USAMO Winners Feted
Common Core Matters
New Writing Award
From the Editor

This issue comes on the heels of the centennial celebration at MAA MathFest in Washington, D.C. I found myself coming back from that meeting feeling as if I had just been to an amazing, long, and exciting birthday party—which, of course, I had! Much cake was eaten, and a great time was had by all! This issue of MAA FOCUS continues that celebration with our coverage of those events and of upcoming events at the 2016 Joint Mathematics Meetings in Seattle, Washington.

Any significant anniversary provides a chance not only for merriment, but also for reflection. The centennial celebration allows us to contemplate our history as mathematicians, as an organization, and as individuals. It is also important to look into the next century and evolve. On this anniversary, the team at MAA FOCUS has been considering what we have done well and looking for changes we can make as we move into the next century of the MAA.

As changes are made, MAA FOCUS will keep many favorite columns, including the “President’s Message,” “Dear MAA,” “Puzzle Page,” and “MAA Books Beat.” We will also continue running features of interest to our readers—look for more articles in our series on the Common Core State Standards for Mathematics (the second of which appears in this issue); a series of reports from CRAFTY about teaching across the first two years; and a series on the state of calculus in the United States.

We hope you enjoy the coverage of MAA MathFest in this issue, and note that there is more content online and many more photos to see (look for Mathematical Association of America on flickr.com). We will continue this trend, increasing our social media presence (follow @maanow on Twitter, maa_photo on Instagram, and the Mathematical Association of America on Facebook) to give you more up-to-date information than this bimonthly publication can provide. Also, look online under your member profile for extended versions of articles appearing in this publication—in particular, the interview with Loren Larson is much longer than what we could include in our pages.

As changes are made, MAA FOCUS looks forward to the next century; we will be introducing several columns and features. For example, we’ll be turning the spotlight on SIGMAAs; offering suggestions and ideas for teaching, technology, and recruitment in “Professional Toolkit”; and providing MAA member profiles.

It is a great time to be part of the MAA, and I am thrilled that as editor of MAA FOCUS, I get to be part of that transition to the next century! As always, the team at MAA FOCUS wants to hear from members. We welcome questions for “Dear MAA,” as well as articles about what is happening in your department, your MAA section, and your research area, and your classroom. Please submit these to maafocus@maa.org.

Our strength comes from the interests and diversity of our membership, and I am delighted to have so many MAA members on board for this journey! I look forward to hearing from you.

Jacqueline Jensen-Vallin
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Seattle, Washington, January 6–9
PDF of MAA program: maa.org/maa-focus-supplements
Complete program online: jointmathematicsmeetings.org/jmm

About the Cover

JMM will take place in Seattle, Washington.
Photo courtesy of Tim Thompson/VisitSeattle.org.

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COME FOR THE MATH. STAY FOR THE STORIES.

Visit QuantaMagazine.org for the latest developments in mathematics, theoretical physics and the life sciences.
Spectacular Centennial Draws Record Crowd

On August 6, more than 2,500 mathematicians gathered in Washington, D.C., at MAA MathFest 2015, where we celebrated 100 years of advancing mathematics. This was the largest MAA MathFest ever, and the attendees were greeted by a festive feeling that lasted throughout the conference. If you need evidence of this, check the photos at http://bit.ly/1gZFcoN and notice the number of people smiling!

In addition to participating in MAAs centennial, mathematicians took advantage of all that D.C. has to offer, including trips to the Smithsonian Institute, the Washington Monument, the Lincoln and Jefferson Memorials, Arlington National Cemetery, and Mount Vernon. Most common, however, seem to have been visits to the zoo, just up Connecticut Avenue from the Marriott Wardman Park and the Omni Shoreham, our meeting headquarters. MAA sponsored a Math Walk (photos at http://bit.ly/1IC3ZZz) and a tour of the association’s headquarters. The Association for Women in Mathematics, meeting in conjunction with MAA MathFest, also sent representatives to the U.S. Capitol to discuss the representation of women in STEM fields.

Although some people began their experience on Monday or Tuesday with the Executive Committee or MAA Board of Governor’s meetings, or by participating in the Project NExT workshop for the 80 new Red ’15 or last year’s Gold ’14 fellows, most people started with the first Centennial Lecture, given by Erik Demaine (MIT), “Replicators, Transformers, and Robot Swarms: Science Fiction through Geometric Algorithms.” See page 9 for coverage of his lecture and the five others:

- Jennifer Chayes (Microsoft Research): “Network Science: From the Online World to Cancer Genomics”
- Ingrid Daubechies (Duke University): “Mathematics for Art Investigation”
- Manjul Bhargava (Princeton University): “Recent Results toward the Birch and Swinnerton-Dyer Conjecture”

These lectures complemented the always-amazing slate of invited addresses at MAA MathFest: the
Hedrick Lectures, given this year by Karen Smith; the Chan-Stanek Lecture for Students by Joe Gallian; the AMS-MAA Joint invited address by Jeff Lagarias; the AWM-MAA Falconer Lecture from Erica Walker; the NAM Blackwell Lecture by Terrence Blackman; and the MAA Leitzel Lecture given by David Bressoud. More on many of these events can be found in this issue.

Students were also lauded at this MAA MathFest. In addition to the MAA and PME student talk sessions, and the MAA undergraduate student activity led by Art Benjamin in a packed ballroom, the MAA sponsored an ice cream social (during which awards went to the best undergraduate student talks), and the MAA sponsored a new event: the Radical Dash—an Instagram scavenger hunt for student teams!

MAA kicked off the celebration with the Centennial Reception (with cake and a rousing rendition of “Happy Birthday to Us!” led by President Francis Su) and Mathematical Carnival, featuring Colm Mulcahy’s mathematical card tricks, Jason Rosenhouse’s Monty Hall Interactive Game, Susan Goldstine’s Flexigons, Dominic Klyve’s juggling and math, and Karl Schaffer’s string polyhedral. Artistic events each evening continued the celebration—Cirque de Mathematique on Wednesday evening, Mathematicians by Day, Musicians by Night on Thursday, and Albert’s Bridge on Friday. MAA also served up cake for the formation of MAA Press, which unites the magazines, journals, and books published by the association.

People got a chance to look back, with two sessions of “Presidential Reminiscences” and the AWM-sponsored “Contributions of Women to Mathematics: 100 Years and Counting” (among others), and look forward in the Project NExT Lecture “Reducing Stereotype Threat in the Mathematics Classroom.” There were 10 sessions about the history and philosophy of mathematics, and a panel on “Finding Your New Niche: Staying Fresh.” Our annual event concluded with the traditional banquet, at which 25-year and 50-year members were honored.

This MAA MathFest gave us a chance to honor where we’ve been, personally and professionally, individually, and as an organization; and provided us with enthusiasm, excitement, and knowledge to keep going. We hope you’ll join us for the Centennial+1 celebration next summer in Columbus, Ohio, back where it all began. 🎂

—Jacqueline Jensen-Vallin

Left: About 320 people presented talks in the contributed paper sessions. Top right: Discussing the movie about Ramanujan were Manjul Bhargava, Robert Kanigel (biographer), Matthew Brown (director), and Ken Ono (consultant on the film). Bottom right: The MAA Players helped bring MAA MathFest to a rousing conclusion.
By the Numbers

2,501
People attending (including 610 students—118 grad students, 464 undergrads, and 28 high school students)

People seen knitting/embroidering/crocheting during a session: 5
Percentage of people who responded to the postconference survey: 20
Percentage of people who gave a positive rating to the conference: 99
Centennial T-shirts sold: 110
Math-minded people wearing white stocks with sandals: 289*
People sporting beards: 289*

*Figure constitutes a wild estimate and may have no connection with reality.

Small boys in matching orange shirts dancing in the aisle to celebrate their mom Talithia Williams’s teaching award:

80
New Project Next Fellows
See list of Red’15 cohort online (maa.org/maa-focus-Supplements).

2
Putnam fellows who spoke

3
Speakers who are members of the National Academy of Sciences

39
Exhibitor booths

1
Fields medalists who spoke (Manjul Bhargava, right)

2
Speakers who had previously given Hedrick Lectures

98
Age of Richard Guy, oldest speaker (he turned 99 in September)

1,000,000*
Times that people asked why there was no coffee

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Overheard at MAA MathFest

“There are no current problems in biology that will be solved without the use of mathematics.”
–Carlos Castillo-Chavez

“I had to ruthlessly cut slides here in order to make this part of the talk incomprehensible.”
–Jeff Lagarias

“There are three kinds of mathematicians. Those who can count, and those who can’t.”
–James Tanton

“We want to have people with more problems.”
–Ingrid Daubechies

“There are two theories about Saturn’s rings: They have been there a long time. And, they haven’t.”
–Jeff Lagarias

“Powerful afternoon. ‘Life is mathematics. Mathematics is Life.’”
–J. Staley on Twitter during session honoring Abdulalim Shabazz

“It’s super! That’s all I can think to say about it, over and over! Super!”
–Exhibit hall attendee looking at Torroid, a Möbius band in red oak and maple by Peter Sittner, one of the entries on display in the Bridges art exhibit.

“Left #MAAthFest all charged up, which is good because I’ve also left with a reading and to-do list as long as my arm.”
–Sara Malec on Twitter

“This is the most fun I’ve had at a conference, and I’ve been to a lot of conferences!”
–on Twitter

“Always read your axes!”
–Victor Piercey on Twitter

MAA provided a centennial backdrop for people to pose in front of. See more on Flickr.com (“MAA MathFest 2015”).

Below: Mathematicians by Day, Musicians by Night showcased the instrumental and vocal talents of many MAA members. The choir was conducted by Matthew DeLong.
Centennial Lectures: Echoes

By Katharine Merow

In choosing Centennial Lecturers to speak at MAA MathFest, the Planning Committee focused on the criteria central to the MAA’s identity and raison d’être: interesting mathematics and masterful exposition.

“We made a serious effort to represent the diversity of the MAA’s membership and our members’ wide-ranging mathematical interests,” said committee cochair Steve Kennedy. Kennedy added that he could not have been happier with how the six lectures played out.

Replicators, Transformers, and Robot Swarms: Science Fiction through Geometric Algorithms


“Join me in the quest of making all science fiction come true,” Demaine invited his MAA MathFest audience. “What could go wrong?”

Network Science: From the Online World to Cancer Genomics

Large-scale networks—technological, social, economic, and biological—are everywhere, Microsoft Research’s Jennifer Chayes reminded her MAA MathFest audience. Analysis of these networks relies on graph theory, combinatorics, probability, and game theory.

Chayes and her colleagues, for instance, have used a formulation of the Steiner tree problem (http://bit.ly/1WoVHeV)—combined with an algorithm that can solve such problems quickly—to reconstruct gene regulatory networks. Problems with these networks, which govern gene expression levels of mRNA and proteins, are linked to many diseases.

MIT’s Fraenkel Lab used Chayes’s Steiner tree techniques, initially deployed on reconstruction of a yeast pheromone response pathway, to identify a previously unknown participant in the pathway for the brain cancer glioblastoma multiforme (GBM): the estrogen receptor. This result not only established the first link between GBM and gender, but also suggested a possible drug therapy.

Using mathematics to advance medicine is gratifying, of course, and not just for the obvious reasons. “You don’t want to tell your mother you’re working on yeast,” Chayes quipped.

Erik Demaine, Jennifer Chayes
Mathematicians Helping Art Historians and Art Conservators

If you’re near Raleigh, North Carolina, in the fall of 2016, you’ll want to pay the North Carolina Museum of Art (NCMA) a visit. There you’ll find an illustration of just how much, to quote the refrain of the Centennial Lecture by Ingrid Daubechies (Duke University), “mathematics can help.”

Help art historians and art conservators, that is.

The NCMA exhibition will feature an altarpiece by Italian painter Francescussio Ghissi, its eight extant panels—many on loan from other museums—reassembled and the lone missing one re-created by artist Charlotte Caspers.

Although the panel Caspers meticulously painted, gilded, and embossed initially stood out from the others, it no longer outshines its 14th-century neighbors. That’s thanks to work Daubechies did—studying crack patterns and pigment fading and darkening—to virtually age it.

“But then I also realized,” Daubechies said at MathFest, “that, with this information, we can also virtually rejuvenate old panels.”

The NCMA exhibition will include a slideshow of virtually rejuvenated paintings along with snippets of video explaining the processes by which mathematics can restore artwork to its original glory.

Role and Function of Mathematical Models in Interdisciplinary Mentorship through Research: Lessons from the World of Epidemics

When, in the early days of the recent West African Ebola outbreak, projections put the number of cases by the end of September 2014 in the millions, a paper (http://bit.ly/YbsSrQ) by Sherry Towers, Oscar Patterson-Lomba, and MAA MathFest speaker Carlos Castillo-Chavez (Arizona State University) predicted 6,800. The actual infections by that date? 7,000.

In his Centennial Lecture, Castillo-Chavez cited results in mathematical epidemiology to argue for the effectiveness of interdisciplinary research in finding solutions to societal ills.

Castillo-Chavez credited much of the work he surveyed to affiliates of the Mathematical and Theoretical Biology Institute (https://mtbi.asu.edu/), which aims to provide support and research-based education to populations underrepresented in the mathematical sciences.

In a project completed mere days before MAA MathFest, Castillo-Chavez and his collaborators modeled a “hypothetical Ebola situation” to investigate the effectiveness of restricting movement into and out of an infected area. The verdict?

“As you allow people to move, you reduce the number of cases of Ebola,” Castillo-Chavez said. “Cordoning these areas is really a way of making epidemics worse, and in fact allowing the movement of people to places where they could get isolated and treated would be beneficial for the overall community.”

“We Are Evidently on the Verge of Important Steps Forward”: The American Mathematical Community, 1915–1950

In a Centennial Lecture that was also the CSHPM Kenneth O. May Lecture, Karen Parshall (University of Virginia) explored the changes in the mathematical landscape that gave mathematicians in mid-20th-century
America the sense that, since the time of the MAA’s founding in 1915, the balance of mathematical power had shifted from Europe to the United States.

Parshall covered efforts in the 1920s to get the National Research Council and the Rockefeller Foundation to fund mathematical research, the initiative in the early 1930s that resulted in the establishment of the Institute for Advanced Study, and the exodus of mathematicians from Europe in the 1930s and 1940s.

Parshall quoted from the congratulatory letter then-president Franklin Delano Roosevelt sent on the occasion of the AMS’s semi-centennial celebration in 1938.

“It is sometimes difficult to comprehend the values accruing to society from mathematics,” FDR wrote.

Yet it is deeply rooted in social progress as a large part of the technological advance made in recent centuries would have been impossible had it not been for the constant refinement of the essential tool of technology, mathematics. Social scientists also owe a large debt to mathematics. Future advances in the social sciences will be largely dependent on mathematical treatment of their data.

Roosevelt’s letter must have been gratifying, Parshall said, since it “reflected a level of awareness that American mathematicians had been trying to achieve since at least the 1920s.”

Recent Results toward the Birch and Swinnerton-Dyer Conjecture

Unlike many of the Clay Millennium Problems (http://bit.ly/1N85kJ), Manjul Bhargava (Princeton University) told his MAA MathFest audience, the Birch and Swinnerton-Dyer conjecture “is fairly explainable in an hour.”

The Birch and Swinnerton-Dyer conjecture involves finding rational solutions to polynomial equations, and Bhargava methodically laid out the mathematics needed to understand the yet-unproven statement. He began with the rational root theorem familiar from high school, walked through the location of rational points on the unit circle, introduced elliptic curves and the group law on them, defined the notion of rank, and marveled at the computer code Birch and Swinnerton-Dyer wrote to perform the computations that led them to formulate their now-famous conjecture.

Working with a paltry 4K of memory, Bhargava said, the researchers were compelled to devise an algorithm so clever that it gave future mathematicians insight into related problems.

“We don’t have that phenomenon as much anymore, that theory gets inspired by an algorithm,” Bhargava said. “But at that time the algorithms had to be so clever because they had to fit in such a tiny amount of memory. Now we have so much memory that we don’t even try to optimize it.”

Katharine Merow is a freelance writer and editor in Washington, D.C.

Karen Parshall, Manjul Bhargava
Top, left: David Kung, on violin, spearheaded the Thursday evening concert. Right: Jennifer Galovich, one of the MAA Players.
Middle, left: This year’s new Project NExT cohort. Right: The popular student center in the exhibit hall offered games and freebies.
Below, left: Sessions and performances drew varied crowds. Right: Noam Elkies (three-time Putnam winner) demonstrating a rhythm.
Woven through this year’s summer conference was a concern for fostering diversity and equity. In addition to panels and paper sessions, two of the invited addresses explored these themes.

“So often young people decide early on they are not math people,” said Erica Walker, addressing a crowded ballroom. National data show that young people’s attitudes toward math become less positive the longer they are in school, which affects their aspirations of becoming math majors in college, she said.

Many of those in the audience—professors, instructors, and students—were familiar with the struggle to draw more people into mathematics. As the 21st Etta Z. Falconer Lecturer, Walker focused on two key concepts she has explored in relation to mathematical learning: multiplicity (or identity) and mathematical spaces.

A Math Identity

Frequently, young people shy away from a mathematical identity because they believe that a “math person” must act a certain way or that understanding mathematics must come naturally to them, Walker explained. But having a range of mathematical role models, or showing “multiplicity” (someone with many identities, including mathematics), can challenge this belief.

Walker pointed to the example of Baltimore Ravens football player John Urschel, a 24-year-old with bachelor’s and master’s degrees in mathematics from Pennsylvania State University. As a national athlete and mathematician, Urschel’s identities upend the common narrative about a singular math identity, said Walker.

Where mathematical identity is cultivated is important too, she said. Many people believe that mathematics happens only in the classroom, but during her research, Walker found that mathematicians describe learning math outside the classroom: at home, at work, and at play. She said, “I define mathematical spaces as sites where mathematical knowledge is shared and disseminated—a site for a relationship to contribute to the development for a mathematical identity.”

These can be physical or online spaces, but a mathematical space must create an opportunity for people to see themselves as mathematical doers, said Walker. One example is after-school tutoring programs for high school students, where high-achieving students help other students. The primary focus is to create experiences that are affirming and positive, but also challenging, she said.

Reaching Goals

Once someone develops a mathematical identity and chooses to pursue higher education, challenges persist—especially for students of color, who face a dearth of role models. The NAM (National Association of Mathematicians) David Harold Blackwell Lecturer, Terrence Blackman, discussed challenges in mathematical equity and suggested how the community can change it.

Blackman pointed out that in 2011, only 21 African Americans received PhDs in mathematics. “I use doctorates because it is the tip of the pyramid,” said Blackman, assistant professor of mathematics at the University of Denver. To earn a
PhD, there are many, many stages that must be accomplished.

What would be necessary for the number of African Americans receiving PhDs to reflect the population? “If we are genuinely serious about the challenge about creating and nurturing more African American mathematicians, then our aim has got to be to create and sustain local, research-driven mathematical communities that are oriented to the challenge within those communities,” he said.

It is easier to expend on structures already in place, and emulate those, rather than devise a new system, Blackman said. Successful mathematical communities for minorities do exist, such as at historically black colleges and universities. For example, most African American mathematicians with a PhD have a connection to Howard University (in Washington, D.C.), one such school, Blackman pointed out.

He also focused on increasing research and publishing opportunities for African American students to increase engagement and equity. “What you also need,” he said, “is to effectively integrate the available technological tools, artistic tools, literary tools, and available cultural tools as a means of enhancing the overall cultural engagement.”

The future of mathematics relies on growing these tools and community because we need more mathematical talent and more diverse mathematicians, Blackman said. “Losing people from mathematics because we don’t have the right structures, or because they don’t fit in, results in less diversity of mathematical thought.”

—Alexandra Branscombe

See William Yslas Vélez’s article in the June/July issue on suggestions for encouraging underrepresented and first-generation college students in mathematics. Log in to your member profile on maa.org to access the issue.
A Math Dash: Student Activities

Just like professional mathematicians, undergraduate students are inspired by different kinds of mathematics. That is the challenge for the MAA Committee on Undergraduate Student Activities and Chapters (CUSAC): to engage students with a range of interests at MAA MathFest. Here are just a few of the ways undergraduate students participated at the centennial celebration.

The Speedsters
Students who love solving computational mathematics quickly and under pressure participated in the Student Problem Solving Competition. Nineteen students had an hour to solve seven problems without a calculator; further, each problem had to be solved in order—no skipping around.

Richard Neal, creator of the competition, has been running it since 1997. A former college athlete, Neal wanted to design a national championship for star mathletes who enjoy performing in a stressful situation, similar to competition sports. Students qualify for the competition by completing Neal’s preliminary problems during the school year, then submitting them through their college or university math department.

“It is very different from what we normally do, [such as] proof-based problems. These are computational and I like computational problems,” says Yijin Wei, a student from Smith College, who placed second in the event. In her second year of competing, Wei solved all seven problems, finishing just behind the first-place winner, Ian Cavey from Boise State University. “I enjoy the process a lot, so I don’t feel too much pressure in this setting,” she says.

The Challenge Seekers
Throughout the conference, a rather different competition was taking place. The Radical Dash is a “mathematical Instagram scavenger hunt,” says Jennifer Bergner, a math professor from Salisbury University who designed the event. “I want students to actually ‘dash’; there needs to be a physical aspect to it.”

On each day of the conference, students solved clues, cracked codes, and completed math problems posted by the Radical Dash organizers on the social media site Instagram (@mathfestdash).

Working in teams of three to five people, 110 students solved the multistage clues to reveal a series of locations throughout the conference venue. Then they posted pictures of themselves at each location on Instagram to prove they had solved the puzzles and earned their points.

The Dash also included daily group activities, such as a mathematical art project with the Bridges Organization and a book embedding problem with Robin Blankenship (Morehead State University). Throughout the event, students could receive points for creativity, such as writing a song or poem to go with their mathematical answer.

“Math students are challenge seekers,” says Bergner, but not everyone likes to perform alone under high pressure. So she decided to “create something that is very open, that invites all undergraduate students to participate and feel comfortable doing mathematics.” She wants it to be a way of building community—and this summer in the premiere of the Radical Dash, she saw that goal realized. Even though teams competed against each other for total points, students in the Radical Dash could be found helping other teams complete clues or solve the math problems. Garret Jones, a student at Slippery Rock, said, “Even though we are all in a competition, we are still all here to do math, and if we can help each other do more math, then in the end, it is a win.”

Several teams received prizes, including Judges’ Choice and People’s Choice, at the awards ceremony. The overall winner, with an almost-perfect score for every challenge, was the Disney Dashers team (Lisa Mueller, Stina Nyhus, Muhammad El Gebali, and Theresa Marlin), who won MAA T-shirts and books.

Now that the Radical Dash organizers have a successful template, says Bergner, it will be easier to implement at upcoming meetings, including the 2016 Joint Mathematics Meetings in Seattle.

The Researchers
Under a different kind of pressure were the 181 students involved in 134 presentations during the
A Round of Applause for Mathematical Theater

To cast a play on the first day of a conference and then perform it three days later—anything could happen, says Steve Abbott, who did just that. Despite the logistical challenges, Abbott pulled together a cast and crew of 14 accomplished mathematicians to put on the mathematical and philosophical play *Albert’s Bridge* by Tom Stoppard for hundreds of their professional peers at MAA MathFest.

“[The play] is very tailored for a mathematical audience in an accurate way,” says Frank Morgan, a mathematics professor at Williams College.

The play follows a philosophy graduate student named Albert who gets a job painting a large bridge above his hometown. An algebraic angle appears early in the show: it takes Albert and three other painters two years to paint the entire bridge; once they are finished, they return to the beginning of the bridge to paint for another two years.

To save money, the city switches to a paint that lasts eight years, needing only one painter—Albert. But a problem arises when Albert is only a quarter of the way through his eight-year job. After two years, the rest of the bridge has fallen into disrepair and looks horrendous.

“It was actually a logical mathematical flaw in the [play’s] argument,” says Morgan, who played Fitch, the economic consultant for the bridge subcommittee. “Everyone forgets about the gap between switching paints—I have told mathematicians about the play’s argument and they don’t catch the mistake right away.”

As the play’s director, Abbott, a mathematics professor at Middlebury College, catered to his audience with some inside jokes. For example, when Fitch is trying to convince Dad (Joe Gallian, University of Minnesota–Duluth) to stay on as the solitary bridge painter, Abbott added a line so the character would say, “C’mon, just say yes!” to Gallian.

“Anyone who knows Joe Gallian knows that ‘Just say yes’ is his tagline for the Project NExT fellowship,” Abbott explains. “I really wanted [Gallian] to play the part as the painter because I really wanted to play that joke. I wanted to play into the fact that these are not actors, they are people from the community.”

Abbot posted another Easter egg in the midst of the images displayed on the projector screens flanking the stage. “And here we are at a conference, so we thought—why don’t we use actual slides from a talk?” he says. This led to placing a slide from Richard Guy’s invited talk into one of the scenes.

Choosing a Tom Stoppard play wasn’t just about mathematics, says Abbott, but also the philosophy and physics all stewed together to create a powerful script. That is typical of Stoppard, says Abbott, to not view these different fields as separate parts of our humanity, but to see everything we do as a single intellectual experience.

—Alexandra Branscombe

**Student Activities, con’t. from p. 15**

MAA undergraduate student paper sessions. All the presenters were celebrated at the student ice cream social on the conference’s final day.

At the social, several student presentations related to particular topics were singled out for special awards: Paul Diaz and Eric Jones (both from Colorado School of Mines) received the Anderson Prize for work in areas related to mathematical biology; Becky Chen (University of Richmond) received the Environmental Mathematics SIGMAA Award; and Kinardi Isnata (Duquesne University) was awarded the Society of Industrial and Applied Mathematics (SIAM) Award.

Twenty-four MAA Outstanding Presentation Awards went to students who gave particularly impressive presentations in any area of mathematics. The winners can be found on the association website: http://bit.ly/1NPVcrL.

—Alexandra Branscombe
Report of the MAA Secretary

By Barbara Faires

AA MathFest 2015 was indeed a celebration of the association’s centennial! I hope you were one of the more than 2,500 who enjoyed the great talks and wonderful evening events at this Washington, D.C., meeting. The list of those who made this meeting such a huge success is long and includes planners, organizers, speakers, entertainers, and most of all, the two who led the charge—Deanna Haunsperger and Stephen Kennedy, cochairs of the Centennial Planning Committee. Thank you!

New Governors

The MAA Board of Governors met on August 4 before the four-day meeting opened, and, as is the norm, we welcomed new governors. Governors with terms that began February 1, 2015, are governors-at-large Elizabeth Burroughs (Montana State) for teacher education and Lloyd Douglas for business, industry, and government; chair of the Committee on Sections, Betty Mayfield (Hood College); and chair of the Council on Publications and Communications, Jennifer Quinn (University of Washington Tacoma). New section governors with three-year terms ending June 30, 2018, are as follows:

<table>
<thead>
<tr>
<th>New Section Governors</th>
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<tbody>
<tr>
<td>Seaway</td>
<td>Jim Conklin, Ithaca College</td>
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<td>Ohio</td>
<td>Bill Higgins, Wittenberg University</td>
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<td>Southeastern</td>
<td>Charlotte Knotts-Zides, Wofford College</td>
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<td>Northeastern</td>
<td>Jason Molitierno, Sacred Heart University</td>
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<td>New Jersey</td>
<td>Hieu Nguyen, Rowan University</td>
</tr>
<tr>
<td>Pacific Northwest</td>
<td>Jennifer Firkins Nordstrom, Linfield College</td>
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<tr>
<td>Missouri</td>
<td>Mary Shepherd, Northwest Missouri State University</td>
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Governance Structure

This board meeting included good discussions on two important topics: governance structure and membership. The Task Force on Governance, chaired by Jennifer Quinn, submitted its final report and asked governors to consider proposed governance models, with the understanding that these will be revised based on the discussion. Other members of the governance task force are Rick Gillman, Karen Saxe, Michael Pearson, and James Epperson.

The membership discussion in the afternoon of the board meeting was enriched by research and analysis that President Francis Su included in his report to the board. He shared information from a 2013 Project NExT survey as well as from his data collection and analysis of MAA membership at 61 colleges and universities. Both membership and governance will be on the JMM 2016 board agenda.

Prizes and Lecturers

The board approved prizes and awards that will be given at the AMS-MAA Joint Prize Session on January 7, 2016, as well as various lecturers. Dusa McDuff (Barnard College, Columbia University) has been selected as the 2017 Hedrick Lecturer for MAA MathFest in Chicago; the 2016 Hedrick Lecturer is Hendrik Lenstra (Leiden University). Annalisa Crannell (Franklin & Marshall College) was approved as the Leitzel Lecturer for MAA MathFest 2016 in Columbus. The board approved the MAA Executive Committee’s recommendation that Susan Colley (Oberlin College) be the next editor of the American Mathematical Monthly; Susan becomes editor-elect on January 1, 2016, with her five-year term as editor beginning a year later.

Each year the board elects one of its members to serve on the Audit Committee; Mary Shepherd (Northwest Missouri State) was elected to a two-year term. The board elected governors-at-large to three-year terms:

Past, present, and future MAA presidents: Henry Pollak, Thomas Branschoff, Anne Watkins, Ron Graham, Ken Ross, David Bressoud, Joe Gallian, Carl Cowen, Francis Su, Paul Zorn, Deanna Haunsperger, and Bob Devaney.
Talitha Washington (Howard University) for minority interests and Gary MacGillivray (University of Victoria) for Canadian membership, as well as council chairs for four-year terms—Jenna Carpenter (Campbell University) as chair of the Council on the Profession, and Elgin Johnston (Iowa State University) as chair of the Council on Outreach. These terms begin February 1, 2016.

The Audit Committee, chaired by Al Hibbard (Central College) reported that the 2014 audit continues an ongoing record of the MAA having “gold standard” audit reviews. Treasurer Jim Daniel reported the MAA to be financially healthy in terms of total net assets. Although the board approved another deficit budget, it was noted that the size of the deficit has been decreasing in recent years. The board approved section bylaws for the following sections: Rocky Mountain, Ohio, and North Central.

The board approves electronically each year many of the prizes and awards as recommended by the various committees. This year board members also approved a new MAA award, the Daniel Solow Author’s Award (see article in the August/September issue of MAA FOCUS), to be given first at MAA MathFest 2016. The primary criterion for selection of an author or authors for the Solow Award will be their material’s impact on undergraduate education in mathematics and/or the mathematical sciences. Nominations for this award are due to me (secretary@maa.org) by October 15. MAA has wonderful programs, including our awards; these are made possible by the work of many volunteers. Thank you to all!

MAA Section Meetings

**INDIANA**
October 17, Purdue North Central, Valparaiso, IN

**IOWA**
October 2-3, Graceland University, Lamoni, IA

**NORTH CENTRAL**
October 23-24, Bemidji State University, Bemidji, MN

**OHIO**
October 23-24, Capital University, Bexley, OH

Sections were encouraged to celebrate the association’s 100th birthday. Shown here: Members doing just that in Texas.
MAA Awards and Prizes Given

**Carl B. Allendoerfer Awards**
Made to authors of articles of expository excellence published in Mathematics Magazine.

**Daniel Heath (Pacific Lutheran University)**

**Citation Excerpt:** “An essential charm of the paper lies in the clear organization, the engaging writing style, and the broad array of mathematical methods and areas employed. . . . This fine paper invites multiple readings.”

**Andrew Beveridge (Macalaster College) and Stan Wagon (Retired)**

**Citation Excerpt:** “Each year, at Harry Potter’s school, Hogwarts, the incoming students are split equally among the houses and apportioned evenly by gender. This serves as an introduction to the analogous problem, very real in many colleges and universities, of matching incoming students with first-year seminars. . . . Beveridge and Wagon recognize it as a constrained optimization problem, and in this paper they show how they solved it with mathematics.”

**Trevor Evans Award**
Made to authors of expository articles accessible to undergraduates and published in Math Horizons.

**Heidi Hulsizer (Hampton-Sydney College)**

**Citation Excerpt:** “Familiar linear algebra results work a bit differently when modular arithmetic is involved, but that is exactly what is needed to solve the dial turning challenge in an add-on to the video game Call of Duty: Black Ops. . . . By the end we can feel satisfaction in both what we have learned about random walks and on the recovery of the author’s cat.”

**Allison Henrich (Seattle University) and Louis H. Kauffman (University of Illinois at Chicago)**

**Citation Excerpt:** “Unknots can appear complicated; in particular, a given unknot diagram may not have any simplifying Reidemeister moves. The authors show an example, without simplifying moves, where the application of Reidemeister moves to make a larger diagram allows the reduction of that larger diagram to the trivial knot. . . . The authors introduce arc-presentations and Morse form with lucid examples, then deftly obtain explicit bounds on the number of Reidemeister moves and the size of the larger diagram needed. . . . These authors have written an enjoyable article that invites significant discussion.”

**Paul R. Halmos–Lester R. Ford Awards**
Recognize authors of articles of expository excellence published in the American Mathematical Monthly.

**Mario Ponce (Catholic University of Chile) and Patricio Santibanez (Instituto Alonso de Ercilla in Santiago de Chile)**

**Citation Excerpt:** “Classical conics have long been studied from diverse perspectives, for instance, as the curves of intersection of a cone and a plane or as the level sets of 2nd order polynomials. This article develops a quite different perspective by treating a conic as the set of points equidistant from two given circles. . . . The authors rigorously develop the technical mathematical ideas while also building the reader’s intuition of the underlying notions.”

**Daniel Velleman (Amherst College)**

**Citation Excerpt:** “Random walks appear in a variety of applications, from economics to physics. This paper further motivates us to learn about this important topic by using the very concrete example that arose when the author’s ill cat required medicine with a dose of half a pill a day. . . . By the end we can feel satisfaction in both what we have learned about random walks and on the recovery of the author’s cat.”

**Erwan Brugallé (École Polytechnique) and Kristin Shaw (Postdoctoral Fellow)**
“A Bit of Tropical Geometry,” American Mathematical Monthly
Citation Excerpt: “This lovely and, as the authors explain in their abstract, ‘friendly introduction to tropical geometry’ does a wonderful job of motivating and explaining this relatively new area of mathematics. . . . Tropical geometry is clearly a fascinating area of mathematics that is full of deep and very compelling problems and this article provides an alluring pathway into the field.”

Merten M. Hasse Prize
Designed to be an encouragement to younger mathematicians to take up the challenge of exposition and communication.

Charles Doran (University of Alberta) and Ursula Whitcher (University of Wisconsin-Eau Claire)
“From Polygons to String Theory,” Mathematics Magazine 85, no. 5 (December 2012): 343–360
Citation Excerpt: “This paper gives a fresh and inviting treatment of the daunting topic of mirror symmetry.”

George Pólya Awards
Made to authors of articles of expository excellence published in the College Mathematics Journal.

Michael Brilleslyper (U.S. Air Force Academy) and Lisbeth Schaubroeck (U.S. Air Force Academy)
Citation Excerpt: “This article is intriguing and very accessible. It will ignite the imaginations of readers and inspire them to investigate variations of this classical family of problems.”

David Joyner (U.S. Naval Academy)
Citation Excerpt: “David Joyner splendidly recounts the tale of two problems—and the tale of two triumphs. Hearing loss and God’s number. . . . Tom and his colleagues determined that God’s number in the face-turn metric is 20.”

Henry L. Alder Awards
for Distinguished Teaching by a Beginning College or University Mathematics Faculty Member
To honor beginning college or university faculty whose teaching has been extraordinarily successful and whose effectiveness in teaching undergraduate mathematics is shown to have influence beyond their own classrooms.

Allison Henrich (Seattle University)
Patrick Rault (State University of New York at Geneseo)
Talithia Williams (Harvey Mudd College)

Mary P. Dolciani Award
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.

Sybilla Beckmann
Citation Excerpt: “Given in recognition of her unique career as a mathematician whose contributions to mathematics education, particularly in the elementary grades, have been extensive and groundbreaking.” 📚
Presented by IAS/PCMI and the AMS:

The Teacher Program Series

This series presents materials from the IAS/PCMI Secondary School Teachers Program, an annual professional development program for teachers specializing in mathematics teaching for grades 3-12. Books in the series are designed to facilitate the SSTP program's goal of improving teacher knowledge via a problem-based approach to learning. Each volume includes a chapter on math concepts, a problem set, and facilitator notes, including solutions and practical tips for running a teacher training session. The series is invaluable for mathematics teacher training programs and for the continuing education of teachers already in practice.

Titles in this series are co-published with the Institute for Advanced Study/Park City Mathematics Institute. Members of the Mathematical Association of America (MAA) and the National Council of Teachers of Mathematics (NCTM) receive a 20% discount from list price.

www.ams.org/bookstore/sstpseries
Core Info about the Common Core for Mathematics

By Katharine Merow

This is the second installment in a series of articles about the Common Core State Standards for Mathematics. Read the first story in the August/September issue, available online through your member profile page.

Why
The Common Core State Standards owe their existence to the perception that the American education system must improve for the United States to stay competitive on the world stage.

In 2008, the National Governors Association (NGA), the Council of Chief State School Officers (CCSSO), and the nonprofit education reform organization Achieve published a report called “Benchmarking for Success: Ensuring U.S. Students Receive a World-Class Education” (http://bit.ly/1dxxNs4). The report outlined five steps, the first of which urged states to “upgrade state standards by adopting a common core of internationally benchmarked standards in math and language arts for grades K-12 to ensure that students are equipped with the necessary knowledge and skills to be globally competitive.”

Stark differences existed, the report warned, between the math and science standards of top-performing nations and those adopted by most U.S. states. The report cited Michigan State University researcher Bill Schmidt’s assessment that most state standards lacked the focus, rigor, and coherence that characterize world-class standards.

State standards needed an upgrade, the reasoning went, and a collaborative effort could bring a host of benefits: It would be easier for students to transfer between schools in different states. Development of textbooks and assessments could be streamlined. Student performance could be more meaningfully compared from state to state.

Who and How
Development of the Common Core standards took place in two phases.

First, a team managed by the NGA and CCSSO and drawing members from the College Board, Achieve, and the nonprofit testing company ACT produced a document titled “College and Career Readiness Standards for Mathematics” (http://bit.ly/1LDvnZf).

Then a team made up of mathematicians, math education researchers, teachers, and representatives of state departments of education (http://bit.ly/1MotWQc) worked backward from the college and career readiness standards to craft K-12 standards outlining grade-level expectations for elementary through high school.

The three lead writers of the Common Core Standards for Mathematics were William McCallum, chair of the University of Arizona mathematics department; Jason Zimba, who had worked with evaluating state assessments (http://n.pr/1Ns046l); and former high school algebra teacher Phil Daro, who was a senior fellow at America’s Choice, a curriculum and teacher-training company.

Drafts of the college and career readiness standards and K-12 standards were released for public review, and the NGA and CCSSO received more than 10,000 comments from teachers, parents, school administrators, and other concerned citizens. For more insight into the role of feedback groups and validation committees in building the standards, see the detailed timeline on the Common Core website (http://bit.ly/1fMJOHG).

The Bill and Melinda Gates Foundation, which sees development and adoption of the Common Core as aligned with its goal of ensuring that all U.S. students can receive a high-quality education, has contributed upwards of $170 million to the effort.

What
Opponents and boosters alike encourage interested people to read the Common Core State Standards for Mathematics for themselves. Here’s what to expect.

The Standards for Mathematical Content make up the bulk of the document (http://bit.ly/QWH70y), but these grade-level expectations are preceded by the Standards for Mathematical Practice. These eight standards, which include directives such as “reason abstractly and quantitatively” and “attend to precision,” describe “ways in which developing student practitioners of the discipline of mathematics increasingly ought to engage with the subject matter as they grow in mathematical maturity and expertise throughout the elementary, middle and high school years.”

The subsequent content standards are divided, for each grade, into groups of related standards called domains.
Domains, which span multiple grade levels, include Operations and Algebraic Thinking, the Number System, and Probability and Statistics. Introductory texts specify priorities for each grade level.

Such priorities are part of the Common Core’s promise to deliver the focus, coherence, and rigor Michigan State researcher Schmidt identified as desirable in a set of mathematics standards. The Common Core aims to help students build strong mathematical foundations by covering fewer topics in greater depth. The standards are also designed to connect learning across grades. And the authors of the Common Core hope that, by promoting conceptual understanding, procedural skills and fluency, and the application of mathematics, the standards will come to undergird a mathematics education that leaves students with a deep, authentic command of mathematical concepts.

What Now
The Common Core standards are but the first step, of course (see box). Their effect—good or ill—will depend on how they are implemented in classrooms across the 40-odd states and territories (http://bit.ly/PiGYUF) that have adopted them. Future installments of this series will examine the standards for mathematical practice more closely, explore how the Common Core relates to issues of equity in mathematics education, and discuss professional development efforts aimed at better equipping educators to teach to the new standards. Stay tuned.

Katharine Marow is a freelance writer and editor in Washington, D.C.

Standards vs. Curriculum: An Analogy
“Standards by themselves don’t do anything,” says William McCallum, one of the lead writers of the Common Core State Standards for Mathematics. At a forum held in conjunction with the National Math Festival in April, he laid out the distinction between standards and curriculum, often conflated in discussions of the Common Core.

“Standards are expectations for what we want students to learn,” he said. “Curriculum is how we help students meet those expectations.”

Suppose a scout leader says, “Today we’re going to climb up to Finger Rock.” (Finger Rock is a distinctive rock formation in Arizona.) That’s what a standard is: a goal, an expectation.

How you get there is different. The leader doesn’t think that one size fits all, a criticism commonly leveled at people who espouse standards. Some kids might leap up this mountain. Others might struggle.

The leader might accommodate different abilities or make everyone hike together. There are different pedagogical strategies for how to achieve this standard. But how the leader conducts the hike, these are choices about curriculum. The standard is the goal. The curriculum is how you get there.

McCallum also noted that much of the controversy around the Common Core concerns neither the standards nor the curricula, but the new assessments being developed.

“The assessment, I suppose, is how you decide whether the scout troop did in fact climb the mountain and get to Finger Rock,” he said.

To the Editor:
I appreciate that the MAA is planning to take a closer look at the Common Core, which is indeed a centrally important topic for college faculty, and I look forward to your coverage of the Common Core getting beyond he-said, she-said sound bites.

I have been working on Common Core implementation, in particular as a content leader at Illustrative Mathematics led by Bill McCallum. My motivation is that I see the Common Core as a basis for a much more faithful reflection of what I do as a mathematician. For example, according to the Common Core students should not only learn the standard multidigit multiplication algorithm, but they should see the roles of place value and distributivity in that algorithm, and before that even proofs of the commutative and distributive properties. I explain further in a piece aimed in part at higher-ed colleagues here: http://pages.uoregon.edu/dps/corerigor.php.

It is very interesting to work closely with teachers to understand what good age-appropriate reasoning (proofs) looks like. And it is exciting to see that reasoning become a part of classrooms across the country.

At this point, I’ve presented to over 2,000 K-12 educators here in Oregon and have worked closely with many teachers and teacher leaders nationwide. These mathematician–K-12 partnerships have come about only because Common Core aspires to more authentic mathematical experiences for all students.

Dev Sinha
Associate Professor of Mathematics
University of Oregon

Letters to the editor should be addressed to maafocus@maa.org.
The MAA American Mathematics Competitions provides:

- Great math problems that engage your students and connect with the Common Core State Standards
- Print and video teaching resources found in Curriculum Inspirations by award-winning mathematics teacher and scholar James Tanton
- MAA K-12 teacher membership – electronic subscriptions to Math Horizons and MAA FOCUS magazines, AMC Math Messenger and MAA Math Alert monthly electronic newsletters plus discounts on national meetings, books and videos

Students use words like “fun,” “challenging,” “great math,” and “bringing math to life” when describing the MAA American Mathematics Competitions.

Register
for the MAA American Mathematics Competitions (AMC), the oldest, largest, and most prestigious mathematics competition in the United States.

AMC 8 Contest Date
Tuesday, November 17, 2015

AMC 10 and AMC 12 Contest Dates
Tuesday, February 2, 2016
Wednesday, February 17, 2016

To register and for more information visit amc.maa.org.
Questions: Email amcinfo@maa.org or call 800 527-3690.
Empowering with Inquiry-Based Learning

By Jacqueline Jensen-Vallin

Ed Burger, president of Southwestern University, called for attendees at the 18th annual Legacy of R. L. Moore–Inquiry-Based Learning Conference to practice education that has an impact. He urged participants to ask, “What will your students remember in 20 years?” As we all know, students will likely forget the mathematics, but can be taught in such a way as to develop autonomy and creativity, and those lessons will be carried for life.

Burger said IBL is the right vehicle for getting students to think through mathematics instead of about mathematics. This process will instill habits of living, such as perseverance, curiosity, and intellectual passion. These will in turn empower students and be lasting lessons. “The Southwestern Experience: An Institutional Commitment to Engaged Student Learning,” Burger’s banquet address, fit in well with the theme of this year’s conference: “Empowering with Inquiry-Based Learning.”

G. Edgar Parker (retired, James Madison University) followed this theme with his presentation “Self-Assessment of Failure and Success,” during which he challenged each audience member to answer two questions: (1) What is your greatest strength as a teacher? (2) What is your greatest weakness as a teacher?

Parker noted that frequently one’s greatest strength, either within a specific class or throughout one’s career, is strongly related to one’s greatest weakness. For instance, while focusing time and effort on one bright yet struggling student, you might neglect students who seem more confident. In so doing, you might miss an opportunity to help another equally bright (or brighter) student. Determining if your strength and weakness are class specific or situation specific can increase your effectiveness in the classroom.

Brian Katz (Augustana College) provided other considerations for classrooms—he gave attendees a cognitive frame of reference for the challenges facing students. In particular, the students are trying to learn not only mathematics but also the social norms specific to the mathematical classroom. Teachers can help students internalize the socio-mathematical norms by posing the correct questions, such as “What do we know about this situation?” and “Is an example enough for a proof?”

Angie Hodge (University of Nebraska–Omaha), Eric Stade, and David Webb (both of University of Colorado Boulder) kicked off the theme of empowerment in their opening plenary address, “Inquiry-Based Learning, Mathematics Teacher Education Partnership, Fundamental Theorem of Calculus, and Me.” They had conference participants attempt an activity the speakers use in their Calculus I classes: groups of three were given packets of blue, green, and salmon papers. The only instruction was that the groups had to make sense of the activity.

In the end, groups gathered the slips of papers into piles containing one blue paper (a function), one green paper (a derivative), and one salmon paper (a verbal description) that were related to each other. This served two purposes—it had faculty explore as their students would, and it gave faculty a chance to discuss the methods used during this exploration.

The latter demonstrated that students will have many different, but equally valid, problem-solving strategies. For instance, some people matched the functions and derivatives first, saving the verbal descriptions for last, while others approached the salmon sheets (“the most challenging”) first.

These samples are just a few of the ways that faculty at the conference discussed empowering students in their classrooms. Do you have other examples or memories from the conference? Contribute them to maafocus@maa.org for possible addition on our website.

Jacqueline Jensen-Vallin is editor of MAA FOCUS.
**Dear MAA**» **Prepping for the Putnam Exam**

**Dear MAA,**

I’m a new faculty member in my department. The senior faculty told me that they used to have students take the Putnam exam, but it hasn’t happened in years. They “convinced” me to run the Putnam preparation group, and I really don’t know what I’m doing. I never even took the Putnam as a student! Can you help? Please?

—*Needing Putnam Help*

**Dear Needing,**

The William Lowell Putnam Mathematical Competition runs the first Saturday in December each year—this year the competition will be on Saturday, December 5. Start times are staggered by time zone so that all students are taking the exam at the same time, regardless of their location in the country.

The competition consists of two three-hour sessions—one in the morning and the other in the afternoon. During these sessions, students are given sets of questions testing original thinking as well as technical competence. These problems assume some knowledge of undergraduate mathematics courses, including group theory, set theory, graph theory, lattice theory, number theory, and cardinal arithmetic.

Each problem is worth up to 10 points. All the necessary work to justify an answer and all the necessary steps of a proof must be shown clearly to obtain full credit. Partial credit may be given, but only when a contestant has shown significant and substantial progress toward a solution.

Registration material can be requested from Leonard F. Klosinski
Putnam Mathematical Competition
Department of Mathematics and Computer Science
Santa Clara University
500 El Camino Real
Santa Clara, CA 95053-0374

Any college or university desiring to compete should complete the registration material and have it back to the director no later than mid-October. The local supervisor must be a faculty member.

In terms of preparing your students—the best thing to do is to have them solve problems. The MAA has published three books of old Putnam problems—but, really, any sort of problem solving will help students. And encourage your students to attempt problems if they have a good approach—they will be surprised at how much they can do on a problem even if it seems foreign at first.

Lastly, remember that historically the median score on the exam runs in the low single digits, so many students will not make measurable progress on the problems during their first attempt, but it is a great experience and the MAA is pleased to sponsor the Putnam exam.

Additional information is at [http://math.scu.edu/putnam](http://math.scu.edu/putnam). Good luck to you and your students.


*Students sitting for the Putnam competition at MIT.*
Imagine, says Adrián Paenza, someone who has never heard a piece of music. Not Beethoven. Not the Beatles. Not so much as “Happy Birthday.”

Now suppose you have the privilege of initiating this person into music appreciation. What would you play? Vivaldi? Madonna? Eminem, perhaps?

The possibilities abound, of course, but Paenza quickly eliminates some of them: “You wouldn’t start with a military march, right?”

Paenza believes that introducing students to mathematics by drilling them on arithmetic facts is comparable to beginning someone’s exposure to music with the likes of “Yankee Doodle.”

Or take this homier analogy: “You wouldn’t invite someone over to your house and say, ‘Okay, right here: This is the bathroom.’ But that’s what we do. We show students the wrong side.”

Or “The Wrong Door,” as Paenza titled the talk he gave at the Embassy of Argentina in Washington, D.C., on July 7 in an event cosponsored by the MAA and the Georgetown University Center for Latin American Studies.

An Argentine mathematics professor and journalist, Paenza received the International Mathematical Union’s prestigious Leelavati Prize in August 2014 in recognition of his contributions to changing the public perception of mathematics. Paenza hosts two weekly television shows, and his children’s book series, Matemática . . . ¿estás ahí? or Math . . . Are You There?, has popularized mathematics throughout Latin America and Europe. (See Paenza’s full Leelavati Prize citation at http://bit.ly/1q8iXKG.)

Questions They Didn’t Ask

“Assume I came here and told you how to collect stamps from Thailand,” Paenza said to his embassy audience. “How long would you stay?”

Most listeners would stick around for a few minutes out of politeness, Paenza predicted, but would then begin to drift away, uninterested. Event attendees don’t want to listen to the answers to questions they didn’t ask, after all. And neither do students.

So here’s what happens (in Paenza’s words) when kids are compelled to endure the unmotivated mathematics force-fed them at school:

They go home and they speak with their father and mother and say, “Let me ask you: When am I going to use this?” And their mother and father, they don’t know either because they didn’t know when they were taught that. So what do they answer? “You’ll see later.” But when does “later” arrive? People have been waiting and waiting for that “later” to come and it never comes.

They Don’t Know What It Is

Misconceptions about mathematics are widespread, Paenza noted. Ask a passer-by what a mathematician does, and you’re more likely to hear speculation about speedy completion of long calculations than an accurate explication of mathematical proof.

Paenza told a story about an unwed princess courted by all the eligible bachelors in her father’s kingdom. They formed a queue at the palace on an appointed day, and each in turn attempted to impress the royal daughter. An acrobat, a bodybuilder, a magician—each strutted his stuff. But the princess remained unmoved.

Finally the throng of contenders had dwindled to one, a short man wearing a backpack. This unassuming beau removed from his backpack a pair of eyeglasses and handed them to the princess. She put them on and smiled at her future husband.

“The problem is not that she didn’t appreciate,” Paenza stressed. “She didn’t see. People reject something that they don’t know. People reject mathematics only because they don’t know what it is.”
We Have to Share the Knowledge

Paenza had a man from a pizza shop—call him José—on his television show once. To illustrate a point he was making, Paenza wanted José to cut a pie in a non-standard way. In describing the orientation and relative position of the desired cuts, Paenza used the word “perpendicular.”

José froze.

Paenza rephrased using “90 degrees.” Still nothing.

Telling José to “make a cross” finally got the job done, but the interaction made Paenza ponder the power dynamic at play when there’s a knowledge imbalance between two people.

Let the uninitiated in on your process.
Show them the intermediate steps by which you reach your final answer.
Entice your audience with math’s playful side.

“Knowledge is power and, when you know something, you have power over the other person,” Paenza said in his lecture. “You own him or her at least in that particular circumstance. You have something that he doesn’t.” And it’s not fair.

“If you know something, you have to share it,” Paenza said. “We have to socialize the knowledge.”

Where the Weird Things Are

So if you know mathematics, don’t keep it to yourself.

Let the uninitiated in on your process. Show them the intermediate steps by which you reach your final answer. Entice your audience with the subject’s playful side. Admit that you make mistakes.

If a student asks whether you’ve committed the 15 times table to memory (this happened to Paenza), sit down (as he did) and help him or her work it out.

Encourage a pair to exchange encrypted messages and try to decode them.

Derive the counterintuitive result that, as long as there are 23 people, there’s a more than 50 percent probability that two of them share a birthday. Test this in a crowded room.

Tell kids about game theory.

“Show them where the weird things are,” Paenza entreated. “Challenge them because we are challenged.”

—in Memoriam

The “In Memoriam” (maa.org/news/memoriam) page on the MAA website features citations for MAA members or other prominent mathematicians who have passed away. In the past year, since I was appointed editor of the page, over 70 new citations have been added going back to 2010, based on what has been reported to me. Citations, while short, typically include information about the person’s career, his or her connections to the MAA, and links to longer articles if available. MAA staff members have been incredibly helpful with research on MAA history and edits of my drafts.

I want to highlight information from one of the citations: Kathryn Baker was a member of the MAA since 1932—a remarkable 82 years. She passed away in 2014 at the age of 101. She was a professor at Baylor University and was known for her twin passions for mathematics and art. She also founded the Baylor Children’s Theater. You can learn more about Baker from her “In Memoriam” citation.

Please send relevant information to me at: inmemoriam@maa.org.

—Ed Aboufadel, Grand Valley State University

Clarifications

In the August/September issue, the teaching award winner for the Southern California–Nevada Section should have been listed: Daphne Liu from California State LA. We apologize for the oversight.

In the August/September interview with Robert Gibbs, the problem highlighted on page 24—which Gibbs provided the solution for early in his career—was posed by the man who later became known as the Unabomber. Readers may have missed the reference in the text explaining this amusing historical coincidence.

—Katharine Merow
A Centennial Gift

By now you may have heard about the resounding success of our centennial MAA MathFest. Outstanding talks during the day coupled with a rich evening slate of mathematical entertainment made for a celebration worthy of our centennial. The electricity in the air was palpable. A large number of people told me the event was the best math conference they had ever attended.

MAA MathFest was a gleaming example of what professional organizations do best—mobilizing the talent within our community to contribute to the advancement of teaching, learning, research, joy; and amplifying such talent for the benefit of all with resources that only an association can provide.

We unite people around a common passion for mathematics in a welcoming community. We publish high-quality journals and books, provide outstanding resources for professional development, and nurture interest in mathematics in middle and high schools through our competitions program. You may have heard about the U.S. team that won the International Mathematical Olympiad recently; it was MAA that cultivated and trained this talent! We advocate for bringing mathematics to a wider circle than ever before, including underserved constituencies. We can do still more, but only with your additional support.

I’d like to ask you to make a special gift toward the MAA Second Century Campaign. Your contribution will help us strengthen and modernize the valuable services we provide to you, your colleagues and students, and future generations of mathematicians and mathematics educators.

If you’ve never made a tax-deductible donation to MAA, would you be willing to make a gift of any amount in this centennial year? If you’ve given in the past, would you be willing to double your contribution this year, in anticipation of our Second Century? I will. Would you consider making MAA part of your annual giving budget? I have.

Whether you are making a donation for the first time, doubling the usual size of your annual contribution, or increasing your usual giving, I encourage you to put a “2” in your amount ($120, $200, $1,200, and so on) in anticipation of the Second Century. Then let me know by sending me an email (su@math.hmc.edu). I’d like to thank you personally for investing in MAA’s Second Century Campaign.

Thank you!

Francis Edward Su
MAA President

Thank you for your generous support!

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U.S. Takes First in International Olympiad

By Mark Saul

Amercia loves winners. National media latched on to the story in July when the U.S. team earned the highest national score at the 56th International Mathematical Olympiad (IMO) in Chiang Mai, Thailand.

The six high school students on the team wrestled individually with six problems in 4.5-hour sessions over two days. The U.S. team's combined score of 185 edged out the Chinese team's score of 181 and the Republic of Korea's third-place score of 161. (A perfect team score would have been 252 points.)

The winning team was drawn from schools all over the country:

- Ryan Alweiss, Bergen County Academies, Hackensack, New Jersey
- Michael Kural, Greenwich High School, Greenwich, Connecticut
- Allen Liu, Penfield Senior High School, Penfield, New York
- Yang Liu, Ladue Horton Watkins High School, Ladue, Missouri
- Shyam Narayanan, Blue Valley West High School, Overland Park, Kansas
- David Stoner, South Aiken High School, Aiken, South Carolina.

Five team members were awarded gold medals at the event, while a sixth earned a silver medal, just one point shy of the gold.

Po-Shen Loh, a member of the mathematics faculty at Carnegie Mellon University, is the national coach of the USA IMO team. He was joined in Chiang Mai by Alex Zhai and John Berman as assistant coaches.

Not Just Six Students

It is important for us to recognize the achievement of these six students. (See the problem and solution online for an idea of the high level of this competition: maa.org/maa-focus-supplements.) But it is equally important to recognize that this result is an achievement of the entire mathematical community. The team was selected through a series of competitions organized by the MAA, culminating with the USA Mathematical Olympiad (USAMO). This contest revealed more than 100 very talented students, from which the team was selected.

The top dozen students were honored by a cash award from Robert Balles, a former math teacher.

Through this contest, 48 younger talented students were also identified and trained for the future. They joined the IMO team at Carnegie Mellon University last June for three weeks of immersion in problem solving at the Mathematical Olympiad Summer Program (MOSP). Established in 1974 to train the first U.S. team to the IMO, MOSP is organized by the MAA, which sustains the program each year with the support of donors, including the Akamai Foundation and the Simons Foundation.

The 550 students who sat for the USAMO, already on a high level, were selected from 7,791 students who took the American Invitational Mathematics Examination, who were invited from the highest scorers on the

Po-Shen Loh (left), national coach, with the U.S. team, which placed first at the 56th IMO, held in Thailand.
American Mathematics Competition 10 and 12, given to more than 180,000 students. All these examinations were developed by panels of MAA members, who volunteer enormous amounts of time to hone and polish the content. Their hard work bears fruit in the discovery, recognition, and development of talented teens who will be the mathematical community of the future.

The AMC competitions have been central in stimulating advanced mathematical study, both in school and after school. A network of mathematical circles, often offshoots of the competitions, is growing nationally. Our published and online literature for advanced elementary mathematics is beginning to rival that of the former Eastern bloc, where mathematicians and graduate students routinely wrote about their cutting-edge work in terms accessible to younger students. All these phenomena have conspired to support our six winners. This system, too, is the result of the work of our entire community.

Our students need support even beyond this community. School personnel—both math teachers and others—act as cheerleaders for our gifted students’ accomplishments. And of course, parents and families put much effort into supporting them—and take pride in their accomplishments. It is a whole American Village that has raised this team.

The team is in fact representative of young America. They eat at McDonald’s. They get their driver’s license at 16. They call each other “dude.” During the IMO festivities in Thailand, they made fast friends through mathematics with gifted students from all over the globe, playing table tennis, going shopping, and even riding elephants. One of the most pleasing side effects of the IMO is that it fosters connections among students who will soon form the international mathematical community.

**Improve a Strong System**

A wider analysis of IMO results shows that our national network of support for gifted students pays off. The U.S. team has not been lower than third place since the 2010 IMO, and the differences among teams have been small. This year’s IMO was by many measures the most difficult in years. For example, the cutoff score for gold medals was significantly higher than in the past. We have built a strong system of talent development in our field.

But our work is not over. Many communities are not included in this system. High school girls are underrepresented at the higher levels of competition. Few students come from working-class or minority backgrounds. And we must work harder at finding ways for competition mathematics to influence regular school mathematics. We have much to do, but many resources to draw on.

Mark Saul is the MAA director of competitions.
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How Geometry Has Influenced Everything

By Katharine Merow

Speaking at the MAA Carriage House on June 16, Judith Grabiner (Pitzer College) noted the meeting space’s abundance of parallel lines. She drew her audience’s attention to the everywhere equidistant outlines of the wood paneling and the beams traversing the ceiling to hit the wall at equal angles.

Remember the theorem from high school geometry about how two lines are parallel if and only if, when they are cut by a transversal, corresponding angles are equal? “If you counted how many times that theorem is in this room, you’d be here all night,” Grabiner quipped. “This is the kind of room you’d design if you wanted to brainwash people to believe that space is Euclidean.”

In “Space: Where Sufficient Reason Isn’t Enough,” Grabiner argued that geometry subtly influences everything from art and architecture to physics, philosophy, and how people see and think about the world.

The World of Sufficient Reason

Even before displaying Euclid’s five postulates, Grabiner observed that the Greek mathematician’s axiomatic approach to geometry shaped conceptions of proof, truth, and certainty for centuries—and not just in mathematics.

Spinoza capped a supposed proof of God’s existence with “Q.E.D.” Newton called his laws of motion “axioms.” Thomas Jefferson gave the Declaration of Independence the flavor of a logical argument in the Euclidean style, complete with “self-evident” truths and a conclusion introduced by “therefore.”

Grabiner described the 18th-century world—the world on the eve of the discovery (or, if you prefer, invention) of non-Euclidean geometry—as “the world of sufficient reason.”

Dating back at least to Archimedes, the principle of sufficient reason states that, for everything that is, there is a reason why it happens as it does and not otherwise. Archimedes used sufficient reason to argue that a lever with equal weights at equal distances from the fulcrum must balance. Giordano Bruno claimed that the principle implies the infinitude of space. (There’s no reason for it to stop at any particular place, after all.) Even the math giant Lagrange appealed to the principle of sufficient reason in an attempted proof of Euclid’s infamously nonintuitive fifth postulate.

The world of sufficient reason was symmetric, balanced, and based on self-evident and necessary truths, Grabiner said, a world embedded in Euclidean space—a notion reinforced by art and architecture—and susceptible to rational interrogation.

Geometry stood, in other words, as humanity’s bedrock. “There are no sects in geometry,” said Voltaire. “One doesn’t say, ‘I’m a Euclidean.’ ‘I’m an Archimedean.’ Demonstrate the truth, and the whole world will be of your opinion.”

The Paradigm Shifts

But then Gauss, Lobachevsky, and János Bolyai came along and—Grabiner quoted Morris Kline—“knocked geometry off its pedestal.”

Their breakthrough, said Grabiner, was recognizing that the seemingly absurd implications of negating Euclid’s fifth postulate are not absurd at all, but rather “truths in some alternative, counterintuitive reality.” Recognition of this reality necessitated a paradigm shift.

“Before non-Euclidean geometry, the laws of space and motion implied an infinite space whose properties were always the same, so we knew what was infinitely far away just as well as we knew the geometry in this room,” said W. K. Clifford. “Lobachevsky has taken this away from us.”
As intellectuals grappled with the new multiplicity of geometries, Poincaré declared that no geometry is more true than any other, just more convenient.

Hermann von Helmholtz used convex mirrors to argue that we can, contrary to Immanuel Kant, order our perceptions in a non-Euclidean space.

Grabiner argued that geometry subtly influences everything from art and architecture to physics, philosophy, and how people see and think about the world.

(Doubtful of your ability to do this? Spend some time looking into your car mirror. “There’s a warning on it, isn’t there?” Grabiner asked her Carriage House audience. “What it means is, ‘Warning: The space you see in this mirror is not Euclidean!’”)

Spanish philosopher José Ortega y Gasset used the advent of non-Euclidean geometry to highlight the inferiority of provincialism to more broad-minded outlooks. For Ortega, Euclidean geometry was an unwarranted extrapolation to the whole universe of what was locally observed. Einstein’s relativity, on the other hand, relied on the alternative geometry of Riemann and promoted a harmonious multiplicity of all points of view.

Ortega drew an analogy between mathematics and society: “There is a Chinese perspective that is fully as justified as the Western,” he said.

Western culture was eventually infiltrated by non-Euclidean geometry, Grabiner pointed out. From Man Ray’s helical Lampshade to the hyperbolic paraboloid of a roof on London’s Olympic Velodrome, non-Euclidean geometric objects are, increasingly, in the public eye.

And the mindset has changed along with the art and architecture.

“Euclidean geometry and the principle of sufficient reason came to mean that reason can figure out the whole universe, and it’s symmetric and it’s stable and it’s uniform and there’s a reason for everything and everybody who studies it will come to agree,” Grabiner said at the close of her talk. “I trust you see that this is not the world we live in now.”

Katharine Merow is a Washington, D.C., freelance writer. Grabiner’s talk was part of the Distinguished Lecture Series funded by the National Security Agency. Videos of the lectures are archived online.
Puzzle Page Solutions

In the August/September issue, Laura Taalman presented three Suoku that come with no number clues. Below are the solutions to these naked puzzles.

1: Product Sudoku

2: Greater Than Greater Sudoku

3: Division Sudoku

Modern Math Workshop
October 29–29, 2015

The nine NSF-funded U.S.-based math institutes present the annual Modern Math Workshop (MMW) on October 28–29 (Wednesday–Thursday) in the Washington, DC area. The MMW is part of the institutes’ Mathematical Sciences Diversity Initiatives and the workshop is a pre-conference activity of the SACNAS National Conference (Society for Advancement of Hispanics/Chicanos and Native Americans in Science, see http://sacnas.org/events/national-conf). The MMW includes two mini-courses for undergraduates and talks related to the research programs at the math institutes that would be of interest to graduate students and early career researchers. The workshop is intended to encourage minority undergraduates to pursue careers in the mathematical sciences and to assist undergrads, graduate students and recent PhD’s in building their research networks. The MMW culminates on Oct. 29 with a plenary lecture by Dr. Freeman Hrabowski, President of UMBC (The University of Maryland, Baltimore County). Minority undergraduates, graduate students, postdocs, and faculty are encouraged to attend the workshop.

For more information and to register, please see www.msri.org/e/MMW2015.

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Mathematical Microaggressions

By Francis Edward Su

I enjoyed many things about growing up in Texas. People there are friendly, hospitable, and love to make small talk with strangers. Nevertheless, as an Asian American in a predominately white and Latino part of the state, I frequently had encounters like this:

Friendly Person: “Wow, your English is so good. Where are you from?”
Me: “From here.”
Friendly Person: “No, where are you really from?”

Though it wasn’t an intentional slight, each time I heard this, the message conveyed was: You don’t belong here.

In today’s parlance, this is an example of a microaggression: a small but commonplace verbal or behavioral slight that can be insulting in light of one’s identity in a stereotyped group. For example, what Friendly Person said to me would have sounded ridiculous if it were said to a white Texan, but Asian Americans are often viewed as foreign.

Microaggressions may not seem like a big deal (they’re micro, so we can just shrug them off, right?), but if you get them repeatedly, their cumulative effect reinforces the message that you don’t belong. They have the strongest effect on those who already doubt themselves.

What I would like to discuss are mathematical microaggressions: in what ways do we communicate “you don’t belong in mathematics”? This can happen because of our language, behavior, and assumptions.

In this column, I’d like to focus on language. Often, microaggressive language is unintentional and the offender is unaware. For such cases, I prefer to use the term microslight.

What are some examples of microslighting language in mathematics? Consider this joke:

Professor: “We’ll skip the proof of the lemma, because it’s obvious. We’ll now use the lemma to prove the theorem . . .”
Student: “I’m sorry, I don’t think the proof of the lemma is obvious.”
Professor: (stops to think about it and, after a long pause, collects herself)“I was right! The proof of the lemma is obvious. We’ll now use the lemma to prove the theorem . . .”

What Are We Saying?
Mathematicians are fond of using terms such as “trivial” and “obvious” and “clear” to mean “straightforward
for someone who has already mastered the material.” But some students may think: “I must not be good at math if I can’t see that it’s obvious.” Those who doubt themselves are most prone to feeling this way.

Should we really worry so much about hurt feelings? After all, we do the best we can as teachers. Bending over backwards to avoid offense may seem to be going too far in a hypersensitive direction. And no one wants to be judged by politically correct zealots for word choices.

So I want to be very clear that my purpose in raising these issues is to encourage thoughtful self-reflection, not self-righteousness. As teachers, we should be cognizant of how our actions may affect our most-vulnerable students.

By their unintentional nature, microslights are hard to self-diagnose. So I’m grateful for friends, including the Project NExT community, who helped me compile this list of common mathematical microslights and suggested alternatives less likely to offend.

“*It is obvious/clear/trivial that . . . .”*

Unintended message: You’re stupid if you can’t see it right away.

Better: Explain the meaning of these phrases in mathematical culture. Or say instead: “It is straightforward, with some work, to show that . . . .”

Using the word “just,” as in “the rest is just algebra.”

Unintended message: You’re not cut out for math if you can’t do algebra. (Beware especially how this message gets conveyed in Lagrange multiplier problems, where the nastiest part of the solution is the algebra!)

Better: Remove the word “just” and explain the difference between calculation and insight.

Avoid unintentionally discouraging students whom we wish to inspire!

Asking in class “Are there any questions?” and then quickly moving on.

Unintended message: Questions are not normal or expected.

Better: Show that questions are welcomed. “It’s normal to have questions, and I’d love to hear yours. And others in our class will thank you for asking a question they’re also thinking.” Pause to give students time to think of a question.

Saying in office hours “See me again if you have questions.”

Unintended message (that could be reinforced by tone of voice and body language): IF you have some silly questions, you’ll be a nuisance; I’d rather not be bothered.

Better: “I hope you’ll visit again! Questions are part of the normal process of learning this stuff.”

“Give the idea of the proof in plain English.”

Unintended message (to international students): You can’t succeed in math if your English skills aren’t good enough.

Better: “Give the idea of the proof in your own words.”

Discussing a proof based on a simple insight: “You either get it, or you don’t.”

Unintended message: You either understand math or you don’t, and if you don’t, you’ll never get it.

Better: “Once you see the main insight, the rest of the proof will make sense and fall into place.”

“There’s a trick for doing this.”

Unintended message: There’s a secret list of things that only insiders know.

Better: “There’s a technique for doing this.”

Using sarcastic language to be funny.

For example, I once joked, “Hello! Is anyone out there?” when no one answered a question I posed to a sleepy 8 a.m. class. Only later did I realize some students felt belittled.

Unintended message: You’re an idiot.

Better: Avoid sarcasm, or repeatedly remind students that your humor has a sarcastic edge.

Using only male pronouns/European names in examples.

Unintended message: Only European men can be mathematicians.

Better: Vary your use of pronouns, names, and cultural examples to reflect the diversity we hope to see in mathematics. These can provide positive associations that break stereotypes.

Let Me Hear from You

Those are a few mathematical microslights. I’m sure you can think of more, and I would be interested in hearing them. In my next column, I will focus on mathematical microaggressions related to behaviors and assumptions.

My hope is to spur thoughtful discussion about better ways to avoid unintentionally discouraging students whom we wish to inspire!

Francis Su, MAA president, is the Benediktsson-Karwa Professor of Mathematics at Harvey Mudd College.

His email is su@math.hmc.edu, and he is on Twitter: @mathyawp.
Loren Larson, The Inquisitive Problem Solver
Professor Emeritus of Mathematics, St. Olaf College

Interviewed by Deanna Haunsperger and Stephen Kennedy

Loren Larson finds inexpressible beauty and delight in well-designed puzzles and well-crafted problems—ask him about one and his face breaks into a warm and endearing smile. This love has directed many years of his life, from 10 years as problems editor for the MAA’s Mathematics Magazine, to a long-time commitment as Convener of the Questions Committee for the MAA’s Putnam exam, to writing The Inquisitive Problem Solver with Paul Vaderlind and Richard Guy, and now more recently to designing and hand crafting wooden mathematical puzzles. We sat down with Loren and two of his colleagues, Matt Richey and Paul Zorn, a few years ago and asked him about his life with puzzles.

The complete interview and others will be online at maa.org/100.

We’re documenting the history of the MAA’s first 100 years, and you’re part of the story.
Yes, the MAA was influential for me.

Can we start with your early life and work our way up? Do you want to tell us about growing up and elementary school?
I grew up in a small prairie town in the Flint Hills of central Kansas, in the region described in William Least Heat-Moon’s book PrairyErth. There were only eight kids in our class, and we were together through eighth grade. I have many happy memories.

Game playing was a big part of our family life, especially card games. My dad was an expert bridge player, and I like to think I inherited some of his math genes. I think card games go a long way toward developing a sense of probability and strategy and memory. I remember when Liz (my wife) and I first dated, we played a few games of Rook with her family, but their interest wasn’t really in winning so much as in seeing what would happen. They would make outrageous bids just for the fun of getting the bid, causing great laughter. I was considered a cut-throat player because I kept track of the cards that had been played and offered postgame analysis. I quickly learned that it wasn’t in my best interest to play games with her relatives.

What did you do in college?
I went to Bethany College in Lindsborg and lived at home; tuition at that time was about $200 a term, but even at that, some of my high school friends felt it was too expensive and went to a state school instead.
Mathematics as taught at a small college like Bethany was much different in those days. We started with a full year of algebra, analytical geometry, and trigonometry. We learned these subjects very well; our manipulation skills were far beyond what is now expected in this regard. This was followed by calculus and differential equations, but not much beyond that: teaching of math, history of math, theory of equations, elementary Euclidean geometry; very little theory and no proof writing.

What provoked you to go to graduate school?
Well, in the spring of my sophomore year, I applied for a summer internship in mathematics at the White Sands Proving Ground in New Mexico. Through some stroke of good fortune, I was accepted. There were eight students in the program, most of them from large technical universities. We lived together in barracks on the base.
We went to classes and staff...
seminars given by senior mathematicians and did computational work that would now be done with a few strokes on a handheld calculator. Among other things, we talked about our studies, exchanged our favorite math problems (e.g., the snowplow problem), talked about our math courses (I learned about group theory and topology and lots more) and our plans, and it kind of raised the bar for me.

**What was graduate school like?**
The first year was a nightmare. Most of us were from small colleges, and our professors fresh out of Cal Tech had no idea how hopeless we were. All but two in our class (of 30+) were on probation after the first term. After the first year, a lot of our class dropped out and became pilots or computer scientists or joined companies looking for math talent. The second year was better; the turning point for me was my year-long course in group theory taught by W. R. Scott, who was then writing his classic book on the subject.

**So what did you decide to study for your PhD work?**
We decided to return to Kansas [from a temporary job at St. Olaf] where I could study commutative algebra. Because of my background in mathematical logic, my thesis direction was to find something in the area between logic and algebra. It took a full year of reading seminal works . . . before I was able to formulate a question that seemed approachable. Once I was able to articulate the problem, the rest was easy and a huge emotional release. I should add that no matter how discouraged I became with my prospects during this year, I could count on expository articles and problems from the *Monthly* to bolster my spirits.

**Did you have a job waiting for you at St. Olaf?**
I did. I had returned to graduate school on a scholarship from the Lutheran church on the condition that I would come back when I finished.

**Is that when the interest in majoring in mathematics at St. Olaf was starting to ramp up?**
Partially yes, but the real increase didn’t happen for another five years. Because of Sputnik and the public interest in space exploration, students realized there were lots of jobs for math majors. For one thing, computers were just beginning to make an impact, and a math major was a tacit prerequisite to a career in computer science.

In the late 1970s we added a number of master teachers who reached those students who weren’t being well served by our pre-graduate-school curriculum. As a result of their leadership, we changed the emphasis from teaching mathematics to teaching students, and this made all the difference. A large percentage of our first-year students enrolled in calculus, so the idea was that if we made these classes fun, they could be enticed to continue with linear algebra. After that, there was a good chance we could offer them attractive and meaningful courses regardless of their major.

**Your mathematical contributions are in the area of problem solving rather than algebra. How did this happen?**
Initially I was determined to keep up-to-date in algebra and logic, and in my first years at St. Olaf, I attended the weekly ring theory seminar at the University of Minnesota. But these sessions, led by Mel Hochster, were very advanced and required more time than I could spare. Furthermore, it wasn’t something I could share with students because of their limited background. So I gave up on algebra research, acknowledging my own limitations as well as my students’ best interests. Here is where the MAA made a huge difference for me. I enjoyed problem solving of the sort featured in the MAA journals, and this was something I could share with students. It was a form of research that was acknowledged as worthwhile in our department, though of course it wouldn’t have amounted to a thing at a research institution . . .

**Tell us about working with the Putnam.**
I acted as the convener of the Questions Committee and was there to offer feedback on questions regarding problem selection: appropriateness (in subject matter, level of difficulty, and ease of solution), originality, understandability, accessibility, attractiveness, gradeability. I was deemed suitable for this task.
because of being at an undergraduate institution and because of my MAA-related experience with problems.

**Is there a secret for writing a good problem?**

If there is, I wish I knew it. A necessary condition, but insufficient, is an appreciation, and a compelling desire to think about it for long periods of time. Well, at least that’s my experience, but then I think some of the people who served on the Questions Committee seemed to be able to come up with good problems out of the blue whenever we needed one at whatever level. I suppose it’s like writing poetry or composing music: it seems easy for some, impossible for others.

**How did you end up doing The Inquisitive Problem Solver with Richard Guy?**

I met Paul Vaderlind at the University of Stockholm in Sweden, and he gave me a copy of his problems book. Because of my Swedish heritage, I was interested in learning Swedish, and I thought translating his book would be a fun way to do it. I submitted the translation to the MAA, and Richard Guy was on the selection committee and thought the book had potential. He recognized that the problems were interesting and that a good problem should suggest other good problems. So he offered to work with me to rewrite it and make it suitable for the MAA, keeping in mind that asking good questions is just as important to the progress of mathematics as answering questions. That became one of our main objectives; hence the title.

We worked on the book for a couple years, exchanging emails daily, and I often went to Calgary for a week or two at a time. These sessions with Richard were the best times of my mathematical life.

We got up at 7:00, walked to his office a mile away, climbed the five flights of stairs to his office, and worked steadily all day without a lunch break. Time passed quickly and soon it was 5:00, and we’d walk back and Louise would have dinner ready. Then we’d clear the table and continue working (that is, playing) until 10:00. On the weekends Louise, Richard, and I would go to the mountains for a full day of hiking (and he was well into his eighties). In the preface, Richard writes, “Have fun reading the book; we doubt if you’ll have more fun than we did in writing it!”

**You were retired so you could work full time?**

I was working on two problem books and the Putnam, and I simply wanted to put all my energy into it. It was a full-time commitment to keep up with George Gilbert, Mark Krusemeyer, Richard Guy, and members of the Questions Committee. This was a once-in-a-lifetime opportunity and a way to make use of my unique background. It seemed important to me to make these problems available to a wider readership and was a way to contribute to the MAA. [The book is still in print: http://bit.ly/1FFN3Dm.]

In addition to this, I had also recently taken up fine woodworking as a hobby, and I intended to make time for that.

**Why woodworking?**

Through high school and college I worked as a carpenter building houses. A couple years before I retired, three old-growth trees fell in our yard and I had the wood milled into boards. I took a few lessons in woodworking and acquired a few necessary hand tools and power equipment. This hobby has grown to the point where woodworking is my passion in the way mathematics used to be. In fact, I now have a website (woodcraftedart.com) and sell crafts at local fairs. I like the challenge and precision that fine woodworking requires and the outlet it offers for creativity.

**What does your wife think about your obsessions with mathematics and woodworking?**

She’s gotten used to it. Fortunately, she also had an active life as a librarian, with involvements in numerous community activities. Plus, she’s an inveterate reader. But she keeps telling me, “Oh, it’s so nice when you’re just sitting here reading in the evenings.” I should add that our family has been the most important thing in our lives—our children and in-laws and grandchildren. They are our world, there’s nothing more to say.

Larson in his woodworking studio. Right: Wooden sculpture of a three-dimensional knight’s tour.
Ken Ono Named New Pólya Lecturer

Successful mathematicians possess myriad talents, but Ken Ono stands out for his range of accomplishments. Specializing in number theory, the Asa Griggs Candler Professor of Mathematics at Emory University is also a journal editor, member of the U.S. National Committee for Mathematics, a competitive triathlete, and a Hollywood consultant and associate producer. Now Ono can add 2017-2018 George Pólya Lecturer to his achievements.

The MAA appoints a new Pólya Lecturer every year, whose primary responsibility is presenting talks at MAA section meetings. Each appointee serves a term of two academic years; the first year overlaps with the second year of the previous Pólya Lecturer. The current lecturer, William Dunham (Muhlenberg College), is in the middle of his 2015-2016 term, and Erica Flapan (Pomona College) will begin hers in 2016. Those chosen have contributed to the public discussion of mathematics, something that Ono actively and creatively accomplishes in his career.

“In a way, I was meant to be a mathematician. Everything about my life has been dictated by the world of mathematics,” says Ono. Ono’s father is Takashi Ono, a mathematician who emigrated from Japan before working as a professor at the Institute for Advanced Study. Now Ono is well on his way to building his own legacy. In 2013 Ono and his colleagues Michael Griffin and Ole Warnaar made history when they discovered four infinite families of Rogers-Ramanujan identities. Together, they solved a century-old mystery of two famous identities first studied by the Indian mathematician Srinivasa Ramanujan in the early 1900s. What Ono and his colleagues found was the framework that shows how Ramanujan’s identities were true—opening up new mathematical territory.

In 2014 he made world news again, this time with John Duncan and Michael Griffin. They proved the Umbral Moonshine conjecture, which extends the Fields Medal work of Berkeley mathematician Richard Borcherds. Their work is now being applied to string theory.

Ono also served as chief mathematical consultant (and associate producer) for The Man Who Knew Infinity, a Hollywood film about Ramanujan. Ono is deeply passionate about both Ramanujan’s beautiful mathematics and his personal story—a mathematical genius who had little formal training and worked as a clerk in India before traveling to the University of Cambridge to publish his findings.

Ono calls the idea of Ramanujan very important—particularly to mathematics students. “We often live life in a frenetic race, chasing random credentials,” he says. “In reality, we should be recognizing and evaluating true achievement.”

Ono finds many opportunities to train future mathematicians: he advises nine PhD students and runs a summer research program (REU) on number theory for up to 10 undergraduates. “Talent is often found in unusual or even unforgiving circumstances,” he says. “As a professor, it is my job to first recognize that talent and then to nurture it.”

Now Ono is looking forward to more opportunities to speak to his peers, and young mathematicians, at section meetings. “I am honored to be named a Pólya Lecturer,” he says. His goals for his lectures, he adds, are twofold: to inspire young mathematicians and to continue driving mathematics toward the future.

—Alexandra Branscombe
For over 40 years, Jerome Hines (1921-2003) sang principal bass roles at the Metropolitan Opera in New York and in opera houses around the world. He was also a math major who retained a lifelong interest in mathematics. During the 1950s Hines published five papers in Mathematics Magazine that were based on work done as a student, and he later produced several lengthy mathematical manuscripts about cardinality and infinite sets. I will discuss some of Hines’ mathematical work, as well as the way in which his undergraduate experience at UCLA converted him from a student with no particular liking for mathematics into an aspiring mathematician. I also hope to explore the question of what mathematics meant to Hines and why, in the midst of demanding musical career, he felt it important for him to develop and publish his mathematical ideas.
algorithm for the envy-free division of a heterogeneous divisible good, such as cake or land, interest in fair division has burgeoned. Besides envy-freeness, properties such as equitability, efficiency, and strategy-proofness have been studied, and both existence results and algorithms to implement them will be discussed (some implementations will be shown to be impossible). More recent work on algorithms for the fair allocation of indivisible items, and tradeoffs among properties, will be presented. Applications, including those to dispute resolution, will be discussed.

MAA INVITED ADDRESS

Alan Schoenfeld / University of California Berkeley

What Makes for Powerful Classrooms—and What Can We Do, Now That We Know?

Friday (1/8), 9:00–9:50 a.m.

We now understand the properties of classrooms that produce powerful mathematical thinkers and problem solvers. The evidence comes mostly but not exclusively from K-12. The question for us: What are the implications for the ways we teach postsecondary mathematics?

MAA INVITED ADDRESS

Charles R. Hadlock / Bentley University

A Mathematical Tour through a Collapsing World

Saturday (1/9), 10:05–10:55 a.m.

If you search the word “collapse” on Google News on any given day, you are sure to get thousands of hits, as well as a healthy reminder that we do live in a world where a very wide variety of things are collapsing every day. When assessing the risk of collapse, one’s initial mind-set about its source can lead to insufficient attention being paid to alternative sources. That’s why financial auditors, accident investigators, and similar professionals follow systematic protocols that attempt to ensure that a wide field of issues are addressed, even in the presence of strong evidence pointing in a particular direction. This same mentality is important in more general and less structured treatments of risk and possible collapses. But beyond capturing the concepts, which itself should not be understated as an important contribution to workers from diverse disciplines, we also offer powerful tools for going deeper to mine important insights, resolve specific uncertainties, and guide future actions. I will expand upon these ideas with examples from the real world and with some mathematical gems that many of us might not ordinarily encounter in our mathematical training or reading. I will also mention how this work grew out of an exhilarating interdisciplinary undergraduate seminar course.

MAA LECTURE FOR STUDENTS

Robert Devaney / Boston University

The Fractal Geometry of the Mandelbrot Set

Friday (1/8), 1:00–1:50 p.m.

In this lecture I describe several folk theorems concerning the Mandelbrot set. While this set is extremely complicated from a geometric point of view, I will show that, as long as you know how to add and how to count, you can understand this geometry completely. We will encounter many famous mathematical objects in the Mandelbrot set, like the Farey tree and the Fibonacci sequence. And we will find many soon-to-be-famous objects as well, like the “Devaney” sequence. There might even be a joke or two in the talk.

MAA-AMs-SIAM GERALD AND JUDITH PORTER LECTURE

Jennifer Chayes, Microsoft Research

Network Science: From the Online World to Cancer Genomics

Saturday (1/9), 3:00–4:00 p.m.

Everywhere we turn these days, we find that networks can be used to describe relevant interactions. In the high-tech world, we see the Internet, the World Wide Web, mobile phone networks, and a variety of online social networks. In economics, we are increasingly experiencing both the positive and negative effects of a global networked economy. In epidemiology, we find disease spreading over our ever-growing social networks, complicated by mutation of the disease agents. In biomedical research, we are beginning to understand the structure of gene regulatory networks, with the prospect of using this understanding to manage many human diseases. In this talk, I look generally at some of the models we are using to describe these networks, processes we are studying on the networks, algorithms we have
devolved for the networks, and finally, methods we are developing to infer network structure from measured data. I’ll discuss in some detail particular applications to cancer genomics, applying network algorithms to suggest drug targets for certain kinds of cancer.

**Conference vs. Convention**

Some sessions are being held in the Washington State Conference Center, which is across the street (by skybridge) from the Washington State Convention Center. Where this is the case, we are writing out Conference Center. Please pay attention!

**AMS Invited Addresses**

*Panagiota Daskalopoulos / Columbia University*

**Title to be announced**

*Saturday (1/9), 9:00 a.m.*

*Alex Eskin / University of Chicago*

**The SL(2,R) Action on Moduli Space**

*Friday (1/8), 10:05 a.m.*

**COLLOQUIUM LECTURES**

*Timothy Gowers / University of Cambridge*

**Generalizations of Fourier Analysis, and How to Apply Them**

*Wednesday–Friday (1/6–1/8), 1:00 p.m.*

**AMS RETIRING PRESIDENTIAL ADDRESS**

*David Vogan / Massachusetts Institute of Technology*

**Conjugacy Classes and Group Representations**

*Thursday (1/7), 3:20 p.m.*

**Information on the JMM website**

The jointmathematicsmeetings.org/jmm site is posted as it is received. For updated conference details:

*Joint Prize Session*

To showcase the achievements of recipients of the 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, ASA, MAA, and SIAM will announce the JPBM Communications Award winner. The AMS, MAA, and SIAM will award the Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student.

The AMS and SIAM will announce the Norbert Wiener Prize in Applied Mathematics. The AMS will announce the winners of the Award for Distinguished Public Service, Chevalley Prize in Lie Theory, Levi L. Conant Prize, E. H. Moore Research Article Prize, David P. Robbins Prize, Leroy P. Steele Prizes, and the Oswald Veblen Prize in Geometry.

The MAA will award the Chauvenet Prize, Euler Book Prize, Deborah and Franklin Tepper Haimo Awards for Distinguished College or University Teaching of Mathematics, and the Yueh-Gin Gung and Dr. Charles Y. Hu Award for Distinguished Service to Mathematics.

The AWM will present the Louise Hay Award for Contributions to Mathematics Education, the M. Gweneth Humphreys Award for Mentorship of Undergraduate Women in Mathematics, and the Alice T. Schafer Prize for Excellence in Mathematics by an Undergraduate Woman.
Joint Invited Addresses

AMS-MAA

Kristin Estella Lauter / Microsoft Research
How to Keep Your Genome Secret
Friday (1/8), 11:10 a.m.

Xiao-Li Meng / Harvard University
Statistical Paradises and Paradoxes in Big Data
Friday (1/8), 11:10 a.m.

AWM-AMS NOETHER LECTURE

Karen E. Smith / University of Michigan
Title to be announced
Thursday (1/7), 10:05 a.m.

MAA Invited Paper Sessions

Current Trends in Mathematical and Computational Biology
Thursday (1/7), 9:00–11:20 a.m., WSCC Room 607

Mathematical and computational biology encompasses a diverse range of biological phenomena and quantitative methods of exploring those phenomena. This session of current research topics will sample from this diversity. Biological application areas will address current research in growth and control of populations, spread and development of disease, evolution and bioinformatics, and molecular interactions in the cell. Mathematical approaches will include deterministic and stochastic dynamical models as well as combinatorial and algebraic models.

Organizers: Brian Walton, James Madison University; and Maeve McCarthy, Murray State University

Speakers:
- Joseph Felsenstein, University of Washington
- Suzanne Lenhart, University of Tennessee
- David Murrugarra, University of Kentucky
- Ami Radunskaya, Pomona College
- Brandilyn Stigler, Southern Methodist University

Sponsor: BIO SIGMAA

What Do We Know about University Mathematics Teaching, and How Can It Help Us?
Friday (1/8), 1:00–5:00 p.m., WSCC Room 607

Research on university-level mathematics teaching and learning has grown over the past few decades from a cottage industry into a robust enterprise, both in general (with findings on problem solving, “powerful teaching,” and understanding how and why teachers make the choices they do while teaching) and with regard to specific courses (e.g., developmental mathematics, linear algebra, proof). In turn, the research has led to applications to teaching. This too is in general (with professional development framed around the issues raised in research leading to changes in teaching) and in particular courses.

Organizers: Michael A. Jones, Mathematical Reviews; and Jennifer Wilson, New School

Speakers:
- Bill Barton, University of Auckland
- Ann Edwards, Carnegie Foundation for the Advancement of Teaching
- Sean Larsen, Portland State University
- Judy Paterson, University of Auckland
- Alon Pinto, UC Berkeley
- Chris Rasmussen, San Diego State University
- Annie and John Selden, New Mexico State University
- Günter Törner, University of Duisburg-Essen

Fair Division
Thursday (1/7), 1:00–4:15 p.m., WSCC Room 607

This session accompanies Steven Brams’s invited address on the same topic. The goal of the session is to show how different types of mathematics can be used to address questions in both theoretical and applied aspects of fair division. Although a relatively new field, fair division now encompasses a wide variety of approaches (analytic, combinatoric, geometric, and axiomatic) to address both discrete and continuous problems. Fairness criteria can be applied to such diverse applications as cake cutting, the establishment of priority lists, and resource allocation. Although the talks will be research oriented, speakers will include an expository overview to introduce fair division to a diverse audience including students.

Organizers: Michael A. Jones, Mathematical Reviews; and Jennifer Wilson, New School

Speakers:
- Julius Barbanel, Union College
- Jonathan Hodge, Grand Valley State University
- Michael A. Jones, Mathematical Reviews
- D. Marc Kilgour, Wilfrid Laurier University
- Kathryn Nyman, Willamette University
- William Webb, Washington State University
The Enjoyment of Employment: Finding the Right Organizational Culture
Wednesday (1/6), 2:15–3:35 p.m., WSCC Room 612
This workshop is targeted to graduate students and postdocs who are considering nonacademic careers. Are you considering a nonacademic career after graduate school or your postdoc? Are you aware of the different kinds of workplace cultures you’ll encounter? People look for different things in a job: one person might want to change the world, while another just wants a paycheck. Matching your work personality to the culture of the organization is one of the prime factors in workplace happiness. In this workshop you’ll assess your workplace personality, which we will then match against different work environments to see what kinds of organizations are compatible with your work style. We’ll end with a checklist and timeline for starting your job search so that you’ll be fully prepared when the time comes. Before the workshop, go to dougsguides .com/personality, take the personality assessment, and bring the results with you.
Organizer: Douglas Kalish, University of California Berkeley

Guiding Your PhDs to Nonacademic Careers
Thursday (1/7), 8:00 – 9:20 a.m., WSCC Room 612
According to the NSF, in 2010 nearly 50 percent of mathematics and statistics PhDs held nonacademic positions. More faculty are accepting and promoting nonacademic career alternatives for their graduate students and postdocs. But for some faculty without extensive industry experience or contacts, it’s difficult to offer advice and counsel to these students. This workshop provides information and tools for faculty who want to mentor their PhDs as to the opportunities available and additional skills required for a successful nonacademic job search. Some of the topics we will cover:
- The nonacademic job market for quantitative PhDs
- Skills required of PhDs for nonacademic jobs
- Making industry internships work for the PhD and adviser
- Counseling and networking resources for nonacademically bound PhDs
- Supporting nonacademic career PhDs emotionally and behaviorally
- Managing academic and nonacademic career PhDs in the same department
- Sharing experiences and challenges in mentoring nonacademic career PhDs
The tools and topics of this workshop are targeted to mathematical sciences faculty who embrace (or at least accept) nonacademic career choices for their graduate students and postdocs. The workshop is not a discussion of the appropriateness of a graduate education for nonacademic career candidates.
Organizer: Douglas Kalish, University of California Berkeley

Applications of Gapminder for Undergraduate Mathematics and Statistics Courses
Thursday (1/7), 8:00–9:20 a.m., Conference Center Tahoma 1
Do a nation’s GDP and its youth’s math ability go hand-in-hand? Are geriatric car crashes on the decline? Which nations are the most “developed”? These are all captivating questions, and the commonality among them is that they were tackled by students using data from Gapminder.org. While such questions are non-trivial for a mathematician or sociologist to approach, it is worthwhile for students to approach them—doing the work could change their mind about the utility of mathematics. Created in 2005, Gapminder is a nonprofit site with the goal of enhancing sustainable global development through an increased use of information regarding social, economic, and environmental development at local and international levels. With more than 520 data sets to peruse, the site is a powerhouse for applications in the classroom; one might use it for demonstrations, short-term assignments, or semester-long research projects. Notwithstanding, deciding how to use the tools so that neither you nor your students become overwhelmed can be a challenge. As such, the first component of this interactive workshop is to familiarize instructors with the site and its visualization tools. Next, we will move on to discuss the applications of it in classes such as college algebra, first-year seminar, introductory and upper-level statistics, differential equations, and other modeling courses. Finally, participants will work in teams to create assignments for immediate use in their classrooms. Whether one has used

Mathematical Art Exhibition
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.
Organizers: 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 Selkoff, Digital Awakening Studios.
the site before or not, each participant should expect to take away meaningful, tangible strategies for its use. Participants should come prepared to learn more about the world and how to bring it into your classroom!

Organizers: Samuel L. Tunstall, Sarah Greenwald, and Bill Bauldry, Appalachian State University

MAA Contributed Paper Sessions

Full descriptions of the paper sessions with themes are on the JMM website.

CONTRIBUTED PAPER SESSIONS WITH THEMES

Experiences and Innovations in Teaching Probability Theory
Wednesday (1/6) morning
Organizers: Jonathon Peterson, Purdue University; and Nathaniel Eldredge, University of Northern Colorado

Topics and Techniques for Teaching Real Analysis
Wednesday (1/6) afternoon
Organizers: Erik Talvila, University of the Fraser Valley; Paul Musial, Chicago State University; Robert Vallin, Lamar University; and James Peterson, Alma College

Using Philosophy to Teach Mathematics
Thursday morning
Organizers: Carl Behrens, Alexandria, Virginia; and Dan Slaughter, Furman University
Sponsor: POM SIGMAA

Common Core State Standards (CCSS) for Mathematics Practices and Content: The Role of Math Departments in Preparing Math Education Candidates for New Assessments
Thursday (1/7) afternoon
Organizers: William Martin, North Dakota State University; Karen Morgan, New Jersey City University; Gulden Karakok, University of Northern Colorado; and James A. Mendoza Epperson, University of Texas–Arlington
Sponsors: MAA Committee on the Mathematical Education of Teachers (COMET) and the MAA Committee on Assessment

The Teaching and Learning of Undergraduate Ordinary Differential Equations
Friday (1/8) morning
Organizers: Christopher S. Goodrich, Creighton Preparatory School; and Beverly H. West, Cornell University
Sponsor: Community of Ordinary Differential Equations Educators (CODEE)

Innovative and Effective Ways to Teach Linear Algebra
Friday (1/8) afternoon
Organizers: David Strong, Pepperdine University; Gil Strang, MIT; and Megan Wawro, Virginia Tech

Helping Students See beyond Calculus
Saturday (1/9) afternoon
Organizers: David Strong, Pepperdine University; James Tanton, MAA; Courtney Davis, Pepperdine University; and Angela Spalsbury, Youngstown State University
Sponsor: SIGMAA TAHSM

Mathematics and the Arts
Wednesday (1/6) morning and afternoon
Organizer: Douglas Norton, Villanova University
Sponsor: SIGMAA ARTS, the SIGMAA on Mathematics and the Arts

The Broad Impact of Math Circles
Thursday (1/7) afternoon
Organizers: Amanda Matson, Clarke University; Katherine Morrison, University of Northern Colorado; and Philip Yasskin, Texas A&M University
Sponsor: SIGMAA MCST, the SIGMAA on Math Circles for Students and Teachers

Mathematics Experiences and Projects in Business, Industry, and Government
Friday (1/8) afternoon
Organizers: Carla D. Martin, Department of Defense, and Allen Butler, Wagner Associates
Sponsor: BIG SIGMAA

The Scholarship of Teaching and Learning in Collegiate Mathematics
Wednesday (1/6) morning and afternoon
Organizers: Jacqueline Dewar, Loyola Marymount University; Thomas Banchoff, Brown University; Curtis Bennett, Loyola Marymount University; Pam Crawford, Jacksonville University; and Edwin Herman, University of Wisconsin–Stevens Point

Sponsor: MAA Committee on the Mathematical Education of Teachers (COMET)

Trends in Undergraduate Mathematical Biology Education
Friday morning
Organizers: Timothy Comar, Benedictine University; and Daniel Hrozencik, Chicago State University
Sponsor: BIO SIGMAA

Mathematics and the Arts
Wednesday (1/6) morning and afternoon
Organizer: Douglas Norton, Villanova University
Sponsor: SIGMAA ARTS, the SIGMAA on Mathematics and the Arts
The Contributions of Minorities to Mathematics throughout History
Friday (1/8) morning
Organizers: Amy Shell-Gellasch, Montgomery College; and Lloyd Douglas, University of North Carolina
Sponsor: HOM SIGMAA

Incorporating the History of Mathematics into Developmental Math Courses
Saturday (1/9) morning
Organizers: Van Herd, University of Texas at Austin; and Amy Shell-Gellasch, Montgomery College
Sponsor: HOM SIGMAA

Integrating Research into the Undergraduate Classroom
Saturday (1/9) afternoon
Organizers: Shannon R. Lockard, Bridgewater State University; and Timothy B. Flowers, Indiana University of Pennsylvania

Graduate Students Teach Too: Ideas and Best Practices
Saturday (1/9) afternoon
Organizer: Samuel L. Tunstall, Michigan State University

Mathematical Modeling in the Undergraduate Curriculum
Saturday (1/9) morning
Organizers: Jason Douma, University of Sioux Falls; and Rachel Levy, Harvey Mudd College
Sponsors: MAA CUPM Mathematics Across the Disciplines Subcommittee and the SIAM Education Committee

Research in Undergraduate Mathematics Education
Thursday (1/7) morning and afternoon
Organizer: Karen A. Keene, North Carolina State University
Sponsor: SIGMAA on RUME

Origami in the Mathematics K-12 Classroom
Saturday (1/9) afternoon
Organizers: Roger Alperin, San Jose State University; and Perla Myers, University of San Diego

Contemplative Pedagogy and Mathematics
Friday (1/8) afternoon
Organizers: Luke Wolcott, Lawrence University; and Justin Brody, Goucher College

Assessing Student Learning: Alternative Approaches
Wednesday (1/6) morning
Organizers: David Clark, Grand Valley State University; Jane Butterfield, University of Victoria; Robert Campbell, College of St. Benedict/St. John’s University; and Cassie Williams, James Madison University

Quantitative Literacy in the K-16 Curriculum
Wednesday (1/6) afternoon
Organizers: Aaron Montgomery, Central Washington University; Gary Franchy, Southwestern Michigan College; Gizem Karaali, Pomona College; Andrew Miller, Belmont University; and Victor Piercey, Ferris State University
Sponsor: SIGMAA QL

Innovative Approaches to One-Semester Calculus Courses
Thursday (1/7) morning
Organizers: Joel Kilty and Alex M. McAllister, Centre College

Conversations with the Partner Disciplines: Collaborations to Improve the Mathematics Curriculum
Saturday (1/9) afternoon
Sponsors: Curriculum Renewal Across the First Two Years (CRAFTY) and Mathematics Across the Disciplines (MAD) subcommittees of CUPM and the journal PRIMUS: Problems, Resources, and Issues in Undergraduate Mathematics Studies
Organizers: Victor Piercey, Ferris State University; Suzanne I. Dorée, Augsburg College; Jason Douma, University of Sioux Falls; and Susan Ganter, East Carolina University

Bringing the Community into the College Mathematics Classroom
Thursday (1/7) afternoon
Organizer: Ksenija Simic-Muller, Pacific Lutheran University

Innovative Targeted Solutions in Teaching Introductory Statistics
Thursday (1/7) afternoon
Organizers: Patti Frazer Lock, St. Lawrence University; Randall Pruim, Calvin College; and Sue Schou, Idaho State University
Sponsor: SIGMAA on Statistics Education

New Ideas in Teaching Upper-Level Statistics Courses
Friday (1/8) afternoon
Organizers: Patti Frazer Lock, St. Lawrence University; Randall Pruim, Calvin College; and Sue Schou, Idaho State University
Sponsor: SIGMAA on Statistics Education

Addressing the Needs of Mathematics and Computer Science Majors in Discrete Mathematics Courses
Saturday (1/9) afternoon
Organizers: Ksenija Simic-Muller, Pacific Lutheran University; and Tom J. Edgar, Pacific Lutheran University

Proofs and Mathematical Reasoning in the First Two Years of College
Wednesday (1/6) morning
Organizers: Joanne Peeples, El Paso Community College; Chris Oehrlein, Oklahoma City Community College; and Dean Gooch, Santa Rosa Junior College
Sponsor: MAA Committee on Two Year Colleges

Professional Development for Mathematicians: A Contributed Paper Session for MAA PREP
Organizers and Participants
Wednesday (1/6) afternoon
Organizers: Jon Scott, Montgomery
College; Barbara Edwards, Oregon State University; Nancy Hastings, Dickinson College; and Stan Yoshinobu, Cal Poly San Luis Obispo

**Sponsor:** MAA Committee on Professional Development

**Inquiry-Based Teaching and Learning**

**Friday (1/8) morning**

**Organizers:** Brian Katz, Augustana College; and Victor Piercey, Ferris State University

**Recreational Mathematics: Puzzles, Card Tricks, Games, Game Shows, and Gambling**

**Thursday (1/7) morning**

**Organizers:** Paul R. Coe, Sara B. Quinn, and Marion Weedermann, Dominican University

**Revitalizing Complex Analysis**

**Saturday (1/9) morning**

**Organizers:** Russell Howell, Western College; Paul Zorn, St. Olaf College; and Alan Noell, Oklahoma State University

**The Development and Adoption of Open Educational Resources for Teaching and Learning**

**Friday (1/8) afternoon**

**Organizers:** Benjamin Atchison, Framingham State University; and Jeremy Russell, the College of New Jersey

**GENERAL CONTRIBUTED PAPER SESSIONS**

**Wednesday, Thursday, Friday, and Saturday (1/6–1/9) morning and afternoon**

**Organizers:** Jennifer Beineke, Western New England University; Bem Cayco, San Jose State University; Timothy Comar, Benedictine University; and T. James Reid, University of Mississippi

The MAA’s General Contributed Paper Session covers all areas of mathematics, curriculum, and pedagogy. They are classified according to the following scheme.

- Assessment
- History or Philosophy of Mathematics
- Interdisciplinary Topics in Mathematics
- Mathematics and Technology
- Mentoring
- Modeling and Applications
- Outreach
- Teaching and Learning Developmental Mathematics
- Teaching and Learning Introductory Mathematics
- Teaching and Learning Calculus
- Teaching and Learning Advanced Mathematics
- Algebra
- Analysis
- Applied Mathematics
- Geometry
- Graph Theory
- Linear Algebra
- Logic and Foundations
- Number Theory
- Probability and Statistics
- Topology
- Other

**MAA Minicourses**

**MINICOURSE 1**

**Introductory Proposal Writing Short Course for Grant Applications to the NSF EHR/Division of Undergraduate Education**

**Tuesday (1/5), 9:00–11:00 a.m. and 2:00–3:00 p.m.**

**Presenters:** John Haddock, Teri Jo Murphy, and Lee Zia, Division of Undergraduate Education, National Science Foundation

Presenters will describe the general NSF grant proposal process and consider particular details relevant to programs in the Division of Undergraduate Education. This course is geared toward 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 affect undergraduate education in mathematics you should attend this session. This two-part short course will provide information on the specific components of an 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 reviewed. Participants should leave this minicourse with a draft of a project summary.

**MINICOURSE 2**

**Visual Topics in Undergraduate Complex Analysis**

**Part A. Wednesday (1/6), 4:45–6:45 p.m., Conference Center Tahoma 5**

**Part B. Friday (1/8), 3:30–5:30 p.m., Conference Center Tahoma 5**

**Presenters:** Michael Brilleslyper, U.S. Air Force Academy; and Michael Dorff, Brigham Young University

Complex analysis is a staple of the undergraduate mathematics curriculum. It is a beautiful mathematical subject that unifies and extends many topics from other courses. The course readily pulls together the theories of polynomial equations, differentiation, integration, and series, while also including geometry and function theory. Unfortunately, many undergraduate courses end right where the cool stuff starts. In this minicourse, the proposers intend to expose the participants to two of the myriad of topics that are possible: (1) the zeros of families of polynomials and (2) the dynamics and locations of zeros of families of polynomials. Both of these topics are accessible to an audience having familiarity with the basics of complex analysis. The course is aimed at instructors of complex variables who are looking for some interesting topics for their courses, mathematicians who want to start learning something about the proposed areas, and instructors looking for potential undergraduate research projects to do with their students. Participants will need to bring their own computers with a current version...
MINICOURSE 3
Designing and Implementing a Problem-Based Mathematics Course
Part A. Wednesday (1/6), 4:45–6:45 p.m., WSCC Tahoma 2
Part B. Friday (1/8), 3:30–5:30 p.m., WSCC Tahoma 2

Presenters: Gail Burrill, Michigan State University; Bowen Kerins, Educational Development Center; and Darryl Yong, Harvey Mudd College

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. The panelists will discuss the design of such a course, consider issues related to teaching the course, and describe how it might be implemented 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.

MINICOURSE 4
Teaching Mathematics with Sports Applications
Part A. Wednesday (1/6), 2:15–4:15 p.m., WSCC Tahoma 2
Part B. Friday (1/8), 1:00–3:00 p.m., WSCC Tahoma 2

Presenter: Rick Cleary, Babson College

This minicourse is designed to help participants who wish to develop a course in mathematics and sports, or to incorporate sports applications into existing courses. The depth of the problems will range from those that require little mathematical background (elementary probability, statistics, and combinatorics) that would be suitable in a first-year seminar or general education course, to more sophisticated topics (linear algebra, operations research, mathematics of finance) that can make up an elective for mathematics majors or minors. Examples will come from many different sports including baseball, basketball, football, figure skating, and distance running, depending on the interest of participants. Application topics will include strategy, ranking and judging, efficient scheduling, and optimization. Participants will find many of the issues are connected to essays in the MAA published book Mathematics and Sports edited by Joe Gallian.

Navajo Math Circles

Wednesday (1/6), 6:30–7:50 p.m.

Hundreds of Navajo children in recent years have found themselves at the center of a lively collaboration with mathematicians from around the world. The children stay late after school and assemble over the summer to study mathematics, using a model called math circles, which originated in Eastern Europe and which has proliferated across the United States. This notion of student-centered learning puts children in charge of exploring mathematics to their own joy and satisfaction, with potentially long-lasting results.

Navajo Math Circles is a one-hour film that is documenting the meeting of two worlds: that of some of the country’s most-accomplished mathematicians and math educators, with the children and teachers in the underserved, largely rural Navajo educational system. An eight-minute trailer gives a taste of the film.

The project is supported by the Mathematical Sciences Research Institute (MSRI) in Berkeley, California, with a generous grant from the Simons Foundation, and by Vision Maker Media (VMM), Lincoln, Nebraska, and by the Corporation for Public Broadcasting (CPB). Following this premiere screening at the 2016 Joint Mathematics Meeting, Vision Maker Media will work with the Corporation for Public Broadcasting to schedule a national broadcast.
summarized by the presenter, and the main statistical ideas of the activity will be explained to the participants.

The activities have been chosen so that they require minimal adaptation for a wide variety of classrooms and are easy to implement. Each activity includes goals, key ideas, prerequisite skills and concepts, connection to other statistical concepts, objectives, known student difficulties, and assessment questions. 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.

MINICOURSE 6
Getting Started in the Scholarship of Teaching and Learning

Part A. Thursday (1/7), 9:00–11:00 a.m., WSCC Tahoma 5
Part B. Saturday (1/9), 9:00–11:00 a.m., WSCC Tahoma 5

Presenters: Jacqueline M. Dewar and Curtis D. Bennett, Loyola Marymount University

This course will introduce participants to the scholarship of teaching and learning (SoTL) in mathematics and help them begin projects of their own. We describe a taxonomy of SoTL questions, provide examples of SoTL projects in mathematics, and discuss methods for investigation. Participants will learn about collecting and analyzing different types of evidence, dealing with human subjects requirements, and selecting venues for presenting or publishing their work. With the presenters’ guidance, participants interactively select and transform a teaching problem of their own into a question for scholarly investigation and identify several types of evidence to gather.

MINICOURSE 7
Making Sense of Calculus with Mapping Diagrams

Part A. Thursday (1/7), 1:00–3:00 p.m., WSCC Tahoma 1
Part B. Saturday (1/9), 1:00–3:00 p.m., WSCC Tahoma 1

Presenter: Martin Flashman, Humboldt State University

In this minicourse, participants will learn how to use mapping diagrams (MD) to visualize functions for many calculus concepts. For a given function, f, a mapping diagram is basically a visualization of a function table that can be made dynamic with current technology. The MD represents x and f(x) from the table as points on parallel axes, and arrows between the points indicate the function relation. The course will start with an overview of MDs and then connect MDs to key calculus definitions and theory including: linearity, limits, derivatives, integrals, and series. Participants will learn how to use MDs to visualize concepts, results, and proofs not easily realized with graphs for both single and multivariable calculus. Participants are encouraged to bring a laptop with wireless capability.

MINICOURSE 8
Algebraic Geometry: A Problem-Based Course

Part A. Wednesday (1/6), 2:15–4:15 p.m., WSCC Tahoma 5
Part B. Friday (1/8), 1:00–3:00 p.m., WSCC Tahoma 5

Presenters: Thomas Garrity, Williams College; and Ryan Brown, Georgia College

Participants will learn how to structure an introductory undergraduate course in algebraic geometry that is problem based (and hence an inquiry-based learning course). As algebraic geometry is one of the core subjects of mathematics, such a course allows undergraduates to be introduced to a tremendous amount of material. Further, such a course can be and has been taught either with an abstract algebra prerequisite or with an increase in student engagement within the classroom. This minicourse, intended for the novice user, will include small group discussion and hands-on development of active-learning strategies. Participants should bring digital copies of their own curriculum material so that strategies can be embedded into personal material during the workshop. Bring a laptop with wireless capability.

Sponsor: MAA-NCTM Joint Committee on Mutual Concerns
MINICOURSE 10
Directing Undergraduate Research
Part A. Thursday (1/7), 1:00–3:00 p.m., Convention Center Tahoma 5
Part B. Saturday (1/9), 1:00–3:00 p.m., Convention Center Tahoma 5
Presenter: Aparna Higgins, University of Dayton
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 11
Implementing Inquiry-Oriented Curricula for Linear Algebra, Differential Equations, and Abstract Algebra
Part A. Wednesday (1/6), 9:00–11:00 a.m., Convention Center Tahoma 2
Part B. Friday (1/8), 9:00–11:00 a.m., Convention Center Tahoma 2
Presenters: Estrella Johnson, Virginia Tech; Karen Keene, North Carolina State University; and Christy Andrews-Larson, Florida State University
This session is designed to inform and support instructors interested in implementing inquiry-oriented curriculum. By inquiry-oriented we mean that the students are engaging in authentic mathematical inquiry and the teachers are actively involved in inquiring into students’ mathematical thinking. This minicourse will have two components. In the first component, participants will engage with mathematical tasks from three different research-based inquiry-oriented curricula that have been developed for linear algebra, differential equations, and abstract algebra. The goals of this component are to familiarize participants with the curricular tasks, the nature of the instruction, and common ways of student thinking. The second component will focus on high-leverage teaching practices that can be used in any inquiry-oriented setting. Examples of such practices include leading whole class discussions and launching instructional tasks. The goals of this component are to provide instructors with opportunities to develop some of the necessary teaching practices needed to implement inquiry-oriented curricula.

MINICOURSE 12
Humanistic Mathematics
Part A. Wednesday (1/6), 9:00–11:00 a.m., Convention Center Tahoma 5
Part B. Friday (1/8), 9:00–11:00 a.m., Convention Center Tahoma 5
Presenters: Gizem Karaali, Pomona College; and Eric Marland, Appalachian State University
The phrase “humanistic mathematics” is historical, going back about 30 years and awakens many connotations in those who hear it. Indeed humanistic mathematics can include a broad range of topics; we use it in two distinct manners. First, as a scholarly perspective, humanistic mathematics describes an approach to mathematics that views it as a human endeavor and focuses on the paths of inquiry that study its aesthetic, cultural, historical, literary, pedagogical, philosophical, psychological, and sociological aspects.
Second, as a pedagogical stance, 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 will introduce participating mathematics faculty to the ideas and scholarship of humanistic mathematics, a body of literature that eschews disciplinary jargon (e.g., edu-speak) in favor of reaching a more diverse audience. As concrete outcomes, participants will
• Develop a viable plan for a liberal arts course that they can offer at their own campuses to invite many new students into the fascinating world of mathematics;
• Come up with ideas for possible scholarly projects in order to contribute to the ongoing conversations in the field;
• Connect with like-minded colleagues; as well as
• Get informed about possible venues of communication, collaboration, and dissemination of materials related to humanistic mathematics.

MINICOURSE 13
Introduction to Process-Oriented Guided Inquiry Learning (POGIL) in Mathematics Courses
Part A. Thursday (1/7), 1:00–3:00 p.m., Convention Center Tahoma 2
Part B. Saturday (1/9), 1:00–3:00 p.m., Convention Center Tahoma 2

Presenters: Zdeňka Guadarrama, Rockhurst University; Jill E. Guerra, University of Kansas Fort Smith; and Laurie Lenz, Marymount University

This workshop will introduce faculty to the guided inquiry instructional method called POGIL (Process-Oriented Guided Inquiry Learning). Participants will use hands-on activities to learn the crucial elements in a successful guided inquiry classroom. The workshop will provide participants with a basic introduction to facilitation techniques and an opportunity to reflect on how facilitation can enhance or interfere with student learning as well as how facilitation strategies can be critical in the development of student process skills. The participants will have the opportunity to examine a POGIL calculus activity and be introduced to the way the learning structure that is integrated into all POGIL activities is implemented in a mathematics specific activity. By the end of the workshop, participants will be trained to begin implementing guided inquiry activities in their own mathematics classrooms.

MINICOURSE 14
Teaching Quantitative Reasoning with Common Sense and Common Knowledge
Part A. Thursday (1/7), 9:00–11:00 a.m., Convention Center Tahoma 2
Part B. Saturday (1/9), 9:00–11:00 a.m., Convention Center Tahoma 2

Presenters: Maura B. Mast, University of Massachusetts Boston; and Ethan D. Bolker, University of Massachusetts Boston

Ten years from now, what do you want or expect your Quantitative Reasoning students to remember? Our answers to those questions profoundly shaped our approach to the course. We realized that in 10 years, what matters will be how students approach a problem using the tools they carry with them—common sense and common knowledge—not the particular mathematics we chose for the curriculum. This has changed how and what we teach. In this minicourse we will provide hands-on experience with class activities using our approach and practice creating examples and exercises from current news.

MINICOURSE 15
Teaching Statistics using R and RStudio
Part A. Thursday (1/7), 10:00 a.m.–noon, Convention Center Tahoma 1
Part B. Saturday (1/9), 10:00 a.m.–noon, Convention Center Tahoma 1

Presenter: Randall Pruim, Calvin College

R is a freely available language and environment for statistical computing and graphics that has become popular in academia and in many industries. But can it be used with students? This minicourse will introduce participants to teaching applied statistics courses using computing in an integrated way. The presenter has been using R to teach statistics to undergraduates at all levels for the last decade and will share an approach and some favorite examples. Topics will include workflow in the RStudio environment, providing novices with a powerful but manageable set of tools, data visualization, basic statistical inference using R, and resampling. Much of this will be facilitated using the mosaic package. The minicourse is designed to be accessible to those with little or no experience teaching with R and will provide participants with skills, examples, and resources that they can use in their own teaching. Participants should bring a laptop to the session.

MINICOURSE 16
Mobile Mathematics—Interactive Apps for Teaching and Learning
Part A. Wednesday (1/6), 4:45–6:45 p.m., Convention Center Tahoma 1
Part B. Friday (1/8), 3:30–5:30 p.m., Convention Center Tahoma 1

Presenters: Lila Roberts, Clayton State University; and Andrew G. Bennett, Kansas State University

Mobile devices have made their way into our lives and our classrooms. In this minicourse, participants will learn about various ways to integrate tablets and other mobile devices into mathematics courses. The presenters will demonstrate interactive resources that they have developed as well as other applications/materials that are ready made and easily available. In addition, participants will learn how to use various ways to develop new and/or adapt existing resources for their face-to-face and online classrooms. Bring your own mobile device and/or a wireless-capable laptop computer.
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With organizations under more pressure than ever to provide an instantaneous, personalized and secure online experience on any device, we need to re-think not only our content, but how it’s delivered.

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**MAA Panel Sessions**

Full descriptions of the panel sessions are online at [http://jointmathematicsmeetings.org/jmm](http://jointmathematicsmeetings.org/jmm).

**NSF Funding Opportunities for the Learning and Teaching of the Mathematical Sciences**

Part I: Undergraduate/Graduate Education, Department of Mathematics Infrastructure, and Human Resource Development (DUE/DGE/DMS/HRD)

*Wednesday (1/6), 8:00–9:15 a.m., WSCC Room 609*

**Organizers:** John Haddock and Lee Zia, Division of Undergraduate Education, NSF; Karen King, Division of Research on Learning, NSF; Tasha Inniss, Division of Human Resource Development, NSF; Jennifer Slimowitz Pearl, Division of Mathematical Sciences, NSF

**Sponsor:** MAA Committee on Professional Development

**MAA Session for Chairs: What Department Chairs Should Know about Teaching with Technology**

*Thursday (1/7), 9:00–10:20 a.m., WSCC Room 609*

**Organizers:** Catherine M. Murphy, Purdue University Calumet; and Daniel Maki, Indiana University

**Panelists:** Michael Gage, University of Rochester; Gavin LaRose, University of Michigan; and Peter Turbek, Purdue University Calumet

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**Advanced Placement Calculus Today: Opportunities and Challenges**

*Wednesday (1/6), 9:35–10:55 a.m., WSCC Room 612*

**Organizer:** Ben Hedrick, College Board

**Panelists:** Don King, Northeastern University; Dan Teague, North Carolina School of Science and Mathematics; Gail Burrill, Michigan State University; and Stephen Davis, Davidson University

**Career Options for Undergraduates**

*Thursday (1/7), 10:35–11:55 a.m., WSCC Room 609*

**Organizers:** Thomas P. Wakefield, Youngstown State University; and Kristine Roinestad, U.S. Census Bureau

**Panelists:** Thomas Grandine, Boeing Corp.; Katie Oliveras, Seattle University; and Marcia A. Ciol, University of Washington

**Sponsor:** Young Mathematicians Network

**College Calculus and the Preparation Gap: Identified Problems and Models for Improvement**

*Friday (1/8), 8:00–9:20 a.m., WSCC Room 612*

**Organizers:** Michael Boardman, Pacific University; Gail Burrill, Michigan State University; and David Bressoud, Macalester College

**Panelists:** David Bressoud, Macalester College; Deborah Hughes Hallett, Harvard University; Robin Cruz, College of Idaho; Dave Dwyer, University of Evansville; and Chad Topaz, Macalester College

**Sponsors:** MAA/NCTM Joint Committee on Mutual Concerns, College Board/MAA Joint Committee on Mutual Concerns

**Creating a Meaningful Calculus I Experience for Students Entering with High School Calculus**

*Wednesday (1/6), 8:00–9:20 a.m., WSCC Room 612*

**Organizer:** Alison Reddy, University of Illinois

**Panelists:** Michael Boardman, Pacific University; Randy McCarthy, University of Illinois; Robin Perman, University of Pennsylvania; and Uri Treisman, University of Texas

**Sponsors:** MAA/NCTM Joint Committee on Mutual Concerns, College Board/MAA Joint Committee on Mutual Concerns

**Developing Mathematical Concepts with Technology**

*Thursday (1/7), 10:35–11:55 a.m., WSCC Room 612*

**Panelists:** Wade Ellis, West Valley Community College; Tom Dick, Oregon State University; Andrew Bennett, University of Kansas; and Gail Burrill, Michigan State University

**Developing the MAA Pedagogy Guide**

*Wednesday (1/6), 2:15–3:35 p.m., WSCC Room 609*

**Organizer:** Martha Abell, Georgia Southern University

**Panelists:** Jacqueline Dewar, Loyola Marymount University; Gavin LaRose, University of Michigan; Carol Schumacher, Kenyon College; Lew Ludwig, Denison University; and Diana White, University of Colorado Denver

**Finding a Thesis Topic and Adviser**

*Wednesday (1/6), 3:50–5:10 p.m., WSCC Room 609*

**Organizers:** Nicholas Scoville, Ursinus College; and Emily Cilli-Turner, Salve Regina University

**Panelists:** Allison Henrich, Seattle University; and Brooke Shipley, University of Illinois at Chicago

**Sponsor:** Young Mathematicians Network

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Comprehensive information about the Joint Meetings is online: [http://jointmathematicsmeetings.org/meetings/national/jmm2016](http://jointmathematicsmeetings.org/meetings/national/jmm2016)
Friday (1/8), 8:00–9:20 a.m., WSCC Room 609
Organizer: Patti Frazer Lock, St. Lawrence University; Sue Schou, Idaho State University; and Randall Pruim, Calvin College
Panelists: Patti Frazer Lock, St. Lawrence University; Michelle Everson, Ohio State University; Chris Franklin, University of Georgia; and Beth Chance, Cal Poly San Luis Obispo
Sponsor: SIGMAA STAT ED

Improving the Preparation of Graduate Students to Teach Mathematics: An NSF-Funded Project
Wednesday (1/6), 3:50–5:10 p.m., WSCC Room 612
Organizer: Jessica Deshler, West Virginia University
Panelists: Jack Bookman, Duke University; Robin Gottlieb, Harvard University; Shandy Hauk, WestEd; Sarah Schott, Duke University; and Natasha Speer, University of Maine
Sponsor: MAA Committee on Professional Development

Instructional Strategies That Can Make a Difference
Friday (1/8), 9:35–10:55 a.m., WSCC Room 612
Panelists: Tom Dick, Oregon State University; Diane Priar, National Council of Teachers of Mathematics; Brian Hopkins, St. Peters University; and Darryl Yong, Harvey Mudd College
Sponsor: MAA/NCTM Joint Committee on Mutual Concerns

Interdisciplinary Modeling Experiences for Undergraduates
Thursday (1/7), 1:00–2:20 p.m., WSCC Room 609
Organizers: Amanda Beecher, Ramapo College of New Jersey; and Chris Arney, U.S. Military Academy

Is Online Inquiry-Based Learning (IBL) Possible?
Thursday (1/7), 2:35–3:55 p.m., WSCC Room 609
Organizers: Padraig McLoughlin, Kutztown University of Pennsylvania; and Perry Y. C. Lee, Kutztown University of Pennsylvania
Panelists: TBD

Learning from Each Other: International Perspectives on the Mathematical Education of Teachers
Friday (1/8), 1:00–2:20 p.m., WSCC Room 612
Organizers: Bonnie Gold, Monmouth University; and David C. Carothers, James Madison University
Panelists: Tad Watanabe, Kennesaw State University; Catherine B. Kessel, Mathematics Education Consultant, Berkeley, California; and William Schmidt, Michigan State University
Sponsor: MAA Committee on the Mathematical Education of Teachers (COMET)

Midcareer Faculty: Charting the Next Half of Your Career
Thursday (1/7), 1:00–2:20 p.m., WSCC Room 612
Organizer: Jenna P. Carpenter, Louisiana Tech University
Panelists: Jonathan K. Hodge, Grand Valley State University; Judith Covington, Louisiana State University at Shreveport; Annalisa Crannell, Franklin and Marshall College; Brigitte Lahme, Sonoma State University; and Ronald Taylor, Berry College
Sponsor: MAA Committee on Professional Development

Perspectives on IBL Teaching: Novice, Experienced, and Master
Friday (1/8), 9:35–10:55 a.m., WSCC Room 609
Organizers: Judith Covington, Louisiana State University at Shreveport; and Theron Hitchman, University of Northern Iowa
Panelists: Angie Hodge, University of Nebraska Omaha; Mitchel T. Keller, Washington and Lee University; and Carol Schumacher, Kenyon College

Summer Research Programs
Thursday (1/7), 2:35–3:55 p.m., WSCC Room 612
Organizers: Lloyd E. Douglas, Independent Consultant; William A. Hawkins Jr., MAA and University of the District of Columbia; and Robert Megginson, University of Michigan
Sponsor: MAA Committee on Minority Participation and the MAA Office of Minority Participation

Undergraduate Research as a Capstone Course
Friday (1/8), 1:00–2:20 p.m., WSCC Room 609
Organizers: Aklilu Zeleke, Michigan State University; James Solazzo, Coastal Carolina University; Michael Karls, Ball State University
Panelists: Anant Godbole, East Tennessee State University; Keshav Jagannathan, Coastal Carolina University; Rebecca Garcia, Sam Houston State University; and Sergio Loch, Grand View University
Sponsor: MAA Subcommittee on Research by Undergraduates

Renewing the First Two Years Curriculum: Calculus, Quantitative Reasoning, Statistics, Precalculus, and Developmental Mathematics
Friday (1/8), 2:35–3:55 p.m., WSCC Room 612
Organizer: Suzanne I. Dorée, Augsburg College
Panelists: Michael Axtell, University
of St. Thomas; Caren Diefenderfer, Hollins University; Patti Frazer Lock, St. Lawrence University; Rebecca Hartzler, Seattle Central College; and Bruce Yoshiwara, Pierce College

Sponsor: MAA Committee on Curriculum Renewal Across the First Two Years (CRAFTY)

Starting a New Track: Actuarial Science, Biomathematics, Environmental Science, Climate Studies
Saturday (1/9), 9:00–10:20 a.m., WSCC Room 609

Organizers: Julie Barnes, Western Carolina University; Martha Siegel, Towson University; and Linda McGuire, Muhlenberg College

Panelists: Jim Daniel, University of Texas at Austin; Tim Comar, Benedictine University; and Ben Galluzzo, Shippensburg University

Sponsors: MAA Committee on the Undergraduate Program in Mathematics (CUPM) and MAA Committee on Professional Development

A Common Vision for the Undergraduate Mathematics Program in 2025
Friday (1/8), 2:35–3:55 p.m., WSCC Room 609

Organizer: Karen Saxe, Macalester College

Panelists: Tara Holm, Cornell University; Helen Burn, Highline College; Rachel Levy, Harvey Mudd College; and Matthew Ando, University of Illinois Urbana–Champaign

International Engagement in Research and Education in the Mathematical Sciences
Saturday (1/9), 1:00–2:20 p.m., WSCC Room 609

Organizer: Overtoun Jenda, Auburn University

Panelists: Neal Koblitz, University of Washington; Overtoun Jenda, Auburn University; Suzanne Lenhart, University of Tennessee; Yuan Lou, Ohio State University; Fred Roberts, Rutgers University

Actuarial Science: Change Is the Norm!
Friday (1/8), 5:00–7:00 p.m., WSCC Room 609

Organizers: Patrick Brewer, Lebanon Valley College; Robert Buck, Slippery Rock University; Bettye Case, Florida State University; Kevin Charlwood, Washburn University; Michelle Guan, Indiana University Northwest; Steve Paris, Florida State University; and Sue Staples, Texas Christian University

Panelists: Steve Armstrong, Casualty Actuarial Society; Robert Buck, Slippery Rock University; Robert Fisette, Milliman; Caitlin Hendricks, Liberty Mutual; Stuart Klugman, Society of Actuaries; John Leo, Regence Group; and Steve Paris, Florida State University

What’s beyond the Curriculum?
Saturday (1/9), 10:35–11:55 a.m., WSCC Room 609

Organizer: Martha Siegel, Towson University

Sponsor: MAA Committee on the Undergraduate Program in Mathematics

Other MAA Sessions

MAA Department Liaisons Meeting
Wednesday (1/6), 9:30–11:00 a.m.

MAA Section Officers Meeting
Wednesday (1/6), 4:00–5:00 p.m.

Chair: Betty Mayfield, Hood College

Section officers will meet with members of the Committee on Sections and MAA staff to share information and discuss current initiatives.

SIGMAA Officers Meeting
Thursday (1/7), 10:30 a.m.–noon

Chair: Karen A. Marrongelle, Portland State University

Presentations by MAA Teaching Award Recipients
Friday (1/8), 2:30–3:50 p.m.

Winners of the Deborah and Franklin Tepper Haimo Awards for Distinguished College or University Teaching will give presentations on the secrets of their success.

Organizers: MAA Secretary Barbara Faires, Westminster College; and MAA President Francis Su, Harvey Mudd College

Project NExT Reception
Friday (1/8), 8:00–10:00 p.m.

All Project NExT fellows, consultants, and other friends of Project NExT are invited.

Organizers: Julia Barnes, Western Carolina University; Alissa Crans, Loyola Marymount University; Matt DeLong, Taylor University; David Kung, St. Mary's College of Maryland; and Anthony Tongen, James Madison University

MAA Business Meeting
Saturday (1/9), 11:10–11:40 a.m.

Chair: MAA President Francis Su, Harvey Mudd College

Mathematically Bent Theater
Friday (1/8), 6:00–7:00 p.m.

Performers: Colin Adams and the Mobiusbandaid Players

Is laughter the body’s attempt to eject excess phlegm? Why did Plato write dialogues instead of monologues? Who walked off with my copy of “Quasi-Linear Perturbations of Hamiltonian Klein-Gordon Equations on Spheres” at the AMS Fellows Reception at the San Antonio Joint Meetings? These are just a few of the questions we will not answer in this theatrical presentation of several short, mathematically inclined humorous pieces.

Poetry + Art + Math
Thursday (1/7), 5:30–7:00 p.m., WSCC Room 608

In the last few years, JMM attendees have enjoyed eclectic poetry readings. This year’s reading will be augmented by a guest lecture by Seattle mathematical artist/poet Michael Schultheis,
whose art will be displayed during the session. Come to share your poetry or simply enjoy the poetry-art-math! Though we can often accommodate last-minute decisions to participate, we encourage poets to submit poetry (up to three poems, totaling no longer than five minutes) and a bio in advance—and, as a result, be listed on our printed program. Submissions (by December 1) and inquiries may be made to Gizem Karaali (gizem.karaali@pomona.edu).

**Organizers:** Gizem Karaali, Pomona College; Lawrence M. Lesser, University of Texas at El Paso; and Douglas Norton, Villanova University

**Sponsors:** The Journal of Humanistic Mathematics and SIGMAA ARTS

**Backgammon!**

**Friday (1/8), 8:00—10:00 p.m.**

Learn to play backgammon from expert players. It’s a fun and exciting game where players with a good mathematics background have a decisive advantage. Boards and free lessons will be provided by members of the U.S. Backgammon Federation. Stop by anytime!

**Organizer:** Arthur Benjamin, Harvey Mudd College

**Find a Research Collaborator Social Hour**

**Thursday (1/7), 3:15—4:15 p.m., WSCC Room 608**

As freshly graduated PhDs will start their research career at a new institution, one of the obstacles observed is finding (1) collaborators in other departments or institutions, and (2) finding topics to work on. This event will consist of small group discussions based on research interests, with the goal of sharing ideas of how to find collaborators and topics, as well as possibly finding a collaborator during the event.

**Organizers:** Jacob White, Texas A&M University; and Timothy Goldberg, Lenoir-Rhyne University

**Sponsor:** Young Mathematicians Network

**Managing Your Own Course Social Hour**

**Friday (1/8), 4:00—5:00 p.m., WSCC Room 2A**

One of the many challenges facing new faculty members (and sometimes advanced teaching assistants) is managing their own courses. This event will consist of small group discussions based on types of courses and perhaps types of institutions, with the goal of sharing ideas and experiences about managing one's own course. This may also include discussions on creating a course.

**Organizers:** Jacob A. White, Texas A&M University; and Timothy Goldberg, Lenoir-Rhyne University

**Sponsor:** Young Mathematicians Network

**Pure and Applied Talks by Women Math Warriors Presented by EDGE (Enhancing Diversity in Graduate Education)**

**Friday (1/8), 8:00—10:55 a.m., WSCC Room 608**

Since its beginning in 1998, nearly 200 women have participated in the EDGE program. Approximately 70 are working toward a PhD, over 100 have earned master's degrees, and 57 have gone on to complete PhDs. This session will comprise research talks in various subdisciplines, given by women involved with the EDGE program. For more information on the EDGE program, see edgeforwomen.org.

**Organizers:** Candice R. Price, Sam Houston State University; and Amy L. Buchmann, Tulane University

**SIGMAA Sessions**

**SIGMAA Officers Meeting**

**Thursday (1/7), 10:30 a.m.—noon**

**Chair:** Karen A. Marrongelle, Portland State University

**SIGMAA on Statistics Education (SIGMAA STAT-ED)**

- **Reception (joint with SIGMAA QL):** Thursday (1/7), 5:30—6:00 p.m., Conference Center Yakima 1
- **Business Meeting:** Thursday (1/7), 6:00—6:45 p.m., Conference Center Yakima 1
- **Guest Lecture, Tim Hesterburg,** Google: Thursday (1/7), 6:50—7:40 p.m., Conference Center Yakima 1
- **Panel Session: Guidelines for Statistics Education:** Friday (1/8), 8:00—9:20 a.m., WSCC Room 609
- **Contributed Paper Session:** Innovative Targeted Solutions in Teaching Introductory Statistics: Thursday (1/7) afternoon
- **Contributed Paper Session:** New Ideas in Teaching Upper-Level Statistics Courses: Friday (1/8) afternoon

**SIGMAA on Quantitative Literacy (SIGMAA QL)**

- **Reception (joint with SIGMAA STAT-ED):** Thursday (1/7), 5:30—6:00 p.m., Conference Center Yakima 1
- **Business Meeting:** Thursday (1/7), 6:00—6:45 p.m., Conference Center Yakima 2
- **Contributed Paper Session:** Quantitative Literacy in the K-16 Curriculum: Wednesday (1/6) afternoon

**SIGMAA on the History of Mathematics (HOM SIGMAA)**

- **Business Meeting and Reception:** Wednesday (1/6), 5:30—6:20 p.m., WSCC Room 607
- **Guest Lecture:** James Evans, University of Puget Sound: Wednesday (1/6), 6:30—7:20 p.m., WSCC Room 607

Comprehensive information about the Joint Meetings is online: [http://jointmathematicsmeetings.org/meetings/national/jmm2016](http://jointmathematicsmeetings.org/meetings/national/jmm2016)
• Contributed Paper Session: The Contributions of Minorities to Mathematics throughout History: Friday morning
• Contributed Paper Session: Incorporating the History of Mathematics into Developmental Math Courses: Saturday (1/9) morning

SIGMAA on Mathematics Instruction Using the WEB (WEB SIGMAA)
• Business Meeting and Reception: Friday (1/8), 5:30–6:00 p.m., WSCC Room 2A
• Guest Lecture: Matthew Leingang, New York University: Friday (1/8), 6:00–6:50 p.m., WSCC Room 2A
Title: “Streamlining Assessment, Feedback, and Archival with Auto-Multiple-Choice”
Abstract: Auto-multiple-choice (AMC) is an open-source optical mark recognition software package built with Perl, LaTeX, XML, and sqlite. I use it for all my in-class quizzes and exams. Unique papers are created for each student, fixed-response items are scored automatically, and free-response problems, after manual scoring, have marks recorded in the same process. In the first part of the talk I will discuss AMC’s many features and why I feel it’s ideal for a mathematics course. My contributions to the AMC workflow include some scripts designed to automate the process of returning scored papers back to students electronically. AMC provides an email gateway, but I have written programs to return graded papers via the DAV protocol to student’s dropboxes on our (Sakai) learning management systems. I will also show how graded papers can be archived, with appropriate metadata tags, into an Evernote notebook.
• Poster Session: Me and My Gadgets—Teaching with Technology

SIGMAA on the Philosophy of Mathematics (POM SIGMAA)
• Contributed Paper Session: Philosophy to Teach Mathematics: Thursday (1/7) morning
• Reception: Thursday (1/7), 5:30–5:50 p.m., WSCC Room 617
• Business Meeting: Thursday (1/7), 6:00–6:20 p.m., WSCC Room 617
• Guest Lecture: Bonnie Gold, Monmouth University: Thursday (1/7), 6:30–7:20 p.m., WSCC Room 617

SIGMAA on Undergraduate Research (UR SIGMAA)
• Business Meeting: Thursday (1/7), 5:30–6:30 p.m., WSCC Room 304
• Guest Lecture: Leah Edelstein-Keshet, University of British Columbia: Thursday (1/7), 7:00–7:50 p.m., WSCC Room 304
• Contributed Paper Session: Trends in Undergraduate Mathematical Biology Education: Friday morning

SIGMAA on Mathematical and Computational Biology (BIO SIGMAA)
• Invited Paper Session: Current Trends in Mathematical and Computational Biology: Thursday (1/7), 9:00–11:20 a.m., WSCC Room 607
• Reception and Business Meeting: Thursday (1/7), 6:00–6:50 p.m., WSCC Room 304
• Guest Lecture: Leah Edelstein-Keshet, University of British Columbia: Thursday (1/7), 7:00–7:50 p.m., WSCC Room 304
• Contributed Paper Session: Trends in Undergraduate Mathematical Biology Education: Friday morning

SIGMAA on Math Circles for Students and Teachers (SIGMAA MCST)
• Math Circle Demonstration: Saturday (1/9), 11:00–11:50 a.m., WSCC Room 612
• Math Wrangle: Saturday (1/9), 1:00–2:30 p.m., WSCC Room 612
• Contributed Paper Session: The Broad Impact of Math Circles: Thursday (1/7) afternoon

SIGMAA on Teaching Advanced High School Mathematics (SIGMAA TAHSM)
• Contributed Paper Session: Helping Students See beyond Calculus: Saturday (1/9) afternoon

SIGMAA on Business, Industry, and Government (BIG SIGMAA)
• Contributed Paper Session: Mathematics Experiences and Projects in Business, Industry, and Government: Friday (1/8), afternoon
• Guest Lecture: Genetha Gray, Intel Corporation: Friday (1/8), 6:15–7:05 p.m., WSCC Room 2B
• Reception: Friday (1/8), 7:05–7:45 p.m., WSCC Room 2B
• Business Meeting: Friday (1/8), 7:45–8:15 p.m., WSCC Room 2B

Research in Undergraduate Mathematics Education (SIGMAA on RUME)
• Contributed Paper Session: Research in Undergraduate Mathematics Education: Thursday morning and afternoon

SIGMAA on Mathematics and the Arts (SIGMAA ARTS)
• Poetry+Art=Math: Thursday (1/7), 5:30–7:00 p.m.
• Contributed Paper Session: Mathematics and the Arts: Wednesday (1/6) morning and afternoon
Some sessions are cosponsored with other organizations. These are noted within the parentheses at the end of each listing, where applicable.

Advances in Free Analysis: The Theory and Applications of Noncommutative Functions, Inequalities, and Domains

Advances in the Theory and Application of Reaction Diffusion Models

Algebraic Theory of Differential and Functional Equations

Algebraic and Topological Methods in Combinatorics

Analysis and Geometry in Non-smooth Metric Measure Spaces

Analysis, Geometry, and Data

Analytic Function Spaces and Operators on Them

Analytic Methods in Geometry

Applications of Logic, Model Theory, and Theoretical Computer Science to Systems Biology

Applied and Computational Topology

Arithmetic Dynamics

Big Demand for Big Data: How Do We Create the Big Supply?

Classification Problems in Operator Algebras

Combinatorial Design Theory

Commutative Algebra (AMS-AWM)

Commutative Algebra and Its Interactions with Algebraic Geometry (AMS-AWM)

Commutative Algebra, I (a Mathematics Research Communities Session)

Current Areas of Interest in the Mathematical Sciences of Medieval Islam

Data-Intensive Modeling in Ecology

Difference Equations and Applications

Differential Equations, Probability, and Sea Ice, I (a Mathematics Research Communities Session)

Distribution of Zeros of Entire Functions

Early-Career Female Mathematicians in Algebra and Topology

Equations of Fluid Motion

Essential Mathematical Structures and Practices in K-12 Mathematics

Financial Mathematics, I (a Mathematics Research Communities Session)

Fractal Geometry and Dynamical Systems

Geometric and Categorical Methods in Representation Theory

Global Harmonic Analysis

Graduate Mathematics Courses and Programs for Secondary Mathematics Teachers

Graph Products

Higher Genus Curves and Fibrations of Higher Genus Curves in Mathematical Physics and Arithmetic Geometry

Innovative Ideas in Enhancing Success in Mathematics Classes (AMS-MAA)

Integrable Systems, Painlevé Equations, and Random Matrices

Interactions between Noncommutative Algebra, Algebraic Geometry, and Representation Theory

Knots in Washington (State)

Mathematical Information in the Digital Age of Science

Mathematical Programming on Integral Invexity

Mathematics and Public Policy

Mathematics in Natural Resource Modeling

Metrical and Topological Fixed Point Theory with Applications

Modular Forms, q-Series, and Mathematics Inspired by Ramanujan

Moduli Spaces in Algebraic Geometry

Moduli Spaces in Symplectic Geometry

Nonlinear Algebra

Nonlinear Waves and Coherent Structures

Number Theory and Cryptography

Operators, Function Spaces, and Models

Origami Methods and Applications

Parabolic Geometries, Twistor Theory, and the AdS/CFT Correspondence

Partial Differential Equations in Complex Analysis

Problems and Challenges in Financial Engineering and Risk Management

Problems in Geometry and Design of Materials

Pseudorandomness and Its Applications

Quantum Walks, Quantum Markov Chains, Quantum Computation, and Related Topics

Random and Complex Dynamics of Reaction-Diffusion Systems

Recent Advances in Dynamical Systems and Mathematical Biology

Recent Advances in Orthogonal Polynomials and Special Functions

Recent Developments in Dispersive Partial Differential Equations and Harmonic Analysis

Representation Theory of Algebraic Groups

Research by Postdocs of the Alliance for Diversity in Mathematics

Research from the 2014 and 2015 Rocky Mountain–Great Plains Graduate Research Workshop in Combinatorics

Research in Mathematics by Undergraduates and Students in Postbaccalaureate Programs (AMS-MAA-SIAM)

Set-Valued Optimization and Variational Problems with Applications
MAA Poster Sessions

Project NExT–YMN Poster Session
Wednesday (1/6), 2:15–4:15 p.m., WSCC Hall 4A
Organizers: Thomas Wakefield, Youngstown State University; and Jonathan Needleman, LeMoyne College

This session is intended to highlight the research activities, both mathematical and pedagogical, of recent or future master’s/PhDs in mathematics and related fields. The organizers 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. The poster size will be 48” wide by 36” high. Poster boards and materials for posting pages on the posters will be provided on site.

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 PhD or master’s degree, and your current college or university affiliation to the organizers. Potential applicants should send a poster abstract to one of the organizers, Thomas Wakefield, tpwakefield@ysu.edu, or Jonathan Needleman, needlejs@lemoyne.edu, to apply for the session. The deadline for submissions is December 15.

Sponsors: Young Mathematicians Network and Project NExT

Mathematical Outreach Programs
Thursday (1/7), 10:00 a.m.–noon, WSCC Hall 4A
Organizer: Betsy Yanik, Emporia State University

This session will feature principal investigators (PIs) presenting progress and outcomes from various NSF-funded projects in the Division of Undergraduate Education. The poster 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.

Projects Supported by the NSF Division of Undergraduate Education
Thursday (1/7), 2:00–4:00 p.m., WSCC Hall 4A
Organizer: Jon Scott, Montgomery College

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.

MAA Student Poster Session
Friday (1/8), 4:30–6:00 p.m., WSCC Hall 4A
Organizer: Joyati Debnath, Winona State University

AMS Sessions for Contributed Papers

There will be sessions of 10-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.

AMS Sessions for Contributed Papers

Special Functions and q-Series
Stochastic Effects in Models for Mathematical Biology and Ecology
Stochastic Models in Population Biology
Surreal Numbers (AMS-ASL)
Tensor Decompositions and Secant Varieties
The History of Mathematics (AMS-MAA)
The Mathematics of Computation
Topological Graph Theory: Structure and Symmetry
Topological Representation Theory
Water Waves
What’s New in Group Theory?

AMS Poster Sessions

Project NExT–YMN Poster Session
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MAA Student Poster Session
Friday (1/8), 4:30–6:00 p.m., WSCC Hall 4A
Organizer: Joyati Debnath, Winona State University
This session features research done by undergraduate students.

Questions regarding this session should be directed to Joyati Debnath (jdebnath@winona.edu).

**Me and My Gadgets—Teaching with Technology**
*Saturday (1/9), 10:00-11:55 a.m.*

Constantly changing technology presents an exciting and shifting opportunity to engage students and improve learning. This electronic poster session will consist of live, interactive demonstrations of applets, widgets, or other technology for teaching mathematics. Rather than preparing a traditional printed poster, presenters will showcase how students engage mathematics through their application using some electronic device such as a tablet, smartphone, or laptop. Preference will be given to presenters demonstrating their own or new applications or to novel approaches in using existing ones. In addition to the active displays, all participants will give a three- to five-minute “Lightning Talk” to demonstrate their application, highlighting where it fits into a mathematics curriculum. These will be scheduled in the middle of the session and included in the program. Potential presenters must submit a detailed description of their application to jmm2016-gadgets@google groups.com and receive approval from the organizers for inclusion in this session. The deadline for submission is December 15.

**Organizer:** John Travis, Mississippi College; Karl Schmitt, Valparaiso University; Tom Hagedorn, College of New Jersey; and Michael Scott, California State University Monterey Bay

**Sponsors:** MAA Committee on Technology in Mathematics Education and WEB SIGMAA

**MAA Sessions for High School Students and Teachers**

**How to Think Brilliantly and Creatively in Mathematics: A Guide for K-12 Educators and Their Students**
*Saturday (1/9), 8:00–8:50 a.m., WSCC Room 612*

**Speaker:** James Tanton, MAA

This lecture is a guide for thinking brilliantly and creatively in mathematics for K-12 educators, their students, and all seeking joyful mathematics doing. How do we model and practice uncluttered thinking and joyous doing in the classroom? Pursue deep understanding over rote practice and memorization? Develop the art of successful flailing? Our complex society demands of its next generation not only mastery of quantitative skills, but also the confidence to ask new questions, explore, wonder, flail, persevere, innovate, and succeed. Let’s not only send humans to Mars—let’s teach our next generation to solve problems and get those humans back if something goes wrong! In this talk, James Tanton will explore five natural principles of mathematical thinking. We will all have fun seeing how school mathematical content is the vehicle for ingenuity and joy. All are so welcome to attend!

**Organizer:** Deanna Haunsperger, Carleton College

**Sponsor:** MAA Council on Outreach

**Math Circle Demonstration**
*Saturday (1/9), 11:00–11:50 a.m., WSCC Room 612*

**Presenter:** Zvezdelina Stankova, Mills College; Berkeley Math Circle Director

A math circle is an enrichment experience that brings mathematics professionals in direct contact with precollege students and/or their teachers. Circles foster passion and excitement for deep mathematics. This demonstration session offers the opportunity for conference attendees to observe and then discuss a math circle experience designed for local students. While students are engaged in a mathematical investigation, mathematicians will have a discussion focused on appreciating and better understanding the organic and creative process of learning that circles offer, and on the logistics and dynamics of running an effective circle.

**Organizers:** Zvezdelina Stankova, Mills College; Tatiana Shubin, San Jose State University; and Paul Zeitz, University of San Francisco

**Sponsor:** SIGMAA MCST

**High School Quadratics: How to Think about and Do Everything about Them Brilliantly and Creatively**
*Saturday (1/9), 9:15–10:45 a.m., WSCC Room 612*

**Presenter:** James Tanton, MAA

James Tanton will now put brilliant and creative thinking practices into an actual high school topic: the study of quadratics in Algebra II. Let’s see how to bring the light of ease and joyful doing into this standard classroom unit. By letting go of a focus on jargon and memorization, we can help our students develop the confidence to “nut their way” through questions and challenges, to engage in problem solving, and to develop the confidence to persevere. We can teach our students to be confident and agile thinkers and still master the curriculum content they are required to know. This workshop will model the presentation of the entire standard quadratics content, illustrating how doing less leads to more!

**Organizer:** Deanna Haunsperger, Carleton College

**Sponsor:** MAA Council on Outreach
Math Wrangle  
**Saturday (1/9), 1:00–2:30 p.m., WSCC Room 612**  
Math Wrangle will pit teams of students against each other, the clock, and a slate of great math problems. The format of a Math Wrangle is designed to engage students in mathematical problem solving, promote effective teamwork, provide a venue for oral presentations, and develop critical listening skills. A Math Wrangle incorporates elements of team sports and debate, with a dose of strategy tossed in for good measure. The intention of the Math Wrangle demonstration at the Joint Mathematics Meetings is to show how teachers, schools, circles, and clubs can get students started in this exciting combination of mathematical problem solving with careful argumentation via public speaking, strategy, and rebuttal.  
**Organizers:** Mark Saul, MAA American Math Competitions; and Ed Keppelmann, University of Nevada Reno  
**Sponsors:** SIGMAA-MCST and MAA American Mathematics Competitions

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### MAA Ancillary Workshops

#### National Research Experiences for Undergraduates Workshop  
**Tuesday, January 5, 9:00 a.m.–4:30 p.m.**  
This workshop will teach participants how to write a competitive grant proposal. This workshop is a hands-on experience where participants write a summary of a proposal and rate an NSF-awarded proposal in a mock panel review. Participants will also learn many helpful hints and fatal flaws to proposal writing. This workshop is appropriate for current principal investigators of MAA's NREUP grants and for those who were denied funding for an MAA grant. Advanced registration is required. Send an email to the organizer at dennis.davenport@howard.edu to register for the workshop.

**Organizer:** Dennis Davenport, Howard University

#### Bringing Passion to your Introductory Statistics Classroom: A Supportive, Multidisciplinary Project-Based Approach  
**Monday, January 4, 9:00 a.m.–4:30 p.m.**  
**Presenter:** Lisa Dierker, Wesleyan University  
This workshop will support instructors who teach an introductory statistics or quantitative research course in designing or redesigning any or all portions of their course to engage students in the rich, complicated, decision-making process of real statistical inquiry. Core features of this passion-driven, flipped-classroom approach include providing opportunities for students to flexibly apply their statistical knowledge in the context of real data, the use of computing as a window to core statistical concepts, supporting students with varying levels of preparation, and attracting and inspiring students from under-represented groups. The workshop will include very brief presentations focused on the nuts and bolts of supporting project-based experiences, followed by ample hands-on opportunities that will be supported by experienced faculty and students. Similar to the approach that will be presented, your experience in the workshop will be individualized to your own interests, background, and needs.  
Advance registration (but no fee) is required. Go to causeweb.org/workshop to register.  
**Organizers:** Lorey Burghard, Pennsylvania State University; Lisa Dierker, Wesleyan University; and Dennis Pearl, Pennsylvania State University  
**Sponsor:** Consortium for the Advancement of Undergraduate Statistics Education (CAUSE)

#### Teaching the Statistical Investigation Process with Randomization-Based Inference  
**Tuesday, January 5, 9:00 a.m.–4:30 p.m.**  
**Presenters:** Nathan Tintle, Dordt College; Todd Swanson, Hope College; and Robin Lock, St. Lawrence University  
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 that 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. The presenters will also offer implementation and assessment suggestions during these activity-based sessions and discussion sessions based on presenters’ experiences with randomization-based curricula in their own classrooms. More information about the project on which this workshop is based can be found at math.hope.edu/isi.  
Advance registration (but no fee) is required. Go to causeweb.org/workshop to register.  
**Organizers:** Lorey Burghard, Pennsylvania State University; and Dennis Pearl, Pennsylvania State University  
**Sponsor:** Consortium for the Advancement of Undergraduate Statistics Education (CAUSE)
Social Events

Full information about these events is at the JMM 2016 website: http://jointmathematicsmeetings.org/meetings/national/jmm2016/2181_social.

All events listed are open to all registered participants. 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 percent refund by returning your tickets to the Mathematics Meetings Service Bureau (MMSB) by January 2, 2016. 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.

Activities for Undergraduates

A list of activities intended for undergraduates is on the JMM website, including the Radical Dash: jointmathematicsmeetings.org/meetings/national/jmm2016/2181_students

2016 AMS Dinner Celebration
Saturday (1/9), 6:30 p.m.
Reception at 6:30 p.m. and doors open at 7:30 pm. Tickets are $69 including tax and gratuity. The student ticket price is $29.

Association of Christians in the Mathematical Sciences (ACMS) Reception and Lecture
Thursday (1/7), 5:30–7:30 p.m.

Association of Lesbian, Gay, Bisexual, and Transgendered Mathematicians Reception
Thursday (1/7), 6:00–8:00 p.m.

Association for Women in Mathematics Reception and Awards Presentation
Reception, which is open to all JMM attendees: 9:30 p.m. following the AMS Gibbs Lecture. Recognition of prize winners: 10:00 p.m.

Backgammon!
Organizer: Arthur Benjamin, Harvey Mudd College
Friday (1/8), 8:00–10:00 p.m.

Budapest Semesters in Mathematics Annual Alumni Reunion
Friday (1/8), 6:00–7:30 p.m.
Informational Session, Friday (1/8), noon–1:00 p.m.

University of Chicago, Mathematics Alumni Reception
Thursday (1/7), 6:00–7:00 p.m.

Reception for Graduate Students and First-Time Participants
Wednesday (1/6), 5:30–6:30 p.m.
Sponsors: AMS and MAA

Knitting Circle
Thursday (1/7), 8:00–9:30 p.m.

EMP Museum and the Seattle Space Needle share acreage on the Seattle Center Grounds.
MAA/Project NExT Reception
Friday (1/8), 8:00–10:00 p.m.
Organizers: Julia Barnes, Western Carolina University; Alissa Crans, Loyola Marymount University; Matt DeLong, Taylor University; Dave Kung, St. Mary’s College of Maryland; and Anthony Tongen, James Madison University.

MAA Two-Year College Reception
Thursday (1/7), 5:45–7:00 p.m.

Mathematical Reviews Reception
Friday (1/8), 6:00–7:00 p.m.

Mathematical Institutes Open House
Wednesday (1/6), 5:30–8:00 p.m.

MSRI Reception for New and Prospective MSRI Donors
Thursday (1/7), 6:30–8:00 p.m.
For more information, contact: Heike Friedman, director of development, hfriedman@msri.org; 510-643-5056.

National Association of Mathematicians Banquet
Friday (1/8), 6:00–8:40 p.m.

NSA Women in Mathematics Society Networking Session
Thursday (1/7), 6:00–8:00 p.m.

Pennsylvania State University Mathematics Alumni Reception
Thursday (1/7), 5:30–7:30 p.m.

SIMIODE Reception
Friday (1/8), 7:00–9:00 p.m.

Student Hospitality Center
Wednesday–Friday (1/6–1/8), 9:00 a.m.–5:00 p.m., and Saturday (1/9), 9:00 a.m.–3:00 p.m.
Sponsor: MAA Committee for Undergraduate Student Activities

Reception for Undergraduates
Wednesday (1/6), 4:00–5:00 p.m.

Registering in Advance

Comprehensive information is online at the the JMM 2016 website. The importance of registering for the meeting cannot be overemphasized. Advanced registration fees are considerably lower than on-site registration fees. Badges are required to enter the Joint Mathematics Meetings (JMM) Exhibits, the Employment Center, and to obtain discounts at the AMS and MAA book sales and cash a check with the Joint Meetings cashier.

Participants who register by November 17 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 Registration and Housing Form.

Materials cannot be mailed to Canada, Mexico, or other countries outside of the United States. Participants from these countries must pick up their materials at the Joint Meetings Registration Desk on the fourth floor of the Washington State Convention Center. A replacement fee of $5 will be charged for programs and badges that were mailed but not brought to the meeting.

Online Registration: The form to register for the meeting and to reserve a hotel room online is located at jointmathematicsmeetings.org/meetreg?meetnum=2181. VISA, MasterCard, Discover, and American Express are the only methods of payment accepted for online registrations, and charges to credit cards will be made in U.S. funds. All registration acknowledgments will be sent by email to all email addresses provided.

Paper Form Registration: The form to register for the meeting and to reserve a hotel room by paper is at jointmathematicsmeetings.org/meetings/national/jmm2016/jmm16_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 security reasons, credit card numbers by email or fax cannot be accepted. If a participant is registering by paper form and would like to pay for the registration or guarantee your hotel reservation by credit card, he or she should indicate this on the form and someone from the MMSB will call that person.

Participant Lists and Mailing Lists: If any participant would like to opt-out of any mailing lists or participant lists that are generated for the meeting, he or she should check the appropriate box on the Registration and Housing Form. All participants who do not opt-out will be included in all mailing lists and participant lists that are generated and distributed for the meeting.

Cancellation Policy: Participants who cancel for the meetings, minicourses, or short course by December 31 will be eligible to receive a 50 percent refund of fees paid. Participants who cancel their banquet tickets by January 2, 2016, will be eligible for a 50 percent refund. No refunds are available after these deadlines.

Registration Category Definitions
Full-Time Students
Graduate Student Member
Undergraduate Student Member
Emeritus
Librarian
Unemployed
Developing Country Participant
Temporarily Employed
Nonmathematician Guest
Commercial Exhibitor

Registration Deadlines
EARLY meetings registration (free room drawing): November 2.
ORDINARY meeting registration (hotel reservations, materials mailed): November 17.
FINAL meeting registration (advanced registration, short course, minicourses, and banquets): December 22.
Early Registration: Participants who register by the early deadline of November 2 will be included in a random drawing to select winners.
of complimentary hotel room nights during the meeting. Rooms with multiple occupants will be included in the drawing. The location of these rooms will be based on the number of complimentary room nights earned in the various hotels. Therefore, a free room will not necessarily be in the winner’s first-choice hotel. All winners will be notified by phone and email prior to December 22, so register early!

**Ordinary Registration:** Participants who register after November 2 and by the ordinary deadline of November 17 may use the housing services offered by the MMSB but are not eligible for the free room drawing. They may also elect to receive their badges and programs by mail in advance of the meeting (U.S. participants only).

**Final Registration:** Participants who register after November 17 and by the final deadline of December 22 must pick up their badges, programs, and any tickets for social events at the meeting. Unfortunately, it is sometimes not possible to provide final participants with housing, so everyone is strongly urged to make their hotel reservations by November 17. The final deadline of December 22 is firm. Any forms received after that date will be returned with full refunds. Registration materials may be picked up at the Meetings Registration Desk on the fourth floor of the Washington State Convention Center.

**Miscellaneous Information**

**Audio-Visual Equipment:** A projection screen is included as standard equipment in all session rooms. Invited 50-minute speakers are automatically provided with an ELMO visual presenter (document camera/projection), and a laptop projector; AMS Special Sessions and Contributed Papers, and MAA Invited and Contributed Paper Sessions, are provided with a screen and a laptop projector. Blackboards are not available, nor are Internet connections 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 audiovisual equipment can be provided for committee meetings or other meetings or gatherings not on the scientific program.

**Child Care:** The AMS and the MAA will provide reimbursement grants of US$250 per family to help with the cost of child care for a number of registered participants at JMM2016. The funds may be used for child care that frees a parent to participate more fully in JMM.

Information about child care grants and deadlines for requesting support will be available prior to the opening of advance registration in September; watch the website at joinmathematicsmeetings.org/meetings/national/jmm2016/2181_childcare.

**Email Services:** Limited email access for all Joint Meetings participants will be available in an email center located near the JMM Registration Desk, Atrium Lobby, on the fourth level in the Washington State 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 in Skybridge (Hall 4D), fourth level of the 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 AMS director of meetings and conferences.

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 $50 (posters are slightly higher) per item. Please contact the exhibits coordinator, 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 visitseattle.org.

**Photograph and Video Policy:** The videotaping of any AMS or joint sponsored events, talks, and sessions is strictly forbidden without the explicit written permission of the AMS director of meetings and conferences. The policy for videotaping of any MAA events, talks, and sessions is posted at www.maa.org/about-maa/policies-and-procedures/recording-or-broadcasting-of-maa-events.

Photographs and videos of meeting interactions will be taken by professional photographers hired by the Joint Mathematics Meetings or by AMS and MAA staff. These photographs and videos may occasionally be used for publicity purposes. By participating in the Joint Mathematics Meetings, attendees acknowledge that their photograph or a video that includes them may be published in material produced by the Joint Meetings, AMS or MAA. AMS and MAA are not responsible for unauthorized photographs or other images not taken by professional photographers hired by the Joint Mathematics Meetings or AMS and MAA staff.

**Telephone Messages:** It will be possible to leave a message for any registered participant at the meetings registration desk from January 6 through 9 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
Seattle is on Pacific Time. The principal airport is the Seattle-Tacoma International Airport (SEA, frequently referred to as Sea-Tac) which is served by all major airlines. The website for Seattle-Tacoma International airport is portseattle.org/Sea-Tac/Pages/default.aspx, and the street address is 17801 International Boulevard, SeaTac, WA, 98158. It is approximately 12 miles from downtown Seattle.

The 2016 Joint Mathematics Meetings will be held in the Washington State Convention Center, 800 Convention Place, Seattle, WA, 98101. The main entrance is on Eighth Avenue between Pike and Seneca.

Airline
The official airline for this meeting is Delta. Participants are encouraged to book their flights for the meeting, if possible, with Delta and receive special pricing (in most cases, a 5 percent discount) on scheduled service to Seattle. Discounts are applicable to U.S.- and Canada-originating passengers. This discount is not valid with other discounts, certificates, coupons, or promotional offers.

To make a reservation, go to delta.com, and click on the box that says “Book a Trip.” At the bottom of the drop-down, click on “Advanced Search” (includes Flexible Airport and Meeting Event Code). On the reservation screen, please enter the Meeting Event Code NMLNH. It is located to the right of “Number of Passengers.” Reservations can also be made by calling Delta Meeting Network Reservations at 800-328-1111 and citing the meeting event code. A direct ticketing charge will apply for booking by phone.

Ground Transportation
Car Rental: All major rental car companies have offices at the Sea-Tac airport. There is a separate rental car facility with dedicated shuttle buses operating on a 24-hour-a-day schedule. Two passenger pick-up areas are located outside baggage claim at the north and south ends of the main terminal. Proceed to the baggage claim level and pick up your checked bags. Exit the sliding glass doors near either carousel 1 or 15 and walk to one of the two designated shuttle bus pick-up areas for transportation to the rental car facility.

Hertz is the official car rental company for the meeting. A brochure with the information for this meeting is located at jointmathematicsmeetings.org/Hertz-info-Seattle.pdf. To access the JMM special meeting rates at www.hertz.com, enter the standard information (pickup location, dates, etc.) and then click the box that says “Enter a discount or promo code” and enter 04N30006 as the convention number (CV#). Reservations can also be made by calling Hertz directly at 800-654-2240 (US 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. Vehicles must be returned to the renting location. Minimum rental age is 20 (age differential charge for 20–24 applies).

Weekend rentals are available in the continental U.S. and Canada for pickup between noon Thursday and noon Sunday and must be returned no later than Monday at 11:59 p.m. Thursday pick-up requires a minimum three-day keep. Friday pick-up requires a minimum two-day keep, and Saturday and Sunday pick-up require a one-day keep. Weekly rentals are from five to seven days. Extra day rate for weekly rentals will be one-fifth the Weekly Rate.

Taxi: The taxi stand is on the third floor of the airport garage. The phone number for Seattle Yellow Cab is 206-622-6500, and the website is seattleyellowcab.com/seatac-taxi-rides/. One-way fare to the downtown area is approximately $45.

Seattle Sound Transit Link Light Rail: The SeaTac/Airport Station is connected to the fourth floor of the airport parking garage by a covered walkway. Wheelchair service is available. Take the train at SeaTac/Airport station and go to the end of the line at Westlake Center. Westlake Center is located at 4th Avenue and Pine Street. To go to the Sheraton Seattle from Westlake Center, go 1/2 block east on Pine Street, and 2 blocks south on Sixth Avenue. Trains run every 8–15 minutes from 5:00 a.m. to 1:00 a.m. on weekdays, and every 15 minutes on Saturday. On Sunday, the trains run from 6:00 a.m. to midnight. One way fare is currently $2.75. The trip takes approximately 35 minutes. The schedule and more information is located at soundtransit.org/Schedules/Link-light-rail.

Downtown Airporter Shuttle: The Downtown Airporter/Shuttle Express picks up and drops off at the inner drive curb on the third floor of the airport garage. It departs twice an hour from 6:30 a.m. to 9:00 p.m., with service to and from many downtown Seattle hotels, including the Crowne Plaza, Fairmont Olympic, Grand Hyatt, Renaissance Seattle, Seattle Sheraton, and the Westin Hotel. Online reservations are required. The fare is approximately $19 one way, and the trip can take up to an hour, depending on traffic. Share ride and private service is also available. Call 425-981-7000 or go to shuttleexpress.com/seattle/airport/downtown-airporter for more detail.

Parking: The Washington State Convention Center operates two parking garages, the WSCC Garage and the Freeway Park Garage. The WSCC Garage entrance is on Eighth Avenue between Pike and Seneca, and it is open daily between 5:30 a.m. and midnight. The entrance to the Freeway Park Garage is on Hubbell Place between Pike and Seneca. It is open Monday–Friday, 5:30 a.m. to 8:00 p.m. Directions to the parking garages and rates are at wscconline.com/ parking-directions. The parking map is located at wscconline.com/sites/default/ files/find-it/files/2014.09.09_FIND_IT_ Parking_map.pdf.

See hotel page for details on parking at the hotels.

Welcoming Environment Policy

The AMS and MAA strive to ensure that participants in the Joint Mathematics Meetings enjoy a welcoming environment. In all JMM activities, the two organizations seek to foster an atmosphere that encourages the free expression and exchange of ideas. The AMS and MAA support equality of opportunity and treatment for all participants, regardless of gender, gender identity or expression, race, color, national or ethnic origin, religion or religious belief, age, marital status, sexual orientation, disabilities, or veteran status.

Harassment is a form of misconduct that undermines the integrity of JMM activities as well as the AMS and MAA missions. The AMS and MAA will make every effort to maintain an environment that is free of harassment, even though they do not control the behavior of third parties. A commitment to a welcoming environment is expected of all attendees at JMM activities, including mathematicians, students, guests, staff, contractors and exhibitors, and participants in scientific sessions and social events.

To this end, the AMS and MAA will include a statement concerning their expectations toward maintaining a welcoming environment in registration materials, and have put in place a mechanism for reporting violations. Violations may be reported confidentially and anonymously to 855-282-5703 or at mathsociety.ethicspoint.com. The reporting mechanism ensures the respect of privacy while alerting the AMS and MAA to the situation.
## 2016 Joint Mathematics Meetings Advance Registration/Housing Form

### 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(es) given here. Check this box to receive a copy in U.S. Mail:

Affiliation for badge
Nonmathematician guest badge name:

I DO NOT want my program and badge to be mailed to me on 12/11/15. (Materials will be mailed to the address listed above unless you check this box.)

### Registration Fees

**Membership** please ✓ all that apply. First row is eligible to register as a member. For undergraduate students, membership in PME and KME also applies.

- AMS ✓ MAA ✓ ASL ✓ CMS ✓ SIAM
- Undergraduate Students Only: ✓ PME ✓ KME
- Other Societies: ✓ AWM ✓ NAM ✓ YMN ✓ AMATYC

#### Joint Meetings

<table>
<thead>
<tr>
<th>Membership</th>
<th>by Dec 22</th>
<th>at mtg</th>
<th>Subtotal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Member AMS, MAA, ASL, CMS, or SIAM</td>
<td>US$262</td>
<td>US$371</td>
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</tr>
<tr>
<td>Nonmember</td>
<td>US$448</td>
<td>US$571</td>
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<tr>
<td>Graduate Student Member (AMS, MAA ASL, CMS, or SIAM)</td>
<td>US$63</td>
<td>US$74</td>
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</tr>
<tr>
<td>Graduate Student (Nonmember)</td>
<td>US$101</td>
<td>US$12</td>
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<tr>
<td>Undergraduate Student (Member AMS, ASL, CMS, MAA, PME, KME, or SIAM)</td>
<td>US$63</td>
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<tr>
<td>Undergraduate Student (Nonmember)</td>
<td>US$101</td>
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<tr>
<td>High School Student</td>
<td>US$6</td>
<td>US$12</td>
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<tr>
<td>Unemployed</td>
<td>US$63</td>
<td>US$74</td>
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<tr>
<td>Temporarily Employed</td>
<td>US$230</td>
<td>US$263</td>
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<tr>
<td>Developing Countries Special Rate</td>
<td>US$63</td>
<td>US$74</td>
<td></td>
</tr>
<tr>
<td>Emeritus Member of AMS or MAA</td>
<td>US$63</td>
<td>US$74</td>
<td></td>
</tr>
<tr>
<td>High School Teacher</td>
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<td>US$74</td>
<td></td>
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<td>Librarian</td>
<td>US$63</td>
<td>US$74</td>
<td></td>
</tr>
<tr>
<td>Press</td>
<td>US$0</td>
<td>US$0</td>
<td></td>
</tr>
<tr>
<td>Exhibitor (Commercial)</td>
<td>US$0</td>
<td>US$0</td>
<td></td>
</tr>
<tr>
<td>Artist Exhibitor (work in JMM Art Exhibit)</td>
<td>US$0</td>
<td>US$0</td>
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</tr>
<tr>
<td>Nonmathematician Guest of registered mathematician</td>
<td>US$18</td>
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</tr>
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</table>

**Member AMS Short Course:** Rigorous Numerics in Dynamics (1/4-1/5)

<table>
<thead>
<tr>
<th>Membership</th>
<th>by Dec 22</th>
<th>at mtg</th>
<th>Subtotal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Member of AMS</td>
<td>US$110</td>
<td>US$144</td>
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</tr>
<tr>
<td>Nonmember</td>
<td>US$165</td>
<td>US$195</td>
<td></td>
</tr>
<tr>
<td>Student, Unemployed, Emeritus</td>
<td>US$50</td>
<td>US$79</td>
<td></td>
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</tbody>
</table>

**MAA Minicourses (see listing in text)**

I would like to attend: ✓ One Minicourse ❏ Two Minicourses

Please enroll me in MAA Minicourse(s) #_____ and #_____.

Price: US$85 for each minicourse.

(For more than 2 minicourses, call or email the MMSB.) $______

**Graduate School Fair**

<table>
<thead>
<tr>
<th>Program Fair</th>
<th>US$75</th>
<th>US$75</th>
</tr>
</thead>
</table>

**Receptions & Banquets**

- Graduate Student/First-Time Attendee Reception (1/6) (no charge)
- NAM Banquet (1/8) US$63 #_____Chicken #_____Vegetarian #_____Kosher
- AMS Dinner (1/9) Regular Price #__ US$69 Student Price #__ US$29

(Additional fees may apply for Kosher meals.) $______

**Total for Registrations and Events** $______

Registration for the Joint Meetings is not required for the short course 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 $______

**Method of Payment**

- Check. Make checks payable to the AMS. 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 #**

- I am willing to serve as a judge for the MAA Undergraduate Student Poster Session
- For planning purposes for the MAA Two-year College Reception, please check if you are a faculty member at a two-year college.
- I am a mathematics department chair.
- Please do not include my name and postal address on any promotional mailing lists. (The JMM does not share email addresses.)
- Please do not include my name on any list of JMM participants other than the scientific program if I am, in fact, making a presentation that is part of the meeting.
- Please ☑ this box if you have a disability requiring special services.

### Deadlines

- Eligible for the complimentary room drawing: Nov. 2, 2015
- Receiving badges/programs in the mail: Nov. 17, 2015
- Housing reservations, changes/cancellations through the JMM website: Dec. 14, 2015
- Advance registration for the Joint Meetings, short course, minicourses, and tickets: Dec. 22, 2015
- 50% refund on banquets, cancel by Jan. 2, 2016*
- 50% refund on advance registration, minicourses, and short course, cancel by Dec. 31, 2015*
- *no refunds issued after this date

### Mailing Address/Contact:

Mathematics Meetings Service Bureau (MMSB)
P. O. Box 6687
Providence, RI 02940-6687 Fax: 401-455-4004; Email: mmsb@ams.org
Telephone: 401-455-4144 or 1-800-321-4267 x4144 or x4137
2016 Joint Mathematics Meetings Hotel Reservations – Seattle, WA

(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 configuration. 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 14, 2015 may be changed to a higher rate. All rates are subject to a room tax plus Seattle Tourism Assessment Fee totaling 15.6%. 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 _____________ Number of children _______________________
Name of Other Adult Room Occupant(s) __________________________________________ 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.

<table>
<thead>
<tr>
<th>Order of choice</th>
<th>Hotel</th>
<th>Single</th>
<th>Double 1 bed-2 people</th>
<th>Double 2 beds-2 people</th>
<th>Triple 3 adults-2 beds</th>
<th>Quad 4 adults-2 beds</th>
<th>Rollaway Cot Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sheraton Seattle (headquarters)</td>
<td>US$ 166</td>
<td>US$ 166</td>
<td>US$ 166</td>
<td>US$ 191</td>
<td>US$ 216</td>
<td>Rollaways available only in king-bedded rooms at no charge</td>
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<tr>
<td></td>
<td>Deluxe Rate</td>
<td>US$ 186</td>
<td>US$ 186</td>
<td>US$ 186</td>
<td>US$ 211</td>
<td>US$ 236</td>
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<tr>
<td></td>
<td>Student Rate</td>
<td>US$ 124.50</td>
<td>US$ 124.50</td>
<td>US$ 124.50</td>
<td>US$ 149.50</td>
<td>US$ 174.50</td>
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<tr>
<td></td>
<td>Grand Hyatt</td>
<td>US$ 159</td>
<td>US$ 159</td>
<td>US$ 159</td>
<td>US$ 184</td>
<td>US$ 209</td>
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<tr>
<td></td>
<td>Student Rate</td>
<td>US$ 125</td>
<td>US$ 125</td>
<td>US$ 125</td>
<td>US$ 150</td>
<td>US$ 175</td>
<td></td>
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<tr>
<td></td>
<td>Fairmont Olympic Hotel Seattle</td>
<td>US$ 152</td>
<td>US$ 152</td>
<td>US$ 152</td>
<td>US$ 182</td>
<td>US$ 212</td>
<td>Rollaways available only in king-bedded rooms for a one-time $15 fee</td>
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<tr>
<td></td>
<td>The Westin Seattle</td>
<td>US$ 139</td>
<td>US$ 139</td>
<td>US$ 139</td>
<td>US$ 169</td>
<td>US$ 199</td>
<td>Rollaways available only in king-bedded rooms at no charge; sleeper sofas in some rooms</td>
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<tr>
<td></td>
<td>Student Rate</td>
<td>US$ 104</td>
<td>US$ 104</td>
<td>US$ 104</td>
<td>US$ 134</td>
<td>US$ 164</td>
<td></td>
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<tr>
<td></td>
<td>Renaissance Seattle Hotel</td>
<td>US$ 139</td>
<td>US$ 139</td>
<td>US$ 139</td>
<td>US$ 159</td>
<td>US$ 179</td>
<td>Rollaways available only in king-bedded rooms at no charge</td>
</tr>
<tr>
<td></td>
<td>Student Rate</td>
<td>US$ 129</td>
<td>US$ 129</td>
<td>US$ 129</td>
<td>US$ 149</td>
<td>US$ 169</td>
<td>Rollaways available only in king-bedded rooms at no charge</td>
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<tr>
<td></td>
<td>The Paramount Hotel Seattle</td>
<td>US$ 130</td>
<td>US$ 130</td>
<td>US$ 130</td>
<td>US$ 150</td>
<td>US$ 170</td>
<td>Rollaways available only in king-bedded rooms at no charge</td>
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<tr>
<td></td>
<td>Student Rate</td>
<td>US$ 120</td>
<td>US$ 120</td>
<td>US$ 120</td>
<td>US$ 140</td>
<td>US$ 160</td>
<td>Rollaways available only in king-bedded rooms at no charge</td>
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<tr>
<td></td>
<td>Hyatt Olive 8 Seattle</td>
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<td>US$ 125</td>
<td>US$ 150</td>
<td>US$ 175</td>
<td>Rollaways available only in king-bedded rooms at no charge</td>
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<tr>
<td></td>
<td>The Inn at the Washington Athletic Club</td>
<td>US$ 125</td>
<td>US$ 125</td>
<td>US$ 125</td>
<td>US$ 145</td>
<td>US$ 165</td>
<td>Rollaways are extremely limited, inquire directly with the MMSB</td>
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<tr>
<td></td>
<td>Crowne Plaza Seattle Downtown</td>
<td>US$ 125</td>
<td>US$ 125</td>
<td>US$ 125</td>
<td>US$ 145</td>
<td>US$ 165</td>
<td>Rollaways available only in king-bedded rooms for a one-time $25 fee</td>
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<tr>
<td></td>
<td>Student Rate</td>
<td>US$ 115</td>
<td>US$ 115</td>
<td>US$ 115</td>
<td>US$ 135</td>
<td>US$ 155</td>
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<tr>
<td></td>
<td>The Roosevelt Hotel</td>
<td>US$ 120</td>
<td>US$ 120</td>
<td>US$ 120</td>
<td>US$ 140</td>
<td>US$ 160</td>
<td>Sofa beds are available in all rooms</td>
</tr>
</tbody>
</table>

People interested in suites should contact the MMSB directly by email at mmsb@ams.org or by calling 800-321-4267, ext. 4137 or 4144 (401-455-4137 or 401-455-4144).
Look at MAA Math Classifieds

Mathematics is a diverse field. Find what’s best for you.

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mathclassifieds.org
Explore what’s available.