussion helped me understand the key role of this principle in Maxwell's thinking. The version of Green's Theorem at issue here establishes an identity between an integral over a two-dimensional surface and an integral over the surrounding volume. Maxwell observes that the theorem relates the energy per unit area on the surface of an electrically charged body to the energy per unit volume, $W$, throughout space. Simpson elaborates:

> Formally, this is just a number, an alternate way of computing $W$. But if we take the identity seriously—with all its rhetorical

> force—it becomes a source of new insight: it suggests that the energy in question need not be thought of as existing on the charged surface. Instead, the energy $W$ may actually be distributed over all space, in a very real *electrostatic field*.

I'm still not sure how to distinguish Green's Theorem as a "figure of thought" from Green's Theorem as a mathematical fact, but Simpson's commentary does illuminate Maxwell's use of the idea.

I wish Simpson had pursued this kind of argument a little further and looked into other developments in mathematical notation and methodology that had a bearing on Maxwell's work. Consider the four equations that we now call Maxwell's equations—the ones that appear on nerdy tee shirts:

$$\nabla \cdot \mathbf{D} = \rho,$$
$$\nabla \cdot \mathbf{B} = 0,$$
$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t},$$
$$\nabla \times \mathbf{H} = \mathbf{J} + \frac{\partial \mathbf{D}}{\partial t}.$$

Maxwell never wrote that particular set of equations; they were given their modern form by Josiah Willard Gibbs after Maxwell's death. It's a curious anomaly of history that Maxwell had sophisticated tools for dealing with operators (in the sense of functions applied to functions) and the apparatus of partial differential equations, but he had no proper representation for vectors in three-dimensional Euclidean space. He had to adapt William Rowan Hamilton's quaternions to the purpose, considering one element of a quaternion to be a scalar magnitude and the other three elements as $x$, $y$, and $z$ vector components. In many cases Maxwell gave up and listed trios of componentwise equations.

### The Future of Math-crit

Will analysis of literary tropes be the next fashion craze in scientific and mathematical writing? I think that's unlikely, if only because so few potential authors are knowledgeable of and interested in both subjects. (Indeed, Simpson might be the unique practitioner of this art.) Looking at it through the other end of the telescope, I doubt that poetics is the most rewarding approach to the scientific and mathematical literature for most readers.

But the method does have its attractions. As a reader of scientific and mathematical prose, I welcome any development that might encourage authors to give greater thought and care to questions of expository technique. In other words, I'd like less badly written good mathematics. As a writer who tries to communicate scientific and mathematical ideas to a wider audience, I am gratified to see serious attention paid to questions at the heart of my own craft, such as how best to engage and motivate readers. More broadly, any practice that brings even a few representatives of the "other culture" to the mathematical literature has got to be a good thing. If it also leads readers back to the well-known but seldom-read classics (as it did me), so much the better.

# Daniel J. Rudolph (1949–2010)

*Mike Boyle*

Dan Rudolph died in February 2010 of ALS (amyotrophic lateral sclerosis, "Lou Gehrig's Disease"). A member of the AMS for many years, he was one of the world's leading ergodic theorists. He combined mathematical brilliance with great generosity and positivity of spirit. He is survived by his wife of eighteen years, Michelle; their three children, Beatrice, Jonah, and Layton; and his brother, Jim.

In ergodic theory Dan was both a problem solver, with a remarkable talent for constructions, and a theory builder. The measurable classification of isometric extensions of Bernoulli shifts, the representation of any measurable flow as a flow under a function assuming just two values, the generalization of this result to $\mathbb{R}^n$ actions, the construction of the minimal self-joinings "counterexample machine", the proof that Lebesgue measure is the only positive entropy ergodic measure on $[0, 1]$ which is invariant under the maps $\times 2$ and $\times 3$, the use of joinings to prove the BFKO "return times theorem" and a generalization, the work on Bernoullicity of geodesic flows with Patterson-Sullivan measure, the Bernoulli theory for constant-to-one endomorphisms developed with Chris Hoffman (and used by Hoffman and Heicklen to solve a problem of Mañé in complex dynamics), the development of criteria for standardness of a reverse filtration of sigma algebras,... the list goes on. His impact was broad and deep.

He developed, eventually in collaboration with Janet Kammeyer and others, a theory of restricted orbit equivalence which placed Ornstein's Bernoulli theory, Dye's theorem, Kakutani equivalence, and other relations in a single unified framework. With Benjamin Weiss he developed the "orbit transference method" for generalizing theorems for $\mathbb{Z}$ actions to actions of amenable groups.

Following his 1975 Ph.D. at Stanford under Don Ornstein, Dan held positions at U.C. Berkeley, Hebrew University, and Stanford before settling in 1981 at the University of Maryland. During his time at Maryland, he performed as a modern dancer, was designated a Distinguished Scholar-Teacher, and was an invited speaker at the International Congress of Mathematicians. He was chair of the graduate program and acting chair of the department. He was a leader in developing a Treisman-style calculus program. He founded and directed the SPIRAL program, an intensive six-week preparation for graduate study in the mathematical sciences, developed in close coordination with a group of minority-serving colleges and universities. This program was acknowledged by the AMS with its 2008 Award for Mathematics Programs That Make a Difference.

In 2005 Dan and Michelle moved their family from the suburbs of Washington, D.C., to the open space and mountains of Dan's old hometown, Fort Collins, where Dan assumed the Albert C. Yates Endowed Chair in Mathematics at Colorado State University. As the ALS emerged and progressed, he continued with department service, Ph.D. students, postdocs, a Math Circle for middle school girls, and his own mathematics. One of his last papers was a joint work with Benjamin Weiss and Matt Foreman, to appear in *Annals of Mathematics*, which proves that the conjugacy equivalence relation on the set of ergodic measure-preserving automorphisms of a standard probability space is complete analytic (in particular, not Borel).

A volume in memory of Dan Rudolph has been published in the journal *Ergodic Theory and Dynamical Systems* (April 2012, Vol. 32, Part 2).

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DOI: http://dx.doi.org/10.1090/noti1040

# William Benter Prize in Applied Mathematics 2014

## *Call for NOMINATIONS*

**The Liu Bie Ju Centre for Mathematical Sciences of City University of Hong Kong is inviting nominations of candidates for the William Benter Prize in Applied Mathematics, an international award.**

### The Prize

The Prize recognizes outstanding mathematical contributions that have had a direct and fundamental impact on scientific, business, financial, and engineering applications.

It will be awarded to a single person for a single contribution or for a body of related contributions of his/her research or for his/her lifetime achievement.

The Prize is presented every two years and the amount of the award is US$100,000.

### Nominations

Nomination is open to everyone. Nominations should not be disclosed to the nominees and self-nominations will not be accepted.

A nomination should include a covering letter with justifications, the CV of the nominee, and two supporting letters. Nominations should be submitted to:

**Selection Committee**
c/o Liu Bie Ju Centre for Mathematical Sciences
City University of Hong Kong
Tat Chee Avenue
Kowloon
Hong Kong

Or **by email to: mclbj@cityu.edu.hk**

**Deadline for nominations: 31 December 2013**

### Presentation of Prize

The recipient of the Prize will be announced at the **International Conference on Applied Mathematics 2014** from 1 to 5 December 2014. The Prize Laureate is expected to attend the award ceremony and to present a lecture at the conference.

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The Prize was set up in 2008 in honor of Mr William Benter for his dedication and generous support to the enhancement of the University's strength in mathematics. The inaugural winner in 2010 was George C Papanicolaou (Robert Grimmett Professor of Mathematics at Stanford University), and the 2012 Prize went to James D Murray (Senior Scholar, Princeton University; Professor Emeritus of Mathematical Biology, University of Oxford; and Professor Emeritus of Applied Mathematics, University of Washington).

The Liu Bie Ju Centre for Mathematical Sciences was established in 1995 with the aim of supporting world-class research in applied mathematics and in computational mathematics. As a leading research centre in the Asia-Pacific region, its basic objective is to strive for excellence in applied mathematical sciences. For more information about the Prize and the Centre, please visit ***http://www.cityu.edu.hk/lbj/***

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# Genesis of Elementary Analysis Courses

*Kenneth A. Ross*

The 1960s was a time of turmoil and change for our nation, education, and mathematics. One change after the 1960s was that more students attended college, many with weaker backgrounds and diverse expectations. This led to changes in the goals and curricula in college and precollege mathematics. Some of these changes were national efforts—for example, calculus reform and discrete mathematics—undoubtedly because they involved client disciplines outside mathematics where students needed calculus for a variety of reasons. Meanwhile, largely within the confines of mathematics departments, elementary analysis courses were quietly popping up without any organized national effort.

This happened spontaneously in response to the following changes. Prior to 1960, calculus courses were taught almost exclusively at the college level, and these courses included a fair amount of theory. The few students who were motivated to go on in mathematics and study analysis at the junior-senior level, as exemplified by the fine "baby Rudin" book [3],[1] were able to cope if not thrive. In the 1970s, the calculus courses dropped their focus on theory to accommodate the diverse skills and interests of their clientele. The gap between these calculus courses and the rigorous baby Rudin courses posed a big problem.

Several college teachers independently tackled this problem, and I was among them. Since my effort led to a text [2] that was widely used and helped make the addition of elementary analysis courses to core mathematics curricula a viable option, I thought it might be of interest to describe the process that led to our course at the University of Oregon. I was the colleague most focused on the problem during the 1970s.

When I arrived at Oregon in 1965, an honors calculus sequence was already in place. Up to about 1970, this sequence served the better students well, though sometimes the better students would master the theory at the expense of learning the techniques. And some of the less-motivated students would get discouraged and leave mathematics when they might well have evolved into strong and useful members of the mathematics community. Also, more and more of the better students were coming to college with advanced placement in calculus and were not motivated to go back and take an honors calculus sequence that necessarily began at the beginning.

Since many worthy students did not take our honors calculus sequence, we experimented with the idea of offering an optional two-credit adjunct to the standard calculus sequence. The experimental courses worked well for a limited number of students,[2] but making this a standard course presented logistical problems with scheduling and

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[1] *This book was affectionately called "baby Rudin", because he wrote two other fine textbooks that were more advanced,* [4] *and* [5].

DOI: http://dx.doi.org/10.1090/noti1039

[2] *Seven students completed the sequence in 1974–75.*

staffing. We were also concerned that, as with the honors calculus sequence, too many potentially successful mathematics students would either miss this optional minicourse or get discouraged in it. Moreover, others who didn't take this adjunct sequence might feel at an automatic disadvantage if they were to pursue more advanced courses in the mathematics program. For a while we used a very nice book by Colin Clark [1].

We finally made the big decision to require mathematics majors to take a one-quarter course that would bridge the gap between calculus and the baby Rudin course. It would also provide other students with a basic background so that they would prosper in analysis courses such as several-variable calculus, differential equations, numerical analysis, complex analysis, Fourier analysis, and mathematics for physicists.

With this required course in mind, I contacted my friend Colin Clark (at the University of British Columbia in Canada) for permission to have our bookstore copy and sell his out-of-print book. Colin consulted his barrister,[3] who advised him to deny such permission. At about the same time, the assistant head of our mathematics department told me that we couldn't or shouldn't require an undergraduate course without a text. I responded, "Then I'll write one." The rest is history [2].

It may be of interest that I was the only teacher of this course until the book was published in 1980.[4] I used my own notes, and I wrote and rewrote the key sections up to §26 using feedback from the students. I never taught the course again, because I feel students in such a course should get two points of view: that of their teacher and that of the textbook. Incidentally, the course assumed that the students were sufficiently comfortable with derivatives and integrals, so it focused on convergence of sequences and series, uniform convergence of sequences of functions, and so on.

In January 1978 I sent the book proposal and most of the first four chapters (§§1–26) to the Springer editor Walter Kaufmann-Bühler.[5] The mathematician-editors for the Undergraduate Texts in Mathematics were Frederick Gehring and Paul Halmos; Paul was my patron. I explained that I would not submit the proposal to any other publisher.

After the book was published, more than one person wrote and thanked me for writing the book because "they" had created such a course. I resisted offering a second edition until early 2012. Fortunately, Springer had always asked whether I wanted or needed a new edition, not the statement "it is time for a new edition," with the understanding that this was not optional, because this was the way to obstruct the used-book market. A key feature of the second edition is that the first edition is embedded in it with compatible numbering of sections, theorems, lemmas, examples, exercises, etc. In other words, users of the first edition will find the transition to the second edition quite straightforward.

I am happy to admit that I had baby Rudin [3] on my desk while I was writing my book [2]. My intention was to have my book provide a relatively smooth transition to Rudin's book. There was one topic that I was not going to include unless I could do better than Rudin—that was Riemann-Stieltjes integrals [3, Chapter 6]. However, I was able to modify the treatment so that the results were more in line with the more generalized Lebesgue-Stieltjes integrals, so I included this development in my book [2, §35].

## References


[1] Colin Clark, *The Theoretical Side of Calculus*, Wadsworth Publishing Co., Inc. 1972.

[2] Kenneth A. Ross, *Elementary Analysis: The Theory of Calculus*, Springer-Verlag, two editions: 1980, 2013.

[3] Walter Rudin, *Principles of Mathematical Analysis*, McGraw-Hill, Inc., three editions: 1953, 1964, 1976.

[4] _____, *Real and Complex Analysis*, McGraw-Hill, Inc., three editions: 1966, 1974, 1987.

[5] _____, *Functional Analysis*, McGraw-Hill, Inc., 1973.


[3] *Lawyer or attorney.*

[4] *There were four of these well-attended courses from fall 1977 through fall 1979.*

[5] *Walter was a wonderful editor who understood and loved a lot of mathematics. He died way too young!*

# Mathematics People

## 2013 Simons Investigators Named

The Simons Foundation has named thirteen mathematicians, theoretical physicists, and theoretical computer scientists as Simons Investigators for 2013. The Simons Investigators program provides a stable base of support for outstanding scientists, enabling them to undertake long-term study of fundamental questions. The names and institutions of the awardees whose work involves the mathematical sciences and brief excerpts from the prize citations follow.

NGÔ BO CHÂU of the University of Chicago produced a proof of the fundamental lemma, a deep conjecture of Langlands, that inaugurated a new geometric approach to problems in harmonic analysis based on arithmetic geometry. His ideas have already inspired work in many areas, including mathematical physics and geometric representation theory.

MARYAM MIRZAKHANI of Stanford University focuses her work on Teichmüller theory and dynamics of natural geometric flows over the moduli space of Riemann surfaces. One of her major results, in joint work with Eskin and Mohammadi, is a proof that stationary measures for the action of $SL_2(R)$ on the space of flat surfaces are invariant, a deep and long-standing conjecture.

KANNAN SOUNDARARAJAN of Stanford University is one of the world's leaders in analytic number theory and related areas. His work is focused on understanding the zeros and value distribution of $L$-functions and on analyzing the behavior of multiplicative functions. In particular, his work (with his coauthors) has led to weak subconvexity bounds for general $L$-functions and to the proof of the holomorphic quantum unique ergodicity conjecture of Rudnick and Sarnak.

DANIEL TATARU of the University of California, Berkeley, has done deep and influential work on nonlinear waves. He proved difficult well-posedness and regularity results for many new classes of equations, including geometric evolutions such as wave and Schrödinger maps, quasilinear wave equations, some of which are related to general relativity, as well as other physically relevant models.

RAJEEV ALUR of the University of Pennsylvania is a leading researcher in formal modeling and algorithmic analysis of computer systems. A number of automata and logics introduced by him have now become standard models with great impact on both the theory and practice of verification. His key contributions include timed automata for modeling of real-time systems, hybrid automata for modeling discrete control software interacting with the continuously evolving physical environment, and visibly pushdown automata for processing of data with both linear and hierarchical structure, such as XML documents.

PIOTR INDYK of the Massachusetts Institute of Technology is noted for his work on efficient approximate algorithms for high-dimensional geometric problems. This includes the nearest neighbor search in which, given a data point, the goal is to find points highly similar to it without scanning the whole data set. To address this problem, he codeveloped the technique of locality sensitive hashing, which proved to be influential in many applications, ranging from data mining to computer vision. He has also made significant contributions to sublinear algorithms for massive data problems. In particular, he has developed several approximate algorithms for massive data streams that use very limited space. Recently, he has codeveloped new algorithms for the sparse Fourier transform, which compute the Fourier transform of signals with sparse spectra faster than the FFT algorithm.

SALIL P. VADHAN of Harvard University has produced a series of original and influential papers on computational complexity and cryptography. He uses complexity-theoretic methods and perspectives to delineate the border between the possible and impossible in cryptography and data privacy. His work also illuminates the relation between computational and information-theoretic notions of randomness, thereby enriching the theory of pseudorandomness and its applications.

Simons investigators are appointed for an initial period of five years with possible renewal for a further five years. Investigators receive research support of US$100,000 per year, with an additional US$10,000 per year provided to the investigator's department.

*—Simons Foundation announcement*

## 2013 Computer-Aided Verification Award Announced

KIM G. LARSEN, Aalborg University; PAUL PETTERSSON, Mälardalen University; and WANG YI, Uppsala University, have been named the recipients of the 2013 Computer-Aided Verification (CAV) Award for the development of UPPAAL, a model checker for real-time systems, "which is the foremost tool suite for the automated analysis and verification of real-time systems."

The prize citation reads in part: "Correct functioning of a wide range of systems, from pacemakers to communication protocols, depends on the timing pattern of the interaction of the system with its environment. UPPAAL is an integrated tool for modeling, simulation, analysis, and verification of such real-time systems.

"In UPPAAL, a system is modeled as a network of timed automata, and the core analysis is performed by symbolic on-the-fly computation of reachable states of the system. The UPPAAL team has made significant conceptual advances on two fronts. First, the scalability of the core reachability analysis has improved dramatically due to the development of new data structures, new abstractions, and optimizations of basic operations used in the algorithm. Second, the model checker has been extended to perform automatic model-based testing (Uppaal-Tron), to analyze quantitative extensions of timed automata (Uppaal-Cora), and to synthesize controllers based on the theory of timed games (Uppaal-Tiga). The evolution of the UPPAAL tool suite has beautifully showcased what can be achieved by means of the fruitful interplay between novel theoretical research and attention to implementation details.

"In summary, UPPAAL is a real success story for the CAV community: while advances in the theory and tools underlying UPPAAL have been a mainstay of research papers published at CAV and related conferences over a twenty-year period, the resulting tool suite is a mature software that is being used for modeling, debugging, and verifying safety-critical systems in academia and industry. This success is mainly due to the creativity, enthusiasm, and sustained investment of time and effort by Kim Larsen, Paul Pettersson, and Wang Yi."

The CAV award is given annually in recognition of a specific fundamental contribution or a series of outstanding contributions to the field of computer-aided verification and includes a cash prize of US$10,000.

*—Rajeev Alur, University of Pennsylvania*

# 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 2013, together with their Ph.D. institutions (in parentheses) and the institutions at which they will use their fellowships.

Stacey Alexeeff (Harvard University), National Center for Atmospheric Research; Mark Allen (Purdue University), University of Texas; Grigori Avramidi (University of Chicago), University of Utah; Matthew Borman (University of Chicago), Stanford University; Nicholas Brubaker (University of Delaware), University of Arizona; Jose Carrion (Purdue University), Pennsylvania State University; Yaim Cooper (Princeton University), Harvard University; Keenan Crane (California Institute of Technology), Columbia University; Max Glick (University of Michigan), University of Minnesota; Elizabeth Gross (University of Illinois, Chicago), North Carolina State University; Daniel Halpern-Leistner (University of California, Berkeley), Columbia University; Daniel Hernandez (University of Michigan), University of Utah; Angela Hicks (University of California, San Diego), Stanford University; Joseph Hirsh (City University of New York), Massachusetts Institute of Technology; Theodore Johnson-Freyd (University of California, Berkeley), Northwestern University; Jonathan Kommemi (University of Cambridge), Princeton University; Holly Krieger (University of Illinois, Chicago), Massachusetts Institute of Technology; Andrew Lawrie (University of Chicago), University of California, Berkeley; Robert Lemke Oliver (Emory University), Stanford University; Sean Li (New York University), University of Chicago; Benjamin Linowitz (Dartmouth College), University of Michigan; Eric Marberg (Massachusetts Institute of Technology), Stanford University; Dani Neftin (Technion), University of Michigan; Joanna Nelson (University of Wisconsin), Barnard College; Elliot Paquette (University of Washington), Weizmann Institute of Science; Stefan Patrikis (Princeton University), Harvard University; Igor Rapinchuk (Yale University), Harvard University; Laura Rider (Louisiana State University), Massachusetts Institute of Technology; Andrew Sanders (University of Maryland), University of Illinois, Chicago; Hayden Schaeffer (University of California, Los Angeles), University of California, Irvine; Adam Topaz (University of Pennsylvania), University of California, Berkeley; Thomas Trogdon (University of Washington), New York University; Robin Tucker-Drob (California Institute of Technology), Rutgers University; John Ullman (Massachusetts Institute of Technology), Stanford University; Christopher Vogl (Northwestern University), University of Washington; Paul Vouga (Columbia University), Harvard University; Brent Werness (University of Chicago), University of Washington; William Yessen (University of California, Irvine), Rice University; and Joshua Zahl (University of California, Los Angeles), Massachusetts Institute of Technology.

*—NSF announcement*

# SIAM Prizes Awarded

The Society for Industrial and Applied Mathematics (SIAM) has awarded a number of prizes for 2013.

Stanley J. Osher of the University of California, Los Angeles, has been named the John von Neumann Lecturer for 2013. The lectureship is awarded for outstanding and distinguished contributions to the field of applied mathematical sciences and for the effective communication of these ideas to the community. It carries a cash award of US$5,000.

Anna C. Gilbert of the University of Michigan was awarded the Ralph E. Kleinman Prize for outstanding research or other contributions that bridge the gap between mathematics and applications, particularly work that uses high-level mathematics and/or invents new mathematical tools to solve applied problems from engineering, science, and technology.

Tyrone Duncan of the University of Kansas has been awarded the W. T. and Idalia Reid Prize in Mathematics. This prize is awarded for research in or other contribu-

tions to the broadly defined areas of differential equations and control theory.

Douglas N. Arnold of the University of Minnesota was awarded the SIAM Prize for Distinguished Service to the Profession. The prize is awarded to an applied mathematician who has made distinguished contributions to the furtherance of applied mathematics on the national level.

Lexing Ying of Stanford University was awarded the James H. Wilkinson Prize in Numerical Analysis and Scientific Computing. The prize is awarded for research in or other contributions to numerical analysis and scientific computing during the six years preceding the award.

Anette Hosoi of the Massachusetts Institute of Technology was named the I. E. Block Community Lecturer. The lectureship is intended to encourage public appreciation of the excitement and vitality of science.

The SIAM Outstanding Paper Prizes have been awarded to the following researchers: Andrew J. Bernoff, Harvey Mudd College, and Chad M. Topaz, Macalester College, for "A Primer of Swarm Equilibria", *SIAM Journal on Applied Dynamical Systems*, vol. 10, issue 1 (2011), pp. 212–250; Daniel Kressner and Christine Tobler, ETH Zurich, for "Krylov Subspace Methods for Linear Systems with Tensor Product Structure", *SIAM Journal on Matrix Analysis and Applications*, vol. 31, issue 4 (2010), pp. 1688–1714; Alexander V. Shapeev, University of Minnesota, for "Consistent Energy-Based Atomistic/Continuum Coupling for Two-Body Potentials in One and Two Dimensions", *SIAM Journal on Scientific Computing*, vol. 34, issue 3 (2012), pp. B335–B360. The prizes are awarded annually to the authors of three outstanding papers published in SIAM journals in the preceding three calendar years.

The SIAM Student Paper Prizes were awarded to the following students: Joscha Gedicke, Humboldt University of Berlin, "An Adaptive Finite Element Eigenvalue Solver of Asymptotic Quasi-Optimal Computational Complexity"; Keiichi Morikuni, Graduate University for Advanced Studies (Sokendai), Japan, "Inner-Iteration Krylov Subspace Methods for Least Squares Problems"; and Vladislav Voroninski, University of California, Berkeley, "PhaseLift: Exact and Stable Signal Recovery from Magnitude Measurements via Convex Programming". A cash prize of US$1,000 is awarded for each paper.

*—From a SIAM announcement*

# MAA Awards Presented

The Mathematical Association of America (MAA) presented several awards at its Summer MathFest in Hartford, Connecticut, in August 2013.

The Carl B. Allendoerfer Awards are made to authors of expository articles published in *Mathematics Magazine* and carry a cash prize of US$500. The awardees for 2013 are: Khristo N. Boyadzhiev, Ohio Northern University, "Close Encounters with the Stirling Numbers of the Second Kind", *Mathematics Magazine* **85**, no. 4 (2012), pp. 252–266; and Adrian Rice, Randolph-Macon College, and Ezra Brown, Virginia Institute of Technology, "Why Ellipses Are Not Elliptic Curves", *Mathematics Magazine* **85**, no. 3 (2012), pp. 163–176.

The Trevor Evans Award is made to authors of exceptional articles that are accessible to undergraduates and published in *Math Horizons*. It carries a cash prize of US$250. The awardee for 2013 is Margaret Symington, Mercer University, "Euclid Makes the Cut", *Math Horizons* **19**, no. 3 (2012), pp. 6–9.

The Halmos-Ford Award is made to authors of outstanding expository papers published in the *American Mathematical Monthly*. The awardees for 2013 are: Robert T. Jantzen and Klaus Volpert, both of Villanova University, "On the Mathematics of Income Inequality: Splitting the Gini Index in Two", *American Mathematical Monthly* **119**, no. 10 (2012), pp. 824–837; Dimitris Koukoulopoulos, University of Montreal, and Johann Thiel, United States Military Academy, "Arrangements of Stars on the American Flag", *American Mathematical Monthly* **119**, no. 6 (2012), pp. 443–450; Lionel Levine, Cornell University, and Katherine E. Stange, University of Colorado, Boulder, "How to Make the Most of a Shared Meal: Plan the Last Bite First", *American Mathematical Monthly* **119**, no. 7 (2012), pp. 550–565; Dan Kalman, American University, and Mark McKinzie, St. John Fisher College, "Another Way to Sum a Series: Generating Functions, Euler, and the Dilog Function", *American Mathematical Monthly* **119**, no. 1 (2012), pp. 42–51.

The Merten M. Hasse Prize is awarded for a noteworthy expository paper appearing in an MAA publication, at least one of whose authors is a younger mathematician, generally under the age of forty. The 2013 awardees are Heiko von der Mosel, RWTH Aachen University, and Henryk Gerlach, "On Sphere-Filling Ropes", *American Mathematical Monthly* **118**, no. 10 (2011), pp. 863–876.

The George Polya Award is given for articles of expository excellence published in the *College Mathematics Journal* and carries a cash prize of US$500. The 2013 awardees are: Jacob Siehler, Washington and Lee University, "The Finite Lamplighter Groups: A Guided Tour", *College Mathematics Journal* **43**, no. 3 (2012), pp. 203–211; David Applegate, AT&T, Marc LeBrun, and Neil J. A. Sloane, OEIS Foundation, "Carryless Arithmetic Mod 10", *College Mathematics Journal* **43**, no. 1 (2012), pp. 43–50.

The Henry L. Alder Award for Distinguished Teaching by a Beginning College or University Mathematics Faculty Member honors beginning college or university faculty members whose teaching has been extraordinarily successful and whose effectiveness in teaching undergraduate mathematics is shown to have influence beyond their own classrooms. The award carries a cash prize of US$1,000. The 2013 awardees are: Kumer Das, Lamar University; Christopher Storm, Adelphi University; and Rachel Levy, Harvey Mudd College.

The Mary P. Dolciani Award recognizes a pure or applied mathematician who is making a distinguished contribution to the mathematical education of K–16 students in the United States or Canada. The 2013 honoree is Hyman Bass, University of Michigan.

*—From an MAA announcement*

# Prizes of the London Mathematical Society

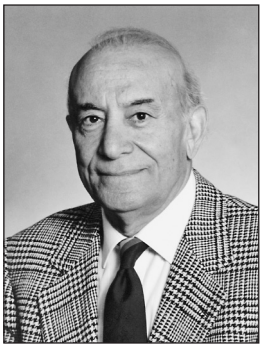
The London Mathematical Society (LMS) has awarded a number of prizes for 2013. The De Morgan Medal was awarded to JOHN THOMPSON of the University of Cambridge for his fundamental contributions to the understanding of the structure of finite groups, especially the finite simple groups. The Naylor Prize and Lectureship in Applied Mathematics was awarded to NICK TREFETHEN of the University of Oxford in recognition of his exceptional contributions to numerical analysis and his ability to communicate the subject to a wider audience. The Senior Whitehead Prize was awarded to FRANCES KIRWAN of the University of Oxford for her work on the geometric invariant theory and the geometry and topology of moduli spaces.

The Whitehead Prizes are given to mathematicians with less than fifteen years' experience at the postdoctoral level (allowing for career breaks). The Whitehead Prizes were awarded to: LUIS ALDAY, University of Oxford, for his work on properties of supersymmetric gauge theory and its connections with two-dimensional conformal field theory and with string theory in anti-de-Sitter space; ANDRE NEVES, Imperial College London, for his work in geometric analysis and in particular his resolution of the Willmore conjecture jointly with Fernando Coda Marques; TOM SANDERS, University of Oxford, for spectacular results in additive combinatorics and related areas, particularly for a paper obtaining the best-known upper bounds for sets of integers containing no three-term arithmetic progressions, for his work dramatically improving bounds connected with Freiman's theorem on sets with small doubling, and for other results in additive combinatorics and harmonic analysis; and CORINNA ULCIGRAI, University of Bristol, for her breakthrough results in dynamical systems.

*—From an LMS announcement*

# Yousef Alavi (1928–2013)

YOUSEF ALAVI, Western Michigan University professor emeritus of mathematics, died at age eighty-five on May 21, 2013, after several months of declining health.



**Yousef Alavi**

Born in Iran, he immigrated to the United States in 1948 to study at Michigan State University, where he earned a bachelor's degree in electrical engineering and master's and doctoral degrees in mathematics. He joined the mathematics faculty at Western Michigan University (WMU) in 1958 and taught for thirty-eight years, retiring in 1996.

Alavi brought great energy and enthusiasm to his work and had a keen talent for engaging colleagues in joint efforts for the department, the university, and the mathematics profession. With his colleagues in graph theory he organized the International Conference on Graph Theory and Combinatorics, held at WMU every four years from 1968 to 2000. Alavi also directed three China-USA International Conferences on Graph Theory, held in both China and the United States from 1985 to 1993. While serving as department chair in 1989–1992, he supported the various area groups in the department by hosting research symposia held at WMU.

WMU honored Alavi with its University Distinguished Service Award in 1980 and its Alumni Teaching Excellence Award in 1996. He was the Ph.D. dissertation advisor for Jiuqiang Liu (1992). The Michigan Section of the MAA awarded him its first Distinguished Service Award in 1986 in recognition of his many years of service to the section. His service to the AMS included chairing the Public Information Committee for both the International Congress of Mathematicians at Berkeley in 1986 and the AMS Centennial celebration in Providence in 1988.

While Yousef Alavi achieved much professionally, his family was his first priority. He was dedicated to his wife, Hedy, and his son, Kayvon, who survive him. His friends and colleagues will remember him for his great energy, his kindness, and his good humor.

*—Joseph Buckley and John Petro*
*Western Michigan University*

# Correction

The author footnote for Mike Eastwood's letter of nomination for Robert Bryant (Election Special Section, *Notices*, September 2013, page 1075) contained incorrect identifying information. It should have read "Mike Eastwood is professor of mathematics at the Australian National University College of Physical and Mathematical Sciences. His email address is michael.eastwood@anu.edu.au."

*—Sandy Frost*

# Mathematics Opportunities

## AMS-AAAS Mass Media Summer Fellowships

The American Mathematical Society provides support each year for a graduate student in the mathematical sciences to participate in the American Association for the Advancement of Science (AAAS) Mass Media Science and Engineering Fellows Program. This summer fellowship program pairs graduate students with major media outlets nationwide where they will research, write, and report on science news and use their skills to bring technical subjects to the general public. The principal goal of the program is to increase the public's understanding of science and technology by strengthening the connection between scientists and journalists. It aims to improve coverage of science-related issues in the media. Past AMS-sponsored fellows have held positions at National Public Radio, *Scientific American*, Voice of America, the *Oregonian*, the *Chicago Tribune*, and the *Milwaukee Journal Sentinel*.

Fellows receive a weekly stipend of US$500, plus travel expenses, to work for ten weeks during the summer as reporters, researchers, and production assistants in newsrooms across the country. They observe and participate in the process by which events and ideas become news, improve their ability to communicate about complex technical subjects in a manner understandable to the public, and increase their understanding of editorial decision making and of how information is effectively disseminated. Each fellow attends an orientation and evaluation session in Washington, D.C., and begins the internship in mid-June. Fellows submit interim and final reports to AAAS. A wrap-up session is held at the end of the summer.

Mathematical sciences faculty are urged to make their graduate students aware of this program. The deadline to apply for fellowships for the summer of 2014 is **January 15, 2014**. Further information about the fellowship program and application procedures is available at http://www.aaas.org/programs/education/MassMedia or applicants may contact Dione Rossiter, Manager, Mass Media Program, AAAS Mass Media Science and Engineering Fellows Program, 1200 New York Avenue, NW, Washington, DC 20005; telephone: 202-326-6645; fax: 202-371-9849; email: drossite@aaas.org. Further information is also available at http://www.ams.org/programs/ams-fellowships/media-fellow/massmediafellow and through the AMS Washington Office, 1527 Eighteenth Street, NW, Washington, DC 20036; telephone: 202-588-1100; fax: 202-588-1853; email: amsdc@ams.org.

*—AMS Washington Office*

## NSF Conferences and Workshops in the Mathematical Sciences

The National Science Foundation (NSF) supports conferences, workshops, and related events (including seasonal schools and international travel by groups). Proposals for conferences, workshops, or conference-like activities may request funding of any amount and for durations of up to three years. Proposals may be submitted only by universities and colleges and by nonprofit nonacademic institutions. For full information, including deadlines for each disciplinary program, see the website http://www.nsf.gov/pubs/2010/nsf10578/nsf10578.htm?WT.mc_id=USNSF_25&WT.mc_ev=click.

*—From an NSF announcement*

## Special Grant-Writing Workshop Offered

The AMS is pleased to again work with the National Science Foundation Directorate for Education and Human Resources (NSF-EHR) to offer a FREE workshop "Writing a Competitive Proposal to NSF-EHR". The workshop will be held in the afternoon on Monday, January 13, 2014, the day before the AMS Department Chairs Workshop and just prior to the Joint Mathematics Meetings in Baltimore, Maryland (January 15–18, 2014). This interactive workshop will provide information on EHR programs and prepare participants to write a competitive proposal.

Although this grant-writing workshop is free to interested participants, registration is required. Information on how to register is provided online at www.ams.org and will be listed in the November 2013 issue of the *Notices*. Please contact the AMS Washington Office at amsdc@ams.org or 202-588-1100 for more information.

*—AMS Washington Office*

## News from MSRI

The Mathematical Sciences Research Institute (MSRI) invites applications for 200 Research Members and 30 semester-long Postdoctoral Fellows in the following programs: New Geometric Methods in Number Theory and Automorphic Forms (August 11, 2014–December 12, 2014); Geometric Representation Theory (August 18, 2014–December 19, 2014); Dynamics on Moduli Spaces of Geometric Structures (January 12, 2015–May 22, 2015); and Geometric and Arithmetic Aspects of Homogeneous Dynamics (January 19, 2015–May 29, 2015). Research Memberships are intended for researchers who

will be making contributions to a program and who will be in residence for one or more months. Postdoctoral Fellowships are intended for recent Ph.D.'s. Interested individuals should carefully describe the purpose of their proposed visit and indicate why a residency at MSRI will advance their research program. To receive full consideration, applications must be completed, including all letters of support, by **December 1, 2013**. It is the policy of MSRI actively to seek to achieve diversity in its programs and workshops. Thus a strong effort is made to remove barriers that hinder equal opportunity, particularly for those groups that have been historically underrepresented in the mathematical sciences. For application information, see the website `https://www.msri.org/web/msri/scientific/member-application`. Programs are funded by the National Science Foundation.

*—MSRI announcement*

# Inside the AMS

## Attention All AMS Authors

Every April the AMS pays authors royalties on book revenues. However, each year we find that we have incorrect addresses for many authors, and we can't pay them. We are seeking address and contact information for our "lost" authors. To let us know if you are one of these authors or if you know the whereabouts of one of them, visit the website `http://www.ams.org/publications/lostauthors` to review the list. Authors' contact information can be sent to us via a form provided on the website. It is important to get the contact information to us before **May 31, 2014**. After this date we may be required to pay the royalties to the state.

*—AMS Fiscal Department*

## From the AMS Public Awareness Office


**Joint International Meeting of the AMS and the Romanian Mathematical Society, in partnership with the "Simion Stoilow" Institute of Mathematics of the Romanian Academy, held in Alba Iulia, Romania.** See photographs, the scientific program, and some of the social events at `http://www.ams.org/ams-romania-mtg13`.

**2013 Mathematics Research Communities.** The 2013 Mathematics Research Communities (MRC) summer conferences, held at the Snowbird Resort in Utah, drew 118 early-career mathematicians. See the sessions and organizers, more feedback from participants, and photos at `http://www.ams.org/mrc-13-highlights`.

**Award for Impact on the Teaching and Learning of Mathematics**. The Award for Impact on the Teaching and Learning of Mathematics, established by the AMS Committee on Education in 2013, will be given annually to a mathematician (or group of mathematicians) for significant contributions of lasting value to mathematics education. Priorities of the award include recognition of (a) accomplished mathematicians who have worked directly with precollege teachers to enhance teachers' impact on mathematics achievement for all students or (b) sustainable and replicable contributions by mathematicians to improving the mathematics education of students in the first two years of college. The endowment fund that supports the award was established in 2012 by a contribution from Kenneth I. and Mary Lou Gross in honor of their daughters, Laura and Karen. The first award of US$1,000 is to be given this fall. See more details about the award at `http://www.ams.org/impact`.

*—Annette Emerson and Mike Breen*
*AMS Public Awareness Officers*
`paoffice@ams.org`

## Deaths of AMS Members

MARCIA ASCHER, of Ithaca, New York, died on June 11, 2013. Born on April 23, 1935, she was a member of the Society for 23 years.

VINCENT E. DIMICELI, professor, Oral Roberts University, died on June 9, 2013. Born on August 18, 1962, he was a member of the Society for 25 years.

CHARLES S. KAHANE, of Nashville, Tennessee, died on May 23, 2013. Born on July 22, 1934, he was a member of the Society for 53 years.

E. R. SURYANARAYAN, professor, University of Rhode Island, died on June 24, 2013. Born on November 15, 1929, he was a member of the Society for 38 years.

EMMET F. WHITTLESEY, of Deerfield, Massachusetts, died on June 8, 2013. Born on October 9, 1923, he was a member of the Society for 61 years.

# Reference and Book List

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

## Contacting the *Notices*

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

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

The electronic-mail addresses are notices@math.wustl.edu in the case of the editor and smf@ams.org in the case of the managing editor. The fax numbers are 314-935-6839 for the editor and 401-331-3842 for the managing editor. Postal addresses may be found in the masthead.

## Upcoming Deadlines

**September 15, 2013, and April 15, 2014**: Applications for spring and fall 2014 semesters (respectively) of Math in Moscow. See http://www.mccme.ru/mathinmoscow or contact: Math in Moscow, P.O. Box 524, Wynnewood, PA 19096; fax: +7095-291-65-01; e-mail: mim@mccme.ru. Information and application forms for the AMS scholarships are available on the AMS website at http://www.ams.org/programs/travel-grants/mimoscow, or contact: Math in Moscow Program, Membership and Programs Department, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294; email: student-serv@ams.org .

**September 15, 2013**: Nominations for 2013 Ostrowski Prize. See the website http://www.ostrowski.ch/index_e.php?ifile=home.

**September 16, 2013**: Nominations for Sloan Fellowships. Contact Sloan Research Fellowships, Alfred P. Sloan Foundation, 630 Fifth Avenue, Suite 2550, New York, New York 10111-0242, or consult the foundation's website: http://www.sloan.org/fellowships.

**September 20, 2013**: Full proposals for NSF Focused Research Groups. See http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5671.

**September 30, 2013**: Nominations for W. K. Clifford Prize. See http://www.wkcliffordprize.org.

**October 1, 2013**: Applications for MSRI research professorships. See https://www.msri.org/web/msri/scientific/member-application.

**October 1, 2013, May 1 and October 1, 2014**: Applications for AWM Travel Grants and Mathematics Education Research Travel Grants. See https://sites.google.com/site/awmmath/programs/travel-grants; or telephone: 703-934-0163; email: awm@awm-math.org; or contact Association for Women in Mathematics, 11240 Waples Mill Road, Suite 200, Fairfax, VA 22030.

**October 1, 2013**: Nominations for Parzen Prize. Submit to Thomas Wehrly, Department of Statistics, 3143 TAMU, Texas A&M University, College Station, Texas 77843-

### Where to Find It

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

**AMS Bylaws**—*January 2012, p. 73*

**AMS Email Addresses**—*February 2013, p. 249*

**AMS Ethical Guidelines**—*June/July 2006, p. 701*

**AMS Officers 2012 and 2013 Updates**—*May 2013, p. 646*

**AMS Officers and Committee Members**—*October 2012, p. 1290*

**Contact Information for Mathematical Institutes**—*August 2013, p. 629*

**Conference Board of the Mathematical Sciences**—*September 2013, p. 1067*

**IMU Executive Committee**—*December 2011, p. 1606*

**Information for *Notices* Authors**—*June/July 2013, p. 776*

**National Science Board**—*January 2013, p. 109*

**NRC Board on Mathematical Sciences and Their Applications**—*March 2013, p. 350*

**NSF Mathematical and Physical Sciences Advisory Committee**—*February 2013, p. 252*

**Program Officers for Federal Funding Agencies**—*October 2013, p. 1188 (DoD, DoE); December 2012, p. 1585 (NSF Mathematics Education)*

**Program Officers for NSF Division of Mathematical Sciences**—*November 2012, p. 1469*

3143. For more information see the website http://www.stat.tamu.edu/awards-and-prize-details.php?prizeid=7.

**October 4, 2013**: Letters of intent for NSF Program ADVANCE Institutional Transformation and Institutional Transformation Catalyst awards. See http://www.nsf.gov/pubs/2012/nsf12584/nsf12584.htm?WT.mc_id=USNSF_36&WT.mc_ev=click.

**October 15, 2013**: Proposals for NSA Grants for Research in Mathematics. See http://www.nsa.gov/research/math_research/index.shtml or contact the program office at 301-688-0400; email: mspgrants@nsa.gov.

**October 16, 2013**: Proposals for National Science Foundation (NSF) Postdoctoral Research Fellowships. See http://www.nsf.gov/pubs/2012/nsf12496/nsf12496.htm.

**November 1, 2013**: Applications for November review for National Academies Research Associateship Programs. See the website http://sites.nationalacademies.org/PGA/RAP/PGA_050491 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 12, 2013**: Full proposals for NSF Program ADVANCE Institutional Transformation and Institutional Transformation Catalyst awards. See http://www.nsf.gov/pubs/2012/nsf12584/nsf12584.htm?WT.mc_id=USNSF_36&WT.mc_ev=click.

**December 1, 2013**: Applications for AMS Centennial Fellowship. See http://www.ams.org/ams-fellowships/. For paper copies of the form, write to the Membership and Programs Department, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294; prof-serv@ams.org; 401-455-4105.

**December 1, 2013**: Applications for MSRI research memberships and postdoctoral fellowships. See https://www.msri.org/web/msri/scientific/member-application.

**December 1, 2013**: Applications for PIMS postdoctoral fellowships. See the website http://www.pims.math.ca/scientific/postdoctoral or contact assistant.director@pims.math.ca.

**December 2, 2013**: Nominations for Ferran Sunyer i Balaguer Prize. See http://ffsb.iec.cat.

**December 31, 2013**: Nominations for Otto Neugebauer Prize. See the website http://www.euro-math-soc.eu/otto_neugebauer_prize.html.

**January 15, 2014**: Applications for AMS-AAAS Mass Media Summer Fellowships. See "Mathematics Opportunities" in this issue.

**February 1, 2014**: Applications for AWM Travel Grants, Mathematics Education Research Travel Grants, Mathematics Mentoring Travel Grants, and Mathematics Education Research Mentoring Travel Grants. See https://sites.google.com/site/awmmath/programs/travel-grants; telephone: 703-934-0163; email: awm@awm-math.org; or contact Association for Women in Mathematics, 11240 Waples Mill Road, Suite 200, Fairfax, VA 22030.

**February 15, 2014**: Nominations for AWM-Joan & Joseph Birman Prize in Topology and Geometry. See the website http://www.awm-math.org.

## DoD Mathematics Staff

The following agencies of the Department of Defense and the Department of Energy fund research in the mathematical sciences. The names, addresses, and telephone numbers of the pertinent staff members are listed.

**Defense Advanced Research Projects Agency**
675 North Randolph Street
Arlington, VA 22203-2114
703-526-6630
http://www.darpa.mil

*Graph-Theoretic Research in Algorithms and the Phenomenology of Social Networks*
Anthony Falcone
anthony.falcone@darpa.mil

*Knowledge-Enhanced Compressive Measurement*
Anthony Falcone
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*Mathematics of Sensing, Exploitation and Execution*
Anthony Falcone
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**Air Force Office of Scientific Research**
Directorate of Mathematics, Information, and Life Sciences
Wright-Patterson Air Force Base, Ohio
http://www.wpafb.af.mil/

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703-696-9545
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*Computational and Machine Intelligence*
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*Development and Verification of Effective First Principles Modeling (Maxwell-Bloch Semiconductor Equations) of Semiconductor Lasers under Nonequilibrium Operating Conditions*
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http://www.arl.army.mil/www/default.cfm?Action=29&Page=216

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http://www.nsa.gov/research/math_research/index.shtml
301-688-0400
MSPgrants@nsa.gov

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## Book List

*The Book List highlights recent books that have mathematical themes and are aimed at a broad audience potentially including mathematicians, students, and the general public. 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 Accidental Statistician: The Life and Memories of George E. P. Box,* by George E. P. Box. Wiley, April 2013. ISBN-13: 978-1-118-40088-3.

*Algorithmic Puzzles,* by Anany Levitin and Maria Levitin. Oxford University Press, October 2011. ISBN-13: 978-01997-404-44.

*Assessing the Reliability of Complex Models: Mathematical and Statistical Foundations of Verification, Validation, and Uncertainty Quantification,* by the National Research Council. National Academies Press, 2012. ISBN-13: 978-0-309-25634-6.

*The Best Writing on Mathematics 2012,* edited by Mircea Pitici. Princeton University Press, November 2012. ISBN-13: 978-06911-565-52.

*Charles S. Peirce on the Logic of Number*, by Paul Shields. Docent Press, October 2012. ISBN-13: 978-0-9837004-7-0.

**Conflict in History, Measuring Symmetry, Thermodynamic Modeling and Other Work*, by Dennis Glenn Collins. Author House, November 2011. ISBN-13: 978-1-4670-7641-8.

*The Continuity Debate: Dedekind, Cantor, du Bois-Reymond, and Peirce on Continuity and Infinitesimals,* by Benjamin Lee Buckley. Docent Press, December 2012. ISBN-13: 978-0-9837004-8-7.

*Decoding the Heavens: A 2,000-Year-Old Computer—and the Century-Long Search to Discover Its Secrets,* by Jo Marchant. Da Capo Press, February 2009. ISBN-13: 978-03068-174-27. (Reviewed June/July 2013).

*Do I Count?: Stories from Mathematics,* by Günter Ziegler (translation of *Darf ich Zahlen?: Geschichte aus der Mathematik,* Piper Verlag, 2010). CRC Press/A K Peters, July 2013. ISBN-13: 978-1466564916

**Figures of Thought: A Literary Appreciation of Maxwell's Treatise on Electricity and Magnetism*, by Thomas K. Simpson. Green Lion Press, February 2006. ISBN-13: 978-18880-093-16. (Reviewed in this issue.)

*The Foundations of Geometry and Religion from an Abstract Standpoint,* by Salilesh Mukhopadhyay. Outskirts Press, July 2012. ISBN-13: 978-1-4327-9424-8.

*The Fractalist: Memoir of a Scientific Maverick,* by Benoît Mandelbrot. Pantheon, October 2012. ISBN-13: 978-03073-773-57.

*Fueling Innovation and Discovery: The Mathematical Sciences in the 21st Century,* by the National Research Council. National Academies Press, 2012. ISBN-13: 978-0-309-25473-1.

*Galileo's Muse: Renaissance Mathematics and the Arts*, by Mark Austin-Peterson. Harvard University Press, October 2011. ISBN-13: 978-06740-597-26. (Reviewed November 2012.)

*Game Theory and the Humanities: Bridging Two Worlds,* by Steven J. Brams. MIT Press, September 2012. ISBN-13: 978-02625-182-53.

*Games and Mathematics: Subtle Connections,* by David Wells. Cambridge University Press, November 2012. ISBN-13: 978-11076-909-12.

*Girls Get Curves: Geometry Takes Shape,* by Danica McKellar. Plume, July 2013. ISBN-13: 978-04522-987-43.

*The Golden Ticket: P, NP, and the Search for the Impossible*, by Lance Fortnow. Princeton University Press, March 2013. ISBN-13: 978-06911-564-91.

*Google's PageRank and Beyond: The Science of Search Engine Rankings*, by Amy Langville and Carl Meyer. Princeton University Press, February 2012. ISBN-13: 978-06911-526-60.

*Gösta Mittag-Leffler: A Man of Conviction,* by Arild Stubhaug (translated by Tiina Nunnally). Springer, November 2010. ISBN-13: 978-36421-167-11. (Reviewed September 2013.)

*Guesstimation 2.0: Solving Today's Problems on the Back of a Napkin*, by Lawrence Weinstein. Princeton University Press, September 2012. ISBN-13: 978-06911-508-02.

*Heavenly Mathematics: The Forgotten Art of Spherical Trigonometry,* by Glen Van Brummelen. Princeton University Press, December 2012. ISBN-13: 978-06911-489-22.

*Henri Poincaré: Impatient Genius,* by Ferdinand Verhulst. Springer, August 2012. ISBN-13: 978-14614-240-62.

*Henri Poincaré: A Scientific Biography,* by Jeremy Gray. Princeton University Press, November 2012. ISBN-13: 978-06911-527-14.

*How to Study as a Mathematics Major,* by Lara Alcock. Oxford University Press, March 2013. ISBN-13: 978-0199661312.

*I Died for Beauty: Dorothy Wrinch and the Cultures of Science*, by Marjorie Senechal. Oxford University Press, December 2012. ISBN-13:978-01997-325-93.

*Ibn al-Haytham's Theory of Conics, Geometrical Constructions and Practical Geometry,* by Roshdi Rashed. Routledge, February 2013. ISBN-13: 978-0-415-58215-5.

*In Pursuit of the Unknown: 17 Equations That Changed the World,* by Ian Stewart. Basic Books, March 2012. ISBN-13: 978-04650-297-30. (Reviewed December 2012.)

*Infinity: New Research Frontiers,* edited by Michael Heller and W. Hugh Woodin. Cambridge University Press, February 2011. ISBN-13: 978-11070-038-73.

*Introduction to Mathematical Thinking,* by Keith Devlin. Keith Devlin, July 2012. ISBN-13: 978-06156-536-31.

*Invisible in the Storm: The Role of Mathematics in Understanding Weather*, by Ian Roulstone and John Norbury. Princeton University Press, February 2013. ISBN-13: 978-06911-527-21. (Reviewed September 2013.)

*The Joy of x: A Guided Tour of Math, from One to Infinity,* by Steven Strogatz. Eamon Dolan/Houghton

Mifflin Harcourt, October 2012. ISBN-13: 978-05475-176-50.

*Late Style: Yuri I. Manin Looking Back on a Life in Mathematics.* A DVD documentary by Agnes Handwerk and Harrie Willems. Springer, March 2012. ISBN NTSC: 978-3-642-24482-7; ISBN PAL: 978-3-642-24522-0. (Reviewed January 2013.)

*Levels of Infinity: Selected Writings on Mathematics and Philosophy,* by Hermann Weyl. Edited by Peter Pesic. Dover Publications, February 2013. ISBN-13: 978-0486489032.

*The Logician and the Engineer: How George Boole and Claude Shannon Created the Information Age,* by Paul J. Nahin, Princeton University Press, October 2012. ISBN-13: 978-06911-510-07. (Reviewed in this issue.)

*Manifold Mirrors: The Crossing Paths of the Arts and Mathematics,* by Felipe Cucker. Cambridge University Press, June 2013. ISBN-13: 978-05217-287-68.

*Math Goes to the Movies,* by Burkard Polster and Marty Ross. Johns Hopkins University Press, July 2012. ISBN-13: 978-14214-048-44.

*Math on Trial: How Numbers Get Used and Abused in the Courtroom,* by Leila Schneps and Coralie Colmez. Basic Books, March 2013. ISBN-13: 978-04650-329-21. (Reviewed August 2013.)

*The Mathematical Writings of Évariste Galois*, edited by Peter M. Neumann. European Mathematical Society, October 2011. ISBN-13: 978-3-03719-104-0. (Reviewed December 2012.)

*A Mathematician Comes of Age*, by Steven G. Krantz. Mathematical Association of America, December 2011. ISBN-13: 978-08838-557-82.

*A Mathematician's Lament: How School Cheats Us Out of Our Most Fascinating and Imaginative Art Form,* by Paul Lockhart. Bellvue Literary Press, April 2009. ISBN-13: 978-1-934137-17-8. (Reviewed April 2013.)

*Mathematicians in Bologna 1861-1960,* edited by Salvatore Coen. Springer, 2012. ISBN-13: 978-30348-0226-0.

*Mathematics in Victorian Britain,* by Raymond Flood, Adrian Rice, and Robin Wilson. Oxford University Press, October 2011. ISBN-13: 978-019-960139-4.

*Maverick Genius: The Pioneering Odyssey of Freeman Dyson,* by Phillip F. Schewe. Thomas Dunne Books, February 2013. ISBN-13:978-03126-423-58.

*Meaning in Mathematics*, edited by John Polkinghorne. Oxford University Press, July 2011. ISBN-13: 978-01996-050-57. (Reviewed May 2013.)

*Measurement,* by Paul Lockhart. Belknap Press of Harvard University Press, September 2012. ISBN-13: 978-06740-575-55.

*The New York Times Book of Mathematics: More Than 100 Years of Writing by the Numbers,* edited by Gina Kolata. Sterling, June 2013. ISBN-13: 978-14027-932-26.

*The Noether Theorems: Invariance and Conservation Laws in the Twentieth Century,* by Yvette Kosmann-Schwarzbach. Springer, December 2010. ISBN-13: 978-03878-786-76. (Reviewed August 2013.)

*Paradoxes in Probability Theory,* by William Eckhardt. Springer, September 2012. ISBN-13: 978-94007-513-92. (Reviewed March 2013.)

*Peirce's Logic of Continuity: A Conceptual and Mathematical Approach,* by Fernando Zalamea. Docent Press, December 2012. ISBN-13: 978-0-9837004-9-4.

*Relations between Logic and Mathematics in the Work of Benjamin and Charles S. Peirce,* by Allison Walsh. Docent Press, October 2012. ISBN-13: 978-0-9837004-6-3.

*The Search for Certainty: A Journey through the History of Mathematics, 1800-2000*, edited by Frank J. Swetz. Dover Publications, September 2012. ISBN-13: 978-04864-744-27.

*Secrets of Triangles: A Mathematical Journey*, by Alfred S. Posamentier and Ingmar Lehman. Prometheus Books, August 2012. ISBN-13: 978-16161-458-73.

*Seduced by Logic: Emilie Du Châtelet, Mary Somerville and the Newtonian Revolution*, by Robyn Arianrhod. Oxford University Press, September 2012. ISBN-13: 978-01999-316-13. (Reviewed June/July 2013).

*Selected Papers: Volume II: On Algebraic Geometry, including Correspondence with Grothendieck*, by David Mumford. Edited by Amnon Neeman, Ching-Li Chai, and Takahiro Shiota. Springer, July 2010. ISBN-13: 978-03877-249-11. (Reviewed February 2013.)

*The Signal and the Noise: Why So Many Predictions Fail—But Some Don't,* by Nate Silver. Penguin Press, September 2012. ISBN-13:978-15942-041-11.

*Simon: The Genius in My Basement,* by Alexander Masters. Delacorte Press, February 2012. ISBN-13: 978-03853-410-80.

*Thinking in Numbers: On Life, Love, Meaning, and Math,* by Daniel Tammet. Little, Brown and Company, July 2013. ISBN-13: 978-03161-873-74.

*Thinking Statistically,* by Uri Bram. CreateSpace Independent Publishing Platform, January 2012. ISBN-13: 978-14699-123-32.

*Transcending Tradition: Jewish Mathematicians in German Speaking Academic Culture,* edited by Birgit Bergmann, Moritz Epple, and Ruti Ungar. Springer, January 2012. ISBN-13: 978-36422-246-38. (Reviewed February 2013.)

*Turbulent Times in Mathematics: The Life of J. C. Fields and the History of the Fields Medal*, by Elaine McKinnon Riehm and Frances Hoffman. AMS, November 2011. ISBN-13: 978-0-8218-6914-7.

*Turing's Cathedral: The Origins of the Digital Universe,* by George Dyson. Pantheon/Vintage, December 2012. ISBN-13: 978-14000-759-97.

*The Universe in Zero Words: The Story of Mathematics as Told through Equations*, by Dana Mackenzie. Princeton University Press, April 2012. ISBN-13: 978-06911-528-20. (Reviewed in this issue.)

*Visions of Infinity: The Great Mathematical Problems,* by Ian Stewart. Basic Books, March 2013. ISBN-13: 978-04650-224-03.

*A Wealth of Numbers: An Anthology of 500 Years of Popular Mathematics Writing,* edited by Benjamin Wardhaugh. Princeton University Press, April 2012. ISBN-13: 978-06911-477-58. (Reviewed March 2013.)

*Who's #1?: The Science of Rating and Ranking*, by Amy N. Langville and Carl D. Meyer. Princeton University Press, February 2012. ISBN-13: 978-06911-542-20. (Reviewed January 2013.)

# From the AMS Secretary

## Report of the Treasurer (2012)

### Introduction

One of the most important duties of the treasurer is to lead the Board of Trustees in the oversight of financial activities of the Society. This is done through close contact with the executive staff of the Society, review of internally generated financial reports, review of audited financial statements, and direct contact with the Society's independent auditors. Through these and other means, the Trustees gain an understanding of the finances of the Society and the important issues surrounding its financial reporting. The Report of the Treasurer is presented annually and discusses the financial condition of the Society as of the immediately preceding fiscal year-end and the results of its operations for the year then ended.

When reviewing the financial results of the AMS, it is important to note that the financial support for its membership and professional programs is derived from multiple sources. First, a board-designated endowment fund named the Operations Support Fund (OSF) provided $1,744,100 in operating support in 2012 to the membership and professional programs. The OSF is a fund that has grown throughout the years through net income from the operations of the AMS as well as investment gains. In addition, the membership and professional programs are supported through dues income and contributions. Finally, the margin from the publication programs supports these membership and professional services as well. Without the margin from publications and the OSF, dues and contributions alone would not provide enough to support the professional programs, such as Mathjobs, scholarships, fellowships, and the *Notices*.

The Society experienced a gain of $2.5 million in net operating income in 2012. Publishing revenues, operating investment income, and lower-than-budgeted personnel costs and equipment costs were the major contributors to the bottom line. The Society's unrestricted net assets increased by $11.9 million primarily due to a 15.5 percent return on the long-term investments and the net operating income.

### Market and Economic Conditions Affecting the Society

In 2012, changes in the publishing industry as well as other market conditions compelled the Society to review personnel costs. For example, the continuing shift from printed to electronic publication formats decreased the need for printing and distribution services within the Society. This and other market factors influenced management in making the decision to eliminate eight full-time equivalent positions in 2012. Although this change did not greatly change personnel costs in 2012, it is expected to reduce costs in 2013.

Investment markets fared well in 2012, recovering from sluggish returns in 2011. The S&P 500 stock index experienced a 16 percent return. The Society's long-term investments benefitted from the bull market, experiencing a 15.5 percent return overall. The Society's investments in foreign equity index funds experienced an 18.6 percent return, and the Society's investments in the bond market fared well with a 10.4 percent gain. The Society continues to experience low returns on short-term investments, as returns on Certificates of Deposits, money market funds, and other short-term investments remain close to 0 percent. However, intermediate-term investments had a 6.5 percent return, contributing $460,000 to the Society net operating income for the year.

Although the Society experienced excellent returns on its endowment investments in 2012, longer-term investment results have not been high enough to sustain a 5 percent spending rate on endowment funds. At the end of 2012, the Board of Trustees decided to decrease the spending rate to 4 percent, so that endowment funds could recover purchasing power in the long-term. In the short-term, a board designated fund, the Endowment Income Stabilization Fund (EISF) was established to supplement endowment income in years when spendable income falls short of program needs.

Membership numbers at the American Mathematical Society continued to decline in 2012. This is a trend many

membership associations are experiencing across the United States. The Society's membership decreased by 4.5 percent in 2012. Within the international institutional membership category, membership increased slightly.

The majority of the Society's publishing revenues are derived from international sales, with a heavy emphasis on European sales. MathSciNet's European sales are primarily made to consortia, and many of the consortia, consisting of various European universities, struggled to maintain their subscriptions in 2012. However, despite Europe's economic struggles, most consortia found the means to continue to subscribe.

Inflation in 2012, as measured by the Consumer Price Index, increased 1.7 percent in 2012. In contrast, the Society's expenses rose 4.3 percent. The total cost for staff salaries rose by 3.5 percent, because positions that had been vacant in 2011 were filled by new employees in 2012, and there were also modest salary raises. Other expense increases and decreases are discussed later in this financial review.

Journal subscriptions to all AMS journals declined in 2012. In addition, the number of books published in 2012 decreased from 95 in 2011 to 78. These factors place increasing pressure on the Society to add new products and respond to new trends in the publishing industry to shore up declining sales. In response to these pressures, the Society has produced new electronic products. In 2012, the new electronic version of the Society's Contemporary Mathematics books series, eCONM, was introduced to great success, creating approximately $460,000 in new book program sales. Despite these increased sales, when adjusted for inflation, publishing sales trends remain flat as shown in Table 1 below.

## 2012 Balance Sheets

The Society's financial statements, including balance sheets and statements of activities are shown at the end of this financial review. At the end of 2012, the balance sheets of the AMS indicated that the organization was financially healthy. Overall, assets increased $13.8 million. The long-term investments increased by approximately $12,500,000 due to a 15.5 percent return on these investments for 2012. Short-term investments as reported on the balance sheets grew by 13.5 percent during 2012, due to the transfer of approximately $829,000 in cash to money market funds and $460,000 in appreciation from interests and dividends. Certificates of Deposits (CDs) decreased by $544,000, because interest on CDs is at historically low levels, and as CDs came due during the year, new CDs were not purchased.

Fixed assets and accounts receivable also increased significantly during 2012. Land, buildings and equipment assets increased by approximately $538,000. There was $1.15 million in additions to these assets, of which, $808,000 was related to the new association management software, Personify. This was partially offset by approximately $612,000 in current year depreciation expense. Customer receivables increased by approximately $367,000 due to an increase in purchases of the new eCONM product at the end of the year as well as an increase in other receivables.

In 2012, the Society's liabilities increased by $717,420. The biggest increase to the liabilities was an increase to the postretirement benefit obligation of $662,000, because the discount rate used to actuarially determine the benefit obligation decreased from 4.3 percent in 2011 to 3.8 percent in 2012.

## 2012 Statements of Activities

The Society's 2012 net operating income of $2.5 million is due to an unexpected 3 percent increase in revenues over 2011, and due to a lower-than-expected increase in expenses of 4.3 percent. Overall, the Society has an $11.9 million increase in unrestricted net assets. This large increase is due mainly to the operating income and the income from unrestricted long-term investments of $9.2 million. In addition, there is a one-time gain associated with capitalizing the expense of labor used to develop the association management software, Personify. This capitalization of $667,014 of labor expense is required by accounting standards, and the asset will be depreciated over a number of years. It is shown below the operating income line so that it does not create fluctuations in operating income from one year to the next. Offsetting these gains is a $458,000 charge related to the post-retirement benefit plan. This large expense is being recognized due to an actuarial change in the discount rate used to calculate the present value of future benefit payments.

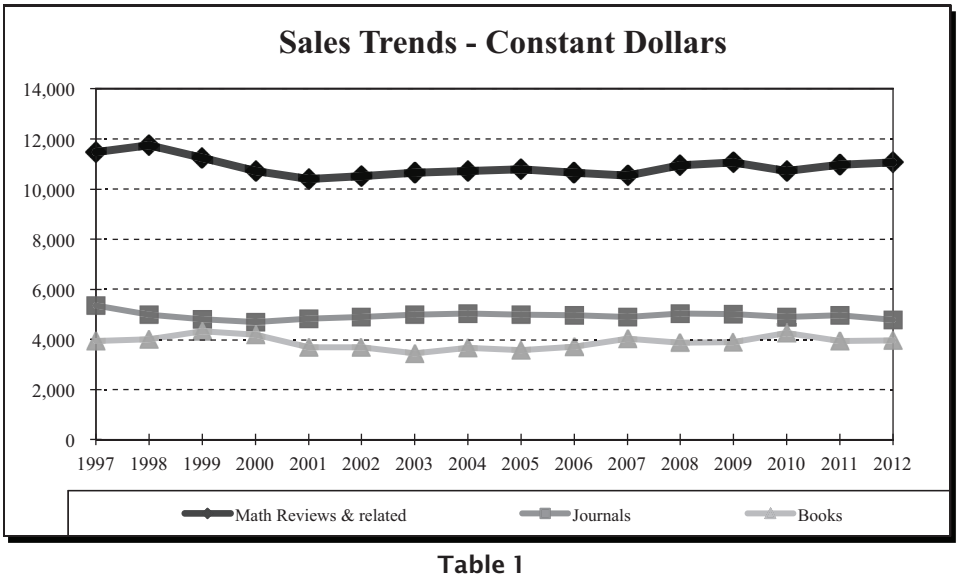


Table 1

**Major Expense Categories (in thousands of dollars)**

| | 2011 Actual | | 2012 Actual | | Variance 11 v. 12 inc(dec) | % chg |
|---|---|---|---|---|---|---|
| Personnel Costs | $17,345 | 70.6% | $18,107 | 70.6% | $762 | 4% |
| Building and Equipment Related | 1,682 | 6.8% | 1,599 | 6.2% | (83) | -5% |
| Postage | 777 | 3.2% | 656 | 2.6% | (121) | -16% |
| Outside Print'g, Bind'g and Mail'g | 587 | 2.4% | 560 | 2.2% | (27) | -5% |
| Printing paper | 378 | 1.5% | 335 | 1.3% | (43) | -11% |
| Travel - Staff, Volunteers and Grants | 681 | 2.8% | 636 | 2.5% | (45) | -7% |
| All Other Expenses | 3,132 | 12.7% | 3,750 | 14.6% | 618 | 20% |
| | $24,582 | 100% | $25,643 | 100% | $ 1,061 | 4% |

**Table 2**

Revenues were $921,000 over budget, primarily due to publishing revenues and other miscellaneous revenues, such as temporary investment income, which was $460,000 in 2012. Publishing revenues exceeded budget by $466,000, because of MathSciNet and data access fee revenues as well as the revenues from the introduction of the new eCONM product. MathSciNet and data access fees increased due to price increases and new subscribers that partially offset the expected subscriber attrition. Other revenue categories that were over budget were dues (+$87,954) and meetings (+$153,055). Dues were over budget, because the attrition in dues-paying members was not as high as expected and the number of international institutional members increased slightly. Meetings revenues were over budget, because the Boston meeting in 2012 was very successful. The attendance at the Boston meeting was 6,608 participants, exceeding expectations by 20 percent.

Table 2 provides a view of the Society's major expense categories in 2012 as compared to 2011. The Society's largest expense is personnel costs. As discussed previously, salaries increased by 3.5 percent partially due to modest raises, and to personnel that were hired in 2011 and 2012 to fill positions that were vacant for at least part of the year in 2011. In a time when benefit costs are rising rapidly, the Society managed to keep benefit increases low at 1.6 percent. This is attributable to actual decreases in some health insurance premiums and a decrease in the utilization of a plan that covers the high deductible on one of the Society health insurance plans. Other benefit plans experienced modest cost increases. The net periodic benefit expense for the post-retirement benefit plan increased by 45 percent due to actuarial changes in the way the expense is calculated.

There was a 5 percent decrease in building and equipment-related costs in 2012. The costs to maintain the Society's buildings have dropped 14 percent since 2008, primarily due to projects that have improved the buildings' energy-efficiency. Costs associated with printing decreased by a combined 16 percent for outside printing, binding, mailing, and printing paper primarily due to the drop in the number of books published from 95 in 2011 to 78 in 2012.

The expense category, all other expenses, increased 20 percent over 2011. A decrease in book inventory in 2012 is partly responsible for this 20 percent change. Inventory increased in 2011, because 95 books were published. In 2012, only 78 books were published and the inventory used was greater than the inventory created, resulting in a large increase in inventory expense as compared to 2011. Another accounting adjustment related to prepaid expenses for work in progress occurred in 2012, also contributing to the 20 percent increase in all other expenses.

Another large increase from 2011 to 2012 in the "all other expense" category in 2012 was in awards, prizes, and grants attributable to increased awards to university departments for the Simons travel grant and awards for the Math in Moscow program. These additional awards amounted to $70,000. In addition, space charges and conference fees were about $90,000 higher, because the Boston meeting was held in a space that was more expensive than the prior year's venue.

## 2012 Statement of Invested Funds

The Statement of Invested Funds of the Society's endowments and quasi-endowments contains two new funds as of 2012. These board-designated funds are the Endowment Income Stabilization Fund (EISF) and the Backfile Digitization Fund. The EISF was established to financially support true endowment funds that fail to produce enough income to cover prizes, awards, lectures, and scholarships. The Backfile Digitization Fund was established to cover the costs of digitizing the Society's backfile of books. Digitized books will be used to create new electronic products.

## Summary Financial Information

The following Statements of Activities and Balance Sheets are from the audited annual financial statements of the AMS, and the Statement of Invested Funds is from the internal financial records of the AMS. Any member may contact the AMS to request the full audited statements of the Society.

## American Mathematical Society—Balance Sheets

| | December 31, 2012 | 2011 |
|---|---|---|
| **Assets** | | |
| Cash and cash equivalents | $ 1,094,226 | $ 1,753,474 |
| Certificates of deposit | 1,520,000 | 2,064,000 |
| Short-term investments | 13,255,356 | 11,675,319 |
| Accounts receivable, net of allowances of $338,805 and $344,066 in 2012 and 2011, respectively | 912,349 | 470,880 |
| Deferred prepublication costs | 728,923 | 765,162 |
| Completed books | 1,384,432 | 1,453,931 |
| Prepaid expenses and deposits | 1,614,823 | 1,677,164 |
| Land, buildings and equipment, net | 5,367,801 | 4,828,711 |
| Long-term investments | 93,748,205 | 81,186,072 |
| **Total assets** | **$ 119,626,115** | **$ 105,874,713** |
| **Liabilities** | | |
| Liabilities: | | |
| Accounts payable and accrued expenses | $ 3,260,488 | $ 3,128,240 |
| Accrued study leave pay | 803,202 | 741,400 |
| Deferred revenue | 12,376,468 | 12,515,534 |
| Postretirement benefit obligation | 6,656,993 | 5,994,557 |
| **Total liabilities** | **23,097,151** | **22,379,731** |
| Net assets: | | |
| Unrestricted: | | |
| Undesignated | 2,261,743 | 1,739,112 |
| Designated | 82,388,405 | 71,018,071 |
| | 84,650,148 | 72,757,183 |
| Temporarily restricted | 6,782,825 | 5,753,285 |
| Permanently restricted | 5,095,991 | 4,984,514 |
| **Total net assets** | **96,528,964** | **83,494,982** |
| **Total liabilities and net assets** | **$ 119,626,115** | **$ 105,874,713** |

## American Mathematical Society—Statements of Activities

| | Years Ended December 31, 2012 | 2011 |
|---|---|---|
| Changes in unrestricted net assets: | | |
| Operating revenue, including net assets released from restrictions: | | |
| Mathematical Reviews | $ 11,087,637 | $ 10,735,499 |
| Journals | 4,829,242 | 4,822,189 |
| Books | 4,023,584 | 3,982,668 |
| Dues, services, and outreach | 3,696,895 | 3,688,175 |
| Investment returns appropriated for spending | 1,772,400 | 1,674,100 |
| Other publications-related revenue | 419,591 | 450,928 |
| Grants, prizes and awards | 1,171,264 | 1,083,719 |
| Meetings | 1,229,138 | 1,034,109 |

*Continued on next page*

## American Mathematical Society—Statements of Activities cont'd.

| | *Years Ended December 31,* | |
|---|---|---|
| | *2012* | *2011* |
| Changes in unrestricted net assets: | | |
| Short-term investment income | 460,062 | 270,132 |
| Other | 54,202 | 47,853 |
| **Total operating revenue** | **28,744,015** | **27,789,372** |
| Operating expenses: | | |
| Mathematical Reviews | 7,055,203 | 6,807,854 |
| Journals | 1,426,643 | 1,421,642 |
| Books | 3,421,212 | 3,395,094 |
| Publications indirect | 1,138,659 | 1,062,353 |
| Customer services, warehousing and distribution | 1,227,921 | 1,313,110 |
| Other publications-related expense | 204,347 | 192,610 |
| Membership, services and outreach | 3,727,374 | 3,842,817 |
| Grants, prizes and awards | 1,329,423 | 1,300,955 |
| Meetings | 1,130,959 | 950,212 |
| Governance | 472,553 | 432,498 |
| Member and professional services indirect | 704,489 | 714,527 |
| General and administrative | 4,364,657 | 3,593,104 |
| Other | 83,619 | 60,302 |
| **Total operating expenses** | **26,287,059** | **25,087,078** |
| **Excess of operating revenue over operating expenses** | **2,456,956** | **2,702,294** |
| Investment returns less investment returns available for spending | 9,227,195 | (1,874,771) |
| Effect of capitalization of labor for in house software development | 667,014 | |
| Postretirement benefit-related changes other than net periodic cost | (458,200) | (1,102,350) |
| Change in unrestricted net assets | 11,892,965 | (274,827) |
| Changes in temporarily restricted net assets: | | |
| Contributions | $ 79,860 | $ 172,731 |
| Investment returns less investment returns appropriated for spending | 1,562,537 | (19,603) |
| Net assets released from restrictions | (612,858) | (607,763) |
| Change in temporarily restricted net assets | 1,029,539 | (454,635) |
| Change in permanently restricted net assets: | | |
| Contributions | 111,477 | 117,390 |
| Change in permanently restricted net assets | 111,477 | 117,390 |
| **Change in net assets** | **13,033,981** | **(612,072)** |
| Net assets, beginning of year | 83,494,982 | 84,107,054 |
| **Net assets, end of year** | **$ 96,528,963** | **$ 83,494,982** |

## American Mathematical Society—Statements of Invested Funds
### As of December 31, 2012 and 2011

| **Income Restricted:** | | **12/31/2012** | **12/31/2011** |
|---|---|---|---|
| Research Prize Funds | **Original Gift** | **Total Value** | **Total Value** |
| Steele | 145,009 | 613,521 | 552,719 |
| Birkhoff | 50,112 | 77,061 | 69,424 |
| Veblen | 29,773 | 40,875 | 36,824 |
| Wiener | 29,773 | 40,875 | 36,824 |
| Bocher | 32,557 | 41,524 | 37,409 |
| Conant | 9,477 | 40,917 | 36,862 |
| Cole Number Theory | 33,063 | 42,320 | 38,136 |
| Cole Algera | 33,063 | 42,320 | 38,136 |
| Satter | 43,212 | 61,151 | 55,091 |
| Doob Prize | 45,000 | 50,585 | 45,572 |
| Robbins Prize | 41,250 | 47,073 | 42,408 |
| Eisenbud Prize | 40,000 | 44,086 | 40,000 |
| Other Prize and Award Funds | | | |
| Morgan | 25,000 | 44,527 | 40,114 |
| Albert Whiteman | 93,618 | 106,442 | 95,893 |
| Arnold Ross Lectures | 70,000 | 79,255 | 71,401 |
| Trjitzinsky | 196,030 | 493,285 | 444,400 |
| C.V. Newsom | 100,000 | 229,548 | 206,799 |
| Centennial | 56,100 | 117,697 | 106,033 |
| Menger | 97,250 | 111,526 | 100,473 |
| Ky Fan (China) | 366,757 | 394,304 | 366,757 |
| Gross | 20,000 | 21,100 | 10,000 |
| Epsilon | 1,753,737 | 1,989,005 | 1,698,148 |
| Einstein Lecture | 100,000 | 114,148 | 102,836 |
| Exemplary Program | 100,000 | 113,450 | 102,207 |
| Mathematical Art | 20,000 | 22,690 | 20,441 |
| **Total (Income Restricted)** | **3,530,781** | **4,979,285** | **4,394,907** |
| **Income Unrestricted:** | | | |
| Endowment | 100,310 | 754,974 | 681,420 |
| Morita | 100,000 | 135,667 | 122,449 |
| Henderson | 548,223 | 4,045,510 | 3,651,371 |
| Schoenfeld/Mitchell | 573,447 | 767,010 | 692,284 |
| Laha | 189,309 | 257,687 | 232,581 |
| Ritt | 51,347 | 241,025 | 217,543 |
| Moore | 2,575 | 22,720 | 20,506 |
| **Total (Income Unrestricted)** | **1,565,211** | **6,224,593** | **5,618,155** |
| **Total Endowment Funds** | **5,095,992** | **11,203,878** | **10,013,061** |
| **Quasi-Endowment Funds:** | | | |
| Journal Archive Fund | | 1,113,204 | 920,784 |
| Young Scholars | | 680,247 | 614,004 |
| Economic Stabilization Fund | | 25,888,951 | 24,430,891 |
| Backfile Digitization Fund | | 400,000 | |
| Endowment Income Stabilization Fund (EISF) | | 500,000 | |
| Operations Support Fund (OSF) | | 53,806,003 | 45,052,391 |
| | | **82,388,405** | **71,018,071** |
| **Total Invested Funds** | | **93,592,283** | **81,031,132** |

# Statistics on Women Mathematicians Compiled by the AMS

At its August 1985 meeting the Council of the AMS approved a motion to regularly assemble and report in the *Notices* information on the relative numbers of men versus women in at least the following categories: membership in the AMS, invited hour addresses at AMS meetings, speakers at Special Sessions at AMS meetings, percentage of women speakers in AMS Special Sessions by gender of organizers, and members of editorial boards of AMS journals.

It was subsequently decided that this information would be gathered by determining the sex of the individuals in the above categories based on name identification if no other means was available and that additional information on the number of Ph.D.s granted to women would also be collected using the AMS-ASA-IMS-MAA-SIAM Annual Survey. Since name identification was used, the information for some categories necessitated the use of three classifications:

**Male:** names that were obviously male

**Female:** names that were obviously female

**Unknown:** names that could not be identified as clearly male or female (e.g., only initials given, non-gender-specific names, etc.)

The following is the twenty-seventh reporting of this information. Updated reports will appear annually in the *Notices*.

**Invited Hour Address Speakers at AMS Meetings (2003–2012)**

| | | |
|---|---|---|
| Male: | 341 | 82% |
| Female: | 73 | 18% |
| Unknown: | 0 | 0% |
| Total: | 414 | |

**Speakers at Special Sessions at AMS Meetings (2008–2012)**

| | | |
|---|---|---|
| Male: | 12,006 | 79% |
| Female: | 3,129 | 20% |
| Unknown: | 142 | 1% |
| Total: | 15,277 | |

**Percentage of Women Speakers in AMS Special Sessions by Gender of Organizers (2012)**

**Special Sessions with at Least One Woman Organizer**

| | | |
|---|---|---|
| Male: | 1039 | 74% |
| Female: | 365 | 26% |
| Unknown: | 4 | <1% |
| Total: | 1,408 | |

**Special Sessions with No Women Organizers**

| | | |
|---|---|---|
| Male: | 1,925 | 83% |
| Female: | 382 | 16% |
| Unknown: | 13 | 1% |
| Total: | 2,320 | |

**2012 Members of the AMS Residing in the U.S.**

| | | |
|---|---|---|
| Male: | 13,889 | 66% |
| Female: | 3,778 | 18% |
| Unknown: | 3,318 | 16% |
| Total: | 20,985 | |

**Trustees and Council Members**

| | 2009 | | 2010 | | 2011 | | 2012 | |
|---|---|---|---|---|---|---|---|---|
| Male: | 29 | 67% | 28 | 67% | 28 | 67% | 26 | 62% |
| Female: | 14 | 33% | 14 | 33% | 14 | 33% | 16 | 38% |
| Total: | 43 | | 42 | | 42 | | 42 | |

**Members of AMS Editorial Committees**

| | 2003 | | 2004 | | 2005 | | 2006 | | 2007 | | 2008 | | 2009 | | 2010 | | 2011 | | 2012 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Male: | 189 | 84% | 180 | 84% | 184 | 83% | 193 | 84% | 194 | 84% | 168 | 83% | 178 | 84% | 176 | 82% | 176 | 83% | 178 | 83% |
| Female: | 35 | 16% | 34 | 16% | 38 | 17% | 36 | 16% | 36 | 16% | 35 | 17% | 34 | 16% | 39 | 18% | 37 | 17% | 37 | 17% |
| Total: | 224 | | 214 | | 222 | | 229 | | 230 | | 203 | | 212 | | 215 | | 213 | | 215 | |

**Ph.D.'s Granted to U.S. Citizens**

| | 2003 | | 2004 | | 2005 | | 2006 | | 2007 | | 2008 | | 2009 | | 2010 | | 2011 | | 2012 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Male: | 341 | 68% | 347 | 68% | 355 | 72% | 399 | 72% | 396 | 69% | 431 | 69% | 515 | 69% | 564 | 71% | 574 | 72% | 621 | 72% |
| Female: | 158 | 32% | 166 | 32% | 141 | 28% | 153 | 28% | 180 | 31% | 191 | 31% | 227 | 31% | 225 | 28% | 228 | 28% | 242 | 28% |
| Total: | 499 | | 513 | | 496 | | 552 | | 576 | | 622 | | 742 | | 790 | | 802 | | 863 | |

# Mathematics Calendar

Please submit conference information for the Mathematics Calendar through the Mathematics Calendar submission form at http://www.ams.org/cgi-bin/mathcal-submit.pl. The most comprehensive and up-to-date Mathematics Calendar information is available on the AMS website at http://www.ams.org/mathcal/.

## October 2013

* 6 **Mini-course: Theoretical and Applied Tools in Population and Medical Genomics**, Centre de recherches mathématiques, Montréal, Canada.
**Description:** This course is an introduction to the coalescent and its applications to modern population genetics and genomics. Derivation and properties of basic coalescent model and extension to include factors such as recombination, geographic structure and natural selection. Use of the coalescent in analyzing data for disease gene mapping, recombination rate estimation, and detection of recent adaptive evolution. Use of coalescent methodologies in large-scale surveys of genetic variation. Applications to standard or next-generation sequencing data for inferences from natural populations and disease cohorts. Use of public domain softwares. This course will be followed by the workshop on Coalescent Theory: New Developments and Applications, October 7–11, 2013.
**Information:** http://www.crm.umontreal.ca/2013/Population13/index_e.php.

* 7–11 **Birational geometry of complex algebraic varieties**, Centre International de Rencontres Mathématiques (CIRM), Luminy, Marseille, France.
**Description:** This conference will gather mathematicians working on different aspects of complex algebraic geometry with a special emphasis on classification theory. During this week, the following topics related to birational geometry will be addressed: links between geometry and arithmetic, hyperbolicity, automorphisms groups, foliations, fundamental group and uniformisation, singularities, rationally connected varieties, moduli spaces of higher dimensional varieties.
**Information:** http://www.cirm.univ-mrs.fr/index.html/spip.php?rubrique2&EX=info_rencontre&annee=2013&id_renc=949

* 7–11 **ERC Workshop on Geometric Measure Theory, Analysis in Metric Spaces and Real Analysis**, Centro di Ricerca Matematica "Ennio De Giorgi", Palazzo Puteano, Piazza dei Cavalieri 3, Pisa, Italy.
**Description:** The workshop is funded by ERC "GeMeThnES GA n. 246923". A number of participation grants are available for young mathematicians upon selection. The schedule will include a special session for short talks of the selected young mathematicians who request to give a talk. To ensure a selection on a larger basis, we call for applications from prospective candidates and invite senior mathematicians to encourage young researchers in this area to apply.
**Organizers:** G. Alberti, L. Ambrosio, C. De Lellis.
**Main speakers:** W. K. Allard, C. Bellettini, V. Bogachev, Z. Buczolich, G. David, G. De Philippis, S. Delladio, B. Kirchheim, A. Lemenant, X. Liang, O. Maleva, A. Máthé, P. Mattila, U. Menne, E. Paolini, M. Petrache, T. Rivière, T. Schmidt, S. Shaposhnikov, G. Speight, Y. Tonegawa, T. Toro, S. Wenger, N. Wickramasekera.
**Deadline for application:** July 31, 2013. Prospective candidates must complete the on-line application and send their curriculum vitae by e-mail to: crm@sns.it. For on-line application log onto http://crm.sns.it/event/278/financial.html.
**Information:** http://crm.sns.it/event/278/index.html#title.

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**This section** contains announcements of meetings and conferences of interest to some segment of the mathematical public, including ad hoc, local, or regional meetings, and meetings and symposia devoted to specialized topics, as well as announcements of regularly scheduled meetings of national or international mathematical organizations. A complete list of meetings of the Society can be found on the last page of each issue.
**An announcement** will be published in the *Notices* if it contains a call for papers and specifies the place, date, subject (when applicable), and the speakers; a second announcement will be published only if there are changes or necessary additional information. Once an announcement has appeared, the event will be briefly noted in every third issue until it has been held and a reference will be given in parentheses to the month, year, and page of the issue in which the complete information appeared. Asterisks (*) mark those announcements containing new or revised information.
**In general,** announcements of meetings and conferences 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/.

* 7–11 **Multiple Zeta Values, Multiple Polylogarithms and Quantum Field Theory**, ICMAT, Campus de Cantoblanco, Madrid, Spain.
**Description:** Multiple zeta values (MZVs) and their generalizations, i.e., multiple polylogarithms (MPLs) have recently attracted much attention, both in pure mathematics and theoretical physics. A systematic study only started in the early 1990s, although the prehistory can be traced back to Euler in the 18th century. Research on MZVs and MPLs comprises several mathematical areas, including algebra (Hopf and Lie algebras), combinatorics (double shuffle relations), algebraic geometry (Grothendieck's motives), Lie group theory (Kashiwara-Vergne conjecture), and, of course, number theory. Moreover, they have deep connections with high-energy physics (Feynman diagrams in perturbative quantum field theory).
**Information:** http://www.icmat.es/congresos/MZV-School/howtoarrive.html; http://www.icmat.es/congresos/MZV-School.

* 11–12 **Workshop on Mathematics of Electoral Systems: Voting, Apportioning and Districting**, Budapest, Hungary.
**Description:** Researchers and advanced Ph.D. students are invited to submit papers to the Workshop. Both theoretical and applied contributions are welcome.
**Keynote speakers:** Felix Brandt (TU München), Friedrich Pukelsheim (Universität Augsburg).
**Deadline:** Papers should be submitted to mes-vad@uni-corvinus.hu by August 20, 2013.
**Information:** http://mes-vad.uni-corvinus.hu.

* 13–17 **Homogeneous Dynamics, Unipotent Flows and Applications**, Israel Institute for Advanced Studies, Jerusalem, Israel.
**Description:** This is the opening conference of a special semester titled "Arithmetics and Dynamics"; which shall be held at the Israel Institute for Advanced Studies located at the Hebrew University of Jerusalem. The conference is in honor of Marina Ratner and her work, and will be devoted to homogeneous dynamics and their applications.
**Organizing and Scientific Committee:** H. Furstenberg, E. Lindenstrauss, S. Mozes, P. Sarnak, B. Weiss.
**Information:** http://www.as.huji.ac.il/content/research-group-conference-homogeneous-dynamics-unipotent-flows-and-applications.

* 18–19 **Lagrange Days**, Centre Internat. de Rencontres Math. (CIRM) Luminy, Marseille, France.
**Description:** Two hundred years after he passed away, CIRM wishes to commemorate Joseph-Louis Lagrange, a mathematician and astronomer who was born in 1736 in Turin and died in 1813 in Paris. Mathematicians and historians from France, Italy, Germany, England and Russia will provide an overview of the significant heritage left by Lagrange. Described as a "mathematician-philosopher", "first geometer since Newton" or "brilliant inventor", he was one of the main scientists who settled the foundations of "calculus of variations", a branch of mathematics with many applications in analytical mechanics and physics, especially through the "principle of least action".
**Themes:** The main themes that will be developed over the two-day conference are dynamical systems, partial differential equations, calculus of variations, probability theory, wave propagation, continuum mechanics, fluids and celestial mechanics.
**Information:** http://math.univ-lyon1.fr/~benzoni/Lagrange/Lagrange-en.html.

* 25–26 **1st Annual Southeastern Conference for Undergraduate Women in Mathematics**, Clemson University, Clemson, South Carolina.
**Description:** The Southeastern Conference for Undergraduate Women in Mathematics is a weekend conference to increase retention of women in mathematics. While everyone is invited to attend the conference, the speakers for this conference will consist of two invited plenary speakers and twenty-minute contributed talks from female undergraduates or first year graduate students speaking on their undergraduate research. In addition to the talks, there will be a panel featuring the plenary speakers and other female mathematicians to address issues relevant to aspiring female mathematicians. We will also host a pizza social on Saturday evening.
**Information:** http://www.ces.clemson.edu/~jimlb/SCCUWM/2013/SCCUWM.html.

## November 2013

* 3–8 **27th Large Installation System Administration Conference**, Washington Marriott, Wardman Park, 2660 Woodley Road, NW Washington, D.C.
**Description:** Join us in Washington, D.C., for LISA '13, the 27th Large Installation System Administration Conference! Please note that for 2013, LISA will take place earlier than in recent years: November 3–8, 2013. The annual LISA conference is the meeting place of choice for system and network administrators and engineers; it is the crossroads of Web operations, DevOps, enterprise computing, educational computing, and research computing. The conference serves as a venue for a lively, diverse, and rich mix of technologists of all specialties and levels of expertise. LISA is the place to teach and learn new skills, debate current issues, and meet industry gurus, colleagues, and friends.
**Information:** http://www.usenix.org/conference/lisa13.

* 4–8 **Mathematics and Geosciences: Global and Local Perspectives**, ICMAT, Campus de Cantoblanco, Madrid, Spain.
**Description:** On the occasion of the MPE 2013, the ICMAT, CSIC, the UAM, the UCM and the UPM want to highlight the decisive role Mathematics plays in the study of local as well as global issues in Earth Sciences.
**Topics:** Climatology and paleoclimatology, oceanography, geomagnetic field, the earth's rotation, remote sensing, natural hazards, structure and geodynamics, renewable energies, social and environmental aspects. These topics will be addressed in a global perspective on the Earth as well as in a local point of view on Earth Science MPE2013 webpage: http://mpe2013.org/workshop/mathematics-and-geosciences-global-and-local-perspectives/.
**Information:** http://www.icmat.es/facilities/howtoarrive; http://www.icmat.es/congresos/mag2013.

* 11–15 **Symplectic Techniques in Dynamical Systems**, ICMAT, Campus de Cantoblanco, Madrid, Spain.
**Description:** This is the first conference organized under the auspices of the Viktor Ginzburg Laboratory (http://www.icmat.es/severo-ochoa/Activities/ICMat_Laboratories/Ginzburg) at ICMAT-Madrid.
**Theme:** The main theme of the conference is the interaction between the dynamics and geometrical perspectives in symplectic and contact topology. The conference is the closing event of the CRM Research Programme of Geometry and Dynamics of Integrable Systems. http://www.crm.cat/en/Activities/Pages/ActivityDescriptions/RP-Geometry-and-Dynamics-of-Integrable-Systems.aspx.
**Organizers:** Alberto Enciso, Viktor Ginzburg, David Martin de Diego, Eva Miranda, Daniel Peralta, Salas Francisco Presas.
**Lodging:** There are available lodging grants for students.
**Information:** http://www.icmat.es/facilities/howtoarrive; http://www.icmat.es/congresos/STDS/.

* 27–29 **BMS Intensive Course on Evolution Equations and their Applications**, Technical University Berlin, Berlin, Germany.
**Description:** The second BMS Intensive Course is a workshop on topics related to evolution equations and their applications. It provides a forum for Ph.D. students, postdoctoral researchers, and young faculty members to present and discuss their current research. It

gives the opportunity to connect to other mathematicians working on similar topics and establish contacts for future collaborations.
**Topics:** Multiscale problems, thin-film and lubrication equations, reaction-diffusion systems, variational methods and numerics of PDEs, gradient flows and optimal transport, stochastic processes and PDEs.
**Information:** http://www.math.tu-berlin.de/?BMS_PDE.

* 27–29 **Recent Trends in Algebraic and Geometric Combinatorics**, ICMAT, Campus de Cantoblanco, Madrid, Spain.
**Description:** Over the past four decades, algebraic combinatorics has evolved into an important branch of modern mathematics. Nowadays, it plays an important role in a wide variety of subjects, such as, for instance, Representation Theory, Number Theory, Free Probability, Quantum Field Theory, Statistical Mechanics, Control Theory, Geometric Integration Methods, Lyons' Rough Paths Theory, Percolation Theory, Discrete Geometry, Algebraic Geometry. The 3-days workshop Recent Trends in Algebraic and Geometric Combinatorics (AlGeCo2013) aims at bringing together leading researchers working in algebraic and geometric combinatorics. The three principal topics are: applications of modern combinatorics in algebra, enumerative combinatorics and combinatorial geometry. The workshop shall provide a platform for discussions around recent progress.
**Information:** http://www.icmat.es/RTAGC/howtoarrive.html.

## December 2013

* 2–4 **Quasilinear PDEs and Game Theory**, Uppsala University, Uppsala, Sweden.
**Description:** In connection with the program on evolutionary problems at Institut Mittag-Leffler, Stockholm, Sweden, there will be an international conference on quasilinear PDEs and game theory in Uppsala, 70 km north of Stockholm.
**Main topics:** Nonlinear partial differential equations, viscosity solutions, game theory, probability theory, stochastic processes.
**Information:** http://www.math.uu.se.quasilinear-pdes-and-game-theory.

* 2–6 **Deterministic and Stochastic Dynamics in Economics and Finance**, Centro di Ricerca Matematica Ennio De Giorgi, Palazzo Puteano, Piazza dei Cavalieri 3, Pisa, Italy.
**Description:** The modeling of economic and financial systems is a complex and challenging task, and, as the current crisis has shown, new ideas and approaches are needed to understand interlinkages and tackle instabilities. The aim of this workshop is to bring together scholars from different disciplines interested in the mathematical modeling of economic and financial systems. Contributions from dynamical systems theory, stochastic processes, statistical physics, and computational economics or finance are presented and discussed. The workshop aims also to bring together ideas and models based on deterministic dynamics as well as stochastic dynamics with a special emphasis on the interaction between these two aspects both in the analysis and in the modelization of financial and economics time series.
**Registration deadline:** November 24, 2013.
**Speakers:** G. Bottazzi, R. Dieci, R. Douady, T. Hens, C. Hommes, S. Marmi, M. Marsili, D. Pinheiro, K. Reiner Schenk-Hoppe', F. H. Westerhoff.
**Information:** http://crm.sns.it/event/282/.

* 3–5 **6th Minimeeting on Differential Geometry**, Center for Research in Mathematics (CIMAT), Guanajuato, Mexico.
**Description:** The aim of the 6th Minimeeting on Differential Geometry is to bring distinguished U.S. based mathematicians to CIMAT to deliver series of lectures for researchers and postgraduate students working in the area of differential geometry, in order to enrich and stimulate the research environment in Mexico and provide a space for academic interaction.
**Guest Speakers:** John Ratcliffe (Vanderbilt University) Distinguished Professor Guest of the Mexican Academy of Sciences, Pablo Suarez Serrato (IMATE-DF, UNAM), Luis Hernandez Lamoneda (CIMAT).
**Support:** There is no registration fee. There will be some financial support for local expenses for participants, mainly graduate students who wish to attend the conference.
**Deadline:** For registration and application for support is November 1, 2013.
**Information:** http://sites.google.com/site/6thminimeetingondiffgeom/.

* 16–19 **deLeónfest 2013**, ICMAT, Campus de Cantoblanco, Madrid, Spain.
**Description:** This workshop is to commemorate the 60th birthday of Manuel de León. Manuel de León is one of the most important researchers on geometric mechanics. It is worth highlighting his contributions on a wide range of topics such as symplectic geometry, Poisson manifolds, nonholonomic mechanics, Cosserat media, geometric integrators, optimal control theory, among many others. Another facet that makes Manuel de León well-known is his intense dedication to the diffusion of mathematics and his role in mathematical organizations at the international and national levels, including the International Mathematical Union (IMU) and the Real Sociedad Matemática Española (RSME). One could keep going by emphasizing his work on the didactics of mathematics, its popularization, edition and direction of scientific journals, and many other facets. The sum of all these contributions makes Manuel de León deserve this tribute.
**Information:** http://www.icmat.es/facilities/howtoarrive; http://www.icmat.es/deLeonfest/.

* 16–20 **2013 Taiwan International Conference on Geometry**, National Taiwan University, Taipei, Taiwan.
**Description:** This conference is of a series of biennial international conferences on Differential Geometry in Taiwan. An important area in Geometry will be specified as the main theme each time. Our purpose is to create a discussion and interaction platform in the chosen area, and at the same time to foster future co-operations and introduce new participants into the field. Some mini courses will also be arranged before the conference as a preparation. The topic for the conference in 2011 was "Special Lagrangians and Related Topics" and for 2013 conference, we will focus on "Geometry of General Relativity".
**Information:** http://www.math.ntu.edu.tw/~ctsdev/workshop/Default/index.php?WID=154.

* 17–20 **International Conference on Mathematics Education and Mathematics in Engineering and Technology**, Mohandas College of Engineering & Technology (MCET), Anad, Nedumangad, Thiruvananthapuram, Kerala state, India.
**Description:** The conference is under the auspices of the Department of Mathematics, technically supported by the Kerala Mathematical Association, Indian Society of Industrial and Applied Mathematics and the Indian Society for Technical Education (Kerala Section). The main thrust areas are mathematical modeling, simulation and computing in engineering, science and technology, random process, distribution theory and applications. calculus, differential and integral equations, numerical analysis, operations research, linear algebra, biomathematics and applications, mathematics and mathematics education for the development of engineering, science, and technology. The conference includes invited talks, paper presentations, poster sessions and panel discussions.
**Information:** http://www.mcetonline.com/icmet.

## January 2014

* 6–11 **Stochastic Partial Differential Equations and Applications**, Bellavista Relax Hotel, Levico (prov. Trento), Italy.
**Description:** It is the 9th edition of the same kind of international meeting about the Stochastic Partial Differential Equations and

Applications, organized by the CIRM (Centro Internazionale per la Ricerca Matematica), by Gnampa (Gruppo Nazionale per l'Analisi Matematica, la Probabilità e le loro Applicazioni) dell Inddam (Istituto Nazionale di Alta Matematica) and by the Department of Mathematics of the University of Trento (Italy). As in the past editions, the meeting will focus on the various aspects theoretical and applicative of the Stochastic Partial Differential Equations.
**Information:** http://www.science.unitn.it/~tubaro/.

## February 2014

* 4–7 **Function Theory on Infinite Dimensional Spaces XIII**, ICMAT, Campus de Cantoblanco, Madrid, Spain.
**Description:** This Conference, organized by ICMAT and the research team Geometric and nonlinear functional analysis, will focus on the interplay of three main lines: Global and geometrical analysis, including analysis on measure metric spaces, convexity, differentiability, and geometry of Banach spaces, hypercyclicity and multilinear analysis in Banach spaces. First Announcement Letter (PDF); http://www.icmat.es/congresos/2014/ftida/FirstAnnouncement_2014.pdf.
**Information:** http://www.icmat.es/facilities/howtoarrive; http://www.icmat.es/congresos/2014/ftida/.

* 10–21 **Higher Structures in Algebraic Analysis**, University of Padova, Department of Mathematics, Padova, Italy.
**Description:** The School will be taught during the first week and center around four minicourses. The Workshop will run during the second week and include a series of colloquium-style talks. We will try to make the School more introductory and the Workshop more advanced. During the first week, the minicourses will be complemented by daily exercise and open discussion sessions. During the second week, the invited talks will be accompanied by short communications by the participants, and time for open discussions will also be provided. Please refer to the homepage for registration. Limited financial support is available for young researchers.
**Topics:** Among the topics discussed: Infinity categories, Derived Geometry, Hodge D-modules, Non-commutative Hodge Structures, Kobayashi-Hitchin correspondence.
**Information:** http://events.math.unipd.it/hsaa/.

## March 2014

* 5–7 **International Workshop on Discrete Structures (IWODS)**, Centre for Advanced Mathematics and Physics, National University of Sciences and Technology, H-12 Islamabad, Pakistan.
**Description:** The workshop will encompass a variety of topics but the main focus will remain on graph theory and discrete optimization. It is our intention to convert this workshop into a memorable event through a variety of activities around various research themes and transform it into platform for discussion fueled by current research. We hope that this will help establish new collaborations and strengthen the old one, at the regional, national, and international levels.
**Information:** http://www.camp.nust.edu.pk/IWODS2014/.

* 10–June 13 **Algebraic Techniques for Combinatorial and Computational Geometry**, Institute for Pure and Applied Mathematics (IPAM), UCLA, Los Angeles, California.
**Description:** In the past four years, the landscape of combinatorial geometry has considerably changed due to the work of Guth and Katz. More recently, Green and Tao stunningly solved the long-standing conjecture of Dirac and Motzkin on the number of ordinary lines. What these results have in common is algebraic geometry. The application of algebraic geometry to problems in incidence geometry has been a rather surprising development. This interdisciplinary work is still at its infancy, and a major goal of this program is to provide a venue for deepening and widening the interaction between combinatorial geometry, algebraic geometry, Fourier analysis, and hopefully other mathematical disciplines too. An application and registration form are available online.
**Application deadline:** December 10, 2013.
**Information:** http://www.ipam.ucla.edu/programs/ccg2014.

* 12–14 **IAENG International Conference on Operations Research 2014**, Hong Kong, China.
**Description:** The conference ICOR'14 is held under the International MultiConference of Engineers and Computer Scientists 2014. The IMECS 2014 is organized by the International Association of Engineers (IAENG), a non-profit international association for the engineers and the computer scientists. All submitted papers will be under peer review and accepted papers will be published in the conference proceeding (ISBN: 978-988-19252-5-1). The abstracts will be indexed and available at major academic databases. The accepted papers will also be considered for publication in the special issues of the journal *Engineering Letters*, in IAENG journals and in edited books.
**Information:** http://www.iaeng.org/IMECS2014/ICOR2014.html.

* 24–28 **Combinatorial Geometry Problems at the Algebraic Interface**, Institute for Pure and Applied Mathematics (IPAM), UCLA, Los Angeles, California.
**Description:** A goal of the workshop is to enhance and foster a two-way interaction between algebraic geometers and combinatorial and computational geometers, so as (a) to allow the latter community to learn more from algebraic geometers about the known tools and techniques that are relevant to combinatorial geometry, and (b) to attract algebraic geometers to the new application area, and get them involved in the study of the numerous challenging problems in algebraic geometry that the new area raises. We expect to achieve this goal by offering several survey talks on algebraic geometry, specially tailored problem sessions, and ample time for free discussions. This workshop will include a poster session; a request for posters will be sent to registered participants in advance of the workshop. An application and registration form are available online.
**Application deadline:** January 27, 2014.
**Information:** http://www.ipam.ucla.edu/programs/ccgws1/.

## April 2014

* 7–11 **Tools from Algebraic Geometry**, Institute for Pure and Applied Mathematics (IPAM), UCLA, Los Angeles, California.
**Description:** A central challenge that the workshop will address is how to adequately identify the class of problems in discrete geometry susceptible to the algebraic method. The workshop will include expository talks by experts that make classical results of algebraic geometry accessible to researchers in discrete geometry by explaining them in modern terms. Another important goal of this workshop is to expose experts in algebraic geometry to new applications, and present them with some open problems. This workshop will include a poster session; a request for posters will be sent to registered participants in advance of the workshop. An application and registration form are available online.
**Application deadline:** February 10, 2014.
**Information:** http://www.ipam.ucla.edu/programs/ccgws2/.

* 28–May 2 **AIM Workshop: Exact crossing numbers**, American Institute of Mathematics, Palo Alto, California.
**Description:** This workshop, sponsored by AIM and the NSF, will be devoted to tackling several long-standing open problems in the field of crossing numbers of graphs.
**Information:** http://www.aimath.org/ARCC/workshops/exactcrossing.html.

## May 2014

* 5–9 **The Kakeya problem, Restriction problem, and Sum-product Theory**, Institute for Pure and Applied Mathematics (IPAM), UCLA, Los Angeles, California.
**Description:** The workshop will also examine questions related to distance sets and sum-product phenomena in continuous and finite field settings. While there has been substantial progress on the corresponding discrete problems, the continuous variants remain less understood. We hope that the new algebraic methods can shed more light on these questions; for instance, a major open problem is whether the sum-product phenomenon can ultimately be understood in an algebraic way. The workshop will be an excellent opportunity for experts who study these problems in different settings to interact and learn from one another. This workshop will include a poster session; a request for posters will be sent to registered participants in advance of the workshop. An application and registration form are available online.
**Application deadline:** March 3, 2014.
**Information:** http://www.ipam.ucla.edu/programs/ccgws3/.

* 12–16 **28th Automorphic Forms Workshop**, Moab, Utah.
**Description:** Over the last 27 years, the annual workshop on automorphic forms and related topics has remained a small and friendly conference. Those attending range from students to new Ph.D.'s to established researchers. For young researchers, the conference has provided support and encouragement. For accomplished researchers, it has provided the opportunity to mentor as well as a forum for exchanging ideas. The workshop has become internationally recognized for both its high-quality research talks and its supportive atmosphere for junior researchers. Participants present cutting-edge research in all areas related to automorphic forms. This year, the 2014 Automorphic Forms Workshop will be held in Moab, Utah at the Moab Arts and Recreation Center. Moab, in southern Utah, is near Arches and Canyonlands National Parks and other scenic landmarks. The Workshop will be organized and hosted by Brigham Young University.
**Information:** http://www.automorphicformsworkshop.org.

* 19–22 **SIAM Conference on Optimization (OP14)**, Town and Country Resort & Convention Center, San Diego, California.
**Description:** The SIAM Conference on Optimization will feature the latest research in theory, algorithms, software and applications in optimization problems. A particular emphasis will be put on applications of optimization in health care, biology, finance, aeronautics, control, operations research, and other areas of science and engineering. The conference brings together mathematicians, operations researchers, computer scientists, engineers, software developers and practitioners, thus providing an ideal environment to share new ideas and important problems among specialists and users of optimization in academia, government, and industry.
**Information:** http://www.siam.org/meetings/op14/.

* 19–23 **Finding Algebraic Structures in Extremal Combinatorial Configurations**, Institute for Pure and Applied Mathematics (IPAM), UCLA, Los Angeles, California.
**Description:** Understanding the fine structure of extremal configurations is a key step in the solution of many problems in extremal combinatorics. For example, in many cases a group action underlies the structure found in an extremal scenario, making the problem amenable to algebraic methods. This principle is illustrated by recent work which has applied techniques from algebra, algebraic geometry, model theory and additive combinatorics to obtain important new results in discrete geometry. We expect this fusion of algebraic geometry and combinatorics to become a very active area of research in the coming months and years. It is our aim to showcase the most exciting results, techniques and recent trends in this workshop. This workshop will include a poster session; a request for posters will be sent to registered participants in advance of the workshop. An application and registration form are available online.
**Application deadline:** March 24, 2014.
**Information:** http://www.ipam.ucla.edu/programs/ccgws4/.

* 22–25 **13th Serbian Mathematical Congress**, Vrnjacka Banja, Serbia.
**Description:** The 13th Serbian Mathematical Congress represents the central scientific event of the year 2014 in the Republic of Serbia. The meeting has an international character and is open for all fields of mathematics and computer sciences. The congress agenda includes plenary lectures, invited lectures and short presentations organized in the following sections: Field 1: Set theory, topology, logic, algebra, discrete mathematics, number theory; Field 2: Numerical mathematics, applied mathematics; Field 3: Real and functional analysis, differential equations, complex analysis, probability and statistics; Field 4: Geometry, algebraic geometry and topology, mathematical physics; Field 5: History, learning, teaching of mathematics; Field 6: Theoretical computer sciences, computer sciences; Field 7: Information technology. Submitted papers will be edited by part of the Programme Committee from the corresponding field.
**Information:** http://tesla.pmf.ni.ac.rs/people/smak/index.php.

* 25–28 **XVIII Geometrical Seminar**, Vrnjačka Banja, Serbia.
**Description:** XVIII Geometrical Seminar will bring together mathematicians, physicists and engineers interested in Geometry and its applications, to give lectures on new results, exchange ideas, problems and conjectures.
**Conference topics:** Differential geometry, topology, Lie groups, mathematical physics, discrete geometry, integrable systems, visualization, computer graphics, engineering graphics. Other subjects related to the main themes are welcome.
**Information:** http://tesla.pmf.ni.ac.rs/people/geometrijskiseminarxviii/index.php.

## June 2014

* 3–6 **Moduli - Operads - Dynamics II**, Tallinn University of Technology, Tallinn, Estonia.
**Description:** Main purpose of MOD '14 is to stimulate and promote interactions between the following major research areas: deformation theory, moduli, operads, the differential graphical calculus (DGC), dynamics. These topics in great deal arise as main ingredients of the applied category theory with wide application prospects everywhere in contemporary science, technology and cognition. Main topics include, but not limited to Architecture and dynamics of operadic systems; Deformation theory and moduli Hopf algebra; Integrable models Lie theory, representation theory; Mathematics of quanta; Noncommutative geometry.
**Information:** http://www.astralgo.com/cweb/mod14/.

* 12–14 **Riemann, topology and physics**, Institut de Recherche Mathematique Avancee, University of Strasbourg, Strasbourg, France.
**Description:** The conference is part of a series of bi-annual conferences "Encounter between Mathematicians and Theoretical Physicists" and it is addressed to a large audience.
**Organizers:** Lizhen Ji (Michigan) and Athanase Papadopoulos (Strasbourg).
**Invited speakers:** Norbert A. Campo (Basel), Nicolas Bergeron (Jussieu), Franis David (CEA, Paris), Charles Frances (Orsay), Jeremy Gray (Open Univ. UK), Joël Merker (Orsay), Catherine Meusburger (Erlangen), Bob Penner (Caltech at Aarhus), Alexey Sossinsky (Moscow) and Dmitri Zvonekine (Paris).
**Language:** English. Some of the talks will be survey talks intended for a general audience. Graduate students and young mathematicians are welcome.

**Registration:** Is required (and free of charge) at this link. Hotel booking can be asked for through the registration link. For practical and other questions please email the organizers: Lizhen Ji, lji@umich.ecu; Athanase Papadopoulos, athanase.papadopoulos@math.unistra.fr.
**Information:** http://www-irma.u-strasbg.fr/article1375.html.

* 16–19 **8th Annual International Conference on Mathematics & Computer Science**, Athens, Greece.
**Description:** The conference is soliciting papers (in English only) from all areas of Mathematics, Computer Sciences (theoretical) and other related areas.
**Information:** http://www.atiner.gr/mathematics.htm.

## July 2014

* 13–15 **8th International Conference on Modelling in Industrial Maintenance and Reliability (MIMAR)**, St. Catherine's, Oxford, United Kingdom.
**Description:** This event is the premier maintenance and reliability modelling conference in the UK and builds upon a very successful series of previous conferences. It is an excellent international forum for disseminating information on the state-of-the-art research, theories and practices in maintenance and reliability modelling and offers a platform for connecting researchers and practitioners from around the world.
**Information:** http://www.ima.org.uk/conferences/conferences_calendar/mimar8.cfm.

* 20–25 **Sixteenth International Conference on Fibonacci Numbers and Their Applications**, Rochester Institute of Technology, Rochester, New York.
**Description:** The purpose of the conference is to bring together people from all branches of mathematics and science with interests in recurrence sequences, their applications and generalizations, and other special number sequences. For the conference Proceedings, manuscripts that include new, unpublished results (or new proofs of known theorems) will be considered.
**Information:** http://www.mathstat.dal.ca/fibonacci/.

## August 2014

* 11–15 **AIM Workshop: Neglected infectious diseases**, American Institute of Mathematics, Palo Alto, California.
**Description:** This workshop, sponsored by AIM and the NSF, will be devoted to mathematical modeling of vector-borne diseases that are a cause of several million deaths and innumerable cases of sickness every year.
**Information:** http://www.aimath.org/ARCC/workshops/neglectedinfect.html.

* 11–December 19 **Understanding Microbial Communities; Function, Structure and Dynamics**, Isaac Newton Institute, Cambridge, United Kingdom.
**Description:** The importance of microbial communities for health, industry and the natural environment cannot be overstated. Despite this, there is an enormous gap between the levels of our empirical knowledge of microbial communities. composition and experimental and theoretical understanding of their function, structure, and dynamics. Developing and advancing mathematical and computational approaches for the study of microbial communities has huge potentials for this field. The aim of this programme is to build an interactive community of theoretical and empirical scientists that can provide these developments. Several workshops will take place during the programme. For full details please see http://www.newton.ac.uk/events.html.
**Information:** http://www.newton.ac.uk/programmes/UMC/.

## September 2014

* 2–7 **12th AHA Conference-Algebraic Hyperstructures and its Applications**, Democritus University of Thrace, School of Engineering, Department of Production and Management Engineering 67100, Xanthi, Greece International Algebraic Hyperstructures Association (IAHA).
**Description:** The series of International Conferences on Algebraic Hyperstructures and Applications (AHA) aims at bringing together researchers and academics for the presentation and discussion of novel theories and applications of Algebraic Hyperstructures. The conference covers a broad spectrum of topics related to Algebraic Hyperstructures including (but not limited): Hypergroupoids, semihypergroups, hypergroups, hyperrings, hyperfields, hypervector spaces, hyperalgebras, hyperlattices, hv-structures, hv-matrices, hyperstructures associated with binary or n-ary relations, non-associative hyperstructures, join spaces, hyperstructures associated to geometric spaces, ordered hyperstructures, t-groupoids, partial semihypergroups, fuzzy algebraic hyperstructures, fuzzy/rough/soft sets and hyperstructures, cryptography, codes, assembly line design, graph and hypergraph theory, formal languages, automata, artificial intelligence, etc.
**Information:** http://aha2014.pme.duth.gr.

* 8–December 12 **Mathematics of Turbulence**, Institute for Pure and Applied Mathematics (IPAM), UCLA, Los Angeles, California.
**Description:** This IPAM program is centered on fundamental issues in mathematical fluid dynamics, scientific computation, and applications including rigorous and reliable mathematical estimates of physically important quantities for solutions of the partial differential equations that are believed, in many situations, to accurately model the essential physical phenomena. This program will bring together physicists, engineers, analysts, and applied mathematicians to share problems, insights, results and solutions. Enhancing communications across these traditional disciplinary boundaries is a central goal of the program. An application and registration form are available online.
**Application deadline:** June 8, 2014.
**Information:** http://www.ipam.ucla.edu/programs/mt2014/.

* 18–20 **Riemann, Einstein and geometry**, Institut de Recherche Mathématique Avancée, University of Strasbourg, France.
**Description:** The conference is part of a series of bi-annual conferences "Encounter between Mathematicians and Theoretical Physicists" and it is addressed to a large audience.
**Organizers:** Althanase Papadopoulos (Strasbourg) and Sumio Yamada (Tokyo).
**Invited speakers:** Jean-Pierre Bourguignon (Paris), Mihalis Dafermos (Princeton), Erwann Delay (Avignon), Jacques Franchi (Strasbourg), Hubert Goenner (Göttingen), Eric Gourgoulhon (Observatoire de Paris), Oussama Hijazi (Nancy), Gerhard Huisken (Tübingen), Emmanuel Humbert (Tours), Marc Mars (Salamanca), Andre Neves (Imperial College, London), Richard Schoen (Stanford) and Tetsuya Shiromizu (Kyoto).
**Language:** English. Some of the talks will be survey talks intended for a general audience. Graduate students and young mathematicians are welcome.
**Registration:** Is required (and free of charge) at this link. Hotel booking can be asked for through the registration link. For practical and other questions please email the organizers: Althanase Papadopoulos, xemailathanase.papadopoulos@math.unistra.fr|; Sumio Yamada, yamada@math.gakushuin.ac.jp.
**Information:** http://www-irma.u-strasbg.fr/article1377.html.

**The following new announcements will not be repeated until the criteria in the next to the last paragraph at the bottom of the first page of this section are met.**

## October 2014

* 23–26 **Ahlfors-Bers Colloquium VI**, Yale University, New Haven, Connecticut.
**Description:** This conference is the sixth in a series of triennial colloquia devoted to the mathematical legacy of Lars Ahlfors and Lipman Bers. The core heritage is in geometric function theory, quasiconformal mapping, Teichmüller theory and Kleinian groups, hyperbolic manifolds, and partial differential equations including Schramm/Stochastic-Loewneer-Evolution/Equations. Today we see the influence of Ahlfors and Bers on algebraic geometry, mathematical physics, dynamics, probability, geometric group theory, number theory and topology.

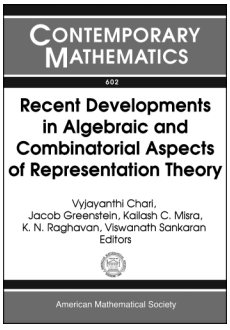
## July 2015

* 6–10 **10th IMACS Seminar on Monte Carlo Methods**, Johannes Kepler University Linz and Radon Institute for Computational and Applied Mathematics, Linz, Austria.
**Description:** The IMACS Seminar on Monte Carlo Methods is a biannual event that previously took place in Brussels, Varna, Salzburg, Berlin, Tallahassee, Reading, Brussels, Borovets, and Annecy-le-Vieux.
**Topics:** Algorithms for high-dimensional problems and complexity, computational stochastic differential equations, generation of random numbers, low discrepancy point sets and sequences, Markov Chain Monte Carlo, multilevel Monte Carlo.
**Information:** `http://www.mcm2015.jku.at`.

# New Publications Offered by the AMS

*To subscribe to email notification of new AMS publications, please go to* http://www.ams.org/bookstore-email.

## Algebra and Algebraic Geometry




### Recent Developments in Algebraic and Combinatorial Aspects of Representation Theory

**Vyjayanthi Chari**, *University of California, Riverside, CA*, **Jacob Greenstein**, *University of Riverside, CA*, **Kailash C. Misra**, *North Carolina State University, Raleigh, NC*, and **K. N. Raghavan** and **Viswanath Sankaran**, *Institute of Mathematical Sciences, Chennai, India*, Editors

This volume contains the proceedings of the International Congress of Mathematicians Satellite Conference on Algebraic and Combinatorial Approaches to Representation Theory, held August 12–16, 2010, at the National Institute of Advanced Studies, Bangalore, India, and the follow-up conference, held May 18–20, 2012, at the University of California, Riverside, CA.

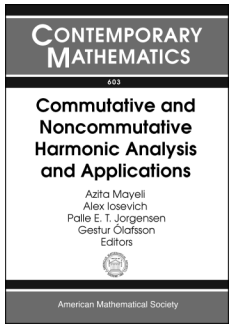
It contains original research and survey articles on various topics in the theory of representations of Lie algebras, quantum groups and algebraic groups, including crystal bases, categorification, toroidal algebras and their generalizations, vertex algebras, Hecke algebras, Kazhdan-Lusztig bases, $q$-Schur algebras, and Weyl algebras.

**Contents: P. N. Achar**, Kostka systems and exotic $t$-structures for reflection groups; **D. Adamović** and **A. Milas**, The doublet vertex operator superalgebras $\mathcal{A}(p)$ and $\mathcal{A}_{2,p}$; **B. Adsul**, **M. Sohoni**, and **K. V. Subrahmanyam**, Quantum deformations of irreducible representations of $GL(mn)$ toward the Kronecker problem; **G. Benkart**, **S. A. Lopes**, and **M. Ondrus**, A parametric family of subalgebras of the Weyl algebra II. Irreducible modules; **B. Deng**, **J. Du**, and **A. Mah**, Generic extensions and composition monoids of cyclic quivers; **N. Jing**, **L. Zhang**, and **M. Liu**, Wedge modules for two-parameter quantum groups; **A. Mathas** and **M. Soriano**, Blocks of the truncated $q$-Schur algebras of type A; **T. Nakashima**, Decorated geometric crystals, polyhedral and monomial realizations of crystal bases; **E. Neher** and **A. Savage**, A survey of equivariant map algebras with open problems; **M. Okado**, Simplicity and similarity of Kirillov-Reshetikhin crystals; **B. J. Parshall** and **L. L. Scott**, Forced gradings and the Humphreys-Verma conjecture.

**Contemporary Mathematics**, Volume 602

December 2013, approximately 211 pages, Softcover, ISBN: 978-0-8218-9037-0, LC 2013016375, 2010 *Mathematics Subject Classification:* 16G20, 16S30, 16S32, 17B10, 17B37, 17B67, 17B69, 20G43, **AMS members US$60.80**, List US$76, Order code CONM/602

## Analysis




### Commutative and Noncommutative Harmonic Analysis and Applications

**Azita Mayeli**, *City University of New York, Queensborough Community College, Bayside, NY*, **Alex Iosevich**, *University of Rochester, NY*, **Palle E. T. Jorgensen**, *University of Iowa, Iowa City, IA*, and **Gestur Ólafsson**, *Louisiana State University, Baton Rouge, LA*, Editors

This volume contains the proceedings of the AMS Special Session on Wavelet and Frame Theoretic Methods in Harmonic Analysis and Partial Differential Equations, held September 22–23, 2012, at the Rochester Institute of Technology, Rochester, NY.

The book features new directions, results and ideas in commutative and noncommutative abstract harmonic analysis, operator theory and applications. The commutative part includes shift invariant spaces, abelian group action on Euclidean space and frame theory; the noncommutative part includes representation theory, continuous and discrete wavelets related to four dimensional Euclidean space, frames on symmetric spaces, $C^*$-algebras, projective multiresolutions, and free probability algebras.

The scope of the book goes beyond traditional harmonic analysis, dealing with Fourier tools, transforms, Fourier bases, and associated

function spaces. A number of papers take the step toward wavelet analysis, and even more general tools for analysis/synthesis problems, including papers on frames (over-complete bases) and their practical applications to engineering, cosmology and astrophysics.

Other applications in this book include explicit families of wavelets and frames, as they are used in signal processing, multiplexing, and the study of Cosmic Microwave Background (CMB) radiation.

For the purpose of organization, we have divided the book into three parts: noncommutative, commutative, and applications. The first group of papers are devoted to problems in noncommutative harmonic analysis, the second to topics in commutative harmonic analysis, and the third to such applications as wavelet and frame theory and to some real-world applications.

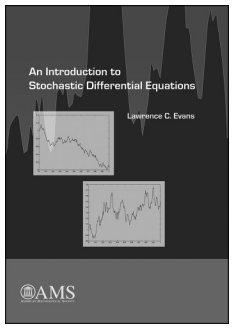
*This item will also be of interest to those working in algebra and algebraic geometry.*

**Contents:** *Part I: Noncommutative harmonic analysis:* **I. Cho** and **P. E. T. Jorgensen**, Krein-space operators induced by Dirichlet characters; **F. Latrémolière** and **J. A. Packer**, Noncommutative solenoids and their projective modules; **I. Z. Pesenson**, Paley-Wiener-Schwartz nearly Parseval frames on noncompact symmetric spaces; **B. Purkis**, Projective multiresolution analyses over irrational rotation algebras; *Part II: Commutative harmonic analysis:* **D. Arnal**, **B. Dali**, **B. Currey**, and **V. Oussa**, Regularity of abelian linear actions; **D. Geller** and **I. Z. Pesenson**, $n$-widths and approximation theory on compact Riemannian manifolds; **M. Ghandehari**, **A. Syzdykova**, and **K. F. Taylor**, A four dimensional continuous wavelet transform; *Part III: Applications:* **R. Aceska**, **A. Aldroubi**, **J. Davis**, and **A. Petrosyan**, Dynamical sampling in shift-invariant spaces; **C. Durastanti** and **X. Lan**, High-frequency tail index estimation by nearly tight frames; **A. Mayeli** and **M. Razani**, Multiplexing and demultiplexing frame pairs.

**Contemporary Mathematics**, Volume 603

December 2013, 195 pages, Softcover, ISBN: 978-0-8218-9493-4, LC 2013018563, 2010 *Mathematics Subject Classification:* 41-XX, 42-XX, 43-XX, 46-XX, 47-XX, **AMS members US$60.80**, List US$76, Order code CONM/603

# Differential Equations




## An Introduction to Stochastic Differential Equations

**Lawrence C. Evans**, *University of California, Berkeley, CA*

*These notes provide a concise introduction to stochastic differential equations and their application to the study of financial markets and as a basis for modeling diverse physical phenomena. They are accessible to non-specialists and make a valuable addition to the collection of texts on the topic.*

***—Srinivasa Varadhan, New York University***

*This is a handy and very useful text for studying stochastic differential equations. There is enough mathematical detail so that the reader can benefit from this introduction with only a basic background in mathematical analysis and probability.*

***—George Papanicolaou, Stanford University***

*This book covers the most important elementary facts regarding stochastic differential equations; it also describes some of the applications to partial differential equations, optimal stopping, and options pricing. The book's style is intuitive rather than formal, and emphasis is made on clarity. This book will be very helpful to starting graduate students and strong undergraduates as well as to others who want to gain knowledge of stochastic differential equations. I recommend this book enthusiastically.*

***—Alexander Lipton, Mathematical Finance Executive, Bank of America Merrill Lynch***

This short book provides a quick, but very readable introduction to stochastic differential equations, that is, to differential equations subject to additive "white noise" and related random disturbances. The exposition is concise and strongly focused upon the interplay between probabilistic intuition and mathematical rigor. Topics include a quick survey of measure theoretic probability theory, followed by an introduction to Brownian motion and the Itô stochastic calculus, and finally the theory of stochastic differential equations. The text also includes applications to partial differential equations, optimal stopping problems and options pricing.

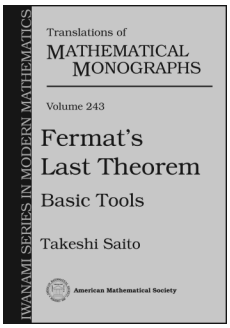
This book can be used as a text for senior undergraduates or beginning graduate students in mathematics, applied mathematics, physics, financial mathematics, etc., who want to learn the basics of stochastic differential equations. The reader is assumed to be fairly familiar with measure theoretic mathematical analysis, but is not assumed to have any particular knowledge of probability theory (which is rapidly developed in Chapter 2 of the book).

*This item will also be of interest to those working in probability and statistics and applications.*

**Contents:** Introduction; A crash course in basic probability theory; Brownian motion and "white noise"; Stochastical integrals, Itô's formula; Stochastic differential equations; Applications; Appendices; Exercises; Bibliography.

January 2014, approximately 142 pages, Softcover, ISBN: 978-1-4704-1054-4, LC 2013024818, 2010 *Mathematics Subject Classification:* 65C30, 60J65, 60H10, 65N75, **AMS members US$27.20**, List US$34, Order code MBK/82

# Number Theory




## Fermat's Last Theorem

### Basic Tools

**Takeshi Saito**, *University of Tokyo, Japan*

This book, together with the companion volume, *Fermat's Last Theorem: The proof*, presents in full detail the proof of Fermat's Last Theorem given by Wiles and Taylor. With these two books, the reader will be able to see the whole picture of the proof to appreciate one of the deepest achievements in the history of mathematics.

Crucial arguments, including the so-called 3–5 trick, $R = T$ theorem, etc., are explained in depth. The proof relies on basic background materials in number theory and arithmetic geometry, such as elliptic curves, modular forms, Galois representations, deformation rings, modular curves over the integer rings, Galois cohomology, etc. The first four topics are crucial for the proof of Fermat's Last Theorem; they are also very important as tools in studying various other problems in modern algebraic number theory. The remaining topics will be treated in the second book to be published in the same series in 2014. In order to facilitate understanding the intricate proof, an outline of the whole argument is described in the first preliminary chapter, and more details are summarized in later chapters.

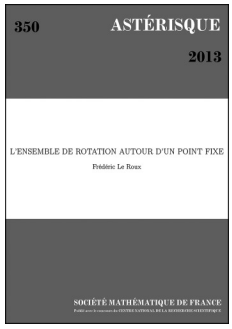
**Contents:** Synopsis; Elliptic curves; Modular forms; Galois representations; The 3–5 trick; $R = T$; Commutative algebra; Deformation rings; Appendix A; Bibliography; Symbol index; Subject index.

**Translations of Mathematical Monographs** (*Iwanami Series in Modern Mathematics*), Volume 243

November 2013, approximately 211 pages, Softcover, ISBN: 978-0-8218-9848-2, LC 2013023932, 2010 *Mathematics Subject Classification:* 11D41; 11G05, 11F11, 11F80, 11G18, **AMS members US$39.20**, List US$49, Order code MMONO/243

# New AMS-Distributed Publications

# Analysis




## L'ensemble de Rotation Autour d'un Point Fixe

**Frédéric Le Roux**, *Université Paris Sud, Orsay, France*

**A note to readers**: This book is in French.

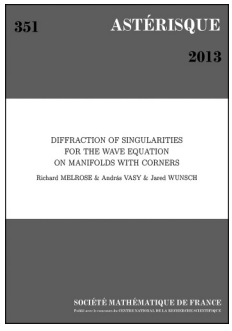
Given a fixed point for a surface homeomorphism, one can define a rotation set around this fixed point, which is a conjugacy invariant. The author initiates the study of this invariant. In particular, he explores the links with other dynamical properties such as the existence of periodic orbits, the differentiability at the fixed point, the Poincaré-Lefschetz index when the fixed point is isolated.

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:** Le nombre de rotation, du cercle aux surfaces; L'ensemble de rotation autour d'un point fixe; Quand ça tourne …; … et quand ça ne tourne pas; Épilogue: le théorème des trois-quatre points fixes; Bibliographie.

**Astérisque**, Number 350

May 2013, 109 pages, Softcover, ISBN: 978-2-85629-366-9, 2010 *Mathematics Subject Classification:* 37E30, 37C25, **AMS members US$41.60**, List US$52, Order code AST/350




## Diffraction of Singularities for the Wave Equation on Manifolds with Corners

**Richard Melrose**, *Massachusetts Institute of Technology, Cambridge, MA*, **András Vasy**, *Stanford University, CA*, and **Jared Wunsch**, *Northwestern University, Evanston, IL*

The authors consider the fundamental solution to the wave equation on a manifold with corners of arbitrary codimension. If the initial pole of the solution is appropriately situated, the authors show that the singularities which are diffracted by the corners (i.e., loosely speaking, are not propagated along limits of transversely reflected rays) are

smoother than the main singularities of the solution. More generally, the authors show that subject to a hypothesis of nonfocusing, diffracted wavefronts of any solution to the wave equation are smoother than the incident singularities. These results extend the authors' previous work on edge manifolds to a situation where the fibers of the boundary fibration, obtained here by blowup of the corner in question, are themselves manifolds with corners.

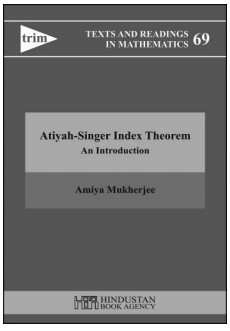
*This item will also be of interest to those working in differential equations.*

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; Geometry: metric and Laplacian; Bundles and bicharacteristics; Edge-b calculus; Differential-pseudodifferential operators; Coisotropic regularity and non-focusing; Edge propagation; Propagation of fiber-global coisotropic regularity; Geometric theorem; Index of notation; Bibliography.

**Astérisque**, Number 351

May 2013, 136 pages, Softcover, ISBN: 978-2-85629-367-6, 2010 *Mathematics Subject Classification:* 58J47, 35L05, 78A45, **AMS members US$41.60**, List US$52, Order code AST/351




## Atiyah-Singer Index Theorem

### An Introduction

**Amiya Mukherjee**, *Indian Statistical Institute, Calcutta, India*

This monograph is a thorough introduction to the Atiyah-Singer index theorem for elliptic operators on compact manifolds without boundary. The main theme is only the classical index theorem and some of its applications, but not the subsequent developments and simplifications of the theory.

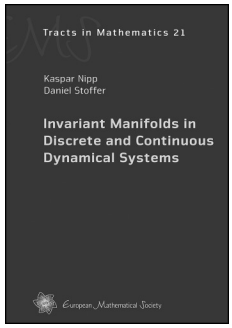
The book is designed for a complete proof of the $K$-theoretic index theorem and its representation in terms of cohomological characteristic classes. In an effort to make the demands on the reader's knowledge of background materials as modest as possible, the author supplies the proofs of almost every result. The applications include Hirzebruch signature theorem, Riemann-Roch-Hirzebruch theorem, and the Atiyah-Segal-Singer fixed point theorem, etc.

A publication of Hindustan Book Agency; distributed within the Americas by the American Mathematical Society. Maximum discount of 20% for all commercial channels.

**Contents:** $K$-theory; Fredholm operators and Atiyah-Jädnich theorem; Bott periodicity and Thom isomorphism; Pseudo-differential operators; Characteristic classes and Chern-Weil construction; Spin structure and Dirac operator; Equivariant $K$-theory; The index theorem; Cohomological formulation of the index theorem; Bibliography; Index.

**Hindustan Book Agency**

September 2013, 276 pages, Hardcover, ISBN: 978-93-80250-54-0, 2010 *Mathematics Subject Classification:* 58-02, 58J20, 58J40, 58A10, 58A12, 58A14, 57R20, 57R50, 55R91, **AMS members US$48**, List US$60, Order code HIN/64




## Invariant Manifolds in Discrete and Continuous Dynamical Systems

**Kaspar Nipp** and **Daniel Stoffer**, *ETH Zürich, Switzerland*

In this book, dynamical systems are investigated from a geometric viewpoint. Admitting an invariant manifold is a strong geometric property of a dynamical system. This text presents rigorous results on invariant manifolds and gives examples of possible applications.

In the first part, discrete dynamical systems in Banach spaces are considered. Results on the existence and smoothness of attractive and repulsive invariant manifolds are derived. In addition, perturbations and approximations of the manifolds and the foliation of the adjacent space are treated. In the second part, analogous results for continuous dynamical systems in finite dimensions are established. In the third part, the theory developed is applied to problems in numerical analysis and to singularly perturbed systems of ordinary differential equations.

The mathematical approach is based on the so-called graph transform, already used by Hadamard in 1901. The aim is to establish invariant manifold results in a simple setting that provides quantitative estimates.

The book is targeted at researchers in the field of dynamical systems interested in precise theorems that are easy to apply. The application part might also serve as an underlying text for a student seminar in mathematics.

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

**Contents:** *Discrete Dynamical Systems—Maps:* Existence; Perturbation and approximation; Smoothness; Foliation; Smoothness of the foliation with respect to the base point; *Continuous Dynamical Systems—ODEs:* A general result for the time-T map; Invariant manifold results; *Applications:* Fixed points and equilibria; The one-step method associated to a linear multistep method; Invariant manifolds for singularly perturbed ODEs; Runge–Kutta methods applied to singularly perturbed ODEs; Invariant curves of perturbed harmonic oscillators; Blow-up in singular perturbations; Application of Runge–Kutta methods to differential-algebraic equations; Appendices; Bibliography; Index.

**EMS Tracts in Mathematics**, Volume 21

August 2013, 225 pages, Hardcover, ISBN: 978-3-03719-124-8, 2010 *Mathematics Subject Classification:* 37-02, 37Cxx, 37Dxx, 35Cxx, 34Dxx, 65Lxx, 65P10, **AMS members US$62.40**, List US$78, Order code EMSTM/21

# Classified Advertisements

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

## CALIFORNIA

### UNIVERSITY OF CALIFORNIA, DAVIS
### Faculty Position in Mathematics

The Department of Mathematics at the University of California, Davis, invites applications for a tenure-track or tenured faculty position starting July 1, 2014.

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 excellent performance in teaching and research. 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/.

Applications will be accepted until the position is filled. To guarantee full consideration, the application should be received by November 30, 2013. To apply: submit the AMS Cover Sheet and supporting documentation electronically through http://www.mathjobs.org/.

The University of California, Davis, is an Affirmative Action/Equal Opportunity Employer.

000042

### UNIVERSITY OF CALIFORNIA, DAVIS
### Arthur J. Krener
### Assistant Professor Positions in Mathematics

The Department of Mathematics at the University of California, Davis, is soliciting applications for one or more Arthur J. Krener positions starting July 1, 2014.

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, 2010. The annual salary is $58,100. The teaching load is 3 to 4 quarter-long courses. Krener 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 95616-8633.

Applications will be accepted until the positions are filled. For full consideration, the application should be received by November 30, 2013. To apply: submit the AMS Cover Sheet and supporting documentation electronically through http://www.mathjobs.org/.

The University of California, Davis, is an Affirmative Action/Equal Opportunity Employer.

000043

### UNIVERSITY OF CALIFORNIA, LOS ANGELES
### Tenured/Tenure-Track positions

The Department of Mathematics invites applications for tenure-track/tenure faculty positions. Salary is commensurate with the level of experience. Job Tracking #1010-1415-05.

For fullest consideration, all application materials should be submitted on or before December 1, 2013. A Ph.D. is required for all positions.

We also plan to make temporary and visiting appointments in the categories 1-4 below. Depending on the level, candidates must give evidence of potential or demonstrated distinction in scholarship and teaching.

Temporary Positions:

(1) E.R. Hedrick Assistant Professorships. Salary is $64,300 and appointments are for three years. The teaching load is four one-quarter courses per year. Job Tracking #1010-1415-01

(2) Computational and Applied Mathematics (CAM) Assistant Professorships. Salary is $64,300, and appointments are for three years. The teaching load is normally reduced by research funding to two quarter courses per year. Job Tracking #1010-1415-02

(3) Program in Computing (PIC) Assistant Adjunct Professorships. Salary is $66,800. 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 additional course every two years. Initial appointments are for one year and

**Suggested** uses for classified advertising are positions available, books or lecture notes for sale, books being sought, exchange or rental of houses, and typing services.

**The 2012 rate is** $3.50 per word with a minimum two-line headline. 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: November 2013 issue–August 29, 2013; December 2013 issue–September 30, 2013; January 2014 issue–October 29, 2013; February 2014 issue–December 2, 2013; March 2014 issue–January 2, 2014; April 2014 issue–January 30, 2014.

**U.S. laws prohibit** discrimination in employment on the basis of color, age, sex, race, religion, or national origin. "Positions Available" advertisements from institutions outside the U.S. cannot be published unless they are accompanied by a statement that the institution does not discriminate on these grounds whether or not it is subject to U.S. laws. Details and specific wording may be found on page 1373 (vol. 44).

**Situations wanted advertisements** from involuntarily unemployed mathematicians are accepted under certain conditions for free publication. Call toll-free 800-321-4AMS (321-4267) in the U.S. and Canada or 401-455-4084 worldwide for further information.

**Submission:** Promotions Department, AMS, P.O. Box 6248, Providence, Rhode Island 02940; or via fax: 401-331-3842; or send email to classads@ams.org. AMS location for express delivery packages is 201 Charles Street, Providence, Rhode Island 20904. Advertisers will be billed upon publication.

possibly longer, up to a maximum service of four years. Job Tracking #1010-1415-03

(4) 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 $54,300-$60,700. The teaching load for Adjuncts is six one-quarter courses per year. Job Tracking #1010-1415-04

Applications and supporting documentation must be submitted electronically via www.mathjobs.org. All letters of evaluation are subject to UCLA campus policies on confidentiality. Refer potential reviewers to the UCLA Statement of Confidentiality at http://www.math.ucla.edu/people/confidentiality.pdf.

For fullest consideration, all application materials should be submitted on or before December 6, 2013. A Ph.D. is required for all positions.

The university is an Equal Opportunity/Affirmative Action Employer. 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 asks that applicants complete the Equal Opportunity Employer survey for Letters and Science at the following URL: http://cis.ucla.edu/facultysurvey. Please use Job Tracking numbers listed above.

000045

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**UNIVERSITY OF CALIFORNIA, SANTA BARBARA**
**Department of Mathematics**
**Tenure-Track Position**

The Department of Mathematics invites applications for a Tenure-Track Assistant Professor position in Analysis with an emphasis in Partial Differential Equations. UC Santa Barbara offers a unique environment where innovative, interdisciplinary, and foundational research is conducted in a collegial atmosphere. We are looking for candidates who have demonstrated exceptional promise through novel research with strong potential to interact with colleagues in applied analysis, the natural sciences, or engineering. Demonstrated research excellence and potential to become an effective teacher are required. Candidates must possess a Ph.D. by September 2014. Appointments begin July 1, 2014. To apply for this position(s), applicants must submit a curriculum vita, statement of research, statement of teaching philosophy, & the American Mathematical Society cover sheet (available online at http://www.ams.org), and arrange for four letters of reference to be sent (at least one of which is directed towards teaching). Materials should be submitted electronically via http://www.mathjobs.org. Applications received on or before November 15, 2013 will be given full consideration. Questions can be emailed to recruitment@math.ucsb.edu. The department is especially interested in candidates who can contribute to the diversity and excellence of the academic community through research, teaching and service. UCSB is an Equal Opportunity/Affirmative Action Employer.

000048

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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. 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.

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 up to 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 www.mathjobs.org. Questions may be directed to apptsec@math.uchicago.edu. We will begin screening applications on November 1, 2013. Screening will continue until all available positions are filled.

The University of Chicago is an Affirmative Action/Equal Opportunity Employer.

000031

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## MARYLAND

**JOHNS HOPKINS UNIVERSITY**
**Department of Mathematics**
**J. J. Sylvester Assistant Professor**

The Department of Mathematics invites applications for 2-year and 3-year nontenure-track Assistant Professor positions beginning Fall 2014. The J.J. Sylvester Assistant Professorship is offered to Ph.D. recipients who are beginning their research career and have outstanding research potential. Candidates in all areas of pure mathematics are encouraged to apply. The teaching load is three courses per academic year. To submit your application, go to http://www.mathjobs.org/jobs/jhu. Submit the AMS cover sheet, your curriculum vitae, and research and teaching statements, and ensure that at least four letters of recommendation, one of which addresses teaching, are submitted by the reference writers. If you are unable to apply online, you may send application materials to: Appointments Committee, Department of Mathematics, Johns Hopkins University, 404 Krieger Hall, Baltimore, MD 21218. If you have questions concerning this position, please write to cpoole@jhu.edu. Preference will be given to applications received by December 1, 2013. The Johns Hopkins University is an Affirmative Action/Equal Opportunity Employer. Minorities and women candidates are encouraged to apply.

000022

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**JOHNS HOPKINS UNIVERSITY**
**Department of Mathematics**
**Tenure-Track Assistant Professor**

The Department of Mathematics invites applications for two positions at the tenure-track Assistant Professor level beginning July 1, 2014. A Ph.D. degree or its equivalent and demonstrated promise in research and commitment to teaching are required. Candidates in all areas of pure mathematics are encouraged to apply. To submit your application, go to http://www.mathjobs.org/jobs/jhu. Submit the AMS cover sheet, your curriculum vitae, list of publications, and research and teaching statements, and ensure that at least four letters of recommendation, one of which addresses teaching, are submitted by the reference writers. If you are unable to apply online, you may send application materials to: Appointments Committee, Department of Mathematics, Johns Hopkins University, 404 Krieger Hall, Baltimore, MD 21218. If you have questions concerning this position, please write to cpoole@jhu.edu. Preference will be given to applications received by October 15, 2013. The Johns Hopkins University is an Affirmative Action/Equal Opportunity Employer. Minorities and

women candidates are encouraged to apply.

000023

**JOHNS HOPKINS UNIVERSITY**
**Department of Mathematics**

The Department of Mathematics invites applications for tenured positions at the Associate and Full Professor level beginning fall 2014 or later. The department is seeking candidates in areas of pure mathematics that fit in with the existing areas of the department, with an emphasis on analysis and geometry. Applications may be submitted online at http://www.mathjobs.org/jobs/jhu or mailed to: Appointments Committee, Department of Mathematics, Johns Hopkins University, 404 Krieger Hall, Baltimore, MD 21218. Submit the AMS cover sheet, a curriculum vitae, a list of publications, and the names and addresses of suggested references. The department will assume the responsibility of soliciting letters of evaluation and will provide evaluators with a summary of policies on confidentiality of letters of evaluation. If you have questions concerning this position, please write to cpoole@jhu.edu. Applications received by October 15, 2013, will be given priority. The Johns Hopkins University is an Affirmative Action/Equal Opportunity Employer. Minorities and women candidates are encouraged to apply.

000024

## MASSACHUSETTS

**MASSACHUSETTS INSTITUTE OF TECHNOLOGY**
**Department of Mathematics**

The Mathematics Department at MIT is seeking to fill positions in Pure and Applied Mathematics, and Statistics at the level of Instructor, Assistant Professor, or higher beginning September 2014. The department also seeks candidates for the Schramm Postdoctoral Fellowship. Appointments are based primarily on exceptional research qualifications. Appointees will be expected to fulfill teaching duties and to pursue their own research program. Ph.D. required by employment start date.

For more information and to apply, please visit http://www.mathjobs.org. To receive full consideration, submit applications by December 1, 2013. MIT is an Equal Opportunity, Affirmative Action Employer.

000046

**WILLIAMS COLLEGE**
**Department of Mathematics and Statistics**

The Williams College Department of Mathematics and Statistics invites applications for two tenure-track positions in mathematics, beginning fall 2014, at the rank of assistant professor (in an exceptional case, a more advanced appointment may be considered). We are seeking highly qualified candidates who have demonstrated excellence in teaching, who will establish an active and successful research program, 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 12-week semester and a winter term course every other January. Applicants are encouraged to apply electronically at http://mathjobs.org or send a vita and have three letters of recommendation on teaching and research sent to Susan Loepp, Chair of the Hiring Committee, Department of Mathematics and Statistics, Williams College, 18 Hoxsey Street, Williamstown, MA 01267. Teaching and research statements are also welcome. Evaluation of applications will begin on or after November 15 and will continue until the position is filled. All offers of employment are contingent upon completion of a background check. Further information is available upon request. For more information on the Department of Mathematics and Statistics, visit http://math.williams.edu/. Williams College is a coeducational liberal arts institution located in the Berkshire Hills of western Massachusetts with easy access to the culturally rich cities of Albany, Boston, and New York City. The college is committed to building and supporting a diverse population of students, and to fostering an inclusive faculty, staff, and curriculum. Williams has built its reputation on outstanding teaching and scholarship and on the academic excellence of its students. Please visit the Williams College website http://www.williams.edu/. Beyond meeting fully its legal obligations for non-discrimination, Williams College is committed to building a diverse and inclusive community where members from all backgrounds can live, learn, and thrive.

000032

## NEW JERSEY

**INSTITUTE FOR ADVANCED STUDY**
**School of Mathematics**
**Princeton, NJ**

During the 2014-15 academic year, the School of Mathematics at the Institute for Advanced Study has a limited number of one- and two-year memberships with financial support for research in mathematics and computer science.

The school frequently sponsors special programs. However, these programs comprise no more than one-third of the membership so that each year a wide range of mathematics is supported. During the 2014-15 academic year, Claire Voisin, Institut de Mathématiques de Jussieu, will be the school's Distinguished Visiting Professor. Professor Voisin will lead a special program on "The Topology of Algebraic Varieties". For more information about the special program for the year, please see the school's homepage.

Several years ago the school established the von Neumann Fellowships. Up to eight of these fellowships will be available for each academic year. To be eligible for the von Neumann Fellowships, applicants should be at least five, but no more than fifteen, years following the receipt of their Ph.D.

The Veblen Research Instructorship is a three-year position which was established in partnership with the Department of Mathematics at Princeton University 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. Usually the first and third year of the instructorship is spent at Princeton University and will carry regular teaching responsibilities. The second year is spent at the Institute and dedicated to independent research of the instructor's choice.

Candidates must have given evidence of ability in research comparable at least with that expected for the Ph.D. degree. Application materials may be requested from Applications, School of Mathematics, Institute for Advanced Study, Einstein Drive, Princeton, NJ 08540; applications@math.ias.edu. Postdoctoral computer science and discrete mathematics applicants may be interested in applying for a joint (2-year) position with one of the following: The Department of Computer Science at Princeton University, http://www.cs.princeton.edu, DIMACS at Rutgers, The State University of New Jersey, http://www.dimacs.rutgers.edu or the Intractability Center, http://intractability.princeton.edu. For a joint appointment, applicants should apply to the School of Mathematics as well as to the above noting their interest in a joint appointment.

Applications may be found online at: https://applications.ias.edu. The deadline for all applications is December 1, 2013. The Institute for Advanced Study is committed to diversity and strongly encourages applications from women and minorities.

000027

## OREGON

**PORTLAND STATE UNIVERSITY**
**Portland, Oregon**
**Fariborz Maseeh Department of Mathematics and Statistics**
**Maseeh Professorship in Mathematical Sciences**

The department invites applications for a Maseeh Professorship in Mathematical Sciences. The position begins in Fall 2014 and is part of a broader initiative to develop a world-class program in computational mathematics and statistics. The initiative is supported by a $3.9M gift received recently from the Massiah Foundation. Exceptional candidates at all levels will be seriously considered, however, the intent is to fill this position at the Associate Professor level with tenure or tenure-track.

The successful candidate is expected to participate in the development of our strong and highly visible research and educational programs. We are looking for exceptional applicants with an outstanding record of research, external funding, and a commitment to excellence in teaching. We are interested in mathematicians and statisticians who demonstrate the willingness and ability to expand the multidisciplinary outreach of the department into the health sciences, engineering, computer science, or finance and business.

The successful candidate is expected to teach graduate and undergraduate courses, participate in supervising graduate students, as well as conduct research. In particular, the new hire is expected to contribute to our novel Mathematical Sciences Ph.D. program (http://www.pdx.edu/math/), to function and communicate effectively and respectfully within the context of varying beliefs, behaviors, and cultural backgrounds, to seek opportunities to gain experience and collaborations in diverse, multicultural, and inclusive settings, adhering to all of PSU's policies including the policies on Prohibited Discrimination & Harassment and the Professional Standards of Conduct.

Candidates should have a Ph.D. degree (preferably in Mathematical Sciences or Statistics) and include a current CV, a statement of interest that contains a discussion of what the candidate brings to the position, a research agenda, a description of the candidate's outreach and teaching philosophies, and at least three letters of recommendation. Please address all materials to the Maseeh Professor Search Committee and send (in PDF format) to maseeh-search@pdx.edu.

Consideration of Applications will begin December 15, 2013, and will continue until the position is filled.

Portland is consistently ranked as one of the world's most livable cities, and Portland State University has established a record of excellence in research, teaching, community outreach, and sustainability. Please see http://www.pdx.edu for more details.

Portland State University is an Affirmative Action, Equal Opportunity Institution, and welcomes applications from diverse candidates and candidates who support diversity.

000035

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**PORTLAND STATE UNIVERSITY**
**Portland, Oregon**
**Fariborz Maseeh Department of Mathematics and Statistics**
**Tenure-Track Position in Mathematical Sciences**

The department invites applications for a tenure-track position in Mathematical Sciences, to begin Fall 2014. The intent is to fill this faculty position at the Assistant Professor level in an area compatible with those currently represented in the department (http://www.pdx.edu/math). Applicants must have a Ph.D. in Mathematics Sciences, or equivalent. We are seeking applicants with the potential for conducting high quality independent research, contributing to our Ph.D. programs, and securing external funding.

The new hire is required to teach graduate and undergraduate courses, actively participate in supervising graduate students, as well as conducting research. It is expected that the new hire will contribute to our novel Mathematical Sciences Ph.D. program (http://www.pdx.edu/math/ph-d-mathematical-sciences) by offering new courses and attracting outstanding students.

Qualified applicants are requested to submit a current CV, a statement of research interest that details what the candidate brings to the position, a description of teaching philosophy, and at least three letters of recommendation. Please address all materials to the Mathematical Sciences Search Committee and send (in PDF format) to mathposition@pdx.edu.

Consideration of applications will begin January 2, 2014, and will continue until the position is filled.

Portland is consistently ranked as one of the world's most livable cities, and Portland State University has an established record of excellence in research, teaching, community outreach, and sustainability. Please see http://www.pdx.edu for more details.

Portland State University is an Affirmative Action, Equal Opportunity Institution, and welcomes applications from diverse candidates and candidates who support diversity.

000036

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**PORTLAND STATE UNIVERSITY**
**Portland, Oregon**
**Fariborz Maseeh Department of Mathematics and Statistics**
**Tenure-Track Position in Mathematics Education**

The department invites applications for a tenure-line faculty position at the assistant or associate professor level in mathematics education with a starting date of September 16, 2014. Applicants must have a Ph.D. in mathematics education and a strong background in mathematics such as a master's degree in the field with an established research record in mathematics education. Applicants must also demonstrate excellence in teaching mathematics, have a record of working with mathematics education doctoral students, and provide evidence of successful funding support for their research and/or graduate students.

The new hire will be joining an active Mathematics Education group. Currently, several NSF funded projects related to undergraduate mathematics education, elementary mathematics education, statistics and computer science education, the professional development of mathematic teachers, research in the teaching and learning of advanced mathematics and teacher learning are in progress. Other collaborations are possible with mathematics educator colleagues residing in the Department of Curriculum and Instruction in the School of Education or faculty in our new STEM center.

Duties include teaching mathematics and mathematics education courses, advising students, committee assignments, and directing Mathematics Education doctoral dissertations and master's level curriculum projects. Successful hires will be expected to continue a strong research program in mathematics education that includes the procurement of external funding. The area of research interest within mathematics, statistics, or computer science education is open.

Several programs are housed in the department involving mathematics education: the Ph.D. in Mathematics Education, MST/MAT in Mathematics (licensing is through the graduate programs in the School of Education), Graduate Certificate in Mathematics for Middle School Teachers, Secondary Education Option in BS/BA Mathematics, and the Mathematics Minor for Middle School Teachers.

Qualified applicants are to submit an application including a letter of intent; a current CV; three letters of recommendation, at least one that addresses teaching; a teaching statement; and a research plan. Transcripts will be requested from finalists. Please address all materials to Mathematics Education Search Committee

and send in (PDF format) electronically to mathed@pdx.edu.

Consideration of applications begins on January 2, 2014, and will continue until the position is filled.

Portland is consistently ranked as one of the world's most livable cities, and Portland State University has an established record of excellence in research, teaching, community outreach, and sustainability. Please see http://www.pdx.edu for more details.

Portland State University is an Affirmative Action, Equal Opportunity Institution, and welcomes applications from diverse candidates and candidates who support diversity.

000037

## PENNSYLVANIA

### PENN STATE UNIVERSITY
### Faculty Positions, Department of Mathematics

Subject to availability of funding, the Penn State Mathematics Department will seek to fill openings for S. Chowla Research Assistant Professors and for tenure and tenure track faculty positions.

**S. Chowla Research Assistant Professor.** Successful candidates will be new or recent Ph.D's with exceptional research potential and a commitment to excellence in teaching. These non-tenure-track appointments are for three years. Starting salary is $53,000 for the nine month academic year. The Chowla program is designed to maximize the professional development of its participants and provides a research stipend. The department may in addition make other postdoctoral appointments. Applicants for the Chowla position will automatically be considered for these appointments also. Initial offers will be made in January 2014.

**Tenure or Tenure-Track Faculty Position.** Candidates from all areas of mathematics will be considered. There may be up to three positions in the area of Probability. A Ph.D. degree or its equivalent is required. Online application via http://www.mathjobs.org is strongly preferred. Review of applications will begin November 15, 2013, and will continue until positions are filled. Required application materials include:

- Online application
- At least three reference letters, one of which should address in detail the candidate's abilities as a teacher
- Curriculum Vitae
- Publication List
- Research Statement
- Teaching Statement

Persons who are unable to apply using the mathjobs.org website or who do not wish to do so may send application materials to:

Search Committee
Department of Mathematics
Penn State University
107 McAllister Building
University Park, PA 16802

We encourage applications from individuals of diverse backgrounds. Penn State is committed to affirmative action, equal opportunity and the diversity of its workforce.

000028

## RHODE ISLAND

### BROWN UNIVERSITY
### Associate Professor

The Mathematics Department at Brown University invites applications for one position at the level of Associate Professor with tenure to begin July 1, 2014 (exceptionally qualified senior candidates may be considered for appointment as Full Professor). Candidates should have a distinguished research record and a strong commitment to excellence in undergraduate and graduate teaching. Preference will be given to applicants with research interests consonant with those of the present members of the department. For more information see: http://www.math.brown.edu/faculty/faculty.html. Qualified individuals are invited to submit a letter of application and a curriculum vitae to: http://www.mathjobs.org. Applicants should include the names of five references that would be contacted at the appropriate time by the Search Committee. Applications received by October 15, 2013, will receive full consideration, but the search will remain open until the position is closed or filled. For further information or inquiries, write to srsearch@math.brown.edu. Brown University is an Equal Opportunity/Affirmative Action Employer and encourages applications from women and minorities.

000040

## SOUTH CAROLINA

### UNIVERSITY OF SOUTH CAROLINA
### Department of Mathematics
### Algebra
### Tenure-track Assistant Professor

Applications are invited for a tenure-track Assistant Professor position in the area of algebra. Areas of particular interest include algebraic geometry, commutative algebra, and representation theory.

Candidates must have a Ph.D. in Mathematics, an outstanding research program, a commitment to effective teaching at the undergraduate and graduate levels, and a demonstrated potential for excellence in both research and teaching.

Applicants must apply electronically at http://www.mathjobs.org. A completed application should contain a cover letter, standard AMS cover sheet, curriculum vitae, description of research plans, statement of teaching philosophy, and four letters of recommendation. One of the letters should appraise the candidate's teaching ability.

The beginning date for the position will be August 16, 2014. Review of applications will begin on December 1, 2013, and continue until the position is filled. To ensure consideration, applications should be received by January 8, 2014. Please address inquiries to vraciu@math.sc.edu.

The Mathematics Department, located in the heart of the historic campus, currently has 34 tenured and tenure-track faculty, 5 instructors, 48 graduate students, over 250 majors, and 40 minors. Faculty research interests include algebra, analysis, applied and computational math, biomath, discrete math, geometry, logic, and number theory.

The University of South Carolina's main campus is located in the state capital, close to the mountains and the coast. The Carnegie Foundation for the Advancement of Teaching has designated the University of South Carolina as one of only 73 public and 32 private academic institutions with "very high research activity" and also lists USC as having strong focus on community engagement. The university has over 31,000 students on the main campus (and over 46,000 students system-wide), more than 350 degree programs, and a nationally-ranked library system that includes one of the nation's largest public film archives. Columbia, the capital of South Carolina, is the center of a greater metropolitan area with a population over 750,000.

The University of South Carolina is an Affirmative Action, Equal Opportunity Employer. Minorities and women are encouraged to apply. The University of South Carolina does not discriminate in educational or employment opportunities or decisions for qualified persons on the basis of race, color, religion, sex, national origin, age, disability, sexual orientation, or veteran status.

000034

### UNIVERSITY OF SOUTH CAROLINA
### Department of Instruction & Teacher Education
### and Department of Mathematics Joint Appointment
### Assistant Professor with Expertise in Mathematics Education

The Departments of Instruction & Teacher Education and Mathematics at the University of South Carolina invite applications for a full-time tenure-track assistant professor in Mathematics Education. The position will require meeting the tenure criteria of the Department of Instruction and Teacher Education but include substantial teaching and service expectations in the Department of Mathematics.

The successful applicant is anticipated to begin work in August 2014

**Qualifications:** Applicants must have an earned or pending doctorate in mathematics, education, or a related field with evidence of significant study and expertise in mathematics education, must also have a master's degree in mathematics or its equivalent (minimum of 24 graduate credits in mathematics or statistics), a record of teaching experience relevant to mathematics education, expertise in educational technology applications, and an emerging record of scholarly work in mathematics education. Preference will be given to applicants with (1) experience working with diverse populations; (2) the potential for success in securing external funding, particularly in the areas of mathematics or education; and (3) expertise in online and distributed learning.

**Responsibilities:** The successful applicant will be expected to teach undergraduate mathematics and mathematics education courses; work to improve the undergraduate sequence of mathematics courses, assist in developing highly effective teaching assistants, collaborate with faculty in mathematics and education on using technology to advance learning, develop a strong record of research and publication in mathematics education; secure external funding for research and service projects; and provide service to the institution, schools, and profession.

**Opportunities:** The successful applicant will have opportunities to initiate and sustain school-university partnerships; to teach courses and conduct research at USC Professional Development School or partnership sites; and to teach and advise undergraduate students majoring in mathematics and in education and graduate students in the Master's of Teaching (M.T./M.A.T) initial certification program in Secondary Education, Master's in Mathematics (M.M.), and Ph.D. in Teaching and Learning programs.

Application: Applicants must apply electronically at http://www.mathjobs.org. A completed application must contain each of the following: (1) a letter of application, (2) standard AMS cover sheet (part of the mathjobs.org registration), (3) curriculum vitae, (4) sample publications, and (5) arrange for four letters of recommendation from references and official transcripts for all earned degrees.

Please address inquiries to either ed.dickey@sc.edu or mcnulty@math.sc.edu. Review of candidate files will begin December 1, 2013, and continue until the position is filled. The University of South Carolina's main campus is located in the state capital, close to the mountains and the coast. The Carnegie Foundation for the Advancement of Teaching has designated the University of South Carolina as one of only 73 public and 32 private academic institutions with "very high research activity" and also lists USC as having strong focus on community engagement. The university has over 31,000 students on the main campus (and over 46,000 students system-wide), more than 350 degree programs, and a nationally-ranked library system that includes one of the nation's largest public film archives. Columbia, the capital of South Carolina, is the center of a greater metropolitan area with a population over 750,000.

The University of South Carolina is an Affirmative Action, Equal Opportunity Employer. Minorities and women are encouraged to apply. The University of South Carolina does not discriminate in educational or employment opportunities or decisions for qualified persons on the basis of race, color, religion, sex, national origin, age, disability, sexual orientation, or veteran status.

000038

## VIRGINIA

### UNIVERSITY OF VIRGINIA
### Department of Mathematics
### Tenure-Track/Tenured Positions

The Department of Mathematics at the University of Virginia, Charlottesville, VA, invites applications for two tenure-track and one tenure-track or tenured open rank full time positions, to begin in the Fall semester of 2014. Applicants must present evidence of outstanding accomplishments and promise in both research and teaching. We seek candidates dedicated to our mission and passionate about teaching in a world class institution. In addition to developing external funding to support research endeavors, candidates will be expected to teach at the graduate and undergraduate levels and provide service to the university, department and professional organizations. Review of applications will begin November 1, 2013; however, the positions will remain open until filled. The appointment start date will begin August 25, 2014. Applicants must be on track to receive a Ph.D. in the relevant field by May 2014 and must hold a Ph.D. at the time of appointment. Priority will be given to applicants in analysis, but candidates whose research interests complement the strengths of the department's current faculty will be considered.

To apply candidates must submit a Candidate Profile through Jobs@UVa (https://jobs.virginia.edu), search on posting number 0612599 and electronically attach the following: a cover letter of interest describing research agenda and teaching experience, a curriculum vitae, and contact information for four references.

In addition, please submit the following required documents electronically through www.MathJobs.org: A cover letter, an AMS Standard Cover Sheet, a curriculum vitae, a publication list, a description of research, and a statement about teaching interests and experience. The applicant must also have at least four letters of recommendation submitted, of which one must support the applicant's effectiveness as a teacher.

Questions regarding the application process in JOBS@UVa should be directed to: Zvezdana Kish, zk4g@virginia.edu, (434) 924-9437.

For additional information about the position contact: http://mathematics-hiring@Virginia.EDU.

The university will perform background checks on all new faculty hires prior to making a final offer of employment.

The College of A&S and the University of Virginia welcome applications from women, minorities, veterans and persons with disabilities; we seek to build a culturally diverse, intellectual environment and are committed to a policy of equal employment opportunity and to the principles of affirmative action in accordance with state and federal laws.

000047

## WASHINGTON

### UNIVERSITY OF WASHINGTON
### Department of Mathematics

Applications are invited for a non-tenure-track Acting Assistant Professor position. The appointment is for a period of up to three years to begin in September 2014. 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, 2013.

The University of Washington is an Affirmative Action, Equal Opportunity Employer. The university is building a culturally diverse faculty and strongly encourages applications from women, minorities, individuals with disabilities, and protected veterans.

000041

## WISCONSIN

### UNIVERSITY OF WISCONSIN-MADISON
### Department of Mathematics

The Department of Mathematics is accepting applications for an assistant professor

(tenure-track) position beginning August 25, 2014, contingent upon budgetary approval by the College of Letters and Science. Applications are invited in all areas of mathematics. The minimum requirement is a Ph.D. in Mathematics or related field, and faculty members are expected to contribute to the research, teaching, and service missions of the department. Candidates should exhibit evidence of outstanding research potential, normally including significant contributions beyond the doctoral dissertation. The teaching responsibility is 3 courses per academic year, including both undergraduate- and graduate-level courses, and a strong commitment to excellence in instruction is also expected. Additional departmental information is available on our website: http://www.math.wisc.edu. An application packet should include a completed AMS Standard Cover Sheet, a curriculum vitae which includes a publication list, and brief descriptions of research and teaching. Application packets should be submitted electronically to http://www.mathjobs.org. Applicants should also arrange to have sent to the above URL address, three to four letters of recommendation, at least one of which must discuss the applicant's teaching experiences and capabilities and potential. To ensure full consideration, application packets must be received by November 15, 2013.

The Department of Mathematics is committed to increasing the number of women and minority faculty. The University of Wisconsin-Madison is an Affirmative Action, Equal Opportunity Employer and encourages applications from women and minorities. Unless confidentiality is requested in writing, information regarding the applicants must be released upon request. Finalists cannot be guaranteed confidentiality. A background check will be required prior to employment.

000039

## KOREA

### INSTITUTE FOR BASIC SCIENCE (IBS)
### Center for Geometry and Physics

The IBS Center for Geometry and Physics (IBS-CGP) invites applications for several tenure-track and postdoctoral research fellowship positions. IBS-CGP is working to bring the world's leading scientists in mathematics together with young researchers to collaborate on research projects with passion and commitment. To this end, IBS recruits based on scientific excellence and creative ideas, rather than pre-determined goals or demonstrated practical outcomes. IBS provides an open and autonomous research environment. The existing members of IBS-CGP are working in symplectic geometry and topology, dynamical systems, mirror symmetry, algebraic geometry, and mathematical aspects of quantum field and string theory.

**Postdoctoral research fellowship positions.** Successful candidates will be new or recent Ph.D.'s with outstanding research potential. These non-tenure-track appointments are for three years, and the salary range is KRW 57,000,000–66,000,000 (approximately USD 50,800–58,800).

**Tenure-track positions.** Successful candidates must have exceptional research qualifications. Starting salary with three years of experience beyond Ph.D. is KRW 92,880,000 (may vary by experience). Relocation expenses and housing allowance for up to 2 years may be provided for qualified overseas candidates.

IBS-CGP offers annual travel funds of KRW 8,000,000 for postdoctoral position and KRW 15,000,000 for tenure-track position in addition to basic research equipment and comprehensive benefits including medical and travel insurance and retirement funds.

A complete application packet should include a cover letter, a curriculum vitae which includes a publication list, a research statement, and at least three letters of recommendation for postdoctoral positions and four for tenure-track positions. For full consideration, application packets must be submitted electronically to cgp@ibs.re.kr by December 15, 2013. IBS encourages applications from individuals of diverse backgrounds. IBS-CGP website: http://cgp.ibs.re.kr.

000044

## SINGAPORE

### NATIONAL UNIVERSITY OF SINGAPORE (NUS)
### Department of Mathematics

The Department of Mathematics at the National University of Singapore (NUS) invites applications for tenured, tenure-track and visiting positions at all levels, beginning in August 2014.

NUS is a research intensive university that provides quality undergraduate and graduate education. The Department of Mathematics has about 65 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, housed in a newly renovated building equipped with state-of-the-art facilities, offers internationally competitive salary with start-up research grants, as well as an environment conducive to active research, with ample opportunities for career development. The teaching load for junior faculty is kept especially light.

The department is particularly interested in, but not restricted to, considering applicants specializing in any of the following areas:

- Ergodic Theory and Dynamical Systems
- Partial Differential Equations and Applied Analysis
- Computational Science, Imaging and Data Science
- Operations Research and Financial Mathematics
- Probability and Stochastic Processes

Application materials should be sent to the Search Committee via email (as PDF files): 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.

000030

## TAIWAN

### NATIONAL CENTRAL UNIVERSITY
### Department of Mathematics

The Department of Mathematics invites applications for the following positions: regular positions at all levels and visiting positions (for a period of up to two years) at the level of assistant professor. All application materials should be sent to department via email (as pdf files) to: ncu5100@ncu.edu.tw or mail to: Chair, Department of Mathematics National Central University No. 300, Jhongda Rd., Jhongli City, Taoyuan County 32001 Taiwan (R. O. C.) Please include the following supporting documentation in the application:

1. Cover letter;
2. Curriculum Vitae;
3. Publication List;
4. Three recommendation Letters (submitted directly by writers).

In order to ensure full consideration, applications should be received by

December 20, 2013. For more information, visit: http://www.math.ncu.edu.tw.

000029

## UNITED ARAB EMIRATES

**THE PETROLEUM INSTITUTE**
**Abu Dhabi, United Arab Emirates**
**Assistant/Associate Professor of Mathematics**

Closing Date: Review of applications will start in September 2013 and continue until all positions are filled.

Job Description: An exciting opportunity exists for early to mid-career mathematicians to join The Petroleum Institute's Department of Mathematics. One position of Assistant/Associate Professor starting in early January 2014 and at least one position of Assistant/Associate Professor starting in August 2014 are available. The department teaches a range of undergraduate and postgraduate level mathematics courses to engineering majors and successful candidates should have the ability to teach across the full range of undergraduate mathematics courses taught by the department.

Selection Criteria: A Ph.D. degree in Mathematics from a recognized university is essential. A minimum of three years tertiary-level teaching experience post Ph.D. and fluency in English are required. In addition, experience in teaching three or more of the following courses: Calculus I, Calculus II, Calculus III, Differential Equations, Probability and Statistics, Linear Algebra, Numerical Methods, and Advanced Engineering Mathematics, to non-mathematics majors is required. Demonstrated commitment to the delivery of high quality teaching including the ability to develop course materials and to coordinate multiple section courses is desirable. Potential to undertake independent research in mathematics or possessing a formal teaching qualification in education would be an advantage.

Additional Details: Salary is competitive and commensurate with qualifications and experience, with an excellent benefits package, including housing and furniture allowance, educational allowance for dependent children, annual airfare allowance, and medical care. The United Arab Emirates levies no income taxes. All applications must include (i) a cover letter expressing interest in the position and earliest availability, (ii) a current curriculum vitae, and (iii) the names, e-mail addresses, and telephone numbers of three references which include both a current/prior employer and a teaching reference. To be considered, you need to apply online through https://career.pi.ac.ae. Only shortlisted candidates will be contacted.

000033

# Mathematical Sciences Employment Center

*Baltimore Convention Center, Baltimore, Maryland*
*January 15–18, 2014*

The Employment Center offers a convenient, safe, and practical meeting place for employers and applicants attending the Joint Meetings. The focus of the Employment Center is on Ph.D.-level mathematical scientists and those that seek to hire them from academia, business, and government.

### Employment Center Web Services

Employment Center registration information will be accessed through the MathJobs.org system. For employers who do not have existing MathJobs.org accounts, it will be possible to set up special Employment Center accounts on MathJobs.org. The website and all information will be available beginning in early September 2013 and will remain accessible through the period of the Employment Center. While some schools may delay appointment-setting until late December, virtually all scheduling will be done before travel takes place, so applicants should expect few or no further appointments after arrival. Registering on site, for applicants, serves no real purpose.

### No Admittance Without a JMM Badge

All applicants and employers planning to enter the Employment Center—even just for one interview—must present a 2014 Joint Meetings Registration badge or they will be denied admittance. Meeting badges are obtained by registering for the Joint Mathematics Meetings and paying a meeting registration fee. See the JMM website at: http://jointmathematicsmeetings.org/jmm for registration instructions and rates.

### Employers: Choose a Table

There are two table types available for employers, based on the number of interviewers who will be present at any one time:

• one or two interviewers per table in the "Quiet Area" (US$315), additional table (US$130).

• three to six interviewers per table in the "Committee Table" area (US$390), additional table (US$140).

• Electricity is available to employers (US$75 per table).

All Employment Center forms are now housed on the MathJobs.org site. An existing account can be used for accessing Employment Center services and paying appropriate fees, or if no account exists, participants can start an account solely for Employment Center use.

Employers are expected to create their own interview schedules as far in advance as possible, using the assisted-email system in Mathjobs.org or using other means of communication.

Please mark appointments as confirmed in your Mathjobs.org account which will allow the appointments to display in the applicants' schedules. At the time of the interview, meet the applicant in the waiting area on site and escort him or her to your table.

### 2014 Employment Center Schedule:

**December 24, 2013**–Advance registration deadline for JMM. Meeting badge will be required for admittance. After this date, meeting registration fees go up and meeting registration may only happen on site in Baltimore.

**OPEN HOURS (NO access before opening time):**

**Wednesday, January 15, 2014–8:00 a.m.–6:00 p.m.**

**Thursday, January 16, 2014–8:00 a.m.–6:00 p.m.**

**Friday, January 17, 2014–8:00 a.m.–6:00 p.m.**

**Saturday, January 18, 2014–9:00 a.m.–12:00 noon.**

**Location:** Exhibit Hall E, Level 100, Baltimore Convention Center, One West Pratt Street, Baltimore, MD

Do not schedule an interview to begin until 15 minutes after opening.

## Employers: How to Register

• Registration runs from early September 2013 through January 18, 2014, at the following website: www.mathjobs.org.

• Use your existing MathJobs.org account or create a new Employer account at www.mathjobs.org. Once a table is reserved, the ad can be placed at any time (or never) and will run until late January.

• To register, go to www.mathjobs.org. Log into your existing account if you have one. Purchase a table by clicking the "EmpCent" logo in the menus along the top tool bar. Use the "buy tables" link. Then post a job using the NewJob link or attach an existing job to your table. By default, applicants may request interviews. You can change this setting.

• Each person who will need to enter the Employment Center area must have a meeting badge (obtained by registering for the JMM and paying a meeting registration fee).

To display an ad on site, and use no Employment Center services at all, submit your one -page paper ad on site in San Diego to the Employment Center staff. There is no fee for this service.

For complete information, visit http://www.ams.org/emp-reg/.

## Applicants: Making the Decision to Attend

• The interview request system which was formerly used by applicants has been discontinued because so few employers were willing to use it. Employers issue invitations based on applications made for the position, and only for candidates that they wish to see.

• The Employment Center offers no guarantees of interviews or jobs. Hiring decisions are not made during or immediately following interviews. In the current job market, the ratio of applicants to employers is about 10:1, and many applicants go completely unnoticed.

• There will ordinarily be no research-oriented postdoctoral positions listed or discussed at the Employment Center.

• Interviews will go to applicants who applied to jobs during the fall and are now being sought out by the institutions for in-person meetings during the JMM.

• There will be no opportunity to speak to employers without a pre-arranged interview, and no walk-up job information tables. Scheduling of interviews is complete prior to the JMM.

In the current job market, the majority of Employment Center employers are academic departments of mathematical sciences seeking to meet a short list of applicants who applied for their open positions during the fall. Each year, a few government or industry employers are present. Often, they are seeking U.S. citizens only due to existing contracts.

All job postings are available on the website in advance, and now that this electronic service is in place, there is no other messaging conducted on paper.

Past attendees have pointed out that all interviews are arranged in advance, and there is no opportunity to make connections on site if it has not happened before the meeting. In a recent survey, fifty percent of applicants responding reported being invited for at least one on-campus visit to an employer they had interviewed with at the Employment Center. Please visit the Employment Center website for further advice, information, and program updates at www.ams.org/emp-reg/.

## Applicants: How to Register

• Early registration is vital since most employers will finalize schedules before arriving in San Diego.

• To register, applicants should log into their MathJobs.org accounts or create a new account, look for the EmpCent icon and mark that they will be attending. Then upload documents, check email for interview invitations, and respond to those.

There are no Employment Center fees for applicants; however, admission to the Employment Center room requires a 2014 JMM badge, obtainable by registering (and paying a fee) for the Joint Mathematics Meetings. To register for the meeting, go to http://jointmathematicsmeetings.org/jmm.

It is possible to attend one or more privately arranged interviews without official Employment Center registration, however, a meeting badge is required to access the interview room.

Applicants should keep track of their interview schedules and note their busy times in their accounts. If invited for an interview at a conflicting time, please ask the employer to offer a new time or suggest one.

For complete information, visit http://www.ams.org/emp-reg/.

Questions about the Employment Center registration and participation can be directed to Steve Ferrucci, AMS Membership and Programs Department, at 800-321-4267, ext. 4113 or by email to emp-info@ams.org.

# AMS Short Course in Baltimore, Maryland

## AMS Short Course on Geometry and Topology in Statistical Inference

This two-day course will take place on Monday and Tuesday before the meeting actually begins. It is organized by **Sayan Mukherjee**, Duke University.

In the current era of information, large amounts of complex data are routinely generated across science and engineering. There are two fundamental challenges to using this data to understand and model the underlying phenomena: the size of the data and the complexity of the data. Often the objects we would like to model have geometric or topological structure; examples include curves or surfaces such as bones or teeth, positive definite matrices or subspaces that describe variation in phenotypic traits due to genetic variation, or the geometry of multivariate trajectories generated from cellular processes or an attack on a computer network.

Modeling these types of data has motivated the use of ideas from geometry and topology in data analysis and has become more prevalent in statistics, computer science, and mathematics. For example, there is a year-long program at the IMA on Scientific and Engineering Applications of Algebraic Topology and a year-long program at SAMSI on low-dimensional representations of high-dimensional data. Two burgeoning research topics related to geometric and topological data analysis are manifold learning, the idea that high-dimensional data is concentrated on low-dimensional manifolds; and topological data analysis, using topological summaries computed from data to model and understand the underlying structure in the data.

In this short course we will explore how geometry and topology are being used in statistical inference to build models that extract structure from data. The main mathematical and statistical ideas we will develop are stochastic models and analysis using geometric and topological objects. The applications we will look at include geometric and topological analysis in (cancer) systems biology, modeling rankings in social networks, and analysis of games using Hodge theory, subspace, and covariance models in quantitative genetics and statistical genetics.

Each talk will be accessible to a general audience and will contain several open questions and/or suggestions for new directions of research. The talks on the first day will provide an overview of the statistical and computational challenges, respectively, in using geometric and topological analysis. An effort will be made in both talks to highlight how geometry and topology play a key role in stochastic modeling and computing. The talks on the second day will consider some specific topics: the interface of topology and geometry with probability, geometry and topology in cancer systems biology, and applications of Hodge theory in data analysis.

### Day One Lectures

(1) **Sayan Mukherjee**, Duke University, *Geometry in statistical inference*: Geometric approaches to data analysis, including manifold learning, subspace inference, factor models, and inferring covariance/positive definite matrices. Applications will be used to highlight methodologies.

(2) **Sayan Mukherjee**, Duke University, *Topology in statistical inference*: Probabilistic perspectives on topological summaries of data such as persistence homology and inference of topological summaries based on the Hodge operator and the Laplacian on forms. Again applications will be used to highlight methodologies.

(3) **Yusu Wang**, Ohio State University, *Computing geometric and topological summaries*: Algorithms for computing geometric and topological summaries of data, including persistence homologies, computational aspects of manifold learning, and distance-based computations in high dimensions.

### Day Two Lectures

(4) **Monica Nicolau**, Stanford University, *Geometry and topology in cancer systems biology*: Examples of geometric and topological data analysis in cancer systems biology. Topological data analysis is used to analyze breast cancer transcriptional data and identify a unique subgroup of Estrogen Receptor-positive (ER+) breast cancers with excellent survival prognosis. A geometric approach to high-dimensional data analysis, called disease-specific genomic analysis (DSGA), will be discussed.

(5) **Matthew Kahle**, Ohio State Unversity, *Random geometry and topology*: The geometry and topology induced by random processes, the topology of random clique complexes, random geometric complexes, limit theorems of Betti numbers of random simplicial complexes.

(6) **Lek-Heng Lim**, University of Chicago, *Hodge operator in data analysis*: Applications of discrete Hodge theory on simplicial complexes to problems in game theory, graphics, imaging, learning, ranking, robotics, voting, and sensor networks.

There are separate registration fees to participate in this course. Advance registration (before December 24): Member US$106, Nonmember US$155; Student, unemployed, or emeritus US$54. Onsite registration: Member US$140; Nonmember US$185; Student, unemployed, or emeritus US$75. To register, go to `http://jointmathematicsmeetings.org/meetings/national/jmm2014/2160_regfees`.

# Meetings & Conferences of the AMS

**IMPORTANT INFORMATION REGARDING MEETINGS PROGRAMS:** AMS Sectional Meeting programs do not appear in the print version of the *Notices.* However, comprehensive and continually updated meeting and program information with links to the abstract for each talk can be found on the AMS website. See `http://www.ams.org/meetings/`. Final programs for Sectional Meetings will be archived on the AMS website accessible from the stated URL and in an electronic issue of the *Notices* as noted below for each meeting.

# Louisville, Kentucky

*University of Louisville*

### October 5–6, 2013

*Saturday – Sunday*

### Meeting #1092

Southeastern Section
Associate secretary: Brian D. Boe
Announcement issue of *Notices*: June 2013
Program first available on AMS website: August 22, 2013
Program issue of electronic *Notices*: October 2013
Issue of *Abstracts*: Volume 34, Issue 3

### Deadlines

For organizers: Expired
For abstracts: Expired

*The scientific information listed below may be dated. For the latest information, see* `www.ams.org/amsmtgs/sectional.html`.

### Invited Addresses

**Michael Hill**, University of Virginia, *Framed manifolds and equivariant homotopy: A solution to the Kervaire Invariant One problem.*

**Suzanne Lenhart**, University of Tennessee and NIMBioS, *Using optimal control of PDEs to investigate population questions.*

**Ralph McKenzie**, Vanderbilt University, *A perspective on fifty years of work, delight and discovery in general algebra.*

**Victor Moll**, Tulane University, *2-adic valuations of classical sequences: A collection of examples.*

### Special Sessions

*Algebraic Coding Theory*, **Steve Szabo**, Eastern Kentucky University, and **Heide Gluesing-Luerssen**, University of Kentucky.

*Algebraic Cryptography*, **Daniel Smith**, University of Louisville.

*Applied Analysis and Inverse Problems*, **Peijun Li**, Purdue University, **Jiguang Sun**, Michigan Technological University, and **Yongzhi Steve Xu**, University of Louisville.

*Combinatorial Commutative Algebra*, **Juan Migliore**, University of Notre Dame, and **Uwe Nagel**, University of Kentucky.

*Commutative Rings, Ideals, and Modules*, **Ela Celikbas** and **Olgur Celikbas**, University of Missouri-Columbia.

*Extremal Graph Theory*, **Jozsef Balogh**, University of Illinois at Urbana-Champaign, and **Louis DeBiasio** and **Tao Jiang**, Miami University, Oxford, OH.

*Finite Universal Algebra*, **Ralph McKenzie**, Vanderbilt University, and **Matthew Valeriote**, McMaster University.

*Fixed Point Theorems and Applications to Integral, Difference, and Differential Equations*, **Jeffrey W. Lyons**, Nova Southeastern University, and **Jeffrey T. Neugebauer**, Eastern Kentucky University.

*Harmonic Analysis and Partial Differential Equations*, **Russell Brown** and **Katharine Ott**, University of Kentucky.

*History of Mathematics and Its Use in Teaching*, **Daniel J. Curtin**, Northern Kentucky University, and **Daniel E. Otero**, Xavier University.

*Homogenization of Partial Differential Equations*, **Zhongwei Shen**, University of Kentucky, and **Yifeng Yu**, University of California, Irvine.

*Mathematical Analysis of Complex Fluids and Flows*, **Xiang Xu**, Carnegie Mellon University, and **Changyou Wang**, University of Kentucky.

*Mathematical Issues in Ecological and Epidemiological Modeling*, **K. Renee Fister**, Murray State University, and **Suzanne Lenhart**, University of Tennessee.

*Mathematical Models in Biology and Physiology*, **Yun Kang**, Arizona State University, and **Jiaxu Li**, University of Louisville.

*Partial Differential Equations from Fluid Mechanics*, **Changbing Hu**, University of Louisville, and **Florentina Tone**, University of West Florida.

*Partially Ordered Sets*, **Csaba Biro** and **Stephen J. Young**, University of Louisville.

*Recent Advances on Commutative Algebra and Its Applications*, **Hamid Kulosman** and **Jinjia Li**, University of Louisville, and **Hamid Rahmati**, Miami University.

*Set Theory and Its Applications*, **Paul Larson**, Miami University, **Justin Moore**, Cornell University, and **Grigor Sargsyan**, Rutgers University.

*Spreading Speeds and Traveling Waves in Spatial-Temporal Evolution Systems*, **Bingtuan Li**, University of Louisville, and **Roger Lui**, Worcester Polytechnic Institute.

*The Work of Mathematicians and Mathematics Departments in Mathematics Education*, **Benjamin Braun**, **Carl Lee**, and **David Royster**, University of Kentucky.

*Topological Dynamics and Ergodic Theory*, **Alica Miller**, University of Louisville, and **Joe Rosenblatt**, University of Illinois at Urbana-Champaign.

*Weak Convergence in Probability and Statistics*, **Cristina Tone**, **Ryan Gill**, and **Kiseop Lee**, University of Louisville.

# Philadelphia, Pennsylvania

*Temple University*

## October 12–13, 2013

*Saturday – Sunday*

## Meeting #1093

Eastern Section
Associate secretary: Steven H. Weintraub
Announcement issue of *Notices*: June 2013
Program first available on AMS website: August 29, 2013
Program issue of electronic *Notices*: October 2013
Issue of *Abstracts*: Volume 34, Issue 3

## Deadlines

For organizers: Expired
For abstracts: Expired

*The scientific information listed below may be dated. For the latest information, see* `www.ams.org/amsmtgs/sectional.html`.

## Invited Addresses

**Patrick Gerald Brosnan**, University of Maryland, *Normal functions.*

**Xiaojun Huang**, Rutgers University at New Brunswick, *Equivalence problems in several complex variables.*

**Barry Mazur**, Harvard University, *Arithmetic statistics: Elliptic curves and other mathematical objects* (Erdős Memorial Lecture).

**Robert Strain**, University of Pennsylvania, *On the Boltzmann equation without angular cut-off.*

## Special Sessions

*Analysis and Computing for Electromagnetic Waves*, **David Ambrose** and **Shari Moskow**, Drexel University.

*Combinatorial Commutative Algebra*, **Tái Huy Há**, Tulane University, and **Fabrizio Zanello**, Massachusetts Institute of Technology and Michigan Technological University.

*Contact and Symplectic Topology*, **Joshua M. Sabloff**, Haverford College, and **Lisa Traynor**, Bryn Mawr College.

*Difference Equations and Applications*, **Michael Radin**, Rochester Polytechnic Institute, and **Faina Berezovskaya**, Howard University.

*Geometric Aspects of Topology and Group Theory*, **David Futer**, Temple University, and **Ben McReynolds**, Purdue University.

*Geometric Topology of Knots and 3-manifolds*, **Abhijit Champanerkar**, **Ilya Kofman**, and **Joseph Maher**, College of Staten Island and The Graduate Center, City University of New York.

*Geometric and Spectral Analysis*, **Thomas Krainer**, Pennsylvania State Altoona, and **Gerardo A. Mendoza**, Temple University.

*Higher Structures in Algebra, Geometry and Physics*, **Jonathan Block**, University of Pennsylvania, **Vasily Dolgushev**, Temple University, and **Tony Pantev**, University of Pennsylvania.

*History of Mathematics in America*, **Thomas L. Bartlow**, Villanova University, **Paul R. Wolfson**, West Chester University, and **David E. Zitarelli**, Temple University.

*Mathematical Biology*, **Isaac Klapper**, Temple University, and **Kathleen Hoffman**, University of Maryland, Baltimore County.

*Meshfree, Particle, and Characteristic Methods for Partial Differential Equations*, **Toby Driscoll** and **Louis Rossi**, University of Delaware, and **Benjamin Seibold**, Temple University.

*Modular Forms and Modular Integrals in Memory of Marvin Knopp*, **Helen Grundman**, Bryn Mawr College, and **Wladimir Pribitkin**, College of Staten Island and the Graduate Center, City University of New York.

*Multiple Analogues of Combinatorial Special Numbers and Associated Identities*, **Hasan Coskun**, Texas A&M University Commerce.

*Nonlinear Elliptic and Wave Equations and Applications*, **Nsoki Mavinga**, Swarthmore College, and **Doug Wright**, Drexel University.

*Parabolic Evolution Equations of Geometric Type*, **Xiaodong Cao**, Cornell University, **Longzhi Lin**, Rutgers University, and **Peng Wu**, Cornell University.

*Partial Differential Equations, Stochastic Analysis, and Applications to Mathematical Finance*, **Paul Feehan** and **Ruoting Gong**, Rutgers University, and **Camelia Pop**, University of Pennsylvania.

*Recent Advances in Harmonic Analysis and Partial Differential Equations*, **Cristian Gutiérrez** and **Irina Mitrea**, Temple University.

*Recent Developments in Noncommutative Algebra*, **Edward Letzter** and **Martin Lorenz**, Temple University.

*Representation Theory, Combinatorics and Categorification*, **Corina Calinescu**, New York City College of Technology, City University of New York, **Andrew Douglas**, New York City College of Technology and Graduate Center, City University of New York, and **Joshua Sussan** and **Bart Van Steirteghem**, Medgar Evers College, City University of New York.

*Several Complex Variables and CR Geometry*, **Andrew Raich**, University of Arkansas, and **Yuan Zhang**, Indiana University-Purdue University Fort Wayne.

*The Geometry of Algebraic Varieties*, **Karl Schwede**, Pennsylvania State University, and **Zsolt Patakfalvi**, Princeton University.

# St. Louis, Missouri

*Washington University*

### October 18–20, 2013

*Friday – Sunday*

### Meeting #1094

Central Section
Associate secretary: Georgia M. Benkart
Announcement issue of *Notices*: August 2013
Program first available on AMS website: September 5, 2013
Program issue of electronic *Notices*: October 2013
Issue of *Abstracts*: Volume 34, Issue 4

### Deadlines

For organizers: Expired
For abstracts: Expired

*The scientific information listed below may be dated. For the latest information, see* `www.ams.org/amsmtgs/sectional.html`.

### Invited Addresses

**Ronny Hadani**, University of Texas at Austin, *Title to be announced.*

**Effie Kalfagianni**, Michigan State University, *Title to be announced.*

**Jon Kleinberg**, Cornell University, *Title to be announced.*

**Vladimir Sverak**, University of Minnesota, *Title to be announced.*

### Special Sessions

*Advances in Difference, Differential, and Dynamic Equations with Applications*, **Elvan Akin**, Missouri S&T University, **Youssef Raffoul**, University of Dayton, and **Agacik Zafer**, American University of the Middle East.

*Advances in Mathematical Methods for Disease Modeling*, **Jimin Ding**, Washington University in St. Louis, **Necibe Tuncer**, University of Tulsa, and **Naveen K. Vaidya**, University of Missouri-Kansas City.

*Algebraic Cycles and Coherent Sheaves*, **Roya Beheshti**, **Matt Kerr**, and **N. Mohan Kumar**, Washington University in St. Louis.

*Algebraic and Combinatorial Invariants of Knots*, **Heather Dye**, McKendree University, **Allison Henrich**, Seattle University, **Aaron Kaestner**, North Park University, and **Louis Kauffman**, University of Illinois.

*Automorphic Forms and Representation Theory*, **Dubravka Ban** and **Joe Hundley**, Southern Illinois University, and **Shuichiro Takeda**, University of Missouri, Columbia.

*Commutative Algebra*, **Lianna Sega**, University of Missouri, Kansas City, and **Hema Srinivasan**, University of Missouri, Columbia.

*Computability Across Mathematics*, **Wesley Calvert**, Southern Illinois University, and **Johanna Franklin**, University of Connecticut.

*Convex Geometry and its Applications*, **Susanna Dann**, **Alexander Koldobsky**, and **Peter Pivovarov**, University of Missouri.

*Geometric Aspects of 3-Manifold Invariants*, **Oliver Dasbach**, Louisiana State University, and **Effie Kalfagianni**, Michigan State University.

*Geometric Topology in Low Dimensions*, **William H. Kazez**, University of Georgia, and **Rachel Roberts**, Washington University in St. Louis.

*Groupoids in Analysis and Geometry*, **Alex Kumjian**, University of Nevada at Reno, **Markus Pflaum**, University of Colorado, and **Xiang Tang**, Washington University in St. Louis.

*Interactions between Geometric and Harmonic Analysis*, **Leonid Kovalev**, Syracuse University, and **Jeremy Tyson**, University of Illinois, Urbana-Champaign.

*Linear and Non-linear Geometry of Banach Spaces*, **Daniel Freeman** and **Nirina Lovasoa Randrianarivony**, St. Louis University.

*Noncommutative Rings and Modules*, **Greg Marks** and **Ashish Srivastava**, St. Louis University.

*Operator Theory*, **John McCarthy**, Washington University in St. Louis.

*PDEs of Fluid Mechanics*, **Roman Shvydkoy**, University of Illinois Chicago, and **Vladimir Sverak**, University of Minnesota.

*Spectral, Index, and Symplectic Geometry*, **Alvaro Pelayo** and **Xiang Tang**, Washington University in St. Louis.

*Statistical Properties of Dynamical Systems*, **Timothy Chumley** and **Renato Feres**, Washington University in St. Louis, and **Hongkun Zhang**, University of Massachusetts, Amherst.

*Topological Combinatorics*, **John Shareshian**, Washington University in St. Louis, and **Russ Woodroofe**, Mississippi State University.

*Wavelets, Frames, and Related Expansions*, **Marcin Bownik**, University of Oregon, **Darrin Speegle**, Saint Louis University, and **Guido Weiss**, Washington University in St. Louis.

*p-local Group Theory, Fusion Systems, and Representation Theory*, **Justin Lynd**, Rutgers University, and **Julianne Rainbolt**, Saint Louis University.

# Riverside, California

*University of California, Riverside*

### November 2–3, 2013

*Saturday – Sunday*

### Meeting #1095

Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: August 2013
Program first available on AMS website: September 19, 2013
Program issue of electronic *Notices*: November 2013
Issue of *Abstracts*: Volume 34, Issue 4

### Deadlines

For organizers: Expired
For abstracts: Expired

*The scientific information listed below may be dated. For the latest information, see* `www.ams.org/amsmtgs/sectional.html`.

### Invited Addresses

**Michael Christ**, University of California, Berkeley, *Title to be announced.*

**Mark Gross**, University of California, San Diego, *Title to be announced.*

**Matilde Marcolli**, California Institute of Technology, *Title to be announced.*

**Paul Vojta**, University of California, Berkeley, *Title to be announced.*

### Special Sessions

*Algebraic Structures in Knot Theory*, **Allison Henrich**, Seattle University, and **Sam Nelson**, Claremont McKenna College.

*Analysis and Geometry of Metric Spaces*, **Asuman G. Aksoy**, Claremont McKenna College, and **Zair Ibragimov**, California State University, Fullerton.

*Categorification in Representation Theory*, **Aaron Lauda** and **David Rose**, University of Southern California.

*Commutative Algebra and its Interaction with Algebraic Geometry and Combinatorics*, **Kuei-Nuan Lin** and **Paolo Mantero**, University of California, Riverside.

*Computational Problems on Large Graphs and Applications*, **Kevin Costello** and **Laurent Thomas**, University of California, Riverside.

*Computer, Mathematics, Imaging, Technology, Network, Health, Big Data, and Statistics*, **Subir Ghosh**, University of California, Riverside.

*Developments in Markov Chain Theory and Methodology*, **Jason Fulman**, University of California, Riverside, and **Mark Huber**, Claremont McKenna College.

*Diophantine Geometry and Nevanlinna Theory*, **Aaron Levin**, Michigan State University, **David McKinnon**, University of Waterloo, and **Paul Vojta**, University of California, Berkeley.

*Dynamical Systems*, **Nicolai Haydn**, University of Southern California, and **Huyi Hu**, Michigan State University.

*Fluids and Boundaries*, **James P. Kelliher**, **Juhi Jang**, and **Gung-Min Gie**, University of California, Riverside.

*Fractal Geometry, Dynamical Systems, and Mathematical Physics*, **Michel L. Lapidus**, University of California, Riverside, **Erin P. J. Pearse**, California State Polytechnic University, San Luis Obispo, and **John A. Rock**, California State Polytechnic University, Pomona.

*From Harmonic Analysis to Partial Differential Equations: In Memory of Victor Shapiro*, **Alfonso Castro**, Harvey Mudd College, **Michel L. Lapidus**, University of California, Riverside, and **Adolfo J. Rumbos**, Pomona College.

*Geometric Analysis*, **Zhiqin Lu**, University of California, Irvine, **Bogdan D. Suceava**, California State University, Fullerton, and **Fred Wilhelm**, University of California, Riverside.

*Geometric and Combinatorial Aspects of Representation Theory*, **Wee Liang Gan** and **Jacob Greenstein**, University of California, Riverside.

*Geometry of Algebraic Varieties*, **Karl Fredrickson**, University of California, Riverside, **Mark Gross**, University of California, San Diego, and **Ziv Ran**, University of California, Riverside.

*Heights, Diophantine Problems, and Lattices*, **Lenny Fukshansky**, Claremont McKenna College, and **David Krumm**, University of Georgia and Claremont McKenna College.

*Homotopy Theory and K-Theory*, **Julie Bergner**, University of California, Riverside, and **Christian Haesemeyer**, University of California, Los Angeles.

*Teaching ODEs: Best Practices from CODEE (Community of Ordinary Differential Equations Educators)*, **Nishu Lal**, Pomona College and Pitzer College, and **Ami Radunskaya**, Pomona College.

*The Mathematics of Planet Earth*, **John Baez**, University of California, Riverside.

# Baltimore, Maryland

*Baltimore Convention Center, Hilton Baltimore, and Baltimore Marriott Inner Harbor Hotel*

**January 15–18, 2014**
*Wednesday – Saturday*

**Meeting #1096**
*Joint Mathematics Meetings, including the 120th Annual Meeting of the AMS, 97th 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: Georgia M. Benkart
Announcement issue of *Notices*: October 2013
Program first available on AMS website: November 1, 2013
Program issue of electronic *Notices*: January 2013
Issue of *Abstracts*: Volume 35, Issue 1

**Deadlines**
For organizers: Expired
For abstracts: September 17, 2013

*The scientific information listed below may be dated. For the latest information, see* `www.ams.org/amsmtgs/national.html`.

**Joint Invited Addresses**

**Benson Farb**, University of Chicago, title to be announced; Friday, 11:10 a.m. (AMS-MAA).

**Eitan Grinspun**, Columbia University, *Movie magic: The mathematics behind Hollywood's visual effects*; Saturday, 3:00 p.m. (MAA-AMS-SIAM Gerald and Judith Porter Public Lecture).

**Carl Pomerance**, Dartmouth College, *Paul Erdős and the rise of statistical thinking in elementary number theory*; Wednesday, 11:10 a.m. (AMS-MAA).

**Joint Prize Session**

In order to showcase the achievements of the recipients of various prizes, the AMS and MAA are cosponsoring this event at 4:25 p.m. on Thursday. A cash bar reception will immediately follow. All participants are invited to attend. The AMS, MAA, and SIAM will award the Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student. The AMS will announce the winners of the Award for Distinguished Public Service, Bôcher Memorial Prize, Frank Nelson Cole Prize in Number Theory, Levi L. Conant Prize, Joseph L. Doob Prize, Leroy P. Steele Prizes, and the Leonard Eisenbud Prize for Mathematics and Physics. The MAA will award the Beckenbach Book Prize; Chauvenet Prize; Euler Book Prize; Yueh-Gin Gung and Dr. Charles Y. Hu Award for Distinguished Service to Mathematics; Deborah and Franklin Tepper Haimo Awards for Distinguished College or University Teaching of Mathematics; David P. Robbins Prize in Algebra, Combinatorics, and Discrete Mathematics; and Certificates of Meritorious Service. The AWM will present the Alice T. Schafer Prize for Excellence in Mathematics by an Undergraduate Woman, Louise Hay Award for Contributions to Mathematics Education, and the M. Gweneth Humphreys Award for Mentorship of Undergraduate Women in Mathematics.

This session will also be the venue for the announcement of the Joint Policy Board for Mathematics (JPBM) Communication Award.

## *120th Meeting of the AMS*

**AMS Invited Addresses**

**Andrew Blake**, Microsoft Research Cambridge, *Machines that see, powered by probability*; Wednesday, 8:20 p.m. (AMS Josiah Willard Gibbs Lecture).

**Emmanuel Candès**, Stanford University, title to be announced; Friday, 10:05 a.m.

**Eric Friedlander**, University of Southern California, title to be announced; Thursday, 3:20 p.m.; (AMS Retiring Presidential Address);

**Christopher Hacon**, University of Utah, *Which powers of a holomorphic function are integrable?* Saturday, 9:00 a.m.

**Dusa McDuff**, Columbia University, *Symplectic Topology Today, I: Recent results and open questions*; *II: Embedding questions: obstructions and constructions*); *III: Embedding ellipsoids and Fibonacci numbers*; Wednesday-Friday, 1:00 p.m. (AMS Colloquium Lectures).

**Paul Seidel**, Massachusetts Institute of Technology, title to be announced.; Wednesday, 10:05 a.m.

**H.-T. Yau**, Harvard University, *Random matrices and regularity of parabolic equations*; Thursday, 2:15 p.m.

**AMS Special Sessions**

**Some sessions are cosponsored with other organizations. These are noted within the parenthesis at the end of each listing, where applicable.**

***Accelerated Advances in Higher Order Invexities/Univexities with Applications to Optimization and Mathematical Programming*** (Code: SS 8A), **Ram U. Verma**, International Publications USA, and **Alexander J. Zaslavski**, Technion-Israel Institute of Technology.

***Advances in Analysis and PDEs*** (Code: SS 49A), **Tepper L. Gill** and **Daniel A. Williams**, Howard University.

***Algebraic Geometry*** (Code: SS 50A), **Christopher Hacon**, University of Utah, and **Zsolt Patakfalvi**, Princeton University.

***Algebraic Structures Motivated by Knot Theory*** (Code: SS 17A), **Mieczyslaw K. Dabkowski**, University of Texas at Dallas, **Jozef Przytycki**, George Washington University, and **Radmila Sazdanovic**, University of Pennsylvania.

***Algebraic and Analytic Aspects of Integrable Systems and Painlevé Equations*** (Code: SS 32A), **Anton Dzhamay**, University of Northern Colorado, **Kenichi Maruno**,

University of Texas-Pan America, and **Christopher Ormerod**, California Institute of Technology.

***Analytic Number Theory*** (Code: SS 23A), **Angel Kumchev**, Towson University, **Scott Parsell**, West Chester University, and **Gang Yu**, Kent State University.

***Applied Harmonic Analysis: Large Data Sets, Signal Processing, and Inverse Problems*** (Code: SS 12A), **Mauro Maggioni**, Duke University, and **Naoki Saito** and **Thomas Strohmer**, University of California, Davis.

***Banach Spaces, Metric Embeddings, and Applications*** (Code: SS 16A), **Mikhail Ostrovskii**, St. John's University, and **Beata Randrianantoanina**, Miami University.

***Big Data: Mathematical and Statistical Modeling, Tools, Services, and Training*** (Code: SS 18A), **Ivo Dinov**, University of California Los Angeles.

***Categorical Topology*** (Code: SS 42A), **Frédéric Mynard**, Georgia Southern University, and **Gavin Seal**, École Polytechnique Fédérale de Lausanne.

***Classification Problems in Operator Algebras*** (Code: SS 38A), **Ionut Chifan**, University of Iowa, and **David Penneys**, University of Toronto.

***Communication of Mathematics via Interactive Activities*** (Code: SS 47A), **Benjamin Levitt** and **Glen Whitney**, National Museum of Mathematics.

***Complex Dynamics, I (a Mathematics Research Communities Session)*** (Code: SS 55A), **Scott Kaschner**, University of Arizona, **Holly Krieger**, Massachusetts Institute of Technology, and **Paul Reschke**, University of Michigan.

***Computability in Geometry and Topology*** (Code: SS 39A), **Mieczyslaw Dabkowski**, University of Texas at Dallas, and **Rumen D. Dimitrov**, Western Illinois University.

***De Bruijn Sequences and Their Generalizations*** (Code: SS 53A), **Abbas Alhakim**, American University of Beirut, and **Steven Butler**, Iowa State University.

***Deformation Spaces of Geometric Structures on Low-dimensional Manifolds*** (Code: SS 40A), **Caleb Ashley**, Howard University, **Michelle Lee** and **Melissa Macasieb**, University of Maryland, and **Andy Sanders**, University of Illinois at Chicago.

***Difference Equations and Applications*** (Code: SS 9A), **Michael A. Radin**, Rochester Institute of Technology.

***Dispersive and Geometric Partial Differential Equations*** (Code: SS 1A), **Shuanglin Shao**, University of Kansas, **Chongchun Zeng**, Georgia Institute of Technology, and **Shijun Zheng**, Georgia Southern University.

***Ergodic Theory and Symbolic Dynamics*** (Code: SS 31A), **Aimee Johnson**, Swarthmore College, and **Cesar Silva**, Williams College.

***Fractal Geometry: Mathematics of Fractals and Related Topics*** (Code: SS 11A), **Michel Lapidus**, University of California Riverside, **Erin Pearse**, California State Polytechnic University, San Luis Obispo, **Robert Strichartz**, Cornell University, and **Machiel Van Frankenhuijsen**, Utah Valley University.

***Fractional, Stochastic, and Hybrid Dynamic Systems with Applications*** (Code: SS 7A), **John Graef**, University of Tennessee at Chattanooga, **Gangaram S. Ladde**, University of South Florida, and **Aghalaya S. Vatsala**, University of Louisiana at Lafayette.

***Geometric Applications of Algebraic Combinatorics*** (Code: SS 48A), **Elizabeth Beazley**, Haverford College, and **Kristina Garrett**, St. Olaf College (AMS-AWM).

***Geometric Group Theory, I (a Mathematics Research Communities Session)*** (Code: SS 54A), **Tariq Aougab**, Yale University, **Curt Kent**, University of Toronto, **Sang Rae Lee**, Texas A&M University, and **Emily Stark**, Tufts University.

***Global Dynamics and Bifurcations of Difference Equations*** (Code: SS 37A), **Mustafa Kulenovic** and **Orlando Merino**, University of Rhode Island.

***Heavy Tailed Probability Distributions and Their Applications*** (Code: SS 22A), **Tuncay Alparslan** and **John P. Nolan**, American University.

***Highlighting Achievements and Contributions of Mathematicians of the African Diaspora*** (Code: SS 34A), **Asamoah Nkwanta**, Morgan State University, and **Talitha M. Washington**, Howard University.

***History of Mathematics*** (Code: SS 29A), **Sloan Despeaux**, Western Carolina University, **Della Dumbaugh**, University of Richmond, and **Glen van Brummelen**, Quest University.

***Homological and Characteristic p Methods in Commutative Algebra*** (Code: SS 4A), **Neil Epstein**, George Mason University, **Sean Sather-Wagstaff**, North Dakota State University, and **Karl Schwede**, Penn State University.

***Homotopy Theory*** (Code: SS 20A), **Niles Johnson**, Ohio State University at Newark, **Mark W. Johnson**, Penn State University, Altoona, **Nitu Kitchloo**, Johns Hopkins University, **James Turner**, Calvin College, and **Donald Yau**, Ohio State University at Newark.

***Hyperplane Arrangements and Applications*** (Code: SS 41A), **Takuro Abe**, Kyoto University, **Max Wakefield**, United States Naval Academy, and **Masahiko Yoshinaga**, Hokkaido University.

***Logic and Probability*** (Code: SS 2A), **Wesley Calvert**, Southern Illinois University, **Doug Cenzer**, University of Florida, **Johanna Franklin**, University of Connecticut, and **Valentina Harizanov**, George Washington University (AMS-ASL).

***Mathematics and Mathematics Education in Fiber Arts*** (Code: SS 14A), **Sarah-Marie Belcastro**, Smith College, and **Carolyn Yackel**, Mercer University.

***Mathematics in Natural Resource Modeling*** (Code: SS 43A), **Shandelle Henson**, Andrews University, and **Catherine Roberts**, College of the Holy Cross.

***Mathematics of Computation: Differential Equations, Linear Algebra, and Applications*** (Code: SS 30A), **Susanne C. Brenner**, Louisiana State University, and **Chi-Wang Shu**, Brown University (AMS-SIAM).

***My Favorite Graph Theory Conjectures*** (Code: SS 35A), **Craig Larson**, Virginia Commonwealth University, and **Ralucca Gera**, Naval Postgraduate School.

***Nineteenth Century Algebra and Analysis*** (Code: SS 10A), **Frank D. Grosshans**, West Chester University, **Karen H. Parshall**, University of Virginia, and **Paul R. Wolfson**, West Chester University.

***Nonlinear Systems: Polynomial Equations, Nonlinear PDEs, and Applications*** (Code: SS 27A), **Wenrui Hao**, University of Notre Dame.

***Outreach for Mathematically Talented Youth*** (Code: SS 45A), **Christina Eubanks-Turner**, University of Louisiana at Lafayette, **Virginia Watson**, Kennesaw State University, and **Daniel Zaharopol**, Art of Problem Solving Foundation.

***Progress in Free Probability*** (Code: SS 26A), **Dmitry Kaliuzhnyi-Verbovetskyi**, Drexel University, and **Todd Kemp**, University of California San Diego.

***Quantum Walks, Quantum Computation, and Related Topics*** (Code: SS 6A), **Chaobin Liu**, Bowie State University, **Takuya Machida**, University of Tokyo, **Nelson Petulante**, Bowie State University, and **Salvador E. Venegas-Andraca**, Tecnológico de Monterrey, Campus Estado de México.

***Random Matrices: Theory and Applications*** (Code: SS 13A), **Paul Bourgade** and **Horng-Tzer Yau**, Harvard University.

***Reaction Diffusion Equations and Applications*** (Code: SS 44A), **Jerome Goddard, II**, Auburn University Montgomery, and **Ratnasingham Shivaji**, University of North Carolina Greensboro.

***Recent Advances in Homogenization and Model Reduction Methods for Multiscale Phenomena*** (Code: SS 21A), **Silvia Jiménez Bolaños** and **Burt S. Tilley**, Worcester Polytechnic Institute.

***Recent Progress in Geometric and Complex Analysis*** (Code: SS 3A), **Zheng Huang**, City University of New York, Graduate Center and College of Staten Island, **Longzhi Lin**, Rutgers University, and **Marcello Lucia**, City University of New York, Graduate Center and College of Staten Island.

***Recent Progress in Multivariable Operator Theory*** (Code: SS 46A), **Ron Douglas**, Texas A&M University, and **Michael Jury**, University of Florida.

***Recent Progress in the Langlands Program*** (Code: SS 15A), **Moshe Adrian**, University of Utah, and **Shuichiro Takeda**, University of Missouri.

***Regulatory Problems for Nonlinear PDEs Modeling Fluids and Complex Fluids, I (a Mathematics Research Communities Session)*** (Code: SS 57A), **Tak Kwong Wong**, University of Pennsylvania, **Hao Jia**, University of Chicago, **Jared Whitehead**, Los Alamos National Laboratory, and **Jacob Bedrossian**, New York University.

***Representation Theory of p-adic Groups and Automorphic Forms*** (Code: SS 28A), **Arsalan Chademan**, University of Kurdistan, and **Manouchehr Misaghian**, Prairie View A&M University.

***Research in Mathematics by Undergraduates and Students in Post-Baccalaureate Programs*** (Code: SS 25A), **Bernard Brooks** and **Jobby Jacobs**, Rochester Institute of Technology, **Jacqueline Jensen-Vallin**, Slippery Rock University, and **Carl Lutzer**, **Darren Narayan**, and **Tamas Wiandt**, Rochester Institute of Technology.

***Set-Valued Optimization and Variational Problems with Applications*** (Code: SS 24A), **Akhtar Khan**, Rochester Institute of Technology, **Mau Nam Nguyen**, Portland State University, **Miguel Sama**, Universidad Nacional de Educacin e Distancia, and **Christiane Tammer**, Martin Luther University of Halle-Wittenberg.

***Structural and Extremal Problems*** (Code: SS 19A), **Daniel Cranston**, Virginia Commonwealth University, and **Gexin Yu**, College of William & Mary.

***Symplectic and Contact Structures on Manifolds with Special Holonomy*** (Code: SS 51A), **Sergey Grigorian**, University of Texas Pan American, **Sema Salur**, University of Rochester, and **Albert J. Todd**, University of California, Riverside.

***The Changing Education of Preservice Teachers in Light of the Common Core*** (Code: SS 52A), **William McCallum**, University of Arizona, **Kristin Umland**, University of New Mexico, and **Ellen Whitesides**, University of Arizona.

***The Ubiquity of Dynamical Systems*** (Code: SS 33A), **Edray H. Goins**, Purdue University, and **Talitha M. Washington**, Howard University.

***Topological Graph Theory: Structure and Symmetry*** (Code: SS 5A), **Jonathan L. Gross**, Columbia University, and **Thomas W. Tucker**, Colgate University.

***Trends in Graph Theory*** (Code: SS 36A), **Ralucca Gera**, Naval Postgraduate School.

***Tropical and Nonarchimedean Analytic Geometry, I (a Mathematics Research Communities Session)*** (Code: SS 56A), **Dustin Cartwright**, Yale University, **Melody Chan**, Harvard University, and **Joseph D. Rabinoff**, Georgia Institute of Technology.

## AMS Sessions for Contributed Papers

There will be sessions of ten-minute contributed talks. Although an individual may present only one contributed paper at a meeting, any combination of joint authorship may be accepted, provided no individual speaks more than once on the program. Contributed papers will be grouped together by related subject classifications into sessions.

## Submission of Abstracts for AMS Sessions

Authors must submit abstracts of talks through `joint mathematicsmeetings.org/meetings/abstracts/abstract.pl?type=jmm`. Indicate the number of authors for the paper, click on the "New Abstract" button, and you will be taken to the submission form. Simply follow the step-by-step instructions (read them carefully) until you received your unique abstract number. No submission is complete until you receive your abstract receipt number. **The deadline for all submissions is September 17, 2013.** Late papers cannot be accommodated. Please email `abscoord@ams.org` if you have questions. If you make an inquiry about your specific abstract, please include your abstract number.

## Other AMS Sessions

***Access and Opportunities in STEM Education: The Challenges of Building an Equitable Diverse Society***, organized by **Carlos Castillo-Chavez**, Arizona State University, Wednesday, 9:30 a.m.–11:00 a.m. The sense of urgency that the NAS's report "Expanding Underrepresented Minority Participation: America's Science and Technology Talent at the Crossroads" places on the diversification of the work force in STEM demands increased access to colleges and universities, not only because it is the right thing to do but because it is in the best national interest. This has been carried out under the leadership of President **Freeman Hrabowski** of the University of Maryland at Baltimore County. President Hrabowski will share the

national responses that this report has generated over the past two years. His presentation will be followed by the responses of two recipients of the Presidential Medal of Science: **James S. Gates**, University of Maryland, College Park, and **Richard Tapia**, Rice University. Cosponsored by the AMS, MAA, and SIAM

***INGenIOuS: Workforce Preparation for Students in the Mathematical Sciences***, organized by **John Bailer**, Miami University; **Jenna Carpenter**, Louisiana Tech University, **William Jaco**, Oklahoma State University, **Peter Turner**, Clarkson University; and **Paul Zorn**, St. Olaf College; Wednesday, 2:15 p.m.–3:45 p.m. Representatives of AMS, ASA, MAA, and SIAM met in July 2013, at the INGenIOuS workshop, to discuss positioning mathematics and statistics departments to create a workforce that is ready to meet the challenges of the 21st century. The goal is to ensure that the next generation of undergraduate and graduate students view the study of mathematical sciences as a vibrant path leading to many career options. Cosponsored by the AMS, ASA, MAA, and SIAM.

***Online Courses: Benefits and Pitfalls***, organized by **Dan Abramovich**, Brown University, and **Patricia Hersh**, North Carolina State University; Wednesday, 4:30 p.m.–6:00 p.m. Massively open online courses (MOOCs) are currently developing at a rapid pace. Their educational potential and possible effect on the structure of colleges and universities are hot topics in higher education. This panel aims to discuss the potential impact on students, faculty and mathematics departments. How is student learning in a MOOC different from in a conventional classroom environment? What kinds of support do students need at their home institutions? How will allowing students to take MOOCs for credit, in lieu of traditional courses, affect departments at the home institutions? How should the mathematics community respond to this trend? The panel will aim to discuss these and other questions concerning MOOCs. Sponsored by the Committee on the Profession.

***Who Wants to Be a Mathematician—National Contest***, organized by **Michael A. Breen**, AMS, and **William T. Butterworth**, DePaul University; Thursday, 9:30 a.m.–11:00 a.m. See ten of the nation's best high school students compete for a US$5,000 first prize for themselves and US$5,000 for their school's math department. Semifinals are at 9:30 a.m. and finals at 10:30 a.m. You are invited to come and take part in this educational and fun presentation.

***Conversation on Nonacademic Employment***, Thursday, 10:30–noon. This session will concentrate on how to find nonacademic positions, types of jobs, the interview process, work environments, and advancement opportunities. The discussion will be led by a panel of mathematical scientists working in government and industry.

***The Genius of Srinivasa Ramanujan***, Thursday, 6:00 p.m.–7:10 p.m. The Prime Minister of India declared 2012 the "National Year of Mathematics" to commemorate the 125th anniversary of the birth of Srinivasa Ramanujan. To honor the occasion, **Nandan Kudhyadi** produced this docudrama. The film features well-known number theorists from around the world associated with Ramanujan's oeuvre. Shot at various locations in India and Cambridge, it serves as a pilgrimage for those interested in the legend and legacy of the great Indian mathematician. The film also highlights the trajectory of Ramanujan's seminal work and its relevance today. Cosponsored by the AMS and MAA.

***Grad School Fair,*** Friday, 8:30 a.m.–10:30 a.m. Here is the opportunity for undergrads to meet representatives from mathematical sciences graduate programs from universities all over the country. January is a great time for juniors to learn more, and college seniors may still be able to refine their search. This is your chance for one-stop shopping in the graduate school market. At last year's meeting about 300 students met with representatives from 50 graduate programs. If your school has a graduate program and you are interested in participating, a table will be provided for your posters and printed materials for US$75 (registration for this event must be made by a person already registered for the JMM), and you are welcome to personally speak to interested students. Complimentary coffee will be served. Cosponsored by the AMS and MAA.

***Current Events Bulletin***, organized by **David Eisenbud**, Mathematical Sciences Research Institute; Friday, 1:00 p.m.–5:00 p.m. Speakers in this session follow the model of the Bourbaki Seminars in that mathematicians with strong expository skills speak on work not their own. Written versions of the talks will be distributed at the meeting and will also be available online at `www.ams.org/ams/current-events-bulletin.html` after the conclusion of the meeting.

***The Public Face of Mathematics,*** Friday, 2:30 p.m.–4:00 p.m. Experienced spokespeople will share ideas and lead discussion about how the mathematics community can mobilize more members to become proactive in representing mathematics to the general public and to key audiences of leaders in discussions of public policy. Sponsored by the Committee on Science Policy and the Committee on Education.

***Promoting Post-Secondary Mathematics Education,*** organized by **Eric M. Friedlander,** University of Southern California, **Mark L. Green,** University of California, Los Angeles, and **Phillip A. Griffiths,** Institute for Advanced Study; Friday, 4:15 p.m.–6:00 p.m. Leaders from outside the academic community of mathematical scientists, including representatives of other math-intensive and interdisciplinary subjects, government, industry, and other employers, will participate in a discussion of the challenges and prospects for systemic change in post-secondary mathematics education. This discussion should promote substantial, constructive responses to achieve goals which include 1) creating and disseminating course content to meet the needs of today's students, especially by emphasizing the roles that mathematics plays in the modern world; 2) strengthening the pipeline for prospective STEM graduates; and 3) developing, adapting, and evaluating new teaching methodologies. Cosponsored by the AMS Committee on Education, MAA, and SIAM.

***Congressional Fellowship Session***, organized by **Samuel M. Rankin III**, AMS; Friday, 4:30 p.m.–6:30 p.m. This fellowship provides a public policy learning experience, demonstrates the value of science-government interaction

and brings a technical background and external perspective to the decision-making process in Congress. Learn more about this program and speak with current and former AMS Fellows. Application deadline for the 2014-15 AMS Congressional Fellowship is February 15, 2014.

### Other AMS Events

***Council***, Tuesday, 1:30 p.m.

***Business Meeting***, Saturday, 11:45 a.m. The Secretary notes the following resolution of the Council: Each person who attends a business meeting of the Society shall be willing and able to identify himself as a member of the Society. In further explanation, it is noted that each person who is to vote at a meeting is thereby identifying himself as and claiming to be a member of the American Mathematical Society. The Society has a Committee on the Agenda for Business Meetings. The purpose is to make business meetings orderly and effective. The committee does not have legal or administrative power. It is intended that the committee consider what may be called "quasipolitical" motions. The committee has several possible courses of action on a proposed motion, including but not restricted to:

(a) doing nothing,

(b) conferring with supporters and opponents to arrive at a mutually accepted amended version to be circulated in advance of the meeting,

(c) recommending and planning a format for debate to suggest to a business meeting,

(d) recommending referral to a committee, and

(e) recommending debate followed by referral to a committee.

There is no mechanism that requires automatic submission of a motion to the committee. However, if a motion has not been submitted through the committee, it may be thought reasonable by a business meeting to refer it rather than to act on it without benefit of the advice of the committee.

In order that a motion for this business meeting receive the service offered by the committee in the most effective manner, it should be in the hands of the AMS Secretary by **December 18, 2013**.

### AMS Short Course on Geometry and Topology in Statistical Inference

This two-day course will take place on Monday and Tuesday before the meeting actually begins. It is organized by **Sayan Mukherjee**, Duke University, who will give talks on *Geometry in statistical inference* and *Topology in statistical inference,* and features these talks by **Yusu Wang**, Ohio State University, *Computing geometric and topological summaries;* **Monica Nicolau**, Stanford University, *Geometry and topology in cancer systems biology*; **Matthew Kahle**, Ohio State University, *Random geometry and topology; and* **Lek-Heng Lim**, University of Chicago, *Hodge operator in data analysis.*

There are separate registration fees to participate in this course. Advance registration (before December 24): Member $106, Nonmember $155, Student, Unemployed, or Emeritus $54. Onsite registration: Member $140, Nonmember $185; Student, Unemployed, or Emeritus $75. Please see the complete article on page 1220 or at www.ams.org/meetings/short-courses/short-course-general.

### NSF-EHR Grant Proposal Writing Workshop

***Writing a Competitive Proposal to NSF-EHR***, Monday, 3:00 p.m.–6:00 p.m. The goal of this workshop is to familiarize participants with current direction/priorities in EHR, familiarize participants with key EHR education research and development programs, consider common issues of competitive proposals, and prepare participants to write a competitive proposal. There is no registration fee for this workshop, but participants must register separately in advance. Please contact the AMS Washington Office at 202-588-1100 or send email to amsdc@ams.org for further information.

### Department Chairs Workshop

This annual one-day workshop for department chairs and leaders is designed to stimulate discussion on a wide range of issues facing departments today, including personnel issues (staff and faculty), long-range planning, hiring, promotion and tenure, budget management, assessments, outreach, stewardship, junior faculty development, communication, and departmental leadership. There is a separate registration and fee to participate. Interested attendees should also consider attending the NSF-EHR Grant Proposal Writing Workshop to be held on Monday, January 13. For further information, please contact the AMS Washington Office at 202-588-1100 or amsdc@ams.org.

## *97th Meeting of the MAA*

### MAA Invited Addresses

**Sarah-Marie Belcastro**, Sarah Lawrence College, *Snark attack!: Visualizations of "uncolorable" graphs on surfaces*; Thursday at 9:00 a.m.

**William Dunham**, Muhlenberg College, *Heron, Newton, Euler, and Barney*; Saturday at 10:05 a.m.

**Helaman and Claire Ferguson,** *Mathematics in stone and bronze*; Wednesday, 2:15 p.m.

**Jill Pipher**, Brown University, *The mathematics of lattice-based cryptography*; Friday at 9:00 a.m.

**Michael Starbird**, University of Texas at Austin, *Effective thinking and mathematics*; Wednesday at 3:20 p.m.

### Presentations by Teaching Award Recipients

Friday, 2:30 p.m.–3:50 p.m., organized by MAA Secretary **Barbara J. Faires**, Westminster College, and MAA President, **Robert Devaney**, Boston University. Winners of the Deborah and Franklin Tepper Haimo Awards for Distinguished College or University Teaching will give presentations on the secrets of their success.

### MAA Invited Paper Sessions

***The Unreasonable Effectiveness of Modern Mathematics,*** organized by **Andrew Conner** and **Ellen Kirkman**, Wake Forest University; Wednesday morning. The session

will demonstrate that abstract mathematics continues to provide tools for use outside of mathematics. Speakers include **Robert Ghrist**, University of Pennsylvania, on topology; **Daniel Nakano**, University of Georgia, on representation theory; **Alice Silverberg**, University of California Irvine, on number theory; and **Bernd Sturmfels**, University of California Berkeley, on algebraic geometry, combinatorics, and commutative algebra.

***The Continuing Influence of Paul Erdős in Number Theory***, organized by **Paul Pollack**, University of Georgia, and **Carl Pomerance**, Dartmouth College; Friday morning. For the better part of the twentieth century, Paul Erdős stood as a leading figure in number theory. This session brings together experts from that area to discuss the impact of Erdős's work on modern research. Speakers include **Michael Filaseta**, University of South Carolina; **Ron Graham**, University of California, San Diego; **Mits Kobayashi**, Cal Poly Pomona; **Florian Luca**, National Autonomous University of Mexico; **Melvyn Nathanson,** City University of New York; and **Andrew Granville**, University of Montreal.

***Uniform Distribution, Discrepancy, and Related Fields***, organized by **Dmitriy Bilyk**, University of Minnesota, and **Jill Pipher**, Brown University; Friday afternoon. How well can one approximate various continuous geometric objects by discrete sets of points and how big are the inevitable errors? Different manifestations of this question, which lies at the interface of number theory, probability, approximation theory, combinatorics, analysis, and geometry, will be discussed from various points of view. Speakers include **Art Owen,** Stanford University; **Michael Lacey**, Georgia Institute of Technology; **Ed Saff**, Vanderbilt University; and **Vladimir Temlyakov**, University of South Carolina.

***Graphs Don't Have to Lie Flat: The Shape of Topological Graph Theory***, organized by **Sarah-Marie Belcastro**, Sarah Lawrence College, and **Mark Ellingham**, Vanderbilt University; Thursday morning. Topological graph theory is the study of graphs drawn on topological surfaces, usually (but not always!) so that no edges cross. The field is concerned with most of the same topics as ordinary graph theory as well as questions that arise from encoding the embedding of a graph in a surface. Speakers include **Mark Ellingham**, Vanderbilt University; **Joan Hutchinson**, Macalester College; **Jo Ellis-Monaghan**, St. Michael's College; and **Michael Pelsmajer**, Illinois Institute of Technology.

***Mathematics and Effective Thinking***, organized by **Michael Starbird**, University of Texas Austin; Thursday, morning and afternoon. Mathematics classes can and do influence students' thinking well beyond the mathematical content. Mathematics classes can help students in all parts of their lives by helping them to think effectively—that is, being innovative problem-solvers, insightful and clear-minded, intellectually curious, able to ask illuminating questions, and confident and competent to reason through complex issues. These habits of mind can be fostered and developed systematically through mathematical experiences. This session focuses on how the mathematical curriculum and strategies of instruction can intentionally help students to learn to think effectively throughout their lives. Speakers include **Deborah Bergstrand**, Swarthmore College; **David Bressoud**, Macalester College; **Edward Burger**, Southwestern University; **Jodi Cotton**, Westchester Community College; **Sandra Laursen**, University of Colorado Boulder; **Michael Pearson**, Mathematical Association of America; **Carol Schumacher**, Kenyon College; **Katherine Socha**, Math for America; **Francis Su**, Harvey Mudd College; **Stan Yoshinobu**, California State University Dominguez Hills; and **Paul Zorn**, St. Olaf College.

***Six Crash Courses on Mapping Class Groups***, organized by **Benson Farb**, University of Chicago, and **Dan Margalit**, Georgia Institute of Technology; Friday morning and Saturday afternoon. Topics will include the basics, mapping class groups in 3-manifold theory, mapping class groups in 4-manifold theory, dynamics of surface diffeomorphisms, braids, (co)homology and char classes of surface bundles, and open problems.

## MAA Minicourses

MAA Minicourses are open only to persons who register for the Joint Meetings and pay the Joint Meetings registration fee in addition to the appropriate minicourse fee. The MAA reserves the right to cancel any minicourse that is undersubscribed. Participants in minicourses 4, 5, and 9 are required to bring their own laptop computer equipped with appropriate software. Instructions on how to download any data files needed for those courses will be provided by the organizers. The enrollment in each minicourse is limited to 50; the cost of a minicourse is US$80.

**Minicourse #1**: ***Humanistic mathematics***, presented by **Gizem Karaali**, Pomona College, and **Eric Marland**, Appalachian State University; Part A, Wednesday, 9:00 a.m.–11:00 a.m.; Part B, Friday, 9:00 a.m.–11:00 a.m. As a scholarly stance, humanistic mathematics describes an approach to mathematics that views it as a human endeavor and focuses on its aesthetic, cultural, historical, literary, pedagogical, philosophical, psychological, and sociological aspects. As a pedagogical framework, humanistic mathematics explores and builds on the relationship of mathematics with its nontraditional partners in the humanities, the fine arts, and social sciences, providing additional perspective for the role of mathematics in a liberal arts education. This minicourse exposes participants to both facets of humanistic mathematics.

In the first session, participants will learn about the implications of a humanistic approach to teaching and explore how it can contribute to a more sophisticated understanding of mathematics for all students. Also included will be a discussion of common implementation issues and an overview of a spectrum of materials available to use in the classroom. In the second session, participants will engage with the scholarship of humanistic mathematics, a body of literature that eschews disciplinary jargon in favor of reaching a more diverse audience. After a thorough introduction, participants will, through guided group work, initiate their own scholarly projects. Possible venues of communication, collaboration, and dissemination of work in humanistic mathematics will be discussed.

**Minicourse #2**: ***CATALST: Introductory statistics using randomization and bootstrap methods***, presented

by **Andrew Zieffler**, **Robert delMas**, and **Nicola Parker**, University of Minnesota; Part A, Thursday, 1:00 p.m.–3:00 p.m.; Part B, Saturday, 1:00 p.m.–3:00 p.m. This workshop introduces and provides hands-on experience with curriculum materials, lesson plans, and student assessments developed as part of the CATALST (Change Agents for Teaching and Learning Statistics) project (NSF DUE-0814433). Focused on the introductory, noncalculus-based statistics course, CATALST's goals were to radically change the content and pedagogy in such a course.

CATALST makes exclusive use of simulation to carry out inferential analyses. The course also builds on best practices and materials developed in statistics education, research and theory from cognitive science, as well as materials and methods that are successfully achieving parallel goals in other disciplines (e.g., mathematics and engineering education).

Minicourse participants will be introduced to the TinkerPlots™ software. They will learn how this software can be used in the classroom to introduce students to randomization and bootstrap methods through empirical simulation. In addition, participants will leave the workshop with lesson plans, in-class student activities, and data to help them teach a one-semester introductory statistics course using randomization and bootstrap methods.

**Minicourse #3**. ***Improvisation for the mathematics classroom***, presented by **Andrea Young**, Ripon College; Part A, Wednesday, 4:45 p.m.–6:45 p.m.; Part B, Friday, 3:30 p.m.–5:30 p.m. Improvisational comedy, or just simply improv, is theater that is made up on the spot. Besides being funny, improv comedians take risks, solve problems, and support fellow actors. In this interactive minicourse, participants will explore how some of the fundamental tenets of improv can be applied to creating an open and engaging mathematics classroom. Participants will learn theater exercises that have been modified for use in undergraduate math courses, both as tools to demonstrate or review course content and as methods to boost participation, collaboration, and creativity of students. Participants will gain experience doing and leading these exercises, which will range from introductory name games to verbal concept-connection exercises to physical exam-review activities. We will also explore the concept of "teacher as performer", and we will see how classroom management skills can be enhanced by the study of improv. Comfortable clothes and shoes are encouraged.

**Minicourse #4**. ***Teaching introductory statistics (for instructors new to teaching intro stats)***, presented by **Michael Posner**, Villanova University, and **Carolyn Cuff**, Westminster College; Part A, Wednesday, 9:00 a.m.–11:00 a.m. ; Part B, Friday, 9:00 a.m.–11:00 a.m. This minicourse, intended for instructors new to teaching statistics, exposes participants to the big ideas of statistics and the ASA-endorsed Guidelines for Assessment and Instruction in Statistics Education (GAISE) report. It considers ways to engage students in statistical literacy and thinking, and contrast conceptual and procedural understanding in the first statistics course. Participants will engage in many of the classic activities that all statistics instructors should know. Internet sources of real data, activities, and best practices articles will be examined. Participants will find out how they can continue to learn about the best practices for the first course in statistics by becoming involved in statistics education related conferences, newsletters, and groups. Participants are required to bring their laptops.

**Minicourse #5**. ***Using randomization methods to build conceptual understanding of statistical inference***, presented by **Robin H. Lock** and **Patti Frazer Lock**, St. Lawrence University; **Kari Lock Morgan** and **Eric Frazer Lock**, Duke University; and **Dennis Frazer Lock**, Iowa State University; Part A, Thursday, 1:00 p.m.–3:00 p.m.; Part B, Saturday, 1:00 p.m.–3:00 p.m. The goal of this minicourse is to demonstrate how computer simulation techniques, such as bootstrap confidence intervals and randomization tests, can be used to introduce students to fundamental concepts of statistical inference in an introductory statistics course. Simulation methods are becoming increasingly important in statistics, and can be effective tools for building student understanding of inference. Through easy to use free online tools and class activities, participants will see how to engage students and make these methods readily accessible. We illustrate how to use these methods to build conceptual understanding and also how to integrate them into an existing introductory statistics course without requiring a major overhaul. Participants are required to bring their laptops.

**Minicourse #6**. ***Historical role-playing in the mathematics classroom***, presented by **John P. Curran**, Eastern Michigan University; Part A, Thursday, 9:00 a.m.–11:00 a.m.; Part B, Saturday, 9:00 a.m.–11:00 a.m. Participants in this session will learn how to use role-playing games in the mathematics classroom according to the "Reacting to the Past" pedagogy. This method lends itself to project-based and group-work-oriented courses, and encourages intensive student participation.

The presenter will discuss two games that he uses, including one he has cowritten. The "Ways & Means 1935" game can be used in a quantitative literacy course. Players, representing congressmen, debate the form of the Social Security bill, which contained a broad range of social welfare provisions in addition to old-age pensions. The game "Math Wars 1870: Educating for Empire", designed by David Cohen et al, is appropriate for a history of mathematics or a mathematical education course. Students act as members of or witnesses testifying at the Royal Commission on Scientific Instruction and the Advancement of Science, intended to reform education at Cambridge University.

In order to learn how to teach with this method, and to gain confidence in it, it is important to play such a game oneself. We will spend part of the session playing a shortened version of one of the games mentioned above.

The session will include a discussion of how to develop games for your own courses.

**Minicourse #7**. ***Mathematics and dance***, presented by **Karl Schaffer**, De Anza College; Part A, Wednesday, 4:45 p.m.–6:45 p.m.; Part B, Friday, 3:30 p.m.–5:30 p.m. We will present several activities which combine dance and mathematics content in nontrivial ways. The activities connect

to a variety of dance forms, as well as to several areas of mathematics, including symmetry, number theory, combinatorics, dynamical systems, and topology. Participants will take away activities useful in a wide range of undergraduate math classes or math clubs. The activities are collaborative and physically comfortable, and easily performed by those with little or no dance experience. These include folk dances, improvisations, and choreographic exercises with specific mathematical content, as well as kinesthetic tasks involving explorations of mathematical principles. In all cases, mathematics will illuminate the dance, and the dance will realize, in kinesthetic form, the mathematical concepts.

**Minicourse #8**. ***Directing undergraduate research***, presented by **Aparna Higgins**, University of Dayton; Part A, Thursday, 9:00 a.m.–11:00 a.m.; Part B, Saturday, 9:00 a.m.–11:00 a.m. This minicourse will cover many aspects of facilitating research by undergraduates, such as getting students involved in research, finding appropriate problems, deciding how much help to provide, and presenting and publishing the results. Similarities and differences between research conducted during summer programs and research that can be conducted during the academic year will be discussed. The minicourse is designed for faculty who are new to directing undergraduate research. Although the examples used will be primarily in the area of discrete mathematics, the strategies discussed can be applied to any area of mathematics.

**Minicourse #9**. ***WeBWorK: An open source alternative for generating and delivering online homework problems***, presented by **John Travis**, Mississippi College; **Jason Aubrey**, University of Missouri; and **Paul Pearson**, Hope College; Part A, Wednesday, 2:15 p.m.–4:15 p.m., Part B, Friday, 1:00–3:00 p.m. We will introduce participants to the WeBWorK online homework system. Supported by grants from the NSF, WeBWorK has been adopted by well over 500 colleges, universities, and secondary schools and is a popular open source alternative to commercial products. WeBWorK can handle problems in college algebra, calculus, linear algebra, ODEs, and more and comes with an extensive library of nearly 30,000 problems across the mathematics curriculum. WeBWorK recognizes a multitude of mathematical objects and allows for elegant solution checking. This minicourse will introduce participants to WeBWorK and equip participants with the knowledge and skills to use WeBWorK in the classroom. Participants are required to bring their own laptops/tablet computers with wireless Internet capabilities.

**Minicourse #10**. ***Heavenly mathematics: The forgotten art of spherical trigonometry***, presented by **Glen Van Brummelen**, Quest University, and **Joel Silverberg**, Roger Williams University; Part A, Friday, 1:00 p.m.–3:00 p.m.; Part B, Saturday, 1:00 p.m.–3:00 p.m. Trigonometry came into being at the birth of science itself, merging Greek geometric models of the motions of celestial bodies with the desire to predict where the planets will go. With the sky as the arena, spherical trigonometry was the "big brother" to the ordinary plane trigonometry our children learn in school. We shall explore the surprisingly elegant theory that emerges, as well as its appropriation into mathematical geography motivated by the needs of Muslim religious ritual. The beautiful modern theory of spherical trigonometry (including the pentagramma mirificum), developed by John Napier along with his logarithms, leads eventually to an astonishing alternate path to the subject using stereographic projection discovered only in the early 20th century. We conclude with a consideration of some of the ingenious techniques developed by navigators in the 19th century to find their locations, using as data only a couple of observations of stellar altitudes.

**Minicourse #11**. ***Public- and private-key cryptography***, presented by **Chris Christensen**, Northern Kentucky University, and **Jeffrey Ehme**, Spelman College; Part A, Wednesday, 4:45 p.m.–6:45 p.m.; Part B, Friday, 3:30 p.m.–5:30 p.m. The interesting mathematical aspects of public-key ciphers have sparked interest by mathematics faculty in these ciphers as applications of mathematics that can be presented in undergraduate courses. Often ignored, however, are the modern private-key ciphers—"the workhorses of cryptography". Modern private-key ciphers are equally mathematically interesting. In this minicourse, we will explore both modern public-key and private-key ciphers and their mathematical foundations. We will also briefly explore the historical evolution of both types of ciphers. No previous experience with these topics is assumed.

**Minicourse #12**. ***A Game Theory path to quantitative literacy***, presented by **David Housman**, Goshen College; Part A, Wednesday, 9:00 a.m.–11:00 a.m.; Part B, Friday, 9:00 a.m.–11:00 a.m. Game Theory, defined in the broadest sense, can be used to model many real world scenarios of decision making in situations involving conflict and cooperation. Further, mastering the basic concepts and tools of game theory requires only an understanding of basic algebra, probability, and formal reasoning. These two features of Game Theory make it an ideal path to developing habits of quantitative literacy among our students. This audience participation minicourse develops some of the material used by the presenter in general education and math major courses on Game Theory and encourages participants to develop their own, similar, courses.

**Minicourse #13**. ***Teaching an applied topology course***, presented by **Colin Adams**, Williams College, and **Robert Franzosa**, University of Maine; Part A, Thursday, 9:00 a.m.–11:00 a.m.; Part B, Saturday, 9:00 a.m.–11:00 a.m. Applications of topology have proliferated in recent years. It is now possible to teach a course in topology, still covering much of the same material that would appear in a traditional topology course, but motivated entirely by applications. Typically, offering an "applied" topology course immediately doubles the enrollments. Applications include areas such as geographic information systems, robotics, chaos, fixed point theory in economics, knots in DNA and synthetic chemistry, and the topology of the spatial universe. Through the applications students become engaged with the material. In this minicourse we will introduce the various applications, and provide participants with the background necessary to design and teach their own applied topology course.

**Minicourse #14**. ***Visualizing projective geometry through photographs and perspective drawings***, presented by **Annalisa Crannell**, Franklin & Marshall College; **Marc Frantz**, Indiana University Bloomington; and **Fumiko Futamura**, Southwestern University; Part A, Wednesday, 2:15 p.m.– 4:15 p.m.; Thursday, 1:00 p.m.–3:00 p.m. Projective geometry is the study of properties invariant under projective transformations, often taught as an upper level course. Although projective geometry was born out of the ideas of Renaissance artists, it is often taught without any reference to perspective drawing or photography. This minicourse seeks to re-establish the link between mathematics and art, motivating several important concepts in projective geometry, including Desargues' Theorem, Casey's Theorem and its applications, and Eves' Theorem. This minicourse will consist of hands-on activities, but no artistic experience is required.

**Minicourse #15**. ***Developing strong mentoring relationships***, presented by **Donna Joyce Dean**, Association for Women in Science; Part A, Wednesday, 2:15 p.m.– 4:15 p.m.; Part B, Friday, 1:00 p.m.–3:00 p.m. This minicourse will provide individuals with an appreciation for the importance of mentoring, from the mentor's perspective as well as from the mentee's perspective. Pragmatic tools and techniques will be presented that participants can deploy in their roles as mentor or mentee. The intent of the minicourse is to help individuals to 1) understand the differences among mentoring, advising, coaching, and sponsoring roles; 2) recognize how to identify mentoring needs from both perspectives; 3) learn how to identify and approach potential mentors; 4) understand how mentors can help participants achieve their professional goals; 5) identify the do's and don'ts involved in being a good mentee or mentor; and 6) appreciate how mentoring can have an impact on understanding one's work-life satisfaction.

## MAA Contributed Papers

The MAA Committee on Contributed Paper Sessions solicits contributed papers pertinent to the sessions listed below. Contributed Paper Session presentations are limited to fifteen minutes, except in the general session where they are limited to ten minutes. Each session room is equipped with a computer projector, an overhead projector, and a screen.

Please note that the days and times scheduled for these sessions remain tentative. Full descriptions of these sessions may be found at `jointmathematicsmeetings.org/meetings/national/jmm2014/2160_maacall`.

A***ssessing Quantitative Reasoning and Literacy***, organized by **Semra Kilic-Bahi**, Colby-Sawyer College; **Eric Gaze**, Bowdoin College; **Andrew Miller**, Belmont University; and **Aaron Montgomery**, Central Washington University; Wednesday morning.

***Assessing Student Learning: Alternative Approaches***, organized by **Jane Butterfield**, University of Minnesota; **Robert Campbell III**, College of St. Benedict/St. John's University; **David Clark**, University of Minnesota; **John Peter**, Utica College; and **Cassie Williams**, James Madison University; Wednesday afternoon.

***Assessment of Proof Writing Throughout the Mathematics Major***, organized by **Sarah Cook**, Washburn University, and **Miriam Harris-Botzum**, Lehigh Carbon Community College; Thursday morning.

***At the Intersection of Mathematics and the Arts***, organized by **Douglas Norton**, Villanova University; Thursday afternoon.

***Bridging the Gap: Designing an Introduction to Proofs Course***, organized by **Sarah Mabrouk**, Framingham State University; Thursday morning.

***Data, Modeling, and Computing in the Introductory Statistics Course***, organized by **Andrew Zieffler**, University of Minnesota; **Scott Alberts**, Truman State University; and **Randall Pruim**, Calvin College; Friday afternoon.

***Flipping the Classroom***, organized by **Krista Maxson**, Shawnee State University, and **Zsuzsanna Szaniszlo**, Valparaiso University; Saturday morning.

***The History of Mathematical Communities***, organized by **Amy Shell-Gellasch**, Montgomery College, and **Linda McGuire**, Muhlenberg College; Thursday afternoon.

***Innovative and Effective Ways to Teach Linear Algebra***, organized by **David Strong**, Pepperdine University; **Gilbert Strang**, MIT; and **Megan Wawro**, Virginia Tech; Friday morning.

***Instructional Approaches to Increase Awareness of the Societal Value of Mathematics***, organized by **Jessica Deshler**, West Virginia University, and **Elizabeth Burroughs**, Montana State University; Friday afternoon.

***Is Mathematics the Language of Science?***, organized by **Carl Behrens**, Alexandria, VA; **Thomas Drucker**, University of Wisconsin Whitewater; and **Dan Sloughter**, Furman University; Wednesday morning.

***Mathematics and Sports***, organized by **Drew Pasteur**, College of Wooster, and **John David**, Virginia Military Institute; Saturday morning.

***Mathematics Experiences in Business, Industry, and Government***, organized by **Carla Martin**, James Madison University; **Phil Gustafson**, Mesa State University; and **Michael Monticino**, University of North Texas; Friday afternoon.

***Open Source Mathematics Textbooks***, organized by **Albert Schueller**, Whitman College, and **Kent Morrison**, American Institute of Mathematics; Friday morning.

***Programs and Approaches for Mentoring Women and Minorities in Mathematics***, organized by **Jenna Carpenter**, Louisiana Tech University, and **Brooke Shipley**, University of Chicago; Wednesday afternoon.

***Projects, Demonstrations, and Activities that Engage Liberal Arts Mathematics Students***, organized by **Sarah Mabrouk**, Framingham State University; Thursday afternoon.

***Putting a Theme in a History of Mathematics Course***, organized by **Eugene Boman**, Penn State Harrisburg, and **Robert Rogers**, SUNY Fredonia; Saturday morning.

***Reinventing the Calculus Sequence***, organized by **David Dwyer** and **Mark Gruenwald**, University of Evansville; Saturday afternoon.

***Research on the Teaching and Learning of Undergraduate Mathematics***, organized by **Kyeong Hah Roh**, Arizona State University, **Mikael Oehrtman**, University of Northern Colorado; and **Timothy Fukawa-Connelly**, University of New Hampshire; Thursday morning and afternoon.

***The Scholarship of Teaching and Learning in Collegiate Mathematics***, organized by **Jackie Dewar**, Loyola Marymount University; **Tom Banchoff**, Brown University; **Curtis Bennett**, Loyola Marymount University; **Pam Crawford**, Jacksonville University; and **Edwin Herman**, University of Wisconsin Stevens Point; Wednesday afternoon.

***Student Activities***, organized by **Lisa Marano**, West Chester University of Pennsylvania, and **Jennifer Bergner**, Salisbury State University; Thursday morning.

***Teaching with Technology: Impact, Evaluation and Reflection***, organized by **Peter Gavin LaRose**, University of Michigan; Saturday afternoon.

***Topics and Techniques for Teaching Real Analysis***, organized by **Paul Musial**, Chicago State University; **Erik Talvila**, University of the Fraser Valley; and **James Peterson**, Benedictine University; Wednesday morning.

***Trends in Undergraduate Mathematical Biology Education***, organized by **Timothy Comar**, Benedictine University; Friday morning.

***USE Math: Undergraduate Sustainability Experiences in the Introductory Mathematics Classroom***, organized by **Ben Galluzzo**, Shippensburg University; **Monika Kiss**, Saint Leo University; and **Corrine Taylor**, Wellesley College; Saturday morning.

***Using Online Resources to Augment the Traditional Classroom***, organized by **Mike May**, Saint Louis University, and **Paul Seeburger**, Monroe Community College; Friday morning.

***Wavelets in Undergraduate Education***, organized by **Caroline Haddad**, SUNY Geneseo; **Edward Aboufadel**, Grand Valley State University; and **John Merkel**, Oglethorpe University; Saturday afternoon.

***We Did More with Less: Streamlining the Undergraduate Mathematics Curriculum***, organized by **Wade Ellis**, West Valley College, and **Barbara Edwards**, Oregon State University; Wednesday afternoon.

***General Contributed Paper Sessions***, organized by **Jennifer Beineke,** Western New England University; **Bem Cayco**, San Jose State University; and **Kimberly Presser**, Shippensburg University of Pennsylvania; Wednesday, Thursday, Friday, and Saturday mornings and afternoons.

These sessions accept contributions in all areas of mathematics, curriculum, and pedagogy. When you submit your abstract you will be asked to classify it according to the following scheme: *Assessment and Outreach*; *Calculus*; *History and Philosophy of Mathematics*; *Interdisciplinary Topics*; *Mathematics Education*; *Mathematics and Technology*; *Modeling and Applications of Mathematics*; *Probability and Statistics*; *Research in Geometry and Linear Algebra*; *Research in Analysis*; *Research in Number Theory*; *Research in Graph Theory and Combinatorics*; *Research in Algebra and Topology*; *Research in Applied Mathematics*; Teaching Introductory Mathematics; *Teaching Mathematics Beyond the Calculus Sequence*; or *Other Assorted Topics*.

## Submission Procedures for MAA Contributed Paper Abstracts

Abstracts must be submitted electronically at `joint mathematicsmeetings.org/meetings/abstracts/abstract.pl?type=jmm`. Simply fill in the number of authors, click "New Abstract", and then follow the step-by-step instructions. **The deadline for abstracts submission is Tuesday, September 17, 2013.**

Each participant may give at most one talk in any one themed contributed paper session or the general contributed paper session. If your paper cannot be accommodated in the session for which it was submitted, it will automatically be considered for the general session.

The organizer(s) of your session will automatically receive a copy of the abstract, so it is not necessary for you to send it directly to the organizer. All accepted abstracts are published in a book that is available to registered participants at the meeting. Questions concerning the submission of abstracts should be addressed to `abs-coord@ams.org`.

## MAA Panels, Posters, Workshops, and Other Sessions

***What Do I Need to Know about Common Core and Common Core Assessments?***, organized by **Bonnie Gold**, Monmouth University, and **Genevieve Knight**, Coppin State University; Wednesday, 9:00 a.m.–10:20 a.m. What are the policy implications of Common Core for higher education? How should mathematics departments prepare for the implementation of Common Core in the K-12 Schools?

Higher education cannot afford to ignore the most important school reform initiative of the past twenty years—the implementation of the Common Core Standards across 48 states. Common Core Standards reflect a national commitment to raising standards in U.S. public schools to invest in the next generation of citizens and increase global competitiveness. This session will describe why the success of this monumental reform effort depends on active support and advocacy from higher education.

Once this school reform effort is successfully implemented, better prepared students will enter our institutions, leading to lower remediation rates, higher retention rates, and higher college completion rates—all emerging accountability measures for higher education.

In order to take best advantage of the new standards, colleges and universities need to become informed about the content and progression of the skills, competencies, and knowledge that students will bring when they enter college. Panelists **Nancy Shapiro**, University System of Maryland; **Bernadette Sandruck**, Howard Community College; and **Denny Gulick**, University of Maryland, will also address the role and relationship between college placement tests and new Common Core Assessments that are designed to assess college readiness. Sponsored by the MAA Committee on Assessment.

***Inquiry-Based Learning Miniworkshop: What is IBL and Why Use It?***, organizeed by **Stan Yoshinobu**, Cal Poly San Luis Obispo; **Matthew Jones**, Cal State Dominguez Hills; and **Carol Schumacher**, Kenyon College; Wednesday, 9:00 a.m.–10:20 a.m. There exists a growing body of evidence that supports the use of active, student-centered instruction, such as Inquiry-Based Learning (IBL). The IBL miniworkshop provides opportunities for math faculty to discuss what IBL is in a mathematics classroom and the evidence why IBL should be used. This workshop is especially useful for instructors who have not used IBL or have just begun using it in their own classes, although all interested faculty are welcome to attend. Attendees of the workshop will be actively involved in discussions, and will also learn about methods that they can take back to the classroom for the upcoming term. Additional support and resources for IBL instructors will also be shared.

***Assistive Technologies for Math Students and Faculty with Disabilities***, organized by **James Hamblin**, Shippensburg University, and **Bruce Yoshiwara**, Los Angeles Pierce College; Wednesday, 9:00 a.m.–10:20 a.m. When creating instructional math content—whether traditional or online—it's important to provide materials that are accessible to all participants, including those with disabilities who may use adaptive software or devices to access the materials. The challenge of making mathematics content accessible is greater than ever—especially for individuals with vision impairment—due in large part to the advent of interactive and dynamic content. Panelists **Rick Clinton**, Pearson Education; **Gaier Dietrich**, De Anza College; and **Maryka Baraka**, Wolfram Research, will discuss factors that make creating accessible mathematics materials particularly challenging, and methods for identifying and delivering acceptable alternatives. Sponsored by the MAA Committee on Technologies in Mathematics Education (CTiME).

***Access and Opportunities in STEM Education: The Challenges of Building an Equitable Diverse Society***, organized by **Carlos Castillo-Chavez**, Arizona State University, Wednesday, 9:30 a.m.–11:00 a.m. The sense of urgency that the NAS's report "Expanding Underrepresented Minority Participation: America's Science and Technology Talent at the Crossroads" places on the diversification of the work force in STEM demands increased access to colleges and universities, not only because it is the right thing to do but because it is in the best national interest. This has been carried out under the leadership of President **Freeman Hrabowski** of the University of Maryland at Baltimore County. President Hrabowski will share the national responses that this report has generated over the past two years. His presentation will be followed by the responses of two recipients of the Presidential Medal of Science: **James S. Gates**, University of Maryland, College Park, and **Richard Tapia**, Rice University. Cosponsored by the MAA Committee on Minority Participation in Mathematics, AMS, and SIAM.

***INGenIOuS: Workforce Preparation for Students in the Mathematical Sciences***, organized by **John Bailer**, Miami University; **Jenna Carpenter**, Louisiana Tech University, **William Jaco**, Oklahoma State University, **Peter Turner**, Clarkson University; and **Paul Zorn**, St. Olaf College; Wednesday, 2:15 p.m.–3:45 p.m. Representatives of AMS, ASA, MAA, and SIAM met in July 2013, at the INGenIOuS workshop, to discuss positioning mathematics and statistics departments to create a workforce that is ready to meet the challenges of the 21st century. The goal is to ensure that the next generation of undergraduate and graduate students view the study of mathematical sciences as a vibrant path leading to many career options. Cosponsored by the AMS, ASA, MAA, and SIAM.

***NSF Programs Supporting Learning, Teaching and the Future Workforce in Mathematics***, organized by **Lee Zia**, **Michael Jacobson**, **Ron Buckmire**, and **Jennifer Pearl,** National Science Foundation; Wednesday, 2:15 p.m. –3:35 p.m. A number of NSF divisions offer a variety of grant programs that support innovations in learning and teaching in the mathematical sciences. These programs will be discussed along with examples of successful projects. Anticipated budget highlights and other new initiatives for the next fiscal year will also be presented. Sponsored by the National Science Foundation.

***Poster Session of Projects Supported by the NSF Division of Undergraduate Education***, organized by **Jon Scott**, Montgomery College; Wednesday, 2:15 p.m.–4:15 p.m. This session will feature principal investigators (PIs) presenting progress and outcomes from various NSF funded projects in the Division of Undergraduate Education. The poster session format will permit ample opportunity for attendees to engage in small group discussions with the PIs and to network with each other. Information about presenters and their projects will appear in the program.

***Career Options for Undergraduate Mathematics Majors***, organized by **Timothy Goldberg**, Lenoir-Rhyne University, and **Ralucca Gera**, Naval Postgraduate School; Wednesday, 2:15 p.m.–3:35 p.m. There are a vast number of options available for students in today's global market. A degree in mathematics continues to be a desirable asset, yet a common question for students to ask is "What options are available for someone with a math degree?" Panelists **Emily Kessler**, Society of Actuaries; **Rebecca Goldin**, George Mason University; **John Workman**, the Advisory Board Company; and **Kim Sacra**, National Security Agency, showcase several options for career paths for students with an undergraduate degree in mathematics and will speak on their own experiences of finding a job. Sponsored by the Young Mathematicians' Network.

***What Experiences Matter On Your Resumé?*** organized by **Kristine Roinestad**, Georgetown College, and **Ralucca Gera**, Naval Postgraduate School; Wednesday, 3:50 p.m.–5:10 p.m. Whether you are looking for a fellowship, a scholarship, a professorship, or a job outside academia, making certain your curriculum vita (CV) stands out is critical for success. A CV is a key element of an application submission, and is an opportunity to concisely showcase your achievements and be shortlisted for an interview. Panelists **Michael Bardzell**, Salisbury University; **Derrick Stolee**, Iowa State University; **Steve Horton**, United States Military Academy; **Robert Campbell**, National Security Agency; and **Glenn Lilly**, National Security Agency, will discuss the type of CV that makes a great first impression

and grabs their attention. Sponsored by the Young Mathematicians' Network.

***Undergraduate Internships and Research Experiences for Undergraduates***, organized by **Thomas Wakefield**, Youngstown State University, and **Ralucca Gera**, Naval Postgraduate School; Thursday, 9:00 a.m.–10:20 a.m. It has become increasingly important for undergraduates to participate in internship or research experiences during their time in college. Panelists **Emily Kessler**, Society of Actuaries; **Stephanie Edwards**, Hope College; **Krista Maxson**, Shawnee State University, **Saad El-Zanati**, Illinois State University; **Leslie Hogben**, Iowa State University; and **Cindy Wyels**, California State University Channel Islands, will discuss various options for undergraduates as they look to apply to REUs or internships. Sponsored by the Young Mathematicians' Network.

***Introductory Proposal Writing Workshop for Grant Applications to the NSF Division of Undergraduate Education***, presented by **John Haddock**, **Michael Jacobson**, and **Lee Zia**, Division of Undergraduate Education, National Science Foundation; Thursday, 9:00 a.m.–10:55 a.m. The presenters will describe the general NSF grant proposal process and consider particular details relevant to programs in the Division of Undergraduate Education. This workshop is geared towards those who have not submitted a proposal to NSF and are unfamiliar with the organization. If you believe you have an idea, project, or program worthy of federal support that will positively impact undergraduate education in mathematics you should attend this session. This workshop will provide information on the specific components of a NSF proposal, demonstrate the NSF peer review process, provide access to previously funded proposals and explicate the NSF merit review criteria by which proposals are evaluated. Participants should leave this workshop with a draft of a project summary. Attendance is **limited to 50 persons**; **please sign up in advance** on the JMM registration form. Sponsored by the National Science Foundation Division of Undergraduate Education.

***Mathematical Outreach Programs***, organized by **Elizabeth Yanik**, Emporia State University; Thursday, 9:00 a.m.–11:00 a.m. This poster session is designed to highlight outreach programs that have been developed to encourage students to maintain and interest in mathematics. These programs might include such activities as after school clubs, weekend activities, one-day conferences, mentoring opportunities, summer camps, etc. This poster session encompasses a wide variety of outreach efforts for a variety of age groups. For example, projects supported by MAA Tensor, SUMMA, and Dolciani grants would find this an ideal venue in which to share the results of their work. We encourage everyone involved with offering mathematical outreach activities to consider submitting an abstract to the session organizer, Betsy Yanik, eyanik@emporia.edu. Sponsored by the MAA Committee on the Participation of Women.

***Math Days for High School Students at Local Colleges and Universities***, organized by **Deanna Haunsperger**, Carleton College, and **Rebecca Swanson**, Colorado School of Mines; Thursday, 10:35 a.m.–11:55 a.m. Some colleges and universities host a day each year for local high school students to visit campus, participate in math activities, attend talks, compete in AMC or regional math competitions, listen to career opportunities in the mathematical sciences, and/or celebrate mathematics. These days not only provide exposure to the physical university campus, which some students would never have had before, but also introduce students to role models, beyond their teachers, for enjoying mathematics. Several colleges with established programs for Math Day-type events will share successful ideas and best practices. Sponsored by the MAA Council on Outreach.

***Finding the Right Grant***, organized by **Josh Laison**, Willamette University, and **Jacob White**, Texas A&M University; Thursday, 1:00 p.m.–2:20 p.m. Are you looking for a grant, and having trouble with the application process? The focus of this panel is on finding and applying for grants, whether they be for education, travel, or research. Panelists **Lloyd Douglas**, University of North Carolina, Greensboro; **Florence Fasanelli**, AAAS; **Eric Gaze,** Bowdoin College; and **Frank Sottile**, Texas A&M University, will discuss the different funding sources, as well as how to make a great application, and to avoid common pitfalls. Sponsored by the Young Mathematicians' Network

***College Board/MAA Mutual Concerns Panel on AP Calculus, Computer Science, and Statistics***, organized by **Roxy Peck**, Cal Poly San Luis Obispo; Thursday, 1:00 p.m.–2:20 p.m. Across the nation, educators are investing much time and effort to understand and improve students' transition from high school to college. To help provide deeper context in these discussions, this panel will address Advanced Placement programs in the mathematical sciences. Panelists **Don King**, Northeastern University; **Paul Tymann**, Rochester Institute of Technology; **Bob Taylor**, Clemson University; and **Lien Diaz**, College Board, will provide updates on the status of AP Calculus, AP Statistics, and AP Computer Science and a report on a new computer science principles course that is under development. They will discuss the use of technology in AP courses, curriculum alignment with college courses, exam development and scoring, gender and ethnic diversity in AP mathematical sciences courses, success rates, and access to AP mathematical sciences courses. Sponsored by the College Board/MAA Committee on Mutual Concerns.

***YMN/Project NExT Poster Session***, organized by **Kim Roth**, Juniata College, and **Mike Axtell**, University of St. Thomas; Thursday, 2:15 p.m.–4:15 p.m. We seek to provide an open venue for people who are near completion, or have finished their graduate studies in the last five years, to present their work and make connections with other same-stage professionals, in much the same spirit as YMN and Project NExT. This poster session is intended to highlight the research activities, both mathematical and pedagogical, of recent or future Master's/Ph.D.s in mathematics and related fields. Trifold posterboards measuring 48" wide by 36" high, plus glue, tape, tacks, etc. will be available at the session to post your material to the posterboard. We expect to accept about forty posters from different areas within the mathematical sciences. To apply, send a poster abstract, when and where you have

or will receive your Ph.D. or master's degree, and your current college or university affiliation to the organizers. Applicants should send a poster abstract to one of the organizers, Kim Roth (roth@juniata.edu) or Mike Axtell (axte2004@stthomas.edu).

***Directing Undergraduate Research: How to Get Started***, organized by **Herbert Medina**, Loyola Marymount University, and **Rebecca Garcia**, Sam Houston State University; Thursday, 2:35 p.m.–3:55 p.m. The number of undergraduates engaging in mathematical sciences research has increased dramatically the past few years. Indicators of this growth are the size of the undergraduate poster session at the Joint Mathematics Meetings (e.g., over 300 posters at the 2013 meeting), the number of mathematics Research Experience for Undergraduates (at least 65), and the recent creation of journals devoted to mathematics research done by undergraduates (e.g., *Involve* at UC Berkeley). This success is in contradiction to the view held by some today and many in the past that "undergraduates cannot do mathematics research because there is so much background needed to understand and successfully tackle a problem."

Many mathematics faculty, some motivated by the success of colleagues with undergraduate research, want to begin their own undergraduate research program, but are hesitant, because they are unsure how to get started. i.e., how to find/choose tractable problems, how to recruit students, how to get funding or release time for the endeavor, how to guide students towards a solution without solving the problem for them, etc. Panelists **Michael Dorff**, Brigham Young University; **Joyati Debnath**, Winona State University; **Angel Pineda**, California State University, Fullerton; and **Sandy Ganzell**, St. Mary's College of Maryland, all having enjoyed success in directing undergraduate research, will address these questions and provide concrete advice on how to get started with directing undergraduate research. Sponsored by the MAA Subcommittee on Research by Undergraduates

***Collaborations Between Two-Year and Four-Year Institutions that Create Pathways to a Math Major***, organized by **Elizabeth Teles**, National Science Foundation, and **Judy Ackerman**, Montgomery College Rockville, Thursday, 2:35 p.m.–3:55 p.m. As more students start their college education at two-year colleges prior to transfering to a four-year program, it is increasingly important for two-year and four-year mathematics departments to collaborate to create student pathways to the mathematics major and for alignment of credit courses. Successful models that attract and retain community college transfer students in the major will be explored by panelists **Debra Poese**, Montgomery College; **Nancy Sattler**, Terra State Community College; and **Eric Kostelich**, Arizona State University. Sponsored by MAA Committee on Two Year Colleges.

***The Genius of Srinivasa Ramanujan***, Thursday, 6:00 p.m.–7:10 p.m. The Prime Minister of India declared 2012 the "National Year of Mathematics" to commemorate the 125th anniversary of the birth of Srinivasa Ramanujan. To honor the occasion, **Nandan Kudhyadi** produced this docudrama. The film features well-known number theorists from around the world associated with Ramanujan's oeuvre. Shot at various locations in India and Cambridge, it serves as a pilgrimage for those interested in the legend and legacy of the great Indian mathematician. The film also highlights the trajectory of Ramanujan's seminal work and its relevance today. Cosponsored by the MAA and AMS.

***Advanced Proposal Writing Workshop for Grant Applications to the NSF Division of Undergraduate Education,*** organized by **John Haddock**, **Michael Jacobson**, and **Lee Zia**, Division of Undergraduate Education, National Science Foundation; Friday, 9:00 a.m.–10:55 a.m. This workshop is geared towards people who have previously submitted a proposal to NSF for funding and intend to do so again. Participants are expected to register in advance and bring a one-page summary of a particular proposal they are intending to submit to NSF's Division of Undergraduate Education in the near future. All participants will have an opportunity to verbally present a one-minute summary of their proposed project and receive written and verbal feedback on it in the presence of NSF program officers. A discussion of the current Transforming Undergraduate Education in STEM (TUES) solicitation and changes to the NSF merit review criteria will occur. Attendance is **limited to 25 persons**; **please sign up in advance** on the JMM registration form. Sponsored by the National Science Foundation Division of Undergraduate Education.

***Maximizing Your Impact in the Classroom: Case Studies in Best Practices for Classroom Teaching***, organized by **Martha Abell**, Georgia Southern University; **Brigitte Lahme**, Sonoma State University; **Michael Oehrtman**, University of Northern Colorado; and **Karen Rhea**, University of Michigan; Friday, 9:00 a.m.–10:20 a.m. The goal of the panel discussion is to address the importance of faculty involvement in student learning while acknowledging the changing times we face in education today. Panelists **Lew Ludwig**, Denison University; **Stan Yoshinobu**, California State University, and **Michelle Zandieh**, Arizona State University, will present case studies in best practices in the use of inquiry-based learning, active learning, and flipped classrooms. In addition, they will share their experiences and provide guidance to audience members in making the most of lecture/class time. The panel discussion also serves as an introduction to materials included in the Pedagogy Guide being developed by the CTUM. Sponsored by the MAA Committee on the Teaching of Undergraduate Mathematics.

***Nonacademic Career Paths for Mathematicians***, organized by **Jennifer Bergner**, Salisbury University; **Lisa Marano**, West Chester University; **Phil Gustafson**, Colorado Mesa University; and **Ben Galluzzo**, Shippensburg University; Friday, 9:00 a.m.–10:20 a.m. You're about to earn a degree in mathematics, now what? You may be surprised to know that teaching isn't your only option; in the "real world" mathematical knowledge is a valued commodity and there are many interesting job opportunities for mathematicians in nonacademic settings. So, whether you are a mathematics student looking for a job once you graduate or an advisor looking for advice to give to future job-seeking students, this session will help you gain new

perspectives on nonacademic career experiences and what employers value in their employees. Panelists **Greg Coxson**, U.S. Naval Research Laboratory; **Jim Fife**, Educational Testing Service; **Carla Martin**, U.S. Government; and **Katie Ford**, NASA Wallops, will share their paths to their current positions and offer advice to others looking for employment in similar venues. The panel discussion will be relevant to all students, but there will be more emphasis on undergraduates than graduates. Sponsored by the MAA Committee on Undergraduate Student Activities and Chapters and BIG SIGMAA.

***MAA Session for Chairs: Planning for the Future with New Curriculum Guides***, organized by **Catherine Murphy**, Purdue University Calumet, and **Daniel Maki**, Indiana University Bloomington; Friday, 1:00 p.m.–2:20 p.m. The soon to be released CUPM Curriculum Guide, the recent METS II, and the ASA guide for the statistics education of teachers are useful planning tools. A distinguished panel of authors of these documents, including **Martha Siegel**, Towson University; **William McCallum**, University of Arizona; and **Christine Franklin**, University of Georgia, will speak to their recommendations and discuss with attendees possible implementation strategies. This is a great opportunity for Chairs to ask questions of experts as well as to give and receive advice from our peers.

***Interactive Dynamic Technology: Its Role in Teaching and Learning Calculus***, organized by **Gail Burrill**, Michigan State University; Friday, 1:00 p.m.–2:20 p.m. Too often calculus courses engage students in procedures to the detriment of understanding. Carefully designed, purposeful activities using interactive dynamic technology can make a difference by helping students as they contend with fundamental calculus concepts. The panelists will discuss how such technology can help students develop key understandings, identify areas in which students need more practice in order to succeed in Advanced Placement Calculus, discuss the issues this raises for designing and scoring AP Tests, and consider what interactive dynamic links can bring to online texts. Panelists **Tom Dick**, Oregon State University; **Wade Ellis**, West Valley Community College; **Steven Kokoska**, Bloomsburg University; and **Gail Burrill**, Michigan State University, will focus on interactive dynamic technology but will also include a broader perspective on technologies available for use in teaching. Questions for the audience will include what they see as barriers to the use of interactive dynamic technologies, what might be done to overcome these barriers, and suggestions for other ways or uses of any types of technology that have been effective in promoting better student learning.

***Designing and Implementing a Problem Based Mathematics Course***, organized by **Gail Burrill**, Michigan State University; Friday, 2:35 p.m.–3:50 p.m. A problem based math course, where students spend most of the time in an interactive, collaborative environment, working on problems connecting various mathematical domains, can simultaneously engage a broad range of students and enlarge their understanding of what it means to do math. Panelists **Darryl Yong**, Harvey Mudd College; **Bowen Kerins**, Educational Development Center; and **Mary Pilgrim**, Colorado State University, will discuss the design of such a course, consider issues related to teaching the course, and describe its implementation in a mathematics program. Such courses were originally developed for teachers at the Park City Mathematics Institute but are applicable for undergraduate majors, prospective teachers, or as part of continuing education programs for experienced teachers. Discussion will be framed by asking what the mathematical goals of such a course might be, how these goals could contribute to a better student understanding of what it means to do mathematics, and how such courses might be part of the offerings in a typical math department.

***The Changing Face of Calculus at the University Level***, organized by **David M. Bressoud**, Macalester College; Friday, 2:35 p.m.—3:55 p.m. More than half the students who take mainstream Calculus I in college have already passed such a course in high school. At research universities, the proportion is over 70%. This is forcing us to rethink what and how we teach in college calculus. Panelists **Larissa Schroeder**, University of Hartford; Angela Kubena, University of Michigan; **Elgin Johnston**, Iowa State University; and **Mariah Birgen**, Wartburg College, will discuss how different institutions are approaching the restructuring of calculus. Cosponsored by the College Board and the MAA Committee on Mutual Concerns.

***Promoting Post-Secondary Mathematics Education***, organized by **Eric M. Friedlander,** University of Southern California, **Mark L. Green,** University of California, Los Angeles, and **Phillip A. Griffiths,** Institute for Advanced Study; Friday, 4:15 p.m.–6:00 p.m. Leaders from outside the academic community of mathematical scientists, including representatives of other math-intensive and interdisciplinary subjects, government, industry, and other employers, will participate in a discussion of the challenges and prospects for systemic change in post-secondary mathematics education. This discussion should promote substantial, constructive responses to achieve goals which include: 1) creating and disseminating course content to meet the needs of today's students, especially by emphasizing the roles that mathematics plays in the modern world; 2) strengthening the pipeline for prospective STEM graduates; 3) developing, adapting, and evaluating new teaching methodologies. Cosponsored by the MAA, AMS, and SIAM.

***Poetry Reading***, organized by **Gizem Karaali**, Pomona College; **Mark Huber**, Claremont McKenna College; and **JoAnne Growney**, `poetrywithmathematics.blogspot.com`; Friday, 4:30 p.m.–6:30 p.m. All mathematical poets and those interested in mathematical poetry are invited. Share your poetry or simply enjoy the company of like-minded poetic-math people! The reading is sponsored by the *Journal of Humanistic Mathematics* (`scholarship.claremont.edu/jhm`). Though we do not discourage last-minute decisions to participate, we invite and encourage poets to submit poetry ($\leq$ 3 poems, $\leq$ 5 minutes) and a biography in advance, and, as a result, be listed on our printed program. Inquiries and submissions may be made to Gizem Karaali (`gizem.karaali@pomona.edu`) **no later than November 30, 2013**.

***Actuarial Science Education Session for Faculty***, organized by **Kevin Charlwood**, Washburn University; **Bettye Anne Case**, Florida State University; **Robert Buck**, Slippery Rock University; **Steve Paris**, Florida State University; and **Patrick Brewer**, Lebanon Valley College; Friday, 5:00 p.m. –7:00 p.m. The pace of change in actuarial science is faster than in most academic areas, and this session aims to help faculty adjust curriculum and activities to meet student needs and expectations. CUPM has a Program Area Study Group concentrating on undergraduate programs in actuarial science. Their progress may be a topic for discussion. The next anticipated changes in the CAS and SOA exam series will also be discussed by panelists **Patrick Brewer**, Lebanon Valley College; **Jim Daniel**, University of Texas at Austin; and **Michelle Guan**, Indiana University Northwest.

***Mathematically Bent Theater,*** by **Colin Adams and the Mobiusbandaid Players**; Friday, 7:30 p.m.–8:30 p.m. Why is it that math and humor are considered synonymous? Why do students laugh maniacally when they see their score on the calculus final? How did the Bernoulli Brothers bring down the house in their first comedy appearance? Who came up with the word "functor"? These are just a few of the questions we will not answer in this presentation of several short mathematically inclined, humorous performances.

***Two Worlds Collide: MOOCs and the Ivory Tower***, organized by **John Travis**, Mississippi College, and **Martha Siegel**, Towson University; Saturday, 8:30 a.m.–9:50 a.m. Massive Open Online Courses (MOOCs) have begun to stir up the academic playing field and force institutions to consider their impact on the usual collection of university course offerings. As students continue to discover MOOCs, the broader academic world should consider whether to embrace, eschew, or just endure them. The efficacy of such courses in mathematics and their impact on learning are currently unknown. This event will attempt to inform participants on the variety of available MOOCs and start a dialogue among all stakeholders.

The panel will include pioneers in MOOC development for mathematics to discuss how MOOCs have been used and how these courses can successfully encourage the cognitive skills unique to mathematics. **Keith Devlin**, Stanford University; **Robert Ghrist**, University of Pennsylvania; **Michael Starbird**, University of Texas Austin; and **Marilyn Carlson**, Arizona State University, will discuss their views on the potential for MOOCs to promote effective teaching and learning and the contribution of technology and social media to enhance student understanding. Sponsored by the MAA Committee on Technologies in Mathematics Education (CTME), MAA Committee on the Undergraduate Program in Mathematics (CUPM), and WebSIGMAA.

***Mathematicians Supporting Implementation of the Common Core State Standards for Mathematics***, organized by **Elizabeth Burroughs**, Montana State University; **Pari Ford**, University of Nebraska at Kearney; and **Debbie Gochenaur**, Shippensburg University; Saturday, 1:00 p.m.–2:20 p.m. Mathematicians have been active in projects that support state-level implementation of the Common Core State Standards for Mathematics (CCSSM). This panel will offer examples of such projects and highlight the roles of mathematicians in each. The projects are varied and will highlight collaborations between mathematicians and teachers, the use of classroom video in teaching mathematics, the development of mathematics tasks via the Illustrative Mathematics Project, and the use of resources developed by the National Council of Teachers of Mathematics. Panelists **Sybilla Beckmann**, University of Georgia; **Sid Rachlin**, East Carolina University; **Alison Superfine**, University of Illinois Chicago; **Kristin Umland**, University of New Mexico; and **Rose Mary Zbiek**, Pennsylvania State University, will provide opportunities for discussion about how mathematicians can engage in the implementation of CCSSM. Sponsored by the MAA Committee on the Mathematical Education of Teachers.

***The Environment, Mathematics, and Community Engagement***, organized by **Ben Fusaro**, Florida State University; **Charlie Hadlock**, Bentley University; and **Marty Walter**, University of Colorado Boulder; Saturday, 2:00 p.m.–5:00 p.m. We have an opportunity—and an obligation—to show how mathematics can help avert an environmental-sustainability cliff. The three presenters (collectively) have been doing their part for over 35 years, working at every level—local to international—to sound the alarm about environmental challenges. Presentations in public forums typically use simple mathematics. A critical aspect is the format and tone of the presentation. Consulting in industry is similar but uses more complex mathematics. This is an opportunity to conserve, or even increase, the momentum generated by Mathematics for Planet Earth 2013 at the San Diego JMM. It is also an opportunity to showcase how we can simplify, clarify, or solve environmental problems. This workshop will be a *We-have-done-it*, *You-can-do-it*, *This–is-how* activity.

If you would like to participate, please contact Ben Fusaro by email at `fusaro@math.fsu.edu` or call him at 850- 297-2052. Sponsored by the SIGMAA on Mathematics and the Environment.

## Special Interest Groups of the MAA (SIGMAAs)

SIGMAAs will be hosting a number of activities, sessions, and guest lectures. There are currently twelve such focus groups in the MAA offering members opportunities to interact, not only at meetings, but throughout the year, via newsletters and email-based communications. For more information visit `www.maa.org/community/sigmaas/`.

***SIGMAA Officers Meeting***, Thursday, 10:30 a.m.–noon, chaired by **Karen A. Marrongelle**, Portland State University.

**Mathematics and the Arts: SIGMAA ARTS**

***At the Intersection of Mathematics and the Arts***, Thursday afternoon (See MAA Contributed Paper Sessions)

**Mathematical and Computational Biology: BIO SIGMAA**

***Reception***, Thursday, 6:00 p.m.– 6:30 p.m.

***Business Meeting***, Thursday, 6:30 p.m.–6:50 p.m.

***Guest Lecture***, Thursday, 7:00 p.m.–8:00 p.m., **Lisa Fauci**, Tulane University, *Explorations in phytoplankton fluid dynamics.*

***Trends in Undergraduate Mathematical Biology Education***; Friday morning (see MAA Contributed Paper Sessions)

**Mathematicians in Business, Industry and Government: BIG SIGMAA**

***Mathematics Experiences in Business, Industry, and Government;*** Friday afternoon (see MAA Contributed Paper Sessions)

***Guest Lecture***, Friday, 6:30 p.m.–7:20 p.m., **William Noel**, University of Pennsylvania, on *Eureka! The Archimedes Palimpsest.*

***Reception***, Friday, 7:30 p.m.–8:00 p.m.

***Business Meeting***, Friday, 8:00 p.m.–9:00 p.m.

***Nonacademic Career Paths for Mathematicians***, Friday, 9:00 a.m.–10:20 a.m. (See MAA Panels, et al.)

**History of Mathematics: HOM SIGMAA**

***Reading, Writing and Doing the History of Mathematics: Learning the Methods of Historical Research***, Monday and Tuesday (See MAA Short Course)

***The History of Mathematical Communities***, Thursday afternoon (see MAA Contributed Paper Sessions)

***Putting a Theme in a History of Mathematics Course***, Saturday morning (see MAA Contributed Paper Sessions)

**Philosophy of Mathematics: POM SIGMAA**

***Is Mathematics the Language of Science?***, Wednesday morning (See MAA Contributed Paper Sessions)

***Reception***, Thursday, 5:30 p.m.–6:00 p.m.

***Business Meeting***, Thursday, 6:00 p.m.– 6:30 p.m.

***Guest Lecture***, Thursday, 6:30 p.m.–7:30 p.m., **Steve Gimbel**, Gettysburg College, *Hermann Minkowski: The quiet genius.*

**Quantitative Literacy: SIGMAA QL**

***Assessing Quantitative Reasoning and Literacy***. Wednesday morning (See MAA Contributed Paper Sessions)

***Reception and Business Meeting***, Thursday, 6:00 p.m.–7:00 p.m.

***Guest Lecture***, Thursday, 7:00 p.m.–7:50 p.m., speaker and title to be announced.

**Research in Undergraduate Mathematics Education: SIGMAA RUME**

***Research on the Teaching and Learning of Undergraduate Mathematics***, Thursday morning and afternoon (See MAA Contributed Paper Sessions)

**Statistics Education: SIGMAA STAT-ED**

***Data, Modeling, and Computing in the Introductory Statistics Course***, Friday afternoon (See MAA Contributed Paper Sessions)

**Mathematics Instruction Using the Web: WEB SIGMAA**

***Business Meeting and Reception***, Friday, 5:00 p.m.–5:30 p.m.

***Guest Lecture***, Friday, 5:30 p.m.–6:30 p.m., **Doug Ensley**, Shippensburg University, *Mobile math apps.*

***Using Online Resources to Augment the Traditional Classroom***, Friday morning (see MAA Contributed Paper Sessions)

***Two Worlds Collide: MOOCs and the Ivory Tower***, Saturday morning (see MAA Panels et al.)

**Environmental Mathematics: SIGMAA EM**

***The Environment, Mathematics, and Community Engagement***, Saturday afternoon (See MAA Panels et al.)

***USE Math: Undergraduate Sustainability Experiences in the Introductory Mathematics Classroom, Saturday morning*** (See MAA Contributed Paper Sessions)

## MAA Sessions for Students

***Grad School Fair***, Friday, 8:30 a.m.–10:30 a.m. Here is the opportunity for undergrads to meet representatives from mathematical sciences graduate programs from universities all over the country. January is a great time for juniors to learn more, and college seniors may still be able to refine their search. This is your chance for one-stop shopping in the graduate school market. At last year's meeting about 300 students met with representatives from 50 graduate programs. If your school has a graduate program and you are interested in participating, a table will be provided for your posters and printed materials for US$75 (registration for this event must be made by a person already registered for the JMM), and you are welcome to personally speak to interested students. Complimentary coffee will be served. Cosponsored by the MAA and AMS.

***MAA Lecture for Students***, Friday, 1:00 p.m.–1:50 p.m., will be given by **Carl Cowen**, Indiana University–Purdue University Indianapolis, on *An unexpected group.*

***Student Poster Session***, organized by **Joyati Debnath**, Winona State University; Friday, 4:30 p.m.–5:30 p.m. The session is reserved for undergraduate and first-year graduate students submitting posters on work done while an undergraduate. Appropriate poster topics include: a new result, a new proof of a known result, a new mathematical model, an innovative solution to a Putnam problem, or a method of solution for an applied problem. Purely expository topics are not appropriate for this session. **The proposal submission deadline is midnight Pacific Daylight Time, October 11**. Notification of acceptance or rejection will be sent by November 1, 2013. See `http://www.maa.org/programs/students/undergraduate-research/jmm-poster-session.html` for further details and a link to the abstracts submission form. See `http://www.maa.org/sites/default/files/pdf/students/writing%20Abstracts.pdf` for "A Guide to Writing an Abstract". Posters will be judged during the session and award certificates will be mailed to presenters with the highest scores. Trifold, self-standing 48" by 36" tabletop poster boards will be provided, plus tape, glue, tacks, etc. for attaching your material to the posterboard. See `http://www.ncsu.edu/project/posters/` for "Creating an Effective Poster". Additional materials and equipment

are the responsibility of the presenters. Participants must be available between 2:30 and 5:30 p.m. for the session (2:30-3:30 set-up, 3:30-4:30 judges only, 4:30-5:30 judges and public viewing). Questions regarding this session should be directed to Joyati Debnath at jdebnath@winona.edu.

Some more advanced students might be interested in these sessions listed elsewhere in this announcement: ***Career Options for Undergraduate Mathematics Majors***, Wednesday at 2:15 p.m.; ***What Experiences Matter On Your Resumé?***, Wednesday at 3:50 p.m.; ***Undergraduate Internships and Research Experiences for Undergraduates***, Thursday at 9:00 a.m.; ***YMN/Project NExT Poster Session***, Thursday at 2:15 p.m.; ***Nonacademic Career Path for Mathematicians***, Friday at 9:00 a.m. See the full descriptions in the "MAA Panels…" section. You may also be interested in the **AMS-MAA-SIAM Special Session on Research in Mathematics by Undergraduates and Students in Post-Baccalaureate Programs** on Wednesday morning and afternoon, Friday morning, and Saturday afternoon, listed in the "AMS Special Sessions" section.

Also see the "Social Events" section for the open hours of the **Student Hospitality Center**, **Reception for Undergraduates**, and **Reception for Graduate Students and First-Time Participants**.

## MAA Short Course

This two-day Short Course on ***Reading, Writing and Doing the History of Mathematics: Learning the Methods of Historical Research*** is organized by **Amy Shell-Gellasch**, Montgomery College. Browse the mathematics section of your favorite book store or catalog and you will have noticed that over the past few decades, the offerings in the history of mathematics and its uses in teaching have skyrocketed. The history of mathematics has become an important component of the study of mathematics. More and more mathematicians are choosing to delve into the history of mathematics, either as a hobby or as a serious pursuit. Likewise, more and more schools are offering history of mathematics courses, and many states are now requiring it of their math education majors. Perhaps you have a growing interest in the field, simply as a consumer or perhaps you are a budding historian yourself. Or perhaps you are finding yourself using it in your teaching more and more. But just as the study of mathematics has rigorous methods that cannot be ignored without peril, so does historical study.

This Short Course will introduce participants to the methods of correct historical research in mathematics, as well as the theory and philosophy underlying accurate and unbiased historical research, analysis and reporting. We will address the following areas: Theories of history, cultural and temporal context, reading historical sources and translating, writing the history of mathematics, history compared to historiography, historical sources, and implications to pedagogy.

The course will consist of lectures by prominent historians, followed by participant workshops in which the participants will examine, analyze, and discuss examples of historical writings and results. We will conclude our course with a panel discussion by all of our experts to discuss how to implement these ideas into the mathematics classroom and the pedagogical implications of correct historical study. The speakers are all established and respected math historians who will share their particular expertise (please note that some talk titles are tentative): **Ron Calinger**, Catholic University of America, *The contextualization of history*; **Joe Dauben**, Lehman College, CUNY, *Cultural bias and translations*; **Michael Fried**, Ben Gurion University of the Negev, Israel, *Our relationship to history: Who does history*; **Colin McKinney**, Wabash College, *Reading and translating without bias. The case of Euclid*; **Karen Parshall**, University of Virginia, *The reading and writing of history*; and **Fred Rickey**, USMA, *Historical documents and sources and implications to pedagogy*.

There are separate registration fees to participate in this Short Course. See the fee schedule on the registration form at the back of this issue or visit jointmathematicsmeetings.org/2160_regfees.html.

## Other MAA Events

**Board of Governors**, Tuesday, 9:00 a.m.–5:00 p.m.

**Department Liaisons Meeting**, Wednesday, 9:30 a.m.–11:00 a.m.

**Section Officers**, chaired by **Rick Gillman**, Valparaiso University; Wednesday, 4:00 p.m.–5:00 p.m.

**Business Meeting**, Saturday, 11:10 a.m.–11:40 a.m., chaired by MAA President **Robert Devaney**, Boston University.

**Minority Chairs Meeting**, day and time to be determined.

See the listings for various receptions in the "Social Events" section.

## MAA Ancillary Workshops

To register for either of the workshops described below, please visit www.causeweb.org/workshop. There is no registration fee, however, participants must register in advance; no walk-ins will be allowed. Registration for the JMM is not a prerequisite for participating in these sessions.

***Interactive Probability Instruction,*** presented by **Dennis Pearl**, The Ohio State University, **Kyle Siegrist**, University of Alabama, and **Ivo Dinov**, University of California Los Angeles; Tuesday, 1:00 p.m.–4:30 p.m. This half-day workshop will introduce participants to novel web-based technologies for blended teaching of computational statistics and applied probability theory. Specifically, 50% of the time will be dedicated to training using the Probability Distributome webapps (www.Distributome.org), 25% for demonstrating the classroom use of the Virtual Laboratories in Probability and Statistics (www.math.uah.edu/stat), and 25% for exploratory data analysis using the Statistics Online Computational Resource (www.SOCR.ucla.edu). Participants should bring a laptop to this workshop to take part in hands-on demonstrations illustrating data modeling, exploring of properties of probability distributions and interdistributional relationships, resampling and simulation, dynamic data plots, and model fitting. These topics and techniques are suitable for introductory and

cross-listed applied probability and statistical methods courses. The workshop is designed to be accessible to those with little or no computational background, and will provide you with skills, examples, and resources that you can use in your own teaching.

***Teaching the Statistical Investigation Process with Randomization-Based Inference***, presented by **Nathan Tintle**, Dordt College, Tuesday, 9:00 a.m.–4:30 p.m. This full day workshop is intended for faculty members who have experience with or soon will be teaching introductory statistics. The goals of this workshop are to help participants to revise their introductory statistics course in two ways: 1) Using randomization-based methods, as opposed to methods based on the normal distribution, to introduce concepts of statistical inference, and 2) Emphasizing the overarching process of conducting statistical investigations, from formulating a question and collecting data through exploring data and drawing inferences to communicating results, throughout the course.

The workshop will provide direct experience with hands-on activities designed to introduce students to fundamental concepts of inference using randomization-based methods. The learning activities involve using freely available applets to explore concepts and analyze real data from genuine research studies. Presenters will also offer implementation and assessment suggestions during these activity-based sessions and discussion sessions. More information about the project on which this workshop is based can be found at `www.math.hope.edu/isi`.

## *Activities of Other Organizations*

This section includes scientific sessions. Several organizations or special groups are having receptions or other social events. Please see the "Social Events" section of this announcement for details.

### Association for Symbolic Logic (ASL)

This-two day program on Friday and Saturday will include sessions of contributed papers as well as Invited Addresses by **Jeremy Avigad**, Carnegie Mellon University; **Damir Dzhafarov**, University of Connecticut; **Su Gao**, University of North Texas; **Joel Hamkins**, City University of New York; **Maryanthe Malliaris**, University of Chicago; and **Alice Medvedev**, City College of New York.

See also the session cosponsored by the ASL, *Logic and Probability,* on Wednesday and Thursday in the "AMS Special Sessions" listings.

### Association for Women in Mathematics (AWM)

***Thirty-Fifth Annual Noether Lecture***, Thursday, 10:05 a.m., will be given by **Georgia Benkart**, University of Wisconsin-Madison, on *Walking on graphs the representation theory way.*

Also see the session on ***Geometric Applications of Algebraic Combinatorics,*** jointly sponsored by the AWM, in the "AMS Special Sessions" listings.

***Building a Research Career in Mathematics***, organized by **Bettye Anne Case**, Florida State University, and **Christina Sormani**, City University of New York; Wednesday, 2:15 p.m.–3:40 p.m. The goal of the discussion will be to discuss ways in which mathematicians can develop a serious research program at any institution. We hope to provide information that will be useful to department chairs who wish to support their faculty as well as providing insights and encouragement directly to the young mathematicians themselves. All panelists, including **Ruth Charney**, Brandeis University; **Joan Hutchinson**, Macalester College; Smith College emerita; **Deleram Kahrobaei**, City University of New York Graduate City and NYC College of Technology; **Tanya Leise**, Amherst College; **Chikako Mese**, John Hopkins University; and **Judy Walker**, University of Nebraska, are mathematicians with highly successful research careers who have worked in a wide range of mathematics departments over the years. See `sites.google.com/site/awmpanel2014/` for the latest information.

***Business Meeting***, Wednesday, 3:45 p.m.–4:15 p.m.

***Workshop Poster Presentations and Reception***, Friday, 6:00 p.m.–7:15 p.m. With funding from the National Science Foundation, AWM will conduct its workshop poster presentations by women graduate students. Organizers for these presentations are **Maria Basterra**, University of New Hampshire; **Erin Chambers**, Saint Louis University; and **Kathryn Leonard**, California State University Channel Islands.

***AWM Workshop***, Saturday, 8:00 a.m.–5:50 p.m. With funding from the National Science Foundation, AWM will conduct its workshop with presentations by senior and junior women researchers. All mathematicians (female and male) are invited to attend the entire program. Departments are urged to help graduate students and recent Ph.D.'s who do not receive funding to obtain some institutional support to attend the workshop and other meeting sessions. Updated information about the workshop is available at `www.awm-math.org/workshops.html`. AWM seeks volunteers to serve as mentors for workshop participants. If you are interested, please contact the AWM office; inquiries regarding future workshops may be made to the office at `awm@awm-math.org`.

***Reception***, Wednesday, 9:30 p.m.–11:00 p.m. See the listing in the "Social Events," section of the announcement.

### National Association of Mathematicians (NAM)

***Granville-Brown-Haynes Session of Presentations by Recent Doctoral Recipients in the Mathematical Sciences***, Friday, 1:00 p.m.–4:00 p.m.

***Cox-Talbot Address***, to be given Friday after the banquet, speaker and title to be announced.

***Panel Discussion,*** Saturday, 9:00 a.m.-9:50 a.m., title to be announced.

***Business Meeting***, Saturday, 10:00 a.m.-10:50 a.m.

***Claytor-Woodward Lecture***, Saturday, 1:00 p.m., speaker and title to be announced.

See details about the banquet on Friday in the "Social Events" section.

### National Science Foundation (NSF)

The NSF will be represented at a booth in the exhibit area. NSF staff members will be available to provide counsel and information on NSF programs of interest to mathematicians. The booth is open the same days and

hours as the exhibits. Times that staff will be available will be posted at the booth.

### Pi Mu Epsilon (PME)

***Council Meeting***, Friday, 8:00 a.m.–11:00 a.m.

### Rocky Mountain Mathematics Consortium (RMMC)

***Board of Directors Meeting***, Friday, 2:15 p.m.–4:10 p.m.

### Society for Industrial and Applied Mathematics (SIAM)

This program consists of an Invited Address at 11:10 a.m. on Thursday given by **Eitan Tadmor**, University of Maryland, and a series of Minisymposia to include *Modeling Modules and Activities for Students*, **Suzranne Lenhart**, University of Tennesee, Knoxville; **Maeve McCarthy**, Murray State University; **Peter Turner**, Clarkson University; and others to be announced.

See also these special presentations cosponsored by SIAM in the AMS or MAA listings: ***Access and Opportunities in STEM Education: The Challenges of Building an Equitable Diverse Society*** (Wednesday at 9:30 a.m.); ***INGenIOuS: Workforce Preparation for Students in the Mathematical Sciences*** (Wednesday at 2:15 p.m.); and ***Promoting Post-Secondary Mathematics Education*** (Friday at 4:15 p.m.).

### Young Mathematicians' Network (YMN)

***Open Forum***, organized by **Jacob White**, Texas A&M University and **Timothy Goldberg**, Lenoir-Rhyne University; Thursday, 7:30 p.m.–8:30 p.m. All meeting participants, especially undergraduates and graduate students, and early career mathematicians are invited to discuss topics and issues affecting early career mathematicians.

Also see details about other sessions cosponsored by the YMN in the MAA Panels, etc. section: ***Project NExT-YMN Poster Session,*** Thursday, 2:15 p.m.; ***Career Options for Undergraduate Mathematics Majors***, Wednesday, 2:15 p.m.; ***What Experiences Matter on Your Resumé?***, Wednesday, 3:50 p.m.; ***Undergraduate Internships and Research Experiences for Undergraduates***, Thursday, 9:00 a.m.; and ***Finding the Right Grant***, Thursday, 1:00 p.m.

### Others

***Mathematical Art Exhibition***, organized by **Robert Fathauer**, Tessellations Company; **Nathaniel A. Friedman**, ISAMA and SUNY Albany, **Anne Burns**, Long Island University C. W. Post Campus, **Reza Sarhangi**, Towson University, and **Nathan Selikoff**, Digital Awakening Studios. A popular feature at the Joint Mathematics Meetings, this exhibition provides a break in your day. On display are works in various media by artists who are inspired by mathematics and by mathematicians who use visual art to express their findings. Topology, fractals, polyhedra, and tiling are some of the ideas at play here. Don't miss this unique opportunity for a different perspective on mathematics. The exhibition will be located inside the Joint Mathematics Exhibits and open during the same exhibit hours.

***Summer Program for Women in Mathematics (SPWM) Reunion***, organized by **Murli M. Gupta**, George Washington University, Thursday, 1:00 p.m.– 4:00 p.m. This is a reunion of the summer program participants from our past 19 years who are in various states in their mathematical careers: some are students (undergraduate or graduate), others are in various jobs, both in academia as well as government and industry. The participants will describe their experiences relating to all aspects of their careers, and a few will give talks on the research areas they are exploring. There will also be a presentation on the increasing participation of women in mathematics over the past two decades and the impact of SPWM and similar programs. See `http://www.gwu.edu/~spwm`.

***Negotiating in Mathematical Careers***, organized by **Janet Best,** Ohio State University; **Christine Guenther**, Pacific University; and **Amber Puha**, California State University San Marcos; Thursday, 1:00 p.m.–2:30 p.m. Panelists **Rachelle De Coste**, Lehman College; **Peter March**, Ohio State University; **Tanya Moore**, Building Diversity in Science; and **Catherine Roberts**, College of the Holy Cross, will address how to negotiate successfully throughout a career in academia or industry, from making the most of a first job offer to maximizing post-promotion opportunities. Strategic career negotiation is of particular relevance to women, who in part because of a reluctance to negotiate earn less than their male counterparts. The panel will cover specific issues to negotiate and strategies for doing so. Sponsored by the Joint Committee on Women in the Mathematical Sciences.

***Pure and Applied Talks by Women Math Warriors presented by EDGE (Enhancing Diversity in Graduate Education),*** organized by **Amy Buchmann**, University of Notre Dame; and **Candice Price**, United States Military Academy, West Point; Saturday, 1:00 p.m.– 5:00 p.m. Since its beginning in 1998 nearly two hundred women have participated in the EDGE program. Approximately seventy are currently working towards a Ph.D., over one hundred have earned Master's, and fifty-four have gone on to successfully complete Ph.D's. This session will be comprised of research talks in a variety of different subdisciplines given by women involved with the EDGE program. For more information on the EDGE program see `www.edgeforwomen.org/`.

## *Social Events*

All events listed are open to all registered participants. It is strongly recommended that for any event requiring a ticket, tickets should be purchased through advance registration. Only a very limited number of tickets, if any, will be available for sale on site. If you must cancel your participation in a ticketed event, you may request a 50% refund by returning your tickets to the Mathematics Meetings Service Bureau (MMSB) by **January 7**. After that date no refunds can be made. Special meals are available at banquets upon advance request, but this must be indicated on the Advanced Registration/Housing Form.

***AMS Dinner Celebrating Connection & Collaboration***: Attend the AMS Dinner and celebrate your connections to collaborators, old friends, and the mathematical community. This event provides an excellent opportunity to socialize with colleagues and reflect on the past while taking a look at new and exciting developments. AMS members present at the dinner will be honored for 25+ years of membership and the longest-term member present will receive a special award. This evening of celebration will include gourmet food stations and a special program. It will be held on Saturday evening with dinner served at 7:30 pm. Tickets are US$62 including tax and gratuity. The banquet will be preceded by a reception at 6:30 pm.

***Association of Christians in the Mathematical Sciences (ACMS) Reception and Guest Lecture***, Thursday, 5:30 p.m.–7:30 p.m. The reception will take place between 5:30 p.m. and 6:30 p.m. and will be followed by a talk at 6:30 p.m. from **John Roe**, Pennsylvania State University, on *Math on the Rocks.* An opportunity will be provided afterwards for participants to go to dinner at local restaurants in small groups.

***Annual Association of Lesbian, Gay, Bisexual, and Transgendered Mathematicians Reception***, Thursday, 6:00 p.m.–8:00 p.m. All are welcome to attend this open reception affiliated with NOGLSTP, the National Organization of Gay and Lesbian Scientists and Technical Professionals, Inc.

***AWM Reception***, Wednesday, 9:30 p.m. after the AMS Gibbs Lecture, has been a popular, well-attended event in the past. All of the honorees of the Alice T. Schaffer Prize for Excellence in Mathematics by an Undergraduate Woman, the recipient of the AWM-Microsoft Research Prize in Algebra and Number Theory, the AWM-Sadosky Research Prize in Analysis, and the AWM Service Awards will be recognized by the AWM President at 10:00 p.m.

***Budapest Semesters in Mathematics Annual Alumni Reunion***, Thursday, 5:30 p.m.–7:00 p.m.

***Reception for Graduate Students and First-Time Participants***, Wednesday, 5:30 p.m.–6:30 p.m. The AMS and MAA cosponsor this social hour. Graduate students and first-timers are especially encouraged to come and meet some old-timers to pick up a few tips on how to survive the environment of a large meeting. Light refreshments will be served.

***University of Illinois at Urbana-Champaign Department of Mathematics Alumni Reception***, Friday, 5:30 p.m.–7:30 p.m. Everyone ever connected with the department is encouraged to get together for conversation and to hear about mathematics at the University of Illinois. Please see `www.math.illinois.edu/jmm-reception.html`.

***Knitting Circle***, Thursday, 8:15 p.m.–9:45 p.m. Bring a project (knitting/crochet/tatting/beading/etc.) and chat with other mathematical crafters!

***MAA/Project NExT Reception***, Friday, 8:00 p.m.–10:00 p.m.; organized by **Julia Barnes**, Western Carolina University; **Judith Covington**, Louisiana State University, Shreveport; **Matthew DeLong**, Taylor University; and **Aparna W. Higgins**, University of Dayton. All Project NExT Fellows, consultants, and other friends of Project NExT are invited.

***MAA Two-Year College Reception***, Thursday, 5:45 p.m.–7:00 p.m., is open to all meeting participants, particularly two-year faculty members. This is a great opportunity to meet old friends and make some new ones. There will be hot and cold refreshments and a cash bar. This reception is sponsored by Pearson.

**Mathematical Reviews *Reception***, Friday, 6:00 p.m.–7:00 p.m. All friends of the *Mathematical Reviews* (MR) are invited to join reviewers and MR editors and staff (past and present) for a reception in honor of all of the efforts that go into the creation and publication of the *Mathematical Reviews* database. Refreshments will be served.

***Mathematical Institutes Open House***, Wednesday, 5:30 p.m.–8:00 p.m. Participants are warmly invited to attend this open house which is co-sponsored by several of the mathematical science institutes in North America. This reception precedes the Gibbs Lecture. Come find out about the latest activities and programs at each of the institutes that may be suited to your own research. Please join us!

***Curious Construction Conclave***, Thursday, 6:30 p.m.–7:30 p.m. Become a part of North America's only Museum of Math! Help construct a new geometric structure for the National Museum of Mathematics in New York City, and sign up to collaborate on new museum content for a chance of winning a family pass to MOMATH!

**National Association of Mathematicians Banquet**, Friday, 6:00 p.m.–8:40 p.m. A cash bar reception will be held at 6:00 p.m., and dinner will be served at 6:30 p.m. Tickets are US$62 each, including tax and gratuity. The Cox-Talbot Invited Address will be given after the dinner.

**NSA Women in Mathematics Society Networking Session**, Thursday, 6:00 p.m.–8:00 p.m. All participants are welcome to this annual event. Please stop by the NSA booth in the exhibit hall for information and the specific location of the event.

**Pennsylvania State University Mathematics Alumni Reception**, Wednesday, 6:30 p.m.–8:30 p.m. Please join us for hors d'oeuvres and beverages and mingle with math alumni, faculty, and College of Science representatives.

**Student Hospitality Center**, Wednesday–Friday, 9:00 a.m.–5:00 p.m., and Saturday, 9:00 a.m.–3:00 p.m., organized by **Richard** and **Araceli Neal**, American Society for the Communication of Mathematics.

**Reception for Undergraduates**, Wednesday, 4:00 p.m.–5:00 p.m.

## *Other Events of Interest*

**AMS Information Booth**: All meetings participants are invited to visit the AMS Information Booth during the meetings. A special gift will be available for participants, compliments of the AMS. AMS staff will be at the booth to answer questions about AMS programs and membership.

**Book Sales and Exhibits**: All participants are encouraged to visit the book, education media, and software exhibits from 12:15 p.m.–5:30 p.m. on Wednesday, 9:30 a.m.–5:30 p.m. on Thursday and Friday, and 9:00 a.m.–noon on Saturday. Books published by the AMS and MAA will be sold at discounted prices somewhat below the cost for the same books purchased by mail. These discounts

will be available only to registered participants wearing the official meetings badge. Participants visiting the exhibits are required to display their meetings badge in order to enter the exhibit area.

The MAA and the AMS cordially invite all registered participants to enjoy complimentary tea and coffee while perusing the associations' booths.

**Mathematical Sciences Employment Center**: Those wishing to participate in the Mathematical Sciences Employment Center should read carefully the important article about the center beginning on page 1218 in this issue of *Notices* or at www.ams.org/emp-reg/. Employers should pay the appropriate fees; there are no fees for applicants to participate, except that all Employment Center participants must also register for the Joint Mathematics Meetings (JMM). Official meeting badges are required to enter the Employment Center.

**Networking Opportunities**: There are many opportunities to meet new friends and greet old acquaintances in addition to the vast array of scientific sessions offered at these meetings. These opportunities are listed on the networking page at jointmathematicsmeetings.org/2160_newcomers.html.

**First-Time Participants**: A special welcome is extended to all new participants of these meetings. For your convenience tips on how to navigate the meetings are found at the newcomers' page at jointmathematicsmeetings/2160_newcomers.html. You may want to investigate the many receptions listed in the "Social Events" section, the Student Hospitality Center, and the Employment Center. On site you will find a Networking Center featuring casual seating and complimentary internet access. This is a great place to relax between sessions and forge new friendships. You should also check out the lists of registered participants sorted by school and math subject classification which will be available on the website for your perusal shortly before the meetings begin in January.

## *Registering in Advance*

The importance of advance registration cannot be overemphasized. Advance registration fees are considerably lower than onsite registration fees. The AMS and the MAA encourage all participants to register for the meeting. When you pay the registration fee, you are helping to support a wide range of activities associated with planning, organizing, and execution of the meetings. All registrations are processed by the Mathematics Meetings Service Bureau (MMSB). Participants who register by **November 19** may receive their badges, programs, and tickets (where applicable) in advance by U.S. mail approximately three weeks before the meetings. Those who do not want their materials mailed should check the appropriate box on the Advance Registration/Housing (ARH) Form. However, materials will not be mailed to Canada, Mexico, or other countries outside of the U.S. due to delays. Participants from these countries must pick up their materials at Advance Registration Pickup Desk at the meetings. Please note that a US$5 replacement fee will be charged for programs and badges that were mailed but not taken to the meeting. See the staff at the Registration Assistance Desk.

Acknowledgments of registrations will be sent by email to the email addresses given on the ARH Form. If you do not wish your registration acknowledged by email, please mark the appropriate box on the ARH form.

Advance registration forms accompanied by insufficient payment will be returned and a US$5 charge will be assessed if an invoice must be prepared to collect the delinquent amount. Overpayments of less than US$5 will not be refunded.

For each invalid check or credit card transaction that results in an insufficient payment for registration or housing, a US$5 charge will be assessed. Participants should check with their tax preparers for applicable deductions for education expenses as they pertain to these meetings.

If you wish to be included in a list of individuals sorted by mathematical interest, please provide the one mathematics subject classification number of your major area of interest on the ARH Form. (A list of these numbers is available by sending an empty email message to abs-submit@ams.org; include the number 1096 as the subject of the message.) Copies of this list will be posted on the JMM website. If you do not wish to be included in any mailing list used for promotional purposes, check the appropriate box on the ARH Form.

**Online Advance Registration**: This service is available for advance registration and hotel reservations at www.jointmathematicsmeetings.org/meetreg?meetnum=2160. VISA, MasterCard, Discover, and American Express are the only methods of payment which are accepted for online advance registrations, and charges to credit cards will be made in U.S. funds. All online advance registrants will receive acknowledgment of payment upon submission of this completed form.

**Paper Form Registration**: For your convenience, a copy of the form is available in pdf format at jointmathematicsmeetings.org/meetings/national/jmm2014/jmm14_regform.pdf. Forms must be mailed or faxed to the MMSB at MMSB, P. O. Box 6887, Providence, RI 02940 or 401-455-4004. For your security, we do not accept credit card numbers by email or fax. If you are registering by paper form and wish to pay for your registration or guarantee your hotel reservation by credit card, please so indicate on the form and someone from the MMSB will contact you by phone.

**Cancellation Policy**: Participants who cancel their advance registration for the meetings, minicourses, short courses, or banquets by **January 7, 2014**, will be eligible to receive a 50% refund of fees paid. No refunds will be issued after January 7.

**Joint Mathematics Meetings Registration Fees**

| | by Dec. 24 | at meeting |
|---|---|---|
| Member of AMS, ASL, CMS, MAA, SIAM | US$240 | US$315 |
| Nonmember | 374 | 486 |
| Graduate Student Member of AMS, MAA | 53 | 63 |
| Graduate Student Nonmember | 82 | 93 |
| Undergraduate Student | 53 | 63 |
| Temporarily Employed | 195 | 224 |
| Emeritus Member of AMS, MAA; | | |

| | | |
|---|---|---|
| Unemployed; High School Teacher; Developing Countries; Librarian | 53 | 63 |
| High School Student | 5 | 10 |
| One-Day Member of AMS, ASL, CMS, MAA, SIAM | N/A | 171 |
| One-Day Nonmember | N/A | 268 |
| Nonmathematician Guest | 15 | 15 |
| Commercial Exhibitor | 0 | 0 |
| **MAA Minicourses** *if space is available | US$80 | US$80* |
| **Grad School Fair Table** (table/posterboard/electricity) | US$75 | US$75 |
| **AMS Short Course** | | |
| Member of AMS or MAA | US$106 | US$140 |
| Nonmember | 155 | 185 |
| Student/Unemployed/Emeritus | 54 | 75 |
| **MAA Short Course** | | |
| MAA or AMS Member | US$159 | US$169 |
| Nonmember | 234 | 244 |
| Student/Unemployed/Emeritus | 81 | 91 |

**Full-Time Students**: Any person who is currently working toward a degree or diploma. Students are asked to determine whether their status can be described as graduate (working toward a degree beyond the bachelor's), undergraduate (working toward a bachelor's degree), or high school (working toward a high school diploma) and to mark the Advance Registration/Housing Form accordingly.

**Graduate Student**: Any graduate student who is a member of the AMS or MAA. These students should check with their department administrator to check their membership status.

**Emeritus**: Any person who has been a member of the AMS or MAA for twenty years or more and who retired because of age or long-term disability from his or her latest position.

**Librarian**: Any librarian who is not a professional mathematician.

**Unemployed**: Any person who is currently unemployed, actively seeking employment, and is not a student. It is not intended to include any person who has voluntarily resigned or retired from his or her latest position.

**Developing Country Participant**: Any person employed in developing countries where salary levels are radically noncommensurate with those in the U.S.

**Temporarily Employed**: Any person currently employed but who will become unemployed by June 1, 2014, and who is actively seeking employment.

**Nonmathematician Guest**: Any family member or friend who is not a mathematician and who is accompanied by a participant in the meetings. These official guests will receive a badge and may accompany a mathematician to a session or talk and may also enter the exhibit area.

Participants who are not members of the AMS or MAA and register for the meetings as a nonmember will receive mailings after the meetings with special membership offers.

All mathematicians who wish to attend sessions are expected to register and should be prepared to show their badges if so requested. Badges are required to enter the Exhibits and the Employment Center, to obtain discounts at the AMS and MAA Book Sales, and to cash a check with the Joint Meetings cashier.

### Advance Registration Deadlines

There are three separate advance registration deadlines, each with its own benefits.

**EARLY** meetings advance registration (room drawing) **November 4**

**ORDINARY** meetings advance registration (hotel reservations, materials mailed) **November 19**

**FINAL** meetings advance registration (advance registration, short courses, minicourses, and banquets) **December 24**

**Early Advance Registration**: Those who register by the early deadline of **November 4** will be included in a random drawing to select winners of complimentary hotel rooms in Baltimore. Multiple occupancy is permissible. The location of rooms to be used in this drawing will be based on the number of complimentary rooms available in the various hotels. Therefore, the free room may not necessarily be in the winner's first-choice hotel. The winners will be notified by mail prior to **December 24**, so register early!

**Ordinary Advance Registration**: Those who register after **November 4** and by the ordinary deadline of **November 19** may use the housing services offered by the MMSB but are not eligible for the room drawing. You may also elect to receive your badge and program by mail in advance of the meetings.

**Final Advance Registration**: Those who register after November 19 and by the final deadline of **December 24** must pick up their badges, programs, and any tickets for social events at the meetings. Unfortunately it is sometimes not possible to provide final advance registrants with housing, so registrants are strongly urged to make their hotel reservations by **November 19**. Please note that the **December 24** deadline is firm; any forms received after that date will be returned and full refunds issued. To pick up your materials, please come to the Meetings Registration Desk located inside the Pratt Street Lobby on the 300 level of the Baltimore Convention Center.

### Hotel Reservations

The AMS and MAA contract only with facilities who are working toward being in compliance with the public accommodations requirements of ADA. Participants requiring hotel reservations should read the instructions on the following hotel pages.

## *Miscellaneous Information*

**Audio-Visual Equipment:** Standard equipment in all session rooms is one overhead projector and screen. Invited 50-minute speakers are automatically provided with an

# How to Obtain Hotel Accommodations – 2014 Joint Mathematics Meetings

## Importance of Staying in an Official JMM Hotel

The importance of reserving a hotel room at one of the official JMM hotels cannot be stressed enough. The AMS and the MAA make every effort to keep participant expenses at meetings, registration fees, and hotel rooms for the meetings as low as possible. They work hard to negotiate the best hotel rates and to make the best use of your registration dollars to keep the meetings affordable. The AMS and the MAA encourage all participants to register for the meeting. When you pay the registration fee and reserve a room with an official JMM hotel, you are helping to support not only the 2014 JMM, but also future meetings.

## General

Participants are encouraged to register for the JMM in advance in order to obtain hotel accommodations through the Mathematics Meetings Service Bureau (MMSB). If you need to reserve a hotel room before you register for the JMM, contact the MMSB at mmsb@ams.org or 1-800-321-4267 ext. 4137 or ext. 4144 for further instructions. Special rates have been negotiated exclusively for this meeting at the following hotels: Hilton Baltimore, Marriott Inner Harbor, Sheraton Inner Harbor Hotel, Hyatt Regency Baltimore, Marriott Waterfront Hotel, Renaissance Harborplace Hotel, Royal Sonesta Harbor Court, Days Inn Baltimore Inner Harbor, Holiday Inn Inner Harbor, and Hotel Monaco.

To receive JMM rates, reservations for the hotels listed must be made through the MMSB, who will be using a Passkey Housing System to process reservations. The hotels will not be able to accept reservations directly until after **December 13, 2013**. At that time, rooms and rates will be based on availability. Higher rates may be applied to any rooms reserved directly with the hotels before **December 13, 2013**.

To reserve a room online, use the housing link provided. If you cannot reserve a room online, please complete the housing section of the Advanced Registration/Housing (ARH) form and send it to the MMSB via email at mmsb@ams.org or fax to 401-455-4004 before **December 13, 2013.** All reservations must be guaranteed by either a credit card or a check deposit in the total amount of your first night stay. If you reserve a room online, only a credit card guarantee is accepted. If you use the paper form, a credit card or a check may be given for guarantee. For your security, credit card numbers will not be accepted by postal mail, email, or fax. If you wish to guarantee your room by credit card and are submitting a paper form, the MMSB will call you at the phone number you provided. The housing link is located on the meeting website at http://www.jointmathematicsmeeting.org. The paper form is located at the back of this announcement. Participants interested in suites should contact the MMSB at mmsb@ams.org or 1-800-321-4267 ext. 4137 or ext. 4144 for further information. Sorry, reservations cannot be taken over the phone.

## ADA Accessibility

We strive to take the appropriate steps required to ensure that no individual with a disability is excluded, denied services, segregated or otherwise treated differently. Please tell us what you require to help make your participation more enjoyable and meaningful. If you require special assistance, auxiliary aids or other reasonable accommodations to fully participate in this meeting, please check off the appropriate box on the ARH Form or email the MMSB at mmsb@ams.org. All requests for special accommodations under the Americans with Disabilities Act of 1990 (ADA) must be made allowing enough time for evaluation and appropriate action by the AMS and MAA. Any information obtained about a disability will remain confidential.

## Cancellation Policies

- The Sheraton, Renaissance, Marriott Waterfront, Royal Sonesta, Days Inn, and the Holiday Inn have a 24-hour cancellation policy prior to check-in.
- The Hotel Monaco has a 48-hour cancellation policy prior to check-in.
- The Hilton, Marriott Inner Harbor, and the Hyatt have a 72-hour cancellation policy prior to check-in.

## Check-in/Check-out

Check-in at all of the hotels, except the Days Inn is 4:00 p.m. Check-in at the Days Inn is 3:00 p.m. Check-out at each hotel is noon.

## Complimentary Room Drawing

All participants who register and reserve a room at any of the official JMM hotels by **November 4, 2013** will automatically be included in a random drawing to select a winner of free room nights in a hotel. The number of drawings is based on the number of complimentary room nights available in the various hotels. Multiple occupancy is permissible. The winners will be drawn at random from the hotel reservation lists and notified by email or phone prior to **December 24, 2013**. Good luck!

## Confirmations

An immediate and real-time email confirmation number will be provided for each reservation made online. This confirmation number will provide you with direct access to edit reservations up to **December 13, 2013**. After this date, a second email confirmation for your reservation will be sent from the hotel. Please contact the MMSB at mmsb@ams.org or 1-800-321-4266, ext. 4137 or 4144 if you did not receive a confirmation number from your hotel or if there are any other questions about the reservation process.

## Deadlines

- Complimentary Room Drawing: **November 4**
- Reservations through MMSB: **November 19**
- Changes/Cancellations through MMSB: **December 13**

## Environmental Policies

All of the listed hotels have environmental-friendly programs in place.

## Guarantee Requirements

- One night deposit by check, or
- Credit cards (online only): Visa, MC, AMEX, and Discover.

For your security, we do not accept credit card numbers by postal mail, email or fax. If you reserve a room by paper form and want to guarantee by credit card, the MMSB will contact you at the phone number you provided.

## Internet Access/Wireless

The Sheraton Inner Harbor, Royal Sonesta, Days Inn Baltimore Inner Harbor, Holiday Inn Inner Harbor, and Hotel Monaco all offer complimentary high-speed wireless in all of their guest rooms and public space.

The Marriott Inner Harbor, Marriott Waterfront, and Renaissance Harborplace Hotel offer complimentary high-speed wireless in all of their public spaces and wired internet in their guest rooms for US$12.95 plus tax per each 24-hour period.

The Hilton Baltimore offers complimentary high-speed wireless in all of their public spaces and wired internet in their guest rooms for US$14.95 plus tax per each 24-hour period.

The Hyatt Regency offers complimentary high-speed wireless high speed internet in all of their public spaces (lobby and second floor) for up to six hours at a time, and wireless access in their sleeping rooms for US$19.95 plus tax per each 24-hour period.

### Looking for a Roommate?

For your convenience, an interactive search board is available at **http://bboards.jointmathematicsmeetings.org** to help you find a roommate.

### Rates

- All rates are subject to applicable local and state taxes in effect at the time of check-in; currently 15.5% state tax.
- Only certified students or unemployed mathematicians qualify for student rates.


### Hilton Baltimore (Co-Headquarters)

**0.2 miles from the Baltimore Convention Center (connected to the center)**

401 West Pratt Street
Baltimore, MD 21201
Single/Double Rate: US$159.00
Student Single/Double Rate: US$127.00

Smoke-free hotel. Restaurants: Diamond Tavern and Lobby Bar; Fitness center; Heated indoor lap pool; UPS Store; Full amenities in guest rooms; Laptop-sized safes in guest rooms; Windows do not open; Children under 17 free in room with an adult; Cribs available upon request at no charge; Rollaways US$25 one-time fee; All size pets allowed; Valet parking US$40 per day with in/out privileges; Self-parking US$28 per day with in/out privileges, tax included in both parking rates. See the travel section of this announcement for other parking options. Confirmations sent by email only.

### Baltimore Marriott Inner Harbor (Co-Headquarters)

**0.2 miles from the Baltimore Convention Center**

110 South Eutaw Street
Baltimore, MD 21201
Single/Double Rate: US$149.00
Student Single/Double Rate: US$115.00

Smoke-free hotel. Restaurants: The Yard and Gift Shop Cafe; Fitness center; Business center; Safes at front desk; Full amenities in guest rooms; Windows do not open; Children under 17 free in room with an adult; Cribs available upon request at no charge; No cost for rollaways; Pets are not allowed; Self-parking US$26 per day with in/out privileges, tax included in parking rate. See the travel section of this announcement for other parking options. Confirmations sent by email only.

### Sheraton Inner Harbor Hotel

**0.3 miles from the Baltimore Convention Center**

300 South Charles Street
Baltimore, MD 21201
Single/Double Rate: US$149.00
Student Single/Double Rate: US$139.00

Smoke-free hotel. Restaurants: Orioles Grille and Morton's, The Steakhouse; Fitness center; Heated indoor pool and sauna; Business center; Full amenities in guest rooms; Windows do not open; Children under 17 free in room with an adult; Cribs available upon request at no charge; Rollaways US$20 per day; Small pets allowed; Valet parking US$33 per day with in/out privileges; Self-parking US$27 per day with in/out privileges, tax included in both parking rates. See the travel section of this announcement for other parking options. Confirmations sent by email only.

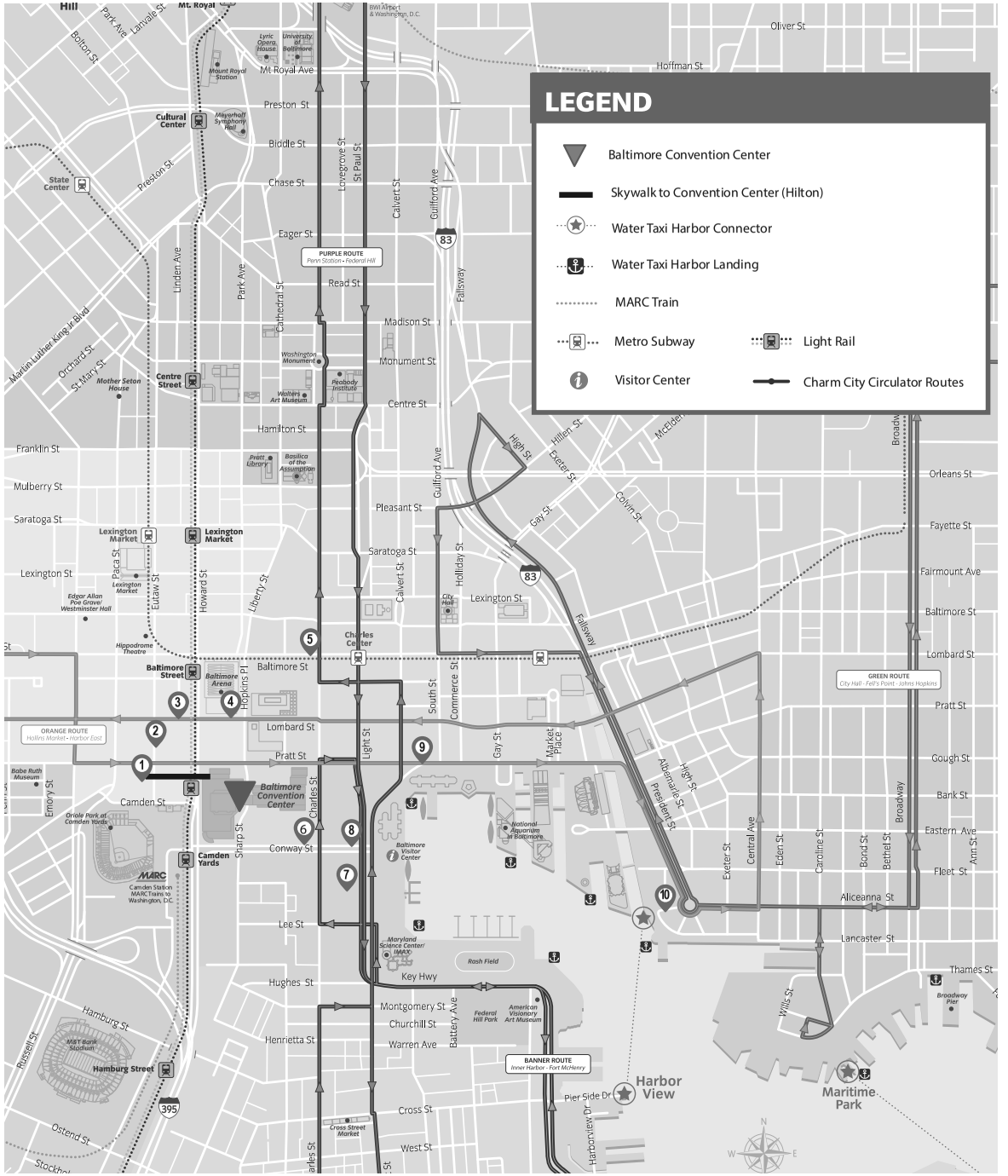
### Hyatt Regency Baltimore on the Inner Harbor

**0.4 miles from the Baltimore Convention Center**

300 Light Street
Baltimore, MD 21202
Single/Double Rate: US$145.00
Student Single/Double Rate: US$135.00

Smoke-free hotel. Restaurants: Bistro 300 and Perk's Coffee House; Fitness center; Seasonal outdoor pool; Business center; Full amenities in guest rooms; Laptop-sized safes in guest rooms; Windows do not open; Children under 18 free in room with an adult; Cribs available upon request at no charge; Rollaways US$25 one-time fee; Pets are not allowed; Valet parking US$40 per day with in/out privileges; Self-parking US$28 per day with in/out privileges, tax included in both parking rates. See the travel section of this announcement for other parking options. Confirmations sent by email only.

| Renaissance Baltimore Harborplace Hotel | Baltimore Marriott Waterfront Hotel | Royal Sonesta Harbor Court Baltimore |
|---|---|---|
| **0.4 miles from the Baltimore Convention Center**<br><br>202 East Pratt Street<br>Baltimore, MD 21202<br>Single/Double Rate: US$135.00<br>Student Single/Double Rate: US$115.00<br><br>Smoke-free hotel. Restaurants: Watertable, Watertable Lounge, and The Ground Floor Café & Bar; Fitness center; Heated indoor lap pool; Business center; Full amenities in guest rooms; Laptop-sized safes in guest rooms; Children under 18 free in room with an adult; Cribs available upon request at no charge; Rollaways US$20 per day; Pets are not allowed; Valet parking US$40 per day with in/out privileges; Self-parking US$28 per day with in/out privileges, tax included in both parking rates. See the travel section of this announcement for other parking options. Confirmations sent by email only. | **1.1 mile from the Baltimore Convention Center**<br><br>700 Alicenna Street<br>Baltimore, MD 21202<br>Single/Double Rate: US$135.00<br>Student Single/Double Rate: US$115.00<br><br>Smoke-free hotel. Restaurants: Grille 700, Kozmo's Lounge, Rigano's Bakery & Deli, and Starbucks; Fitness center; Heated indoor pool; Business center; Full amenities in guest rooms; Laptop-sized safes in guest rooms; Windows do not open; Children under 18 free in room with an adult; Cribs available upon request at no charge; No additional charge for rollaways; Pets are not allowed; Valet parking US$40 per day with in/out privileges; Self-parking US$26 per day with in/out privileges, tax included in both parking rates. See the travel section of this announcement for other parking options. Confirmations sent by email only. | **0.5 miles from the Baltimore Convention Center**<br><br>550 Light Street<br>Baltimore, MD 21202<br>Single/Double Rate: US$125.00<br>Student Single/Double Rate: US$99.00<br><br>Smoke-free hotel. Restaurants: Brighton's, Explorers Lounge, and Formula Espresso; Fitness center; Heated indoor pool; Business center; Full amenities in guest rooms; Laptop-sized safes in guest rooms; Windows do not open; Children under 18 free in room with an adult; Cribs available upon request at no charge; Rollaways US$25 daily fee; Small pets allowed with US$150 per-stay accommodation fee; Valet parking US$36 per day with in/out privileges; Self-parking US$26 per day with in/out privileges; parking fees are subject to an additional 20% tax. See the travel section of this announcement for other parking options. Confirmations sent by email only. |
| **Days Inn Baltimore Inner Harbor** | **Holiday Inn Inner Harbor** | **Hotel Monaco** |
| **0.1 miles from the Baltimore Convention Center**<br><br>100 Hopkins Place<br>Baltimore, MD 21201<br>Single/Double Rate: US$119.00<br>Student Single/Double Rate: US$109.00<br><br>Smoke-free hotel. Restaurants: Flemings Steak House, Kawasaki Japanese, and Kona Grill; Fitness center; Business center; Full amenities in guest rooms; Laptop-sized safes in guest rooms; Windows do not open; Children under 16 free in room with an adult; Cribs available upon request at no charge; Rollaways US$10 daily fee; Pets under 20 lbs allowed with a US$100 refundable deposit; Self-parking only US$25 per day with in/out privileges, tax included in parking rates. See the travel section of this announcement for other parking options. Confirmations sent by email only. | **0.1 miles from the Baltimore Convention Center**<br><br>301 West Lombard Street<br>Baltimore, MD 21201<br>Single/Double Rate: US$119.00<br>Student Single/Double Rate: US$99.00<br><br>Smoke-free hotel. Restaurants: Eden West Restaurant, Dottie's Café, and Eden West Lounge; Fitness center; Heated indoor pool; Business center; Safe deposit boxes at front desk; Full amenities in guest rooms; Windows do not open; Children under 16 free in room with an adult; Cribs available upon request at no charge; Rollaways US$15 daily fee; Small pets allowed; Self-parking only US$25 per day with in/out privileges, tax included in parking rate. See the travel section of this announcement for other parking options. Confirmations sent by email only. | **0.4 miles from the Baltimore Convention Center**<br><br>2 North Charles Street<br>Baltimore, MD 21201<br>Single/Double Rate: US$119.00<br>Student Single/Double Rate: US$109.00<br><br>Smoke-free hotel. Restaurant: B&O Brasserie; Fitness center; Business center; Full amenities in guest rooms; Laptop-sized safes in guest rooms; Windows do not open; Children under 16 free in room with an adult; Cribs available upon request at no charge; Rollaways US$25 one-time fee; All size pets allowed; Valet parking only US$45 per day with in/out privileges, tax included in parking rate. See the travel section of this announcement for other parking options. Confirmations sent by email only. |




## 2014 Joint Mathematics Meetings

1. Hilton Baltimore Convention Center*
2. Baltimore Marriott Inner Harbor*
3. Holiday Inn Inner Harbor Hotel
4. Days Inn Inner Harbor
5. Hotel Monaco Baltimore
6. Sheraton Inner Harbor
7. Royal Sonesta Harborcourt Hotel
8. Hyatt Regency Baltimore
9. Renaissance Harborplace Hotel
10. Baltimore Marriott Waterfront

* Co-Headquarters Hotel

approx. 1/4 mile (0.4 km)

*Map courtesy of*

Visit Baltimore

ELMO visual presenter (document camera/projector), one overhead projector, and a laptop projector; AMS Special Sessions and Contributed Papers, and MAA Invited and Contributed Paper Sessions, are provided with the standard equipment and a laptop projector. Blackboards are not available, nor are Internet hookups in session rooms. Any request for additional equipment should be sent to meet@ams.org and **received by November 1**.

Equipment requests made at the meetings most likely will not be granted because of budgetary restrictions. Unfortunately no audio-visual equipment can be provided for committee meetings or other meetings or gatherings not on the scientific program.

**Childcare:** The AMS and the MAA will again offer childcare services for the Joint Mathematics Meetings to registered participants.

The childcare will be offered through KiddieCorp Children's Program. KiddieCorp is an organization that has been providing high-quality programs for children of all ages at meetings throughout the United States and Canada since 1986. Read all about them at www.kiddiecorp.com/.

The childcare services provided at the JMM are for children ages 6 months through 12 years old. Space per day will be limited and is on a space available basis. The dates and times for the program are January 15–18, 2014, 8:00 a.m.–5:00 p.m. each day. It will be located at the Marriott Baltimore Inner Harbor at Camden Yards. If you would like to know how many children will be in the same age group as your child's, please call KiddieCorp. Parents are encouraged to bring snacks and beverages for their children but items such as juice boxes, Cheerios, and crackers will be provided. KiddieCorp can arrange meals for children at cost plus 15% or parents can be responsible for meals for their children. Parents who have questions about specific programs that will be offered or special requests, rules, or needs for their children must call KiddieCorp ahead of time.

Registration starts on **September 3**. The registration fee is US$30 per family (nonrefundable). Additional cost will be US$16 per hour per child or US$11 per hour per child for graduate students. These reduced child care rates are made possible to the meetings participants by the MAA and the AMS, who heavily subsidize the cost of this service, thus keeping this program affordable for families. Parents must be registered for the JMM to participate. Full payment is due at the time of registration with KiddieCorp. The **deadline for registering is December 18, 2013**.

If parents do not pick up their children at the time scheduled or by the end of the day (no later than 5:00 p.m.), they will be charged a late fee of US$5 per child for every 15 minutes thereafter.

**Cancellations must be made to KiddieCorp prior to December 18, 2013, for a full refund**. Cancellations made after that date will be subject to a 50% cancellation fee. Once the program has begun, no refunds will be issued.

To register, go to www.kiddiecorp.com/jmmkids.htm or jointmathematicsmeetings.org/2141_daycare.html, or call KiddieCorp at 858-455-1718 to request a form.

**Email Services**: Limited email access for all Joint Meetings participants will be available in an email center located near the JMM Registration Desk, Pratt Lobby, on the 300 level in the Baltimore Convention Center. The hours of operation will be published in the program. Participants should be aware that **complimentary Internet access** will be available in the networking center located in Hall F, ground level of the Baltimore Convention Center.

**Information Distribution**: Tables are set up in the exhibit area for dissemination of general information of possible interest to the members and for the dissemination of information of a mathematical nature not promoting a product or program for sale. Information must be approved by the director of meetings prior to being placed on these tables.

If a person or group wishes to display information of a mathematical nature promoting a product or program for sale, they may do so in the exhibit area at the Joint Books, Journals, and Promotional Materials exhibit for a fee of US$50 (posters are slightly higher) per item. Please contact the exhibits manager, MMSB, P.O. Box 6887, Providence, RI 02940, or by email at cpd@ams.org for further details.

The administration of these tables is in the hands of the AMS-MAA Joint Meetings Committee, as are all arrangements for Joint Mathematics Meetings.

**Local Information**: For information about the city see baltimore.org.

**Telephone Messages**: It will be possible to leave a message for any registered participant at the meetings registration desk from January 15 through 18 during the hours that the desk is open. These messages will be posted on the Mathematics Meetings Message Board in the networking center; however, staff at the desk will try to locate a participant in the event of a bona fide emergency. The telephone number will be published in the program and daily newsletter.

## Travel/Transportation

Baltimore is on Eastern Standard Time. The Baltimore/Washington International, Thurgood Marshall Airport (**BWI**) (www.bwiairport.com/en) is served by all major airlines and is approximately twelve miles from the Inner Harbor area where the Baltimore Convention Center and the conference hotels are located. The street address of the airport is 7062 Elm Road, Baltimore, MD 21240.

**Airline**: The official airline for this meeting is **Delta Airlines**. Participants are encouraged to book their flights for the meeting, where possible, with Delta and receive special pricing (in most cases a 5% discount) on scheduled service to Baltimore. Discounts are applicable to U. S. and Canada originating passengers. The discount is not valid with other discounts, certificates, coupons, or promotional offers. To make a reservation, go to www.Delta.com, and click on the box that says "Book a Trip". At the bottom of the box, click on "More Search Options (includes Flexible Airport and Meeting Event Code)". On the reservation screen, please enter the **Meeting Event Code NMGJ8**. It will be to the right of "Number of Passengers". Please note that reservations can also be made by calling Delta at 1-800-328-1111 and giving the meeting ticket designation

file number of **NMGJ8**. A US$25 ticketing fee will be levied for reservations made by telephone.

**Super Shuttle** offers service from the airport to downtown; see www.supershuttle.com/Locations/BWIAirportShuttleBaltimore.aspx, or call 800-BLUE VAN (800-258-3826). There are two shuttle ticket counters located on the lower level baggage claim area. One is near door #2 near the Southwest Airlines Terminal in Concourse A, and the other is near door #9 in Concourse C. They are open between the hours of 6:00 a.m. and 2:00 a.m. When the counters are closed, please call 800-258-3826 for information or to arrange service. The fare for the shuttle is currently US$14 (one person, one way).

**Car Rental**: The car rental facility at BWI is located at 7432 New Ridge Road, Hanover, MD, 21076 and hosts all of the major car rental agencies. Free shuttle service carries customers to and from the airport approximately every 10 minutes. The shuttle leaves the lower level terminal near the baggage claim area. The trip takes around 10 minutes. **Hertz** is the official car rental company for the meeting. To access the JMM special meeting rates at www.hertz.com, please click the box that says "Enter a discount or promo code" and enter **CV#04N30004** as the convention number. Reservations can also be made by calling Hertz directly at 800-654-2240 (U.S. and Canada) or 405-749-4434. Meeting rates include unlimited mileage and are subject to availability. Advance reservations are recommended and blackout dates may apply. Government surcharges, taxes, tax reimbursement, airport-related fees, vehicle licensing fees and optional items are extra. Standard rental conditions and qualifications apply. Minimum rental age is 20 (age differential charge for 20-24 applies). At the time of your reservation, the meeting rates will be automatically compared to other Hertz rates and you will be quoted the best comparable rate available.

**Driving Directions from the Airport**: Head northeast and take I-195 West. Take exit 2A to get on Maryland 295N/Baltimore Washington Parkway towards Baltimore and drive approximately seven miles. Turn right onto W. Pratt Street. The Convention Center will be on the right.

**Taxis**: The taxi stand is located just outside of the baggage claim area of the lower level of the terminal. There are always taxis available. For more information, call 410-859-1100 or visit www.bwiairporttaxi.com. The average taxi fare to the Baltimore Inner Harbor area is US$35.

**Public Transportation from the Airport**: Take the Light Rail from the BWI Marshall Light Rail Station, located outside the lower level of the terminal building near Concourse E. The route is called "Hunt Valley and BWI Marshall Airport". Take the train towards Hunt Valley. There is a stop at the Convention Center (Howard and Pratt Street), after Camden Yards, and the Hilton and Marriott Inner Harbor hotels are one block west of the stop. For more details, see mta.maryland.gov/light-rail. The train runs from 5:00 a.m. to 11:00 p.m. weekdays, 6:00 a.m. to 11:00 p.m. on Saturday, and 11:00 a.m. to 7:00 p.m. on Sunday, approximately every 30 minutes (varies with time of day) and takes about 30-35 minutes. The cost is US$1.60 one way.

Please refer to www.bwiairport.com/en/travel/ground-transportation for additional information about ground transportation from the airport.

**Public Transportation in Baltimore**: The MTA-Maryland Transit Administration Baltimore has a regular bus, subway, and light rail system. For details, maps, and schedules see mta.maryland.gov/ or call 410-539-5000. One-way fares are currently US$1.60. In addition, Baltimore also has a free shuttle service with four routes around Baltimore, called the Charm City Circulator (CCC), see www.charmcitycirculator.com/ for information on routes and schedules. The Green Route runs from City Hall to Fells Point to Johns Hopkins, the Purple Route runs from Penn Station to Federal Hill, the Orange Route runs from Hollins Market to Harbor East, and the Banner Route runs from the Inner Harbor to Fort McHenry. All the routes have stops in the Inner Harbor area. The Orange route has a Convention Center stop, and the Banner Route has stops at Pratt Street and at Otterbein, both near the Convention Center. The Purple route has a stop at Pratt and South Calvert Street. The Green route stops near the Baltimore Marriott Waterfront Hotel. Many local attractions are accessible on the CCC. The National Aquarium, the Jewish Museum of Baltimore, and the B&O Railroad Museum are on the Orange Line. The Banner Line goes to Fort McHenry, the Baltimore Museum of Industry, and the American Visionary Art Museum. The airport is not included on CCC routes.

**Train**: Amtrak Baltimore Penn Station is located at 1500 North Charles Street, Baltimore, approximately two miles from the Inner Harbor area. For information about rail service to Baltimore, please call 1-800-USA-RAIL, or visit www.amtrak.com.

**Parking**: There are online and downloadable maps of parking garages at the "Visit Baltimore" parking information page at baltimore.org/transportation/parking-information/. The online map at baltimore.org/maps will display the local parking garages if you select "parking". The parking information page also offers a link to a service called "Parking Panda", which allows you to book your parking space at a nearby garage in advance; see https://www.parkingpanda.com/baltimore-parking. More information about parking can be found at www.baltimorecity.gov/Government/QuasiAgencies/ParkingAuthority/ParkingGarages.aspx.

# Knoxville, Tennessee

*University of Tennessee, Knoxville*

### March 21–23, 2014

*Friday – Sunday*

### Meeting #1097

Southeastern Section
Associate secretary: Brian D. Boe
Announcement issue of *Notices*: January 2014
Program first available on AMS website: February 6, 2014
Program issue of electronic *Notices*: March 2014

Issue of *Abstracts*: Volume 35, Issue 2

### Deadlines

For organizers: Expired
For abstracts: January 28, 2014

*The scientific information listed below may be dated. For the latest information, see* www.ams.org/amsmtgs/sectional.html.

### Invited Addresses

**Maria Chudnovsky**, Columbia University, *Title to be announced* (Erdős Memorial Lecture).

**Ilse Ipsen**, North Carolina State University, *Title to be announced*.

**Daniel Krashen**, University of Georgia, *Title to be announced*.

**Suresh Venapally**, Emory University, *Title to be announced*.

### Special Sessions

*Commutative Ring Theory (in honor of the retirement of David E. Dobbs)* (Code: SS 1A), **David Anderson**, University of Tennessee, Knoxville, and **Jay Shapiro**, George Mason University.

*Diversity of Modeling and Optimal Control: A Celebration of Suzanne Lenhart's 60th Birthday* (Code: SS 3A), **Wandi Ding**, Middle Tennessee State University, and **Renee Fister**, Murrray State University.

*Fractal Geometry and Ergodic Theory* (Code: SS 2A), **Mrinal Kanti Roychowdhury**, University of Texas Pan American.

*Harmonic Analysis and Nonlinear Partial Differential Equations* (Code: SS 5A), **J. Denzler**, **M. Frazier**, **Tuoc Phan**, and **T. Todorova**, University of Tennessee, Knoxville.

*Invariant Subspaces of Function Spaces* (Code: SS 6A), **Catherine Beneteau**, University of South Florida, **Alberto A. Condori**, Florida Gulf Coast University, **Constanze Liaw**, Baylor University, and **Bill Ross**, University of Richmond.

*Randomized Numerical Linear Algebra* (Code: SS 4A), **Ilse Ipsen**, North Carolina State University.

# Baltimore, Maryland

*University of Maryland, Baltimore County*

### March 29–30, 2014

*Saturday – Sunday*

### Meeting #1098

Eastern Section
Associate secretary: Steven H. Weintraub
Announcement issue of *Notices*: January 2014
Program first available on AMS website: February 26, 2014
Program issue of electronic *Notices*: March 2014
Issue of *Abstracts*: Volume 35, Issue 2

### Deadlines

For organizers: Expired
For abstracts: January 28, 2014
*The scientific information listed below may be dated. For the latest information, see* www.ams.org/amsmtgs/sectional.html.

### Invited Addresses

**Maria Gordina**, University of Connecticut, *Title to be announced*.

**L. Mahadevan**, Harvard University, *Title to be announced*.

**Nimish Shah**, Ohio State University, *Title to be announced*.

**Dani Wise**, McGill University, *Title to be announced*.

### Special Sessions

*Invariants in Low-Dimensional Topology* (Code: SS 1A), **Jennifer Hom**, Columbia University, and **Tye Lidman**, University of Texas at Austin.

*Knots and Applications* (Code: SS 3A), **Louis Kauffman**, University of Illinois at Chicago, **Samuel Lomonaco**, University of Maryland, Baltimore County, and **Jozef Przytycki**, George Washington University.

*Mathematical Finance* (Code: SS 2A), **Agostino Capponi**, John Hopkins University.

*Novel Developments in Tomography and Applications* (Code: SS 4A), **Alexander Katsevich**, **Alexandru Tamasan**, and **Alexander Tovbis**, University of Central Florida.

*Theory and Applications of Differential Equations on Graphs* (Code: SS 5A), **Jonathan Bell**, University of Maryland Baltimore County, and **Sergei Avdonin**, University of Alaska Fairbanks.

# Albuquerque, New Mexico

*University of New Mexico*

### April 5–6, 2014

*Saturday – Sunday*

### Meeting #1099

Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: January 2014
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: April 2014
Issue of *Abstracts*: To be announced

### Deadlines

For organizers: Expired
For abstracts: February 11, 2014

*The scientific information listed below may be dated. For the latest information, see* www.ams.org/amsmtgs/sectional.html.

### Invited Addresses

**Anton Gorodetski**, University of California, Irvine, *To be announced.*

**Fan Chung Graham**, University of California, San Diego, *To be announced.*

**Adrian Ioana**, University of California, San Diego, *To be announced.*

**Karen Smith**, University of Michigan, Ann Harbor, *To be announced.*

### Special Sessions

*Commutative Algebra* (Code: SS 7A), **Daniel J. Hernandez**, University of Utah, **Karen E. Smith**, University of Michigan, and **Emily E. Witt**, University of Minnesota.

*Descriptive Set Theory and its Applications* (Code: SS 6A), **Alexander Kechris**, California Institute of Technology, and **Christian Rosendal**, University of Illinois, Chicago.

*Interactions in Commutative Algebra* (Code: SS 4A), **Louiza Fouli** and **Bruce Olberding**, New Mexico State University, and **Janet Vassilev**, University of New Mexico.

*Progress in Noncommutative Analysis* (Code: SS 2A), **Anna Skripka**, University of New Mexico, and **Tao Mei**, Wayne State University.

*Stochastics and PDEs* (Code: SS 5A), **Juraj Földes**, Institute for Mathematics and Its Applications, **Nathan Glatt-Holtz**, Institute for Mathematics and Its Applications and Virginia Tech, and **Geordie Richards**, Institute for Mathematics and Its Applications and University of Rochester.

*The Inverse Problem and Other Mathematical Methods Applied in Physics and Related Sciences* (Code: SS 1A), **Hanna Makaruk**, Los Alamos National Laboratory, and **Robert Owczarek**, University of New Mexico and Enfitek, Inc.

*Topics in Spectral Geometry and Global Analysis* (Code: SS 3A), **Ivan Avramidi**, New Mexico Institute of Mining and Technology, and **Klaus Kirsten**, Baylor University.

# Lubbock, Texas

*Texas Tech University*

### April 11–13, 2014

*Friday – Sunday*

### Meeting #1100

Central Section
Associate secretary: Georgia M. Benkart
Announcement issue of *Notices*: February 2014
Program first available on AMS website: February 27, 2014
Program issue of electronic *Notices*: April 2014
Issue of *Abstracts*: Volume 35, Issue 2

### Deadlines

For organizers: September 18, 2013
For abstracts: February 10, 2014

*The scientific information listed below may be dated. For the latest information, see* www.ams.org/amsmtgs/sectional.html.

### Invited Addresses

**Nir Avni**, Northwestern University, *To be announced.*

**Alessio Figalli**, University of Texas, *To be announced.*

**Jean-Luc Thiffeault**, University of Wisconsin-Madison, *To be announced.*

**Rachel Ward**, University of Texas at Austin, *To be announced.*

### Special Sessions

*Algebraic Geometry* (Code: SS 9A), **David Weinberg**, Texas Tech University.

*Analysis and Applications of Dynamic Equations on Time Scales* (Code: SS 2A), **Heidi Berger**, Simpson College, and **Raegan Higgins**, Texas Tech University.

*Applications of Special Functions in Combinatorics and Analysis* (Code: SS 12A), **Atul Dixit**, Tulane University, and **Timothy Huber**, University of Texas Pan American.

*Complex Function Theory and Special Functions* (Code: SS 7A), **Roger W. Barnard** and **Kent Pearce**, Texas Tech University, **Kendall Richards**, Southwestern University, and **Alex Solynin** and **Brock Williams**, Texas Tech University.

*Fractal Geometry and Dynamical Systems* (Code: SS 3A), **Mrinal Kanti Roychowdhury**, The University of Texas-Pan American.

*Homological Methods in Algebra* (Code: SS 8A), **Lars W. Christensen**, Texas Tech University, **Hamid Rahmati**, Miami University, and **Janet Striuli**, Fairfield University.

*Interactions between Commutative Algebra and Algebraic Geometry* (Code: SS 11A), **Brian Harbourne** and **Alexandra Seceleanu**, University of Nebraska-Lincoln.

*Issues Regarding the Recruitment and Retention of Women and Minorities in Mathematics* (Code: SS 5A), **James Valles Jr.** and **Doug Scheib**, Saint Mary-of-the-Woods College.

*Noncommutative Algebra, Deformations, and Hochschild Cohomology* (Code: SS 10A), **Anne Shepler**, University of North Texas, and **Sarah Witherspoon**, Texas A&M University.

*Qualitative Theory for Non-linear Parabolic and Elliptic Equations* (Code: SS 6A), **Akif Ibragimov**, Texas Tech University, and **Peter Polacik**, University of Minnesota.

*Recent Advancements in Differential Geometry and Integrable PDEs, and Their Applications to Cell Biology and Mechanical Systems* (Code: SS 4A), **Giorgio Bornia**, **Akif Ibragimov**, and **Magdalena Toda**, Texas Tech University.

*Topology and Physics* (Code: SS 1A), **Razvan Gelca** and **Alastair Hamilton**, Texas Tech University.

# Tel Aviv, Israel

*Bar-Ilan University, Ramat-Gan and Tel-Aviv University, Ramat-Aviv*

**June 16–19, 2014**
*Monday – Thursday*

**Meeting #1101**
*The Second Joint International Meeting between the AMS and the Israel Mathematical Union.*
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: January 2014
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 abstracts: To be announced

*The scientific information listed below may be dated. For the latest information, see* www.ams.org/amsmtgs/internmtgs.html.

**Special Sessions**
*Mirror Symmetry and Representation Theory*, **David Kazhdan**, Hebrew University, and **Roman Bezrukavnikov**, Massachusetts Institute of Technology.
*Nonlinear Analysis and Optimization*, **Boris Mordukhovich**, Wayne State University, and **Simeon Reich** and **Alexander Zaslavski**, The Technion-Israel Institute of Technology.
*Qualitative and Analytic Theory of ODE's*, **Yosef Yomdin**, Weizmann Institute.

# Eau Claire, Wisconsin

*University of Wisconsin-Eau Claire*

**September 20–21, 2014**
*Saturday – Sunday*

**Meeting #1102**
Central Section
Associate secretary: Georgia M. Benkart
Announcement issue of *Notices*: June 2014
Program first available on AMS website: August 7, 2014
Program issue of electronic *Notices*: September 2014
Issue of *Abstracts*: Volume 35, Issue 3

**Deadlines**
For organizers: March 20, 2014
For abstracts: July 29, 2014

*The scientific information listed below may be dated. For the latest information, see* www.ams.org/amsmtgs/sectional.html.

**Invited Addresses**
**Matthew Kahle**, Ohio State University, *To be announced.*
**Markus Keel**, University of Minnesota, *To be announced.*
**Svitlana Mayboroda**, University of Minnesota, *To be announced.*
**Dylan Thurston**, Indiana University, *To be announced.*

**Special Sessions**
*Directions in Commutative Algebra: Past, Present and Future* (Code: SS 1A), **Joseph P. Brennan**, University of Central Florida, and **Robert M. Fossum**, University of Illinois at Urbana-Champaign.

# Halifax, Canada

*Dalhousie University*

**October 18–19, 2014**
*Saturday – Sunday*

**Meeting #1103**
Eastern Section
Associate secretary: Steven H. Weintraub
Announcement issue of *Notices*: August 2014
Program first available on AMS website: September 5, 2014
Program issue of electronic *Notices*: October 2014
Issue of *Abstracts*: Volume 35, Issue 3

**Deadlines**
For organizers: March 18, 2014
For abstracts: August 19, 2014

*The scientific information listed below may be dated. For the latest information, see* www.ams.org/amsmtgs/sectional.html.

**Invited Addresses**
**François Bergeron**, Université du Québec à Montréal, *Title to be announced.*
**Sourav Chatterjee**, New York University, *Title to be announced.*
**William M. Goldman**, University of Maryland, *Title to be announced.*
**Sujatha Ramdorai**, University of British Columbia, *Title to be announced.*

# San Francisco, California

*San Francisco State University*

**October 25–26, 2014**
*Saturday – Sunday*

**Meeting #1104**
Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: August 2014

Program first available on AMS website: September 11, 2014
Program issue of electronic *Notices*: October 2014
Issue of *Abstracts*: Volume 35, Issue 4

### Deadlines

For organizers: March 25, 2014
For abstracts: September 3, 2014

*The scientific information listed below may be dated. For the latest information, see* www.ams.org/amsmtgs/sectional.html.

### Invited Addresses

**Kai Behrend**, University of British Columbia, Vancouver, Canada, *To be announced*.

**Kiran S. Kedlaya**, University of California, San Diego, *To be announced*.

**Julia Pevtsova**, University of Washington, Seattle, *To be announced*.

**Burt Totaro**, University of California, Los Angeles, *To be announced*.

### Special Sessions

*Algebraic Geometry* (Code: SS 1A), **Renzo Cavalieri**, Colorado State University, **Noah Giansiracusa**, University of California, Berkeley, and **Burt Totaro**, University of California, Los Angeles.

*Geometry of Submanifolds* (Code: SS 3A), **Yun Myung Oh**, Andrews University, **Bogdan D. Suceava**, California State University, Fullerton, and **Mihaela B. Vajiac**, Chapman University.

*Polyhedral Number Theory* (Code: SS 2A), **Matthias Beck**, San Francisco State University, and **Martin Henk**, Universität Magdeburg.

# Greensboro, North Carolina

*University of North Carolina, Greensboro*

### November 8–9, 2014

*Saturday – Sunday*

### Meeting #1105

Southeastern Section
Associate secretary: Brian D. Boe
Announcement issue of *Notices*: August 2014
Program first available on AMS website: September 25, 2014
Program issue of electronic *Notices*: November 2014
Issue of *Abstracts*: Volume 35, Issue 4

### Deadlines

For organizers: April 8, 2014
For abstracts: September 16, 2014

*The scientific information listed below may be dated. For the latest information, see* www.ams.org/amsmtgs/sectional.html.

### Invited Addresses

**Susanne Brenner**, Louisiana State Unviersity, *Title to be announced*.

**Skip Garibaldi**, Emory University, *Title to be announced*.

**Stavros Garoufaldis**, Georgia Institute of Technology, *Title to be announced*.

**James Sneyd**, University of Auckland, *Title to be announced* (AMS-NZMS Maclaurin Lecture).

# San Antonio, Texas

*Henry B. Gonzalez Convention Center and Grand Hyatt San Antonio*

### January 10–13, 2015

*Saturday – Tuesday*

### Meeting #1106

*Joint Mathematics Meetings, including the 121st Annual Meeting of the AMS, 98th 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 of Symbolic Logic (ASL), 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*: Volume 36, Issue 1

### Deadlines

For organizers: April 1, 2014
For abstracts: To be announced

# Washington, District of Columbia

*Georgetown University*

### March 7–8, 2015

*Saturday – Sunday*
Eastern Section
Associate secretary: Steven H. Weintraub
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 7, 2014
For abstracts: To be announced

# Huntsville, Alabama

*University of Alabama in Huntsville*

**March 20–22, 2015**
*Friday – Sunday*
Southeastern Section
Associate secretary: Brian D. Boe
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 20, 2014
For abstracts: To be announced

# Las Vegas, Nevada

*University of Nevada, Las Vegas*

**April 18–19, 2015**
*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 18, 2014
For abstracts: To be announced

# Porto, Portugal

*University of Porto*

**June 11–14, 2015**
*Thursday – Sunday*
*First Joint International Meeting involving the American Mathematical Societry (AMS), the European Mathematical Society (EMS), and the Sociedade de Portuguesa Matematica (SPM).*
Associate secretary: Georgia M. Benkart
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*: Not applicable

**Deadlines**
For organizers: To be announced
For abstracts: To be announced

# Chicago, Illinois

*Loyola University Chicago*

**October 3–4, 2015**
*Saturday – Sunday*
Central Section
Associate secretary: Georgia M. Benkart
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: October 2015
Issue of *Abstracts*: To be announced

**Deadlines**
For organizers: March 10, 2015
For abstracts: To be announced

# Fullerton, California

*California State University, Fullerton*

**October 24–25, 2015**
*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*: October 2015
Issue of *Abstracts*: To be announced

**Deadlines**
For organizers: March 27, 2015
For abstracts: To be announced

# Seattle, Washington

*Washington State Convention Center and the Sheraton Seattle Hotel*

**January 6–9, 2016**
*Wednesday – Saturday*
*Joint Mathematics Meetings, including the 122nd Annual Meeting of the AMS, 99th 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 of 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 2015
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: January 2016
Issue of *Abstracts*: Volume 37, Issue 1

**Deadlines**
For organizers: April 1, 2015
For abstracts: To be announced

# Program at a Glance

This document provides a thumbnail sketch of all scientific and social events so you can easily see which events may overlap and better plan your time.


## Monday, January 13

| | |
|---|---|
| 9:00 a.m.–3:45 p.m. | **AMS SHORT COURSE ON GEOMETRY AND TOPOLOGY IN STATISTICAL INFERENCE, PART I** |
| 9:00 a.m.–5:00 p.m. | **MAA SHORT COURSE ON READING, WRITING, AND DOING THE HISTORY OF MATHEMATICS: LEARNING THE METHODS OF HISTORICAL RESEARCH, PART I** |
| 3:00 p.m.–6:00 p.m. | **NSF-EHR GRANT PROPOSAL WRITING WORKSHOP** |

## Tuesday, January 14

| | |
|---|---|
| 8:00 a.m.–6:30 p.m. | **AMS DEPARTMENT CHAIRS WORKSHOP** |
| 9:00 a.m.–4:45 p.m. | **AMS SHORT COURSE ON GEOMETRY AND TOPOLOGY IN STATISTICAL INFERENCE, PART II** |
| 9:00 a.m.–5:00 p.m. | **MAA SHORT COURSE ON READING, WRITING, AND DOING THE HISTORY OF MATHEMATICS: LEARNING THE METHODS OF HISTORICAL RESEARCH, PART II** |
| 9:00 a.m.–4:30 p.m. | **MAA ANCILLARY WORKSHOP ON TEACHING THE STATISTICAL INVESTIGATION PROCESS WITH RANDOMIZATION-BASED INFERENCE** |
| 9:00 a.m.–5:00 p.m. | **MAA BOARD OF GOVERNORS** |
| 1:00 p.m.–4:30 p.m. | **MAA ANCILLARY WORKSHOP ON INTERACTIVE PROBABILITY INSTRUCTION** |
| 1:30 p.m.–10:00 p.m. | **AMS COUNCIL** |
| 3:00 p.m.–8:00 p.m. | **JOINT MEETINGS REGISTRATION**, Pratt Street Lobby, 300 Level, BCC |
| 3:00 p.m.–8:30 p.m. | **EMAIL CENTER** |

## Wednesday, January 15

| | |
|---|---|
| 7:30 a.m.–4:00 p.m. | **JOINT MEETINGS REGISTRATION**, Pratt Street Lobby, 300 Level, BCC |
| 7:30 a.m.–9:30 p.m. | **EMAIL CENTER** |

**AMS SPECIAL SESSIONS**

| | |
|---|---|
| 8:00 a.m.–10:50 a.m. | *Logic and Probability, I (AMS-ASL)* |
| 8:00 a.m.–10:50 a.m. | *Applied Harmonic Analysis: Large Data Sets, Signal Processing, and Inverse Problems, I* |
| 8:00 a.m.–10:50 a.m. | *Random Matrices: Theory and Applications, I* |
| 8:00 a.m.–10:50 a.m. | *Mathematics and Mathematics Education in Fiber Arts, I* |
| 8:00 a.m.–10:50 a.m. | *Recent Progress in the Langlands Program, I* |
| 8:00 a.m.–10:50 a.m. | *Algebraic Structures Motivated by Knot Theory, I* |
| 8:00 a.m.–10:50 a.m. | *Structural and Extremal Problems, I* |
| 8:00 a.m.–10:50 a.m. | *Research in Mathematics by Undergraduates and Students in Post-Baccalaureate Programs, I* |
| 8:00 a.m.–10:50 a.m. | *Nonlinear Systems: Polynomial Equations, Nonlinear PDEs, and Applications, I* |

8:00 a.m.–10:50 a.m. *History of Mathematics, I*
8:00 a.m.–10:50 a.m. *Classification Problems in Operator Algebras, I*
8:00 a.m.–10:50 a.m. *Recent Progress in Geometric and Complex Analysis, I*
8:00 a.m.–10:50 a.m. *Hyperplane Arrangements and Applications, I*
8:00 a.m.–10:50 a.m. *Advances in Analysis and PDEs, I*
8:00 a.m.–10:50 a.m. *Algebraic Geometry, I*
8:00 a.m.–10:50 a.m. *Symplectic and Contact Structures on Manifolds with Special Holonomy, I*
8:00 a.m.–10:50 a.m. *The Changing Education of Preservice Teachers in Light of the Common Core, I*
8:00 a.m.–10:50 a.m. *Fractional, Stochastic, and Hybrid Dynamic Systems with Applications, I*
8:00 a.m.–10:50 a.m. *Difference Equations and Applications, I*

**MAA INVITED PAPER SESSION**
8:00 a.m.–10:15 a.m. *The Unreasonable Effectiveness of Modern Mathematics*

**MAA CONTRIBUTED PAPER SESSIONS**
8:00 a.m.–11:00 a.m. *Is Mathematics the Language of Science?*
8:00 a.m.–11:00 a.m. *Assessing Quantitative Reasoning and Literacy*
8:00 a.m.–11:00 a.m. *Topics and Techniques for Teaching Real Analysis*

8:00 a.m.–6:00 p.m. **SIAM MINISYMPOSIUM**

8:00 a.m.–10:55 a.m. **AMS SESSIONS FOR CONTRIBUTED PAPERS**

8:00 a.m.–11:00 a.m. **MAA GENERAL CONTRIBUTED PAPER SESSIONS**

9:00 a.m.–11:00 a.m. **MAA MINICOURSE: #12: PART A** *A game theory path to quantitative literacy.*

9:00 a.m.–11:00 a.m. **MAA MINICOURSE #1: PART A** *Humanistic mathematics.*

9:00 a.m.–11:00 a.m. **MAA MINICOURSE #4A: PART A** *Teaching introductory statistics (for instructors new to teaching intro stats).*

9:00 a.m.–10:20 a.m. **MAA INQUIRY-BASED LEARNING MINIWORKSHOP** *What is IBL and why use it?*

9:00 a.m.–10:20 a.m. **MAA COMMITTEE ON ASSESSMENT PANEL DISCUSSION** *What do I need to know about Common Core and Common Core assessments?*

9:00 a.m.–10:20 a.m. **MAA COMMITTEE ON TECHNOLOGIES IN MATHEMATICS EDUCATION PANEL DISCUSSION** *Assistive technologies for math students and faculty with disabilities.*

9:00 a.m.–5:00 p.m. **STUDENT HOSPITALITY/INFORMATION CENTER**

9:30 a.m.–11:00 a.m. **MAA-AMS-SIAM SPECIAL PRESENTATION** *Access and opportunities in STEM education: The challenges of building an equitable diverse society.*

9:30 a.m.–11:00 a.m. **MAA DEPARTMENT LIAISONS COMMITTEE MEETING**

10:05 a.m.–10:55 a.m. **AMS INVITED ADDRESS** *Title to be announced.* **Paul Seidel**

11:10 a.m.–12:00 p.m. **AMS-MAA INVITED ADDRESS** *Paul Erdős and the rise of statistical thinking in elementary Number Theory.* **Carl Pomerance**

12:00 p.m.–5:00 p.m. **MATHEMATICAL INSTITUTES OPEN HOUSE**

12:15 p.m.–5:30 a.m. **EXHIBITS AND BOOK SALES** *Come to the Grand Opening at 12:15 p.m.!*

1:00 p.m.–1:50 p.m. **AMS COLLOQUIUM LECTURES, LECTURE I** *Symplectic topology today: Recent results and open questions.* **Dusa McDuff**

2:15 p.m.–3:05 p.m. **MAA INVITED ADDRESS** *Mathematics in stone and bronze.* **Helaman and Claire Ferguson**

**AMS SPECIAL SESSIONS**
2:15 p.m.–6:05 p.m. *Mathematics of Computation: Differential Equations, Linear Algebra, and Applications, I (AMS-SIAM)*
2:15 p.m.–6:05 p.m. *Logic and Probability, II (AMS-ASL)*
2:15 p.m.–6:05 p.m. *Applied Harmonic Analysis: Large Data Sets, Signal Processing, and Inverse Problems, II*
2:15 p.m.–6:05 p.m. *Random Matrices: Theory and Applications, II*
2:15 p.m.–6:05 p.m. *Mathematics and Mathematics Education in Fiber Arts, II*
2:15 p.m.–6:05 p.m. *Recent Progress in the Langlands Program, II*
2:15 p.m.–6:05 p.m. *Algebraic Structures Motivated by Knot Theory, II*

2:15 p.m.–6:05 p.m. *Structural and Extremal Problems, II*
2:15 p.m.–6:05 p.m. *Research in Mathematics by Undergraduates and Students in Post-Baccalaureate Programs, II*
2:15 p.m.–6:05 p.m. *Nonlinear Systems: Polynomial Equations, Nonlinear PDEs, and Applications, II*
2:15 p.m.–6:05 p.m. *History of Mathematics, II*
2:15 p.m.–6:05 p.m. *Classification Problems in Operator Algebras, II*
2:15 p.m.–6:05 p.m. *Recent Progress in Geometric and Complex Analysis, II*
2:15 p.m.–6:05 p.m. *Hyperplane Arrangements and Applications, II*
2:15 p.m.–6:05 p.m. *Algebraic Geometry, II*
2:15 p.m.–6:05 p.m. *Symplectic and Contact Structures on Manifolds with Special Holonomy, II*
2:15 p.m.–6:05 p.m. *The Changing Education of Preservice Teachers in Light of the Common Core, II*
2:15 p.m.–6:05 p.m. *Fractional, Stochastic, and Hybrid Dynamic Systems with Applications, II*
2:15 p.m.–6:05 p.m. *Difference Equations and Applications, II*
2:15 p.m.–4:15 p.m. **MAA MINICOURSE: #14: PART A** *Visualizing projective geometry through photographs and perspective drawings.*
2:15 p.m.–4:15 p.m. **MAA MINICOURSE #15: PART A** *Developing strong mentoring relationships.*
2:15 p.m.–4:15 p.m. **MAA MINICOURSE #9: PART A** *WeBWorK: An open-source alternative for generating and delivering online homework problems.*

**MAA CONTRIBUTED PAPER SESSIONS**
2:15 p.m.–6:00 p.m. *Assessing Student Learning: Alternative Approaches*
2:15 p.m.–6:00 p.m. *Programs and Approaches for Mentoring Women and Minorities in Mathematics*
2:15 p.m.–6:00 p.m. *Scholarship of Teaching and Learning in Collegiate Mathematics*
2:15 p.m.–6:00 p.m. *We Did More with Less: Streamlining the Undergraduate Mathematics Curriculum*
2:15 p.m.–5:55 p.m. **AMS SESSIONS FOR CONTRIBUTED PAPERS**
2:15 p.m.–6:00 p.m. **MAA GENERAL CONTRIBUTED PAPER SESSIONS**
2:15 p.m.–3:45 p.m. **AMS-ASA-MAA-SIAM SPECIAL PRESENTATION** *INGenIOuS: Workforce preparation for students in the mathematical sciences.*
2:15 p.m.–3:35 p.m. **MAA-YOUNG MATHEMATICIANS' NETWORK PANEL DISCUSSION** *Career options for undergraduate mathematics majors.*
2:15 p.m.–3:35 p.m. **MAA-NSF PANEL DISCUSSION** *NSF programs supporting learning, teaching, and the future workforce in mathematics.*
2:15 p.m.–4:15 p.m. **MAA POSTER SESSION OF PROJECTS SUPPORTED BY THE NSF DIVISION OF UNDERGRADUATE EDUCATION**
2:15 p.m.–3:40 p.m. **AWM PANEL DISCUSSION** *Building a research career in mathematics.*
3:20 p.m.–4:10 p.m. **MAA INVITED ADDRESS** *Effective thinking and mathematics.* **Michael Starbird**
3:45 p.m.–4:15 p.m. **AWM BUSINESS MEETING**
3:50 p.m.–5:10 p.m. **MAA-YOUNG MATHEMATICIANS' NETWORK PANEL DISCUSSION** *What experiences matter on your resumé?*
4:00 p.m.–5:00 p.m. **MAA SECTION OFFICERS**
4:00 p.m.–5:00 p.m. **RECEPTION FOR UNDERGRADUATE STUDENTS**
4:30 p.m.–6:00 p.m. **AMS COMMITTEE ON THE PROFESSION PANEL DISCUSSION** *Online courses: Benefits and pitfalls.*
4:45 p.m.–6:45 p.m. **MAA MINICOURSE: #11: PART A** *Public and private-key cryptography.*
4:45 p.m.–6:45 p.m. **MAA MINICOURSE #3: PART A** *Improvisation for the mathematics classroom.*
4:45 p.m.–6:45 p.m. **MAA MINICOURSE #7: PART A** *Mathematics and dance.*
5:30 p.m.–6:30 p.m. **RECEPTION FOR GRADUATE STUDENTS AND FIRST-TIME PARTICIPANTS**
5:30 p.m.–8:00 p.m. **MATHEMATICAL INSTITUTES OPEN HOUSE**
6:00 p.m.–8:15 p.m. **PENNSYLVANIA STATE UNIVERSITY MATHEMATICS ALUMNI RECEPTION**
6:30 p.m.–8:00 p.m. **MAA NEW COMMITTEE CHAIRS**

8:30 p.m.–9:30 p.m. **AMS JOSIAH WILLARD GIBBS LECTURE** *Machines that see, powered by probability.* **Andrew Blake**

9:30 p.m.–11:00 p.m. **AWM RECEPTION**

# Thursday, January 16

7:30 a.m.–4:00 p.m. **JOINT MEETINGS REGISTRATION**, Pratt Street Lobby, 300 Level, BCC

7:30 a.m.–8:00 p.m. **EMAIL CENTER**

**AMS SPECIAL SESSIONS**

8:00 a.m.–11:50 a.m. *Mathematics of Computation: Differential Equations, Linear Algebra, and Applications, II (AMS-SIAM)*

8:00 a.m.–11:50 a.m. *Applied Harmonic Analysis: Large Data Sets, Signal Processing, and Inverse Problems, III*

8:00 a.m.–11:50 a.m. *Random Matrices: Theory and Applications, III*

8:00 a.m.–11:50 a.m. *Recent Progress in the Langlands Program, III*

8:00 a.m.–11:50 a.m. *Algebraic Structures Motivated by Knot Theory, III*

8:00 a.m.–11:50 a.m. *Structural and Extremal Problems, III*

8:00 a.m.–11:50 a.m. *History of Mathematics, III*

8:00 a.m.–11:50 a.m. *The Ubiquity of Dynamical Systems, I*

8:00 a.m.–11:50 a.m. *My Favorite Graph Theory Conjectures, I*

8:00 a.m.–11:50 a.m. *Classification Problems in Operator Algebras, III*

8:00 a.m.–11:50 a.m. *Computability in Geometry and Topology, I*

8:00 a.m.–11:50 a.m. *Advances in Analysis and PDEs, II*

8:00 a.m.–11:50 a.m. *Algebraic Geometry, III*

8:00 a.m.–11:50 a.m. *Symplectic and Contact Structures on Manifolds with Special Holonomy, III*

8:00 a.m.–11:50 a.m. *The Changing Education of Preservice Teachers in Light of the Common Core, III*

8:00 a.m.–10:50 a.m. *Geometric Group Theory, I (a Mathematics Research Communities Session)*

8:00 a.m.–10:50 a.m. *Complex Dynamics, I (a Mathematics Research Communities Session)*

8:00 a.m.–10:50 a.m. *Tropical and Nonarchimedean Analytic Geometry, I (a Mathematics Research Communities Session)*

8:00 a.m.–10:50 a.m. *Regulatory Problems for Nonlinear PDEs Modeling Fluids and Complex Fluids, I (a Mathematics Research Communities Session)*

**MAA CONTRIBUTED PAPER SESSIONS**

8:00 a.m.–12:00 p.m. *Assessment of Proof Writing Throughout the Mathematics Major*

8:00 a.m.–12:00 p.m. *Bridging the Gap: Designing an Introduction to Proofs Course*

8:00 a.m.–12:00 p.m. *Student Activities*

8:00 a.m.–12:00 p.m. *Research on the Teaching and Learning of Undergraduate Mathematics, I*

8:00 a.m.–6:00 p.m. **SIAM MINISYMPOSIUM**

8:00 a.m.–11:55 a.m. **AMS SESSIONS FOR CONTRIBUTED PAPERS**

8:00 a.m.–12:00 p.m. **MAA GENERAL CONTRIBUTED PAPER SESSIONS**

9:00 a.m.–9:50 a.m. **MAA INVITED ADDRESS** *Snark attack! Visualizations of "uncolorable" graphs on surfaces.* **Sarah-Marie Belcastro**

**MAA INVITED PAPER SESSIONS**

9:00 a.m.–11:50 a.m. *Mathematics and Effective Thinking, I*

9:00 a.m.–11:00 a.m. **MAA MINICOURSE: #13: PART A** *Teaching an applied topology course.*

9:00 a.m.–11:00 a.m. **MAA MINICOURSE #6: PART A** *Historical role-playing in the mathematics classroom.*

9:00 a.m.–11:00 a.m. **MAA MINICOURSE: #8: PART A** *Directing undergraduate research.*

9:00 a.m.–10:55 a.m. **MAA WORKSHOP** *Introductory proposal writing for grant applications to the NSF Division of Undergraduate Education.*

9:00 a.m.–10:20 a.m. **MAA-YOUNG MATHEMATICIANS' NETWORK PANEL DISCUSSION** *Undergraduate internships and research experiences for undergraduates.*

9:00 a.m.–11:00 a.m. **MAA COMMITTEE ON THE PARTICIPATION OF WOMEN POSTER SESSION** *Mathematical outreach programs.*

9:00 a.m.–5:00 p.m. **STUDENT HOSPITALITY/INFORMATION CENTER**

9:30 a.m.–11:00 a.m. **AMS SPECIAL PRESENTATION** *Who wants to be a mathematician—National contest.*

9:30 a.m.–5:30 p.m. **EXHIBITS AND BOOK SALES**

10:00 a.m.–10:55 a.m. **AWM NOETHER LECTURE** *Walking on graphs the representation theory way.* **Georgia M. Benkart**

**MAA INVITED PAPER SESSIONS**

10:00 a.m.–11:50 a.m. *Graphs Don't Have to Lie Flat: The Shape of Topological Graph Theory*

10:30 a.m.–12:00 p.m. **AMS SPECIAL PRESENTATION** *A conversation on nonacademic employment.*

10:30 a.m.–12:00 p.m. **MAA SIGMAA OFFICERS MEETING**

10:35 a.m.–11:55 a.m. **MAA COUNCIL ON OUTREACH PRESENTATION** *Math Days for high school students at local colleges and universities.*

1:00 p.m.–1:50 p.m. **AMS COLLOQUIUM LECTURES, LECTURE II** *Symplectic topology today: Embedding questions: obstructions and constructions.* **Dusa McDuff**

**AMS SPECIAL SESSIONS**

1:00 p.m.–3:50 p.m. *Logic and Probability, III (AMS-ASL)*

1:00 p.m.–3:50 p.m. *Fractal Geometry: Mathematics of Fractals and Related Topics, I*

1:00 p.m.–3:50 p.m. *Big Data: Mathematical and Statistical Modeling, Tools, Services, and Training*

1:00 p.m.–3:50 p.m. *Homotopy Theory, I*

1:00 p.m.–3:50 p.m. *Analytic Number Theory, I*

1:00 p.m.–3:50 p.m. *Progress in Free Probability, I*

1:00 p.m.–3:50 p.m. *Nonlinear Systems: Polynomial Equations, Nonlinear PDEs, and Applications, III*

1:00 p.m.–3:50 p.m. *My Favorite Graph Theory Conjectures, II*

1:00 p.m.–3:50 p.m. *Recent Progress in Geometric and Complex Analysis, III*

1:00 p.m.–3:50 p.m. *Hyperplane Arrangements and Applications, III*

1:00 p.m.–3:50 p.m. *Recent Progress in Multivariable Operator Theory, I*

1:00 p.m.–3:50 p.m. *Advances in Analysis and PDEs, III*

1:00 p.m.–3:50 p.m. *Homological and Characteristic p Methods in Commutative Algebra, I*

1:00 p.m.–3:50 p.m. *Geometric Group Theory, II (a Mathematics Research Communities Session)*

1:00 p.m.–3:50 p.m. *Complex Dynamics, II (a Mathematics Research Communities Session)*

1:00 p.m.–3:50 p.m. *Tropical and Nonarchimedean Analytic Geometry, II (a Mathematics Research Communities Session)*

1:00 p.m.–3:50 p.m. *Regulatory Problems for Nonlinear PDEs Modeling Fluids and Complex Fluids, II (a Mathematics Research Communities Session)*

1:00 p.m.–3:50 p.m. *Topological Graph Theory: Structure and Symmetry, I*

**MAA INVITED PAPER SESSIONS**

1:00 p.m.–3:50 p.m. *Mathematics and Effective Thinking, II*

1:00 p.m.–3:00 p.m. **MAA MINICOURSE: #14: PART B** *Visualizing projective geometry through photographs and perspective drawings.*

1:00 p.m.–3:00 p.m. **MAA MINICOURSE #2: PART A** *CATALST: Introductory statistics using randomization and bootstrap methods.*

1:00 p.m.–3:00 p.m. **MAA MINICOURSE #5A: PART A** *Using randomization methods to build conceptual understanding of statistical inference.*

**MAA CONTRIBUTED PAPER SESSIONS**

1:00 p.m.–4:00 p.m. *Projects, Demonstrations, and Activities that Engage Liberal Arts Mathematics Students*

1:00 p.m.–4:00 p.m. *At the Intersection of Mathematics and the Arts*

1:00 p.m.–4:00 p.m. *Research on the Teaching and Learning of Undergraduate Mathematics, II*

1:00 p.m.–4:00 p.m. *History of Mathematical Communities*

1:00 p.m.–4:10 p.m. **AMS SESSIONS FOR CONTRIBUTED PAPERS**

1:00 p.m.–4:00 p.m. **MAA GENERAL CONTRIBUTED PAPER SESSIONS**

1:00 p.m.–2:20 p.m. **MAA-YOUNG MATHEMATICIANS' NETWORK PANEL DISCUSSION** *Finding the right grant.*

1:00 p.m.–2:20 p.m. **MAA COMMITTEE ON MUTUAL CONCERNS-COLLEGE BOARD PANEL DISCUSSION** *AP calculus, computer science, and statistics.*

1:00 p.m.–2:30 p.m. **JOINT COMMITTEE ON WOMEN IN THE MATHEMATICAL SCIENCES PANEL DISCUSSION** *Negotiating in mathematical careers.*

1:00 p.m.–4:00 p.m. **SUMMER PROGRAM FOR WOMEN IN MATHEMATICS (SPWM) REUNION**

2:15 p.m.–3:05 p.m. **AMS INVITED ADDRESS** *Random Matrices and Regularity of Parabolic Equations.* **Horng-Tzer Yau**

2:15 p.m.–4:15 p.m. **YOUNG MATHEMATICIANS' NETWORK-PROJECT NEXT POSTER SESSION**

2:35 p.m.–3:55 p.m. **MAA SUBCOMMITTEE ON RESEARCH BY UNDERGRADUATES PANEL DISCUSSION** *Directing undergraduate research: How to get started.*

2:35 p.m.–3:55 p.m. **MAA COMMITTEE ON TWO-YEAR COLLEGES PANEL DISCUSSION** *Collaborations between two-year and four-year institutions that create pathways to a math major.*

3:20 p.m.–4:10 p.m. **AMS RETIRING PRESIDENTIAL ADDRESS** *Title to be announced.* **Eric Friedlander**

4:25 p.m.–5:25 p.m. **JOINT PRIZE SESSION**

5:30 p.m.–7:20 p.m. **SIGMAA ON THE PHILOSOPHY OF MATHEMATICS RECEPTION, BUSINESS MEETING, AND GUEST LECTURE**

5:30 p.m.–7:30 p.m. **ASSOCIATION OF CHRISTIANS IN THE MATHEMATICAL SCIENCES ANNUAL RECEPTION AND LECTURE**

5:30 p.m.–7:00 p.m. **BUDAPEST SEMESTERS IN MATHEMATICS ANNUAL ALUMNI REUNION**

5:30 p.m.–6:30 p.m. **JOINT PRIZE SESSION RECEPTION**

5:45 p.m.–7:00 p.m. **MAA TWO-YEAR COLLEGE RECEPTION**

6:00 p.m.–7:50 p.m. **SIGMAA ON MATHEMATICAL AND COMPUTATIONAL BIOLOGY BUSINESS MEETING AND GUEST LECTURE**

6:00 p.m.–7:50 p.m. **SIGMAA ON QUANTITATIVE LITERACY RECEPTION, BUSINESS MEETING, AND GUEST LECTURE**

6:00 p.m.–7:10 p.m. **AMS-MAA SPECIAL FILM PRESENTATION** *The Genius of Srinivasa Ramanujan.*

6:00 p.m.–8:00 p.m. **ASSOCIATION OF LESBIAN, GAY, BISEXUAL, AND TRANSGENDERED MATHEMATICIANS ANNUAL RECEPTION**

6:30 p.m.–7:30 p.m. **THE NATIONAL MUSEUM OF MATHEMATICS' MUSEUM CONTENT CREATION CONCLAVE**

7:30 p.m.–8:30 p.m. **YOUNG MATHEMATICIANS' NETWORK OPEN FORUM**

8:15 p.m.–9:45 p.m. **KNITTING CIRCLE** *Bring a project (knitting/crocheting/tatting/beading/etc.) and chat with other crafters.*

# Friday, January 17

7:30 a.m.–4:00 p.m. **JOINT MEETINGS REGISTRATION**, Pratt Street Lobby, 300 Level, BCC

7:30 a.m.–7:00 p.m. **EMAIL CENTER**

8:00 a.m.–5:00 p.m. **ASL INVITED ADDRESSES AND CONTRIBUTED PAPER SESSIONS**

**AMS SPECIAL SESSIONS**

8:00 a.m.–10:50 a.m. *Geometric Applications of Algebraic Combinatorics, I (AMS-AWM)*

8:00 a.m.–10:50 a.m. *Fractal Geometry: Mathematics of Fractals and Related Topics, II*

8:00 a.m.–10:50 a.m. *Homotopy Theory, II*

8:00 a.m.–10:50 a.m. *Analytic Number Theory, II*

8:00 a.m.–10:50 a.m. *Research in Mathematics by Undergraduates and Students in Post-Baccalaureate Programs, III*

8:00 a.m.–10:50 a.m. *Progress in Free Probability, II*

8:00 a.m.–10:50 a.m. *Ergodic Theory and Symbolic Dynamics, I*

8:00 a.m.–10:50 a.m. *Highlighting Achievements and Contributions of Mathematicians of the African Diaspora, I*

8:00 a.m.–10:50 a.m. *My Favorite Graph Theory Conjectures, III*
8:00 a.m.–10:50 a.m. *Mathematics in Natural Resource Modeling, I*
8:00 a.m.–10:50 a.m. *Recent Progress in Multivariable Operator Theory, II*
8:00 a.m.–10:50 a.m. *Homological and Characteristic p Methods in Commutative Algebra, II*
8:00 a.m.–10:50 a.m. *Geometric Group Theory, III (a Mathematics Research Communities Session)*
8:00 a.m.–10:50 a.m. *Complex Dynamics, III (a Mathematics Research Communities Session)*
8:00 a.m.–10:50 a.m. *Tropical and Nonarchimedean Analytic Geometry, III (a Mathematics Research Communities Session)*
8:00 a.m.–10:50 a.m. *Regulatory Problems for Nonlinear PDEs Modeling Fluids and Complex Fluids, III (a Mathematics Research Communities Session)*
8:00 a.m.–10:50 a.m. *Topological Graph Theory: Structure and Symmetry, II*
8:00 a.m.–10:50 a.m. *Accelerated Advances in Higher Order Invexities/Univexities with Applications to Optimization and Mathematical Programming, I*

**MAA INVITED PAPER SESSIONS**

8:00 a.m.–11:00 a.m. *The Continuing Influence of Paul Erdős in Number Theory*
8:00 a.m.–11:00 a.m. *Six Crash Courses on Mapping Class Groups, I*

**MAA CONTRIBUTED PAPER SESSIONS**

8:00 a.m.–11:00 a.m. *Trends in Undergraduate Mathematical Biology Education*
8:00 a.m.–11:00 a.m. *Using Online Resources to Augment the Traditional Classroom*
8:00 a.m.–11:00 a.m. *Open Source Mathematics Textbooks*
8:00 a.m.–11:00 a.m. *Innovative and Effective Ways to Teach Linear Algebra*

8:00 a.m.–6:00 p.m. **SIAM MINISYMPOSIUM**

8:00 a.m.–10:55 a.m. **AMS SESSIONS FOR CONTRIBUTED PAPERS**

8:00 a.m.–11:00 a.m. **MAA GENERAL CONTRIBUTED PAPER SESSIONS**

8:00 a.m.–11:00 a.m. **PME COUNCIL MEETING**

8:30 a.m.–10:30 a.m. **AMS-MAA GRAD SCHOOL FAIR** *Undergrads! Take this opportunity to meet representatives from mathematical science graduate programs.*

9:00 a.m.–9:50 a.m. **MAA INVITED ADDRESS** *The mathematics of lattice-based cryptography.* **Jill Pipher**

9:00 a.m.–11:00 a.m. **MAA MINICOURSE: #12: PART B** *A game theory path to quantitative literacy.*

9:00 a.m.–11:00 a.m. **MAA MINICOURSE #1: PART B** *Humanistic mathematics.*

9:00 a.m.–11:00 a.m. **MAA MINICOURSE #4A: PART B** *Teaching introductory statistics (for instructors new to teaching intro stats).*

9:00 a.m.–10:55 a.m. **MAA WORKSHOP** *Advanced proposal writing for grant applications to the NSF Division of Undergraduate Education. (advance registration required)*

9:00 a.m.–10:20 a.m. **MAA COMMITTEE ON THE TEACHING OF UNDERGRADUATE MATHEMATICS PANEL DISCUSSION** *Maximizing your impact in the classroom: Case studies in best practices for classroom teaching.*

9:00 a.m.–10:20 a.m. **MAA COMMITTEE ON UNDERGRADUATE STUDENT ACTIVITIES AND CHAPTERS-SIGMAA ON MATHEMATICS IN BUSINESS, INDUSTRY, AND GOVERNMENT PANEL DISCUSSION** *Nonacademic career paths for mathematicians.*

9:00 a.m.–5:00 p.m. **STUDENT HOSPITALITY/INFORMATION CENTER**

9:30 a.m.–5:30 p.m. **EXHIBITS AND BOOK SALES**

10:05 a.m.–10:55 a.m. **AMS INVITED ADDRESS** *Title to be announced.* **Emmanuel Candès**

11:10 a.m.–12:00 p.m. **AMS-MAA INVITED ADDRESS** *Title to be announced.* **Benson Farb**

1:00 p.m.–1:50 p.m. **AMS COLLOQUIUM LECTURES, LECTURE III** *Symplectic Topology Today: Embedding ellipsoids and Fibonacci numbers.* **Dusa McDuff**

1:00 p.m.–1:50 p.m. **MAA LECTURE FOR STUDENTS** *An unexpected group.* **Carl Cowen**

1:00 p.m.–4:45 p.m. **AMS CURRENT EVENTS BULLETIN**

**AMS SPECIAL SESSIONS**

1:00 p.m.–5:50 p.m. *Geometric Applications of Algebraic Combinatorics, II (AMS-AWM)*
1:00 p.m.–5:50 p.m. *Nineteenth Century Algebra and Analysis*
1:00 p.m.–5:50 p.m. *Fractal Geometry: Mathematics of Fractals and Related Topics, III*
1:00 p.m.–5:50 p.m. *Homotopy Theory, III*
1:00 p.m.–5:50 p.m. *Heavy Tailed Probability Distributions and Their Applications, I*
1:00 p.m.–5:50 p.m. *Analytic Number Theory, III*
1:00 p.m.–5:50 p.m. *The Ubiquity of Dynamical Systems, II*
1:00 p.m.–5:50 p.m. *Computability in Geometry and Topology, II*
1:00 p.m.–5:50 p.m. *Deformation Spaces of Geometric Structures on Low-dimensional Manifolds, I*
1:00 p.m.–5:50 p.m. *Mathematics in Natural Resource Modeling, II*
1:00 p.m.–5:50 p.m. *Outreach for Mathematically Talented Youth, I*
1:00 p.m.–5:50 p.m. *Recent Progress in Multivariable Operator Theory, III*
1:00 p.m.–5:50 p.m. *Homological and Characteristic p Methods in Commutative Algebra, III*
1:00 p.m.–5:50 p.m. *Topological Graph Theory: Structure and Symmetry, III*
1:00 p.m.–5:50 p.m. *Quantum Walks, Quantum Computation, and Related Topics, I*
1:00 p.m.–4:00 p.m. *Fractional, Stochastic, and Hybrid Dynamic Systems with Applications, III*
1:00 p.m.–5:50 p.m. *Accelerated Advances in Higher Order Invexities/Univexities with Applications to Optimization and Mathematical Programming, II*

**MAA INVITED PAPER SESSIONS**

1:00 p.m.–3:50 p.m. *Uniform Distribution, Discrepancy, and Related Fields*
1:00 p.m.–3:00 p.m. **MAA MINICOURSE: #10: PART A** *Heavenly mathematics: The forgotten art of spherical trigonometry.*
1:00 p.m.–3:00 p.m. **MAA MINICOURSE #15: PART B** *Developing strong mentoring relationships.*
1:00 p.m.–3:00 p.m. **MAA MINICOURSE #9: PART B** *WeBWorK: An open-source alternative for generating and delivering online homework problems.*

**MAA CONTRIBUTED PAPER SESSIONS**

1:00 p.m.–6:00 p.m. *Instructional Approaches to Increase Awareness of the Societal Value of Mathematics*
1:00 p.m.–6:00 p.m. *Mathematics Experiences in Business, Industry, and Government*
1:00 p.m.–6:00 p.m. *Data, Modeling, and Computing in the Introductory Statistics Course*
1:00 p.m.–4:00 p.m. **NAM GRANVILLE-BROWN-HAYNES SESSION OF PRESENTATIONS BY RECENT DOCTORAL RECIPIENTS IN THE MATHEMATICAL SCIENCES**
1:00 p.m.–5:55 p.m. **AMS SESSIONS FOR CONTRIBUTED PAPERS**
1:00 p.m.–6:00 p.m. **MAA GENERAL CONTRIBUTED PAPER SESSIONS**
1:00 p.m.–2:20 p.m. **MAA PANEL DISCUSSION** *Interactive dynamic technology: Its role in teaching and learning calculus.*
1:00 p.m.–10:20 a.m. **MAA SESSION FOR CHAIRS** *Planning for the future with new curriculum guides.*
2:15 p.m.–4:00 p.m. **ROCKY MOUNTAIN MATHEMATICS CONSORTIUM BOARD OF DIRECTORS MEETING**
2:30 p.m.–3:50 p.m. **PRESENTATIONS BY MAA TEACHING AWARD RECIPIENTS**
2:30 p.m.–4:00 p.m. **AMS COMMITTEE ON SCIENCE POLICY-AMS COMMITTEE ON EDUCATION PANEL DISCUSSION** *The public face of mathematics.*
2:35 p.m.–3:50 p.m. **MAA PANEL DISCUSSION** *Designing and implementing a problem-based mathematics course.*
3:30 p.m.–5:30 p.m. **MAA MINICOURSE: #11: PART B** *Public and private-key cryptography.*
3:30 p.m.–5:30 p.m. **MAA MINICOURSE #3: PART B** *Improvisation for the mathematics classroom.*
3:30 p.m.–5:30 p.m. **MAA MINICOURSE #7: PART B** *Mathematics and dance.*
4:15 p.m.–6:00 p.m. **AMS-MAA-SIAM JOINT PANEL DISCUSSION** *Promoting post-secondary mathematics education.*
4:30 p.m.–5:30 p.m. **MAA STUDENT POSTER SESSION**

4:30 p.m.–6:00 p.m. **AMS CONGRESSIONAL FELLOWSHIP SESSION**

4:30 p.m.–6:30 p.m. **MAA SPECIAL PRESENTATION: POETRY READING** *All mathematical poets and those interested in mathematical poetry are invited.*

5:00 p.m.–6:20 p.m. **SIGMAA ON MATHEMATICS INSTRUCTION USING THE WEB BUSINESS MEETING, RECEPTION, AND GUEST LECTURE**

5:00 p.m.–7:00 p.m. **MAA PANEL DISCUSSION** *Actuarial science education session for faculty.*

5:30 p.m.–7:30 p.m. **UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN DEPARTMENT OF MATHEMATICS ALUMNI RECEPTION**

6:00 p.m.–7:15 p.m. **AWM WORKSHOP POSTER PRESENTATIONS AND RECEPTION**

6:00 p.m.–7:00 p.m. ***MATHEMATICAL REVIEWS* RECEPTION**

6:00 p.m.–8:40 p.m. **NATIONAL ASSOCIATION OF MATHEMATICIANS RECEPTION AND BANQUET**

6:30 p.m.–9:00 p.m. **SIGMAA ON BUSINESS, INDUSTRY, AND GOVERNMENT GUEST LECTURE, RECEPTION, AND BUSINESS MEETING**

7:30 p.m.–8:30 p.m. **MAA SPECIAL DRAMATIC PRESENTATION** *Mathematically Bent Theater.*

7:45 p.m.–8:30 p.m. **NAM COX-TALBOT ADDRESS** *Speaker and title to be announced.*

8:00 p.m.–10:00 p.m. **PROJECT NEXT RECEPTION** *All Project NExT Fellows, consultants, and other friends of Project NExT are invited.*

# Saturday, January 18

7:00 a.m.–8:45 a.m. **MAA MINORITY CHAIRS BREAKFAST**

7:30 a.m.–2:00 p.m. **JOINT MEETINGS REGISTRATION**, Pratt Street Lobby, 300 Level, BCC

7:30 a.m.–2:00 p.m. **EMAIL CENTER**

8:00 a.m.–5:00 p.m. **ASL INVITED ADDRESSES AND CONTRIBUTED PAPER SESSIONS**

**AMS SPECIAL SESSIONS**

8:00 a.m.–10:50 a.m. *Geometric Applications of Algebraic Combinatorics, III (AMS-AWM)*
8:00 a.m.–10:50 a.m. *Banach Spaces, Metric Embeddings, and Applications, I*
8:00 a.m.–10:50 a.m. *Dispersive and Geometric Partial Differential Equations, I*
8:00 a.m.–10:50 a.m. *Recent Advances in Homogenization and Model Reduction Methods for Multiscale Phenomena, I*
8:00 a.m.–10:50 a.m. *Set-Valued Optimization and Variational Problems with Applications, I*
8:00 a.m.–10:50 a.m. *Progress in Free Probability, III*
8:00 a.m.–10:50 a.m. *Representation Theory of p-adic Groups and Automorphic Forms, I*
8:00 a.m.–10:50 a.m. *Ergodic Theory and Symbolic Dynamics, II*
8:00 a.m.–10:50 a.m. *Algebraic and Analytic Aspects of Integrable Systems and Painlevé Equations, I*
8:00 a.m.–10:50 a.m. *Trends in Graph Theory, I*
8:00 a.m.–10:50 a.m. *Global Dynamics and Bifurcations of Difference Equations, I*
8:00 a.m.–10:50 a.m. *Deformation Spaces of Geometric Structures on Low-dimensional Manifolds, II*
8:00 a.m.–10:50 a.m. *Categorical Topology, I*
8:00 a.m.–10:50 a.m. *Reaction Diffusion Equations and Applications, I*
8:00 a.m.–10:50 a.m. *Outreach for Mathematically Talented Youth, II*
8:00 a.m.–10:50 a.m. *De Bruijn Sequences and Their Generalizations, I*

**MAA CONTRIBUTED PAPER SESSIONS**

8:00 a.m.–11:00 a.m. *Putting a Theme in a History of Mathematics Course*
8:00 a.m.–11:00 a.m. *USE Math: Undergraduate Sustainability Experiences in the Introductory Mathematics Classroom*
8:00 a.m.–11:00 a.m. *Flipping the Classroom*
8:00 a.m.–11:00 a.m. *Mathematics and Sports*

8:00 a.m.–6:00 p.m. **SIAM MINISYMPOSIUM**

8:00 a.m.–5:50 p.m. **AWM WORKSHOP**

| | |
|---|---|
| 8:00 a.m.–10:55 a.m. | **AMS SESSIONS FOR CONTRIBUTED PAPERS** |
| 8:00 a.m.–11:00 a.m. | **MAA GENERAL CONTRIBUTED PAPER SESSIONS** |
| 8:30 a.m.–9:50 a.m. | **MAA COMMITTEE ON TECHNOLOGIES IN MATHEMATICS EDUCATION-MAA COMMITTEE ON THE UNDERGRADUATE PROGRAM IN MATHEMATICS-WEBSIGMAA PANEL DISCUSSION** *Two worlds collide: MOOCs and the ivory tower.* |
| 9:00 a.m.–9:50 a.m. | **AMS INVITED ADDRESS** *Which Powers of a Holomorphic Function are Integrable?* **Christopher Hacon** |
| 9:00 a.m.–11:00 a.m. | **MAA MINICOURSE: #13: PART B** *Teaching an applied topology course.* |
| 9:00 a.m.–11:00 a.m. | **MAA MINICOURSE #6: PART B** *Historical role-playing in the mathematics classroom.* |
| 9:00 a.m.–11:00 a.m. | **MAA MINICOURSE: #8: PART B** *Directing undergraduate research.* |
| 9:00 a.m.–9:50 a.m. | **NAM PANEL DISCUSSION** *Title to be announced.* |
| 9:00 a.m.–3:00 p.m. | **STUDENT HOSPITALITY/INFORMATION CENTER** |
| 9:00 a.m.–12:00 p.m. | **EXHIBITS AND BOOK SALES** |
| 10:00 a.m.–10:50 a.m. | **NAM BUSINESS MEETING** |
| 10:05 a.m.–10:55 a.m. | **MAA INVITED ADDRESS** *Heron, Newton, Euler, and Barney.* **William Dunham** |
| 11:10 a.m.–11:40 a.m. | **MAA BUSINESS MEETING** |
| 11:45 a.m.–12:15 p.m. | **AMS BUSINESS MEETING** |
| 12:15 p.m.–2:15 p.m. | **MAA COMMITTEE ON COMMITTEES AND COUNCILS** |
| 1:00 p.m.–2:00 p.m. | **NAM CLAYTOR-WOODARD LECTURE** *Speaker and itle to be announced.* |
| | **AMS SPECIAL SESSIONS** |
| 1:00 p.m.–5:50 p.m. | *Banach Spaces, Metric Embeddings, and Applications, II* |
| 1:00 p.m.–5:50 p.m. | *Dispersive and Geometric Partial Differential Equations, II* |
| 1:00 p.m.–5:50 p.m. | *Recent Advances in Homogenization and Model Reduction Methods for Multiscale Phenomena, II* |
| 1:00 p.m.–5:50 p.m. | *Heavy Tailed Probability Distributions and Their Applications, II* |
| 1:00 p.m.–5:50 p.m. | *Set-Valued Optimization and Variational Problems with Applications, II* |
| 1:00 p.m.–5:50 p.m. | *Research in Mathematics by Undergraduates and Students in Post-Baccalaureate Programs, IV* |
| 1:00 p.m.–5:50 p.m. | *Representation Theory of p-adic Groups and Automorphic Forms, II* |
| 1:00 p.m.–5:50 p.m. | *Ergodic Theory and Symbolic Dynamics, III* |
| 1:00 p.m.–5:50 p.m. | *Algebraic and Analytic Aspects of Integrable Systems and Painlevé Equations, II* |
| 1:00 p.m.–5:50 p.m. | *Highlighting Achievements and Contributions of Mathematicians of the African Diaspora, II* |
| 1:00 p.m.–5:50 p.m. | *Trends in Graph Theory, II* |
| 1:00 p.m.–5:50 p.m. | *Global Dynamics and Bifurcations of Difference Equations, II* |
| 1:00 p.m.–5:50 p.m. | *Categorical Topology, II* |
| 1:00 p.m.–5:50 p.m. | *Reaction Diffusion Equations and Applications, II* |
| 1:00 p.m.–5:50 p.m. | *Communication of Mathematics via Interactive Activities* |
| 1:00 p.m.–5:50 p.m. | *De Bruijn Sequences and Their Generalizations, II* |
| 1:00 p.m.–5:50 p.m. | *Quantum Walks, Quantum Computation, and Related Topics, II* |
| | **MAA INVITED PAPER SESSIONS** |
| 1:00 p.m.–5:00 p.m. | *Six Crash Courses on Mapping Class Groups, II* |
| 1:00 p.m.–3:00 p.m. | **MAA MINICOURSE: #10: PART B** *Heavenly mathematics: The forgotten art of spherical trigonometry.* |
| 1:00 p.m.–3:00 p.m. | **MAA MINICOURSE #2: PART B** *CATALST: Introductory statistics using randomization and bootstrap methods.* |
| 1:00 p.m.–3:00 p.m. | **MAA MINICOURSE #5A: PART B** *Using randomization methods to build conceptual understanding of statistical inference.* |
| | **MAA CONTRIBUTED PAPER SESSIONS** |
| 1:00 p.m.–5:00 p.m. | *Reinventing the Calculus Sequence* |
| 1:00 p.m.–5:00 p.m. | *Wavelets in Undergraduate Education* |

| | |
|---|---|
| 1:00 p.m.–5:00 p.m. | *Teaching with Technology: Impact, Evaluation, and Reflection* |
| 1:00 p.m.–5:55 p.m. | **AMS SESSIONS FOR CONTRIBUTED PAPERS** |
| 1:00 p.m.–5:00 p.m. | **MAA GENERAL CONTRIBUTED PAPER SESSIONS** |
| 1:00 p.m.–2:20 p.m. | **MAA COMMITTEE ON THE MATHEMATICAL EDUCATION OF TEACHERS PANEL DISCUSSION** *Mathematicians supporting implementation of the Common Core State Standards for mathematics.* |
| 1:00 p.m.–4:00 p.m. | **PURE AND APPLIED TALKS BY WOMEN MATH WARRIORS PRESENTED BY EDGE (ENHANCING DIVERSITY IN GRADUATE EDUCATION)** |
| 2:00 p.m.–5:00 p.m. | **MAA WORKSHOP** *The environment, mathematics, and community engagement.* |
| | **AMS SPECIAL SESSIONS** |
| 2:30 p.m.–5:50 p.m. | *Deformations Spaces of Geometric Structures on Low-dimensional Manifolds, III* |
| 3:00 p.m.–4:00 p.m. | **MAA-AMS-SIAM GERALD AND JUDITH PORTER PUBLIC LECTURE** *Movie magic: The mathematics behind Hollywood's visual effects.* **Eitan Grinspun** |
| 6:30 p.m.–7:30 p.m. | **AMS DINNER CELEBRATING CONNECTION & COLLABORATION RECEPTION** |
| 7:30 p.m.–10:30 p.m. | **AMS DINNER CELEBRATING CONNECTION & COLLABORATION** |

# 2014 Joint Mathematics Meetings Advance Registration/Housing Form

JOINT MATHEMATICS MEETINGS
BALTIMORE • JAN 15-18, 2014
AMERICAN MATHEMATICAL SOCIETY
MATHEMATICAL ASSOCIATION OF AMERICA

Name _____
(please write name as you would like it to appear on your badge)

Mailing Address _____

_____

Telephone _____ Fax: _____

In case of emergency (for you) at the meeting, call: Day #_____ Evening #:_____

Email Address _____ Additional email address for receipt_____

Acknowledgment of this registration and any hotel reservations will be sent to the email address(s) given here. **Check this box for a copy in U.S. Mail:** ☐

Affiliation for badge _____ Nonmathematician guest badge name: _____
(company/university) (Note fee of US$15)

☐ **I DO NOT want my program and badge to be mailed to me on 12/13/13. (Materials will be mailed to the address listed above unless you check this box.)**

## Registration Fees

**Membership** please ✓ that apply. First row is eligible to register as a JMM member.
☐ AMS ☐ MAA ☐ ASL ☐ CMS ☐ SIAM
☐ ASA ☐ AWM ☐ NAM ☐ YMN

| **Joint Meetings** | **by Dec 24** | **at mtg** | **Subtotal** |
|---|---|---|---|
| ☐ Member AMS, MAA, ASL, CMS, SIAM | US$240 | US$ 315 | |
| ☐ Nonmember | US$374 | US$ 486 | |
| ☐ Graduate Student (Mem. of AMS or MAA) | US$ 53 | US$ 63 | |
| ☐ Graduate Student (Nonmember) | US$ 82 | US$ 93 | |
| ☐ Undergraduate Student | US$ 53 | US$ 63 | |
| ☐ High School Student | US$ 5 | US$ 10 | |
| ☐ Unemployed | US$ 53 | US$ 63 | |
| ☐ Temporarily Employed | US$195 | US$ 224 | |
| ☐ Developing Countries Special Rate | US$ 53 | US$ 63 | |
| ☐ Emeritus Member of AMS or MAA | US$ 53 | US$ 63 | |
| ☐ High School Teacher | US$ 53 | US$ 63 | |
| ☐ Librarian | US$ 53 | US$ 63 | |
| ☐ Press | US$ 0 | US$ 0 | |
| ☐ Nonmathematician Guest | US$ 15 | US$ 15 | |
| | | | $ _____ |

**AMS Short Course:** *Geometry and Topology in Statistical Inference (1/13–1/14)*

| | | | |
|---|---|---|---|
| ☐ Member of AMS or MAA | US$106 | US$ 140 | |
| ☐ Nonmember | US$155 | US$ 185 | |
| ☐ Student, Unemployed, Emeritus | US$ 54 | US$ 75 | |
| | | | $ _____ |

**MAA Short Course:** *Reading, Writing and Doing the History of Mathematics: Learning the Methods of Historical Research (1/13–1/14)*

| | | | |
|---|---|---|---|
| ☐ Member of MAA or AMS | US$ 159 | US$ 169 | |
| ☐ Nonmember | US$ 234 | US$ 244 | |
| ☐ Student, Unemployed, Emeritus | US$ 81 | US$ 91 | |
| | | | $ _____ |

**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$80 for each minicourse.
(For more than 2 minicourses, call or email the MMSB.) $ _____

**Graduate School Fair**
☐ Graduate Program Table US$ 75 US$ 75
(includes table, posterboard & electricity) $ _____

**MAA Workshops**
☐ Introductory Proposal Writing Workshop for Grant Applications to the NSF Div. of Undergraduate Education (1/16) (no charge)
☐ Advanced Proposal Writing Workshop for Grant Applications to the NSF Div. of Undergraduate Education (1/17) (no charge)

**Receptions & Banquets**
☐ Graduate Student/First Time Attendee Reception (1/15) (no charge)
☐ NAM Banquet (1/17) US$ 62 #___Chicken #___Fish
#___Kosher #___Vegan
☐ AMS Dinner (1/18) US$ 62
(Additional fees may apply for Kosher meals.) $ _____

**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. To register for the Employment Center, go to www.ams.org/profession/employment-services/employment-center.*

## Payment

Registration & Event Total (total from column on left) $ _____

Hotel Deposit (only if paying by check) $ _____

**Total Amount To Be Paid** **$** _____

(Note: A US$5 processing fee will be charged for each returned check or invalid credit card. Debit cards cannot be accepted.)

**Method of Payment**

☐ **Check**. Make checks payable to the AMS. Checks drawn on foreign banks must be in equivalent foreign currency at current exchange rates. For all check payments, please keep a copy of this form for your records.

☐ **Credit Card**. All major credit cards accepted. For your security, we do not accept credit card numbers by postal mail, email or fax. If the MMSB receives your registration form by fax or postal mail, it will contact you at the phone number provided on this form. For questions, contact the MMSB at mmsb@ams.org.

Signature: _____

☐ **Purchase Order #**_____ (please enclose copy)

## Other Information

*Mathematical Reviews* field of interest #_____

How did you hear about this meeting? Check one:
☐ Colleague(s) ☐ Internet ☐ *Notices* ☐ *Focus* ☐ Other_____

☐ 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 would like to receive promotions for future JMM meetings.
☐ Please do not include my name on any promotional mailing lists.
☐ Please do not include my name on any list of participants distributed or displayed at any time.
☐ Please ✓ this box if you have a disability requiring special services.

## Mailing Address/Contact:

**Mathematics Meetings Service Bureau (MMSB)**
**P. O. Box 6887**
**Providence, RI 02940-6887** **Fax**: 401-455-4004; **Email:** mmsb@ams.org
**Telephone**: 401-455-4144 or 1-800-321-4267 x4144 or x4137

## Deadlines

| | |
|---|---|
| To be eligible for the complimentary room drawing: | **Nov. 4, 2013** |
| For receiving badges/programs in the mail: | **Nov. 19, 2013** |
| For housing changes/cancellations through MMSB: | **Dec. 13, 2013** |
| For advance registration for the Joint Meetings, short courses, minicourses, and tickets: | **Dec. 24, 2013** |
| For 50% refund on banquets, cancel by: | **Jan. 7, 2014*** |
| For 50% refund on advance registration, minicourses & short courses, cancel by: | **Jan. 10, 2014*** |

***no refunds issued after this date**

# 2014 Joint Mathematics Meetings Hotel Reservations – Baltimore, Maryland

(Please see the hotel page in the announcement or on the web for detailed information on each hotel.) To ensure accurate assignments, please rank hotels in order of preference by writing 1, 2, 3, etc. in the column on the left and by circling the requested bed confirguration. If your requested hotel and room type is no longer available, you will be assigned a room at the next available comparable rate. Please call the MMSB for details on suite configurations, sizes, availability, etc. All reservations, including suite reservations, must be made through the MMSB to receive the JMM rates. Reservations made directly with the hotels before **December 13, 2013** may be changed to a higher rate. All rates are subject to a 15.5% sales/occupancy tax. **Guarantee requirements: First night deposit by check (add to payment on reverse of form) or a credit card guarantee.**

☐ **Deposit enclosed (see front of form**)

☐ **Hold with my credit card**. **For your security, we do not accept credit card numbers by postal mail, email or fax.** If the MMSB receives your registration form by postal mail or fax, we will contact you at the phone number provided on the reverse of this form.

**Date and Time of Arrival** _____ **Date and Time of Departure**_____ **Number of adult guests in room** _____

**Name of Other Adult Room Occupant** _____ **Arrival Date**_____ **Departure Date**_____

**Name of Other Adult Room Occupant** _____ **Arrival Date**_____ **Departure Date** _____

**Name of Other Adult Room Occupant** _____ **Arrival Date**_____ **Departure Date** _____

**Housing Requests:**.(example: rollaway cot, crib, nonsmoking room, low floor) _____

☐ I have disabilities as defined by the ADA that require a sleeping room that is accessible to the physically challenged. My needs are: _____

☐ I am a member of a hotel frequent-travel club and would like to receive appropriate credit. The hotel chain and card number are: _____

☐ I am not reserving a room. I am sharing with_____ , who is making the reservation.

| Order of choice | Hotel | Bed configuration (please circle preference) | Single/Double Rate | Additional Adult (More than 2 adults; Max: 4) | Rollaway Cot Fee (add to special requests) |
|---|---|---|---|---|---|
| | **Hilton Baltimore (htqrs)** | King bed or 2 double beds | US$ 159 | US$ 20 per person | US$ 25.00 (one time) |
| | **Student Rate** | King bed or 2 double beds | US$ 127 | US$ 20 per person | US$ 25.00 (one time) |
| | **Baltimore Marriott Inner Harbor (htqrs)** | King bed or 2 double beds | US$ 149 | US$ 20 per person | No charge |
| | **Student Rate** | King bed or 2 double beds | US$ 115 | US$ 20 per person | No charge |
| | **Sheraton Inner Harbor** | King bed or 2 double beds | US$ 149 | US$ 20 per person | US$ 20.00 (per day) |
| | **Student Rate** | King bed or 2 double beds | US$ 139 | US$ 20 per person | US$ 20.00 (per day) |
| | **Hyatt Regency Baltimore** | King, Queen or 2 double beds | US$ 145 | US$ 25 per person | US$ 25.00 (one time) |
| | **Student Rate** | King, Queen or 2 double beds | US$ 135 | US$ 25 per person | US$ 25.00 (one time) |
| | **Renaissance Baltimore Harborplace** | King, Queen or 2 double beds | US$ 135 | US$ 20 per person | US$ 20.00 (per day) |
| | **Student Rate** | King, Queen or 2 double beds | US$ 115 | US$ 20 per person | US$ 20.00 (per day) |
| | **Baltimore Marriott Waterfront** | King bed or 2 double beds | US$ 135 | US$ 20 per person | No charge |
| | **Student Rate** | King bed or 2 double beds | US$ 115 | US$ 20 per person | No charge |
| | **Royal Sonesta Harbor Court** | King bed or 2 double beds | US$ 125 | US$ 20 per person | US$ 25.00 (per day, king bed room only) |
| | **Student Rate** | King bed or 2 double beds | US$ 99 | US$ 20 per person | US$ 25.00 (per day, king bed room only) |
| | **Days Inn Baltimore Inner Harbor** | King, Queen or 2 double beds | US$ 119 | No charge | US$ 10.00 (per day, king bed room only) |
| | **Student Rate** | King, Queen or 2 double beds | US$ 109 | No charge | US$ 10.00 (per day, king bed room only) |
| | **Holiday Inn Inner Harbor** | King, Queen or 2 double beds | US$ 119 | No charge | US$ 15.00 (per day, king bed room only) |
| | **Student Rate** | King, Queen or 2 double beds | US$ 99 | No charge | US$ 15.00 (per day, king bed room only) |
| | **Hotel Monaco** | King, 2 Queens or 2 double beds | US$ 119 | US$ 20 per person | US$ 25.00 (per day, king bed room only) |
| | **Student Rate** | King, 2 Queens or 2 double beds | US$ 109 | US$ 20 per person | US$ 25.00 (per day, king bed room only) |

**People interested in suites should contact the MMSB directly at mmsb@ams.org or call 800-321-4267, ext. 4137 or 4144 (401-455-4137 or 401-455-4144)**

# Meetings and Conferences of the AMS


**Associate Secretaries of the AMS**

**Central Section**: **Georgia Benkart**, University of Wisconsin-Madison, Department of Mathematics, 480 Lincoln Drive, Madison, WI 53706-1388; e-mail: benkart@math.wisc.edu; telephone: 608-263-4283.

**Eastern Section**: **Steven H. Weintraub**, Department of Mathematics, Lehigh University, Bethlehem, PA 18105-3174; e-mail: steve.weintraub@lehigh.edu; telephone: 610-758-3717.

**Southeastern Section**: **Brian D. Boe,** Department of Mathematics, University of Georgia, 220 D W Brooks Drive, Athens, GA 30602-7403, e-mail: brian@math.uga.edu; telephone: 706-542-2547.

**Western Section: Michel L. Lapidus,** Department of Mathematics, University of California, Surge Bldg., Riverside, CA 92521-0135; e-mail: lapidus@math.ucr.edu; telephone: 951-827-5910.


The Meetings and Conferences section of the *Notices* gives information on all AMS meetings and conferences approved by press time for this issue. Please refer to the page numbers cited in the table of contents on this page for more detailed information on each event. Invited Speakers and Special Sessions are listed as soon as they are approved by the cognizant program committee; the codes listed are needed for electronic abstract submission. For some meetings the list may be incomplete. **Information in this issue may be dated. Up-to-date meeting and conference information can be found at** www.ams.org/meetings/.

## Meetings:



## Important Information Regarding AMS Meetings

Potential organizers, speakers, and hosts should refer to page 274 in the the February 2013 issue of the *Notices* for general information regarding participation in AMS meetings and conferences.

## Abstracts

Speakers should submit abstracts on the easy-to-use interactive Web form. No knowledge of LaTeX is necessary to submit an electronic form, although those who use LaTeX may submit abstracts with such coding, and all math displays and similarly coded material (such as accent marks in text) must be typeset in LaTeX. Visit http://www.ams.org/cgi-bin/abstracts/abstract.pl. Questions about abstracts may be sent to abs-info@ams.org. Close attention should be paid to specified deadlines in this issue. Unfortunately, late abstracts cannot be accommodated.

**Conferences in Cooperation with the AMS:** (see http://www.ams.org/meetings/ for the most up-to-date information on these conferences.)

November 1–3, 2013: Sixth International Conference on Science and Mathematics Education in Developing Countries, Mandalay, Myanmar.

# IBS Center for Geometry and Physics

## Group Leader Positions

*Contact topology, dynamic systems, algebraic geometry*

*Pohang (POSTECH), South Korea*

The IBS Center for Geometry and Physics (IBS-CGP) invites applications for up to 2 Group Leader positions from mathematicians of exceptional research record and leadership in the area of **contact topology**, **dynamical systems**, or **algebraic geometry** (related to GW invariants and homological mirror symmetry).

IBS-CGP is working to bring the world's leading scientists in mathematics together with young researchers to collaborate on research projects with passion and commitment. IBS provides an open and autonomous research environment. The existing members of IBS-CGP are working on symplectic geometry and topology, dynamical systems, mirror symmetry, algebraic geometry, and mathematical aspects of quantum field and string theory.

IBS-CGP offers globally competitive compensation which will be determined based on experience and qualifications of each candidate. IBS-CGP also offers comprehensive benefits including medical and travel insurance, worker's compensation, and retirement fund. More specifics for successful candidates are as follows:

- **Internationally competitive salary** (negotiable).
- **Dual appointment at POSTECH as a tenured or tenure-track faculty member** depending on the candidate's qualifications. (This is subject to review and approval by the Department of Mathematics and the administration of POSTECH. However, POSTECH will respect the recommendations of the IBS-CGP director and the IBS Headquarters as long as the candidate's qualifications meet the POSTECH requirements.)
- Teaching load of one graduate course per year at POSTECH.
- Generous and flexible research grant.
- Can hire 1-2 tenure-track and 3-4 postdoctoral researchers for his/her research group. (Unlike Group Leader, researchers will not be given appointments at POSTECH.)
- Free housing of about 105 $m^2$ in size at the POSTECH Faculty Apartment for 10 years.
- For qualified overseas candidates, relocation expenses and some educational allowance for up to 2 children will be provided.

IBS and POSTECH encourage applications from individuals of diverse backgrounds. Non-Korean citizens are also welcome to apply.

A complete application packet should include:

- ☑ Cover letter
- ☑ Curriculum vitae (including a publication list)
- ☑ Research statement
- ☑ At least 5 letters of recommendation

For full consideration, complete application packets must be submitted electronically to cgp@ibs.re.kr by **February 15, 2014.**

**We are also accepting applications for tenure-track and non-tenure-track research fellow positions.**

For more information, please visit the IBS-CGP Website: http://cgp.ibs.re.kr.

ibs Institute for Basic Science

POSTECH