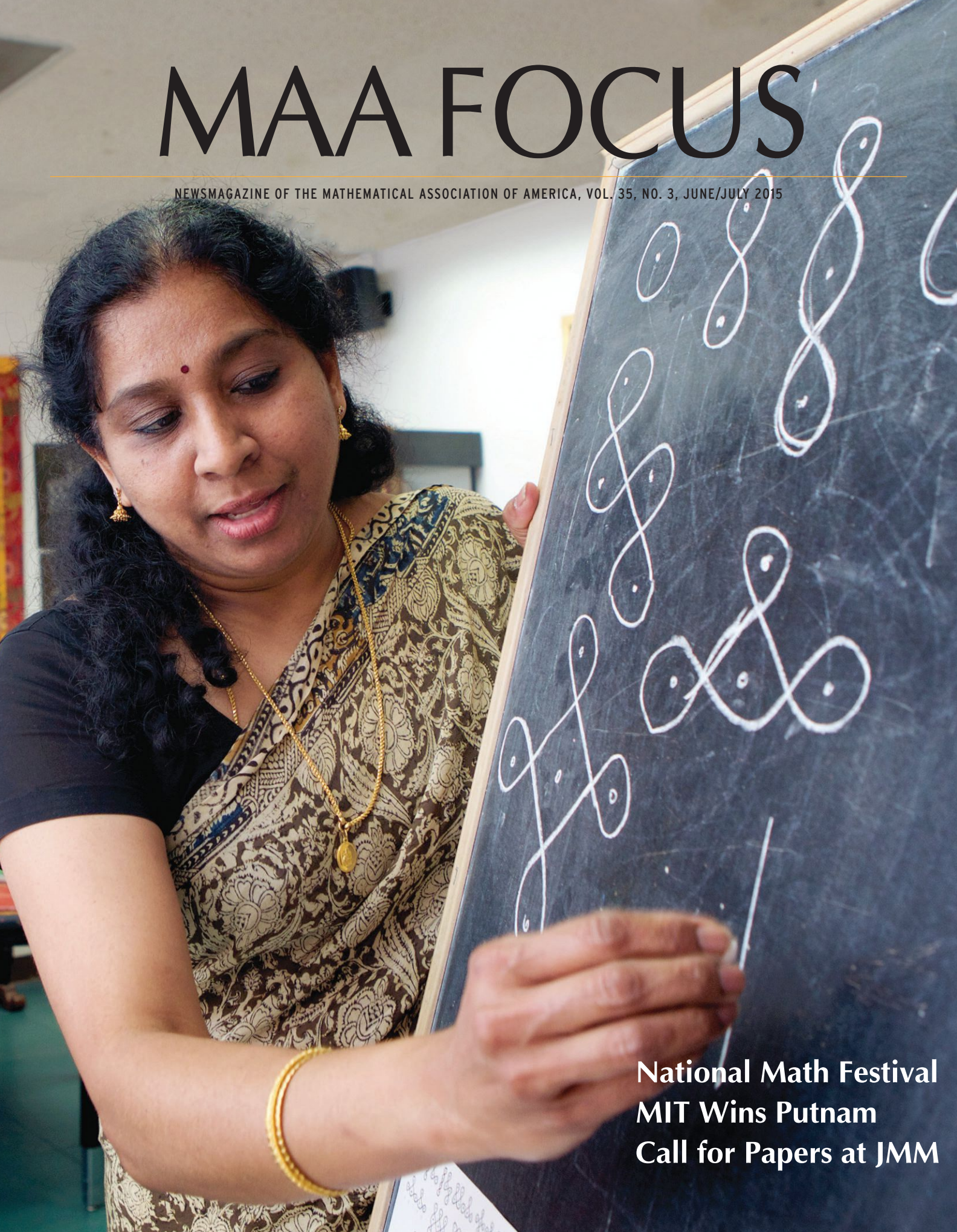
MAA FOCUS

NEWSMAGAZINE OF THE MATHEMATICAL ASSOCIATION OF AMERICA, VOL. 35, NO. 3, JUNE/JULY 2015



National Math Festival
MIT Wins Putnam
Call for Papers at JMM

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Advertising inquiries: *advertising@maa.org*

***MAA FOCUS* Staff**
Director of Publications: Jim Angelo
Editor: Ivars Peterson, *ipeterson@maa.org*
Managing Editor & Art Director: Lois M. Baron, *lbaron@maa.org*
Staff Writer: Alexandra Branscombe

Letters to the editor should be addressed to Ivars Peterson, Mathematical Association of America, 1529 18th Street, NW, Washington, DC 20036, or by email to *ipeterson@maa.org*.

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MAA National Positions Filled

The MAA Officers Election ended on May 4. The officers elected are as follows:

President-Elect
Deanna Haunsperger
Carleton College

First Vice President
Matt Boelkins
Grand Valley State University

Second Vice President
Tim Chartier
Davidson College

Two new members of the nominating committee were elected:

Rick Cleary
Babson College

Susan Jane Colley
Oberlin College

All terms begin February 1, 2016. The MAA congratulates the new officers and thanks all who participated in the election.

Falconer Lecturer: Nominations

The Association for Women in Mathematics and the Mathematical Association of America annually present the Etta Z. Falconer Lecture to honor women who have made distinguished contributions to the mathematical sciences or mathematics education. These one-hour expository lectures are presented at MAA MathFest each summer.

Nominations for the 2016 AWM-MAA Falconer Lecture are solicited and will remain active for a total of two years (one year beyond the initial nominations). The letter of nomination should include an outline of the nominee's distinguished contributions to the mathematical sciences or mathematics education and address the nominee's capability of delivering an expository lecture. The deadline for nominations is September 1.

Nomination materials for this award should be compiled into one PDF file and submitted online at MathPrograms.org. The link to MathPrograms will be available 45 days prior to deadline. Check awm-math.org for more details.

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Guided by Shanthi Chandrasekar, National Math Festival attendees discovered the beautiful curved loops and geometric symmetry of kolam, a South Indian style of painting using rice flour. Above right, a girl pulls a bubble at the festival's Oobleck Olympics.

Photos: MSRI, National Math Festival

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National Math Festival Brings Math to the Mall

By Katharine Merow

As he made his way to the National Mall in Washington, D.C., on April 18, University of Maryland math professor Larry Washington worried.

He worried about the weather, whether it was too nice. He worried about star power, the allure of Usher and Mary J. Blige.

Would folks forsake the sunshine, he wondered, to hear a lecture about the Rubik's cube in the subterranean depths of the Smithsonian's Ripley Center? Could even a giant square-wheeled tricycle compete with Gwen Stefani and the other big-name artists performing in the free Earth Day concert across the Mall?

Would anyone, in other words, come to the National Math Festival?

Washington worried for naught. People came to the National Math Festival in droves. Official estimates put attendance upward of 10,000. Visitors young and old thronged the Smithsonian's Enid A. Haupt Garden, the Ripley Center next door, the National Museums of Natural and American History across the lawn-turned-construction-site. They enjoyed mathematical balloon twisting, an exhibition of math-inspired art, lectures about Archimedes and Minecraft and fair lane assignment in BMX bicycle racing.

Organized by the Mathematical Sciences Research Institute (MSRI) and the Institute for Advanced Study in cooperation with the Smithsonian Institution, the National Math Festival made good on its promise to "enliven the National Mall with dozens of interactive math experiences."

Ivars Peterson indicates a population distribution created by the hands of people touching (and staining) a sharp corner at the National Gallery of Art's East Building.

K. MEROW

MAA at the National Math Festival

For its contribution to the festival, MAA coaxed its onetime Director of Publications Ivars Peterson out of semi-retirement to lead a Math on the National Mall tour. Decked out in several MAA monograms, Peterson walked grandmothers, schoolchildren, and teachers through the mathematical aspects of the monuments, museums, and lawns at the heart of the nation's capital.

He pointed out the wrench-proof pentagonal lug nuts on fire hydrants and the Möbius nature of the recycling symbol. He explained why his Twitter page (https://twitter.com/mathtourist) features a photo of Kenneth Snelson's Needle Tower.

Extending his arm to the lavender-pink marble, Peterson pointed out that the discoloration on the 19-degree corner of the National Gallery of Art's East Building serves as a population distribution. He said that the two-foot smudge, tapered at both ends, represents all the passersby who have reached out and touched the enticingly sharp corner.

Download Peterson's "Field Guide to Math on the National Mall" at http://bit.ly/1IV8DAK.

Getting Students Involved

The National Math Festival relied on an army of volunteers to man tables inside the Ripley Center and activity stations in the Smithsonian's Haupt Garden, and college students made up much of the labor force.

The Society for Industrial and Applied Mathematics (SIAM) provided funding for more than 60 students from eight universities to staff the 20 exhibits in the

National Museum of Mathematics's Math Midway (http://mathmidway.org).

Members of Eve Torrence's Art of Mathematics class at Randolph-Macon College led activities sponsored by the Bridges Organization's MoSAIC outreach program (mosaicmathart.org/mosaic-plan). They helped visitors build icosahedrons and dodecahedrons decorated with Persian patterns, construct the five Platonic solids from punch-out sheets, and make an origami octahedral skeleton.

"The public day was bigger, more diverse, and had more excitement than I'd dreamed."

—David Eisenbud, MSRI Director

"The students were champs working with the public," Torrence said.

Undergrads from Marymount University interacted with festival-goers, too, as they built a hyperbolic star out of Zometools in the Ripley Center concourse. Marymount mathematics professor Alice Petillo sees value in providing out-of-classroom opportunities for people to experience mathematics, and she is trying to uncover the effect of the National Math Festival on Marymount's approximately 40 volunteers. She collected pre- and postfestival reflection data and hopes to report on her findings soon.

Before the Fun and Games

However effective at deepening appreciation for the importance, beauty, or fun of mathematics, the day of public activities on the Mall was really the culmination of the National Math Festival. The meeting of minds in fact began two days earlier.

On April 16, a breakfast briefing on Capitol Hill brought together mathematicians, educators, and lawmakers—including Senators Harry Reid (D-Nevada), Chuck Schumer (D-New York), Al Franken (D-Minnesota), Patty Murray (D-Washington), and Lamar Alexander (R-Tennessee), and House Minority Leader Nancy Pelosi (D-California)—to discuss the professional development of math teachers.

At a math education forum that afternoon, speakers tackled topics such as education reform, the Common Core State Standards, and the challenges of educating underserved populations.

A gala dinner capped off the day as policymakers, philanthropists, and scientists gathered in the Great Hall at the Library of Congress to celebrate public and private support for basic scientific and mathematics research.

Then, on April 17, MSRI and the Children's Book Council held a press conference to announce the inaugural winners of a new youth book prize, Mathical, that honors inspiring math-related fiction and nonfiction for readers in grades pre-K through 12. The 2014 winners were *Have You Seen My Dragon?* by Steve Light, *One Big Pair of Underwear* by Laura Gehl, *Really Big Numbers* by Richard Evan Schwartz, and *Nearly Gone* by Elle Cosimano. Read more at http://mathicalbooks.org/.

More Festivals

MSRI Director David Eisenbud said he could not be happier with how the first-of-its-kind festival played out. "The public day was bigger, more diverse, and had more excitement than I'd dreamed," he said. "The two education events and the gala went off very smoothly. Given the success, we are just beginning to think about a repeat—possibly in 2017." (The USA Science and Engineering Festival will come to D.C. in the off year, he explained.)

In the meantime, those in need of a festival fix can consider attending—or organizing—a Julia Robinson Mathematics Festival. Held throughout North America—in the Ripley Center in 2012 (http://bit.ly/1DIEH6y)—Julia Robinson Mathematics Festivals introduce kids young and old to the beauty of mathematics by presenting them with engaging, thought-provoking problems. See a list of upcoming festivals at http://jrmf.org/register.php. For information on hosting or sponsoring one, email info@jrmf.org.

And, of course, there's that other celebration of mathematics coming to D.C. before summer's end. Join MAA for its much-anticipated centennial celebration at MAA MathFest 2015.

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

The National Math Festival was sponsored by the following: Carnegie Corporation of New York, Google, Howard Hughes Medical Institute, Simons Foundation, Charles and Lisa Simonyi Fund for Arts and Sciences, Alfred P. Sloan Foundation, The Kavli Foundation, Gordon and Betty Moore Foundation, Research Corporation for Science Advancement, and IBM.

Program partners included the Elwyn & Jennifer Berlekamp Foundation, the National Museum of Mathematics (MoMath), and NOVA.

Facebook for Professional Educators

By Dana C. Ernst, Matthew Leingang, and Ron Taylor

As educators we idealistically dream of students wanting to interact with professors outside of class. This seems to be one reason we are required to hold office hours. But sometimes students want to interact in nonacademic ways. With the rise of social media, students are increasingly more interested in connecting with their professors on sites such as Facebook, Google+, LinkedIn, Tumblr, and Twitter.

Facebook, in particular, has been a positive experience for all three of us authors. It has allowed us to be in touch with each other and with other colleagues far away. And in some cases we have developed relationships with students outside of class that have led to better interactions in class.

Our aim here is to encourage faculty to think about the ways in which they are comfortable interacting with students outside of class. In particular, we are interested in the question of whether to be Facebook "friends" with students.

In this article we restrict our attention to Facebook, though much of what we say applies more broadly across social media. The main reason for this is that in our view Facebook provides a robust ecosystem for interaction between several parties in more or less real time.

Additionally, although the use of FB among college students may be on the decline, it seems to be the most widely used of the various social media platforms.

The three of us agree that it is a bad idea to initiate friend requests to students. The power differential is too great; the student may be uncomfortable accepting the request, but feel uneasy ignoring or rejecting it. Some students will inevitably see it as an intrusion into their private life. Plus, you would be showing favor toward the students you friend online.

What should you do when you get a Facebook friend request from a student? We believe that it is important to have a consistent policy in place to handle fairly this inevitability. Make your policy public by stating it on the first day of class or including it on your syllabus. Before settling on a policy, we encourage you to find out if your school and/or department has an official or unofficial policy regarding interaction with students on social media.

Potential Policies

Here we lay out three potential policies and discuss their merits.

Open to all. At one extreme is a policy of maximum openness: "Feel free to friend me on Facebook. I accept all friend requests from students."

It's fun to see what your students are up to. You'll find some of your current students are friends with some of your former students (keep that in mind as you consider recycling exam problems). You'll learn which of your students like to sing and who likes to race cars on the weekend. You might find out some things you wish you hadn't known, but by and large learning more about your students makes them easier to teach.

> **For starters, find out if your school or department has a policy regarding interaction with students on social media.**

They will also find out more about you. Since you hold such enormous power over them, they may have trouble conceiving of you as a human being with your own family, hobbies, and interests. Seeing your life outside the classroom can help them identify with you. And you can use your posts to evangelize about math every once in a while.

You can maintain some boundaries between you and your student Facebook friends using Facebook lists and privacy settings, which we will describe below.

Not while you're my student. At the opposite extreme is a policy that goes something like: "I will not accept a Facebook friend request from an individual that is or has the potential to be my student."

Once you are sure an individual will no longer be your student, you get to decide which friend requests to accept and which to deny. This policy allows you to treat all students equally while you are in a position of power, and later you can filter the individuals to whom you allow access to your personal life.

A variation is to not accept friend requests until a student graduates. One disadvantage of such play-it-safe policies is that you forego an opportunity to deepen the student-teacher relationship. In particular, if you share mathematics or education-related content on Facebook (as we often do), then you give up the chance to provide valuable insight into your career and craft.

Let's wait and see. Somewhere in the middle we have a policy along the lines of: "I do accept friend requests from students, but not until after the semester is over if they are currently in one of my courses for the first time."

This allows you to share the fun of the social media experience with your students, like the "Open to All" policy, but the delay allows time for a course to end. This alleviates the pressure of students hoping that the friending process will improve their grade. We have the opportunity to connect with students sooner rather than later, but also after we have had some time to develop a rapport with them.

Of course, all these policies will have exceptions based on the culture of your institution or the kinds of interactions you have with students (research students, graders, tutors, etc.). But the central point is still to have a policy and try to apply it uniformly.

Facebook Lists and Privacy Settings

You can use friend lists on Facebook to create sets of friends, and then set options for which lists can see which of your posts. Matthew uses a list called "Students" and adds students to that list when he accepts their friend request. The page facebook.com/help/friends/lists has up-to-date documentation on how to configure these lists.

You can also configure your privacy settings to control who sees which types of automatic notifications. If you have your students in a list and you are worried one of your high school buddies is going to tag you in a picture doing the sort of thing you don't want to see your students doing, for example, you can make sure that your student list will not see pictures you are tagged in.

You can also customize the privacy settings of any single post, so if you want to vent about students, you can restrict them from seeing it. To be vigilant about your Facebook privacy, consult LifeHacker's always up-to-date guide at http://tinyurl.com/LH-FB-Privacy.

On the other hand, it might behoove you to clean up your act on social media. Facebook is more open and public than it used to be, so you should probably behave on Facebook more often as you do in mixed company than you might among your close friends. If you are always on your best behavior, you do not have to worry about who is eavesdropping.

Connect

Being friends with students on Facebook is not the same as being friends in real life and need not infringe on the professional relationship between teacher and student. Don't be afraid to be friends with your students. As long as you do it fairly and responsibly, it can both preserve your authority and enhance the relationships you already have with them.

Dana C. Ernst (dana.ernst@ nau.edu) is an assistant professor at Northern Arizona University. Matthew Leingang (leingang@nyu.edu) is a clinical associate professor of mathematics at the NYU Courant Institute of Mathematical Sciences. Ron Taylor (rtaylor@berry.edu) is an associate professor at Berry College. Look for them on Facebook.

Supporting a Statistician in a Math Department

Many mathematical sciences departments are finding themselves responsible for teaching statistics. Although statistics uses mathematical concepts in an essential way, administrators and colleagues must recognize the important differences between the fields, how each subject should be taught, and how a statistician should be evaluated for tenure.

Professional Development

Mentoring and professional development are important for all new faculty hires, but are even more important for a statistician in a mathematical sciences department. Statistician mentors are recommended for new faculty in statistics, especially if this person is the only statistician in the department (http://goo.gl/35PbDC). If there are no senior statistician mentors available in the department, contact the Isolated Statisticians Network, a committee of the American Statistical Association (ASA), for advice (http://goo.gl/6FRXsE).

It is particularly important for new statistics faculty members, in a department without other statistics faculty, to travel to conferences and workshops in order to have the opportunity to talk with other statisticians about both their research and the teaching of statistics. In addition, departments should recognize the need for statisticians to have specialized software for their research and their teaching.

Applied statistics instructors should use very different pedagogical approaches than teachers of pure mathematics courses (http://goo.gl/w0evfj). Students in a first statistics course should learn to reason about the world through examples involving real and often-messy data (http://goo.gl/Li52hW). A statistics faculty member must spend a lot of time searching for good real-world data sets for examples and exercises. He or she must keep abreast of a field that is rapidly and continually changing; in particular, he or she must keep up with the new advances in technology and statistical computing that are having a major impact on both research and teaching.

Thus, a statistics faculty member must devote a significant amount of time developing the support materials for the technology in addition to developing course content. See the recent recommendation from the MAA-ASA Joint Committee on Statistics Education for a discussion of qualifications for teaching introductory statistics courses (http://goo.gl/29gfRq); this statement has been endorsed by the boards of the MAA and the ASA.

Evaluating Their Work

The work of statisticians is different from the work of most mathematicians. Thus, the evaluation of the quality of their work requires familiarity within their field and its many nuances. For example, statisticians are often involved in important interdisciplinary work that may be published in a journal that does not include statistics (or mathematics) in the title. Statisticians are often listed as the third or fourth author even though their contributions are essential. In many cases, a statistician may consult on a project that requires thoughtful and time-consuming work, but may produce outcomes that are not statistically significant and, consequently, may not result in a publication.

Statistical consulting (paid and unpaid) is an important form of scholarship and professional development for many statisticians. A new statistician on campus will often receive requests for help with data from faculty, students, staff, and even outside the college or university. If the new statistician is expected to provide such a service, then some form of reassigned/released time may be warranted. Otherwise, the faculty member's performance in those areas that are most closely aligned to tenure and promotion could be adversely affected.

The American Statistical Association has endorsed the MAA's "Guidelines for Programs and Departments in the Undergraduate Mathematical Sciences." In addition, the ASA's endorsement lists specific areas of support for new statistics faculty members (http://goo.gl/HiEbWK). As the need for qualified statistics instructors continues to grow, it is essential for mathematicians and statisticians to appreciate the distinct differences between the approaches to research and pedagogy between the two fields.

The ASA-MAA Joint Committee on Statistics Education tries to stimulate effective change in undergraduate statistics education, especially in the many institutions where the department of mathematics bears primary responsibility for the teaching of statistics.Contact: Michael Posner at Michael.Posner@Villanova.edu.

SHUTTERSTOCK

SIGMAA on Undergraduate Research Formed

By Dominic Klyve

Some of my most exciting and professionally useful moments with colleagues in the MAA have occurred by participating in SIGMAAs. These Special Interest Groups of the MAA bring together people with shared interests, either in person or via email discussion lists. For example, SIGMAAs find that the Joint Mathematics Meetings provide a convenient venue to meet, exchange ideas, and generally have a great time.

For these reasons, I am very pleased to announce the formation of a SIGMAA focused on undergraduate research. The new group, UR SIGMAA, was officially incorporated this spring and is open for membership.

Rising Interest

Undergraduate research, as MAA members know, has risen dramatically in its impact on the mathematical community over the last decade. The MAA already supports this activity in innumerable ways, and there has been a demand for a special interest group dedicated to undergraduate research for some time. (In fact, a call sent out via Project NExT lists and other sources quickly resulted in the names of 96 people who expressed interest in being charter members!)

What will this new SIGMAA do? The short answer is that this decision will rest with its members. I'm expecting that the group will be very active.

According to the charter, the UR SIGMAA will "promote undergraduate research within the MAA through greater awareness of the work in this area currently underway, and by encouraging members to become involved."

The group will also provide development opportunities for faculty interested in beginning work in undergraduate research.

Some members of other SIGMAAs have reported that the most beneficial aspect to membership is joining the email list. All members will have the option to belong to a dedicated email list on which members can ask questions, exchange ideas, and make connections.

The UR SIGMAA will provide a useful structure around which talks or sessions at section or national meetings can be organized. (It's worth noting, however, that, like all SIGMAAs, the UR SIGMAA will not monopolize activity in this area. We expect that many of the talks and poster sessions on this subject will continue to be run much as they have been for years, whether or not the organizers join the SIGMAA.)

Become a Charter Member

At this point, I'm sure most readers are wondering: Can I join now? The best news of all is—yes, you can join UR SIGMAA today! Although patient MAA members can wait until they renew their dues and check the "UR SIGMAA" box on the renewal form, those wishing to join sooner can call MAA customer service at 800-331-1622, or send an email to maaservice@maa.org to add the SIGMAA before their next membership renewal. It's not too late to become a charter member!

For those who want to do more than join, it's possible to become even more involved. Four of the officer positions were filled, under provisions of our charter, before the MAA approved the charter. Two-thirds of the initial slate of interim officers has therefore been selected:

Chair – Dominic Klyve, Central Washington University
Outreach Coordinator – Michael Dorff, Brigham Young University
Secretary-Treasurer – Jan Rychtar, University of North Carolina–Greensboro
Program Coordinator – Christina Eubanks-Turner, Loyola Marymount University

During the first year, however, a chair-elect will be chosen by the membership. We are also looking for an electronic resources coordinator. If more than one person expresses interest in this position, we'll hold an early election for this too. The other officers will be replaced at staggered intervals over the next three years.

The UR SIGMAA plans to expand and to develop even further the exciting work happening in regard to undergraduate research throughout the MAA. I hope many MAA members will consider joining us as charter members and help set the course of this new group.

Dominic Klyve is on the faculty at Central Washington University, Ellensburg, Washington.

SHUTTERSTOCK

Tensor Foundation Grants Awarded to 27 Projects

Although the MAA is not a grant-making organization, we administer a variety of programs for public and private sources that fund activities that advance the association's goals. The MAA does this for the Tensor Foundation, which finances one program for women and mathematics and one for strengthening underrepresented minority mathematics achievement (SUMMA).

Tensor Grants for Women and Mathematics support projects designed to encourage college and university women or high school and middle school girls to study mathematics.

Tensor-SUMMA Grants support programs that encourage pursuit and enjoyment of mathematics among middle school students, high school students, and/or beginning college students from groups traditionally underrepresented in the field of mathematics.

Tensor-SUMMA Grants

Project Title	Project Organizer	Project Institution	Institution City
Increasing the Participation of Hispanic Students in AIM's Morgan Hill Math Program	Brian Conrey	American Institute of Mathematics	San Jose, CA
Enhancing Diversity: The CSU Channel Islands Mathematics REU	Geoffrey Buhl	California State University Channel Islands	Camarillo, CA
Cougar Math Advancement Project (C-MAP)	Sofia Agrest	College of Charleston	Charleston, SC
Science and Technology Academy for Residence Scholars (STARS)	Mazen Shahin	Delaware State University	Dover, DE
InSTEM (Inspiring STEM in Girls)	Nell Cobb	DePaul University	Chicago, IL
Fisk University Math Club	Qingxia Li	Fisk University	Nashville, TN
Supporting Math Majors Project	Aimee Tennant	Huston-Tillotson University	Austin, TX
The Maximizing Mathematics Achievement (MaxiMA) Project	Shenglan Yuan	LaGuardia Community College, CUNY	Long Island City, NY
San Francisco Math Circle	Eric Hsu	San Francisco State University	San Francisco, CA
Navajo Nation Math Circles	Tatiana Shubin	San Jose State University	San Jose, CA
The Math Games Project: Math Games in a Youth Sports League Setting to Enhance Mathematical Learning in Minority Students	Gregory Budzban	Southern Illinois University	Carbondale, IL
CHAMP-Cougars and Houston Area Math Program	Mark Tomforde	University of Houston	Houston, TX
Maryland Mathematics Camp (Mathletics)	Stephanie Timmons Brown	University of Maryland	College Park, MD
Wellesley Emerging Scholars Initiative	Stanley Chang	Wellesley College	Wellesley, MA
Minorities in Mathematics Speaker Series (MIMSS)	Alicia Prieto-Langarica	Youngstown State University	Youngstown, OH

TROY UNIVERSITY

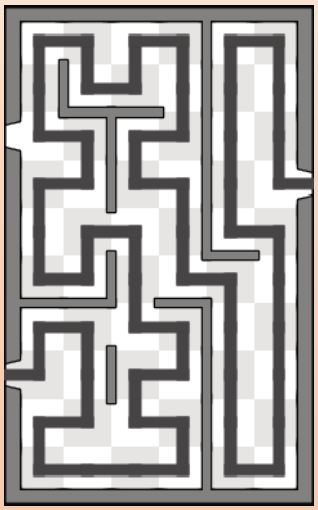
A 2013 summer commuter math and science camp (Mathematics, the Queen of Sciences) held at Troy University, Dothan Campus, Alabama, received a Tensor grant.

Tensor Grants for Women and Mathematics

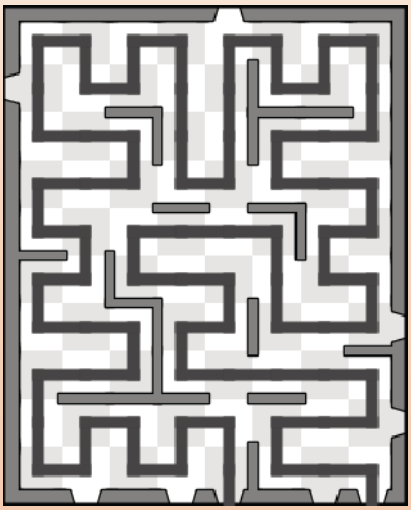
Project Title	Project Organizer	Institution Name	City
GirlsGetMath@ICERM	Jill Pipher	Brown University	Providence, RI
Mathematics & Mentoring Program	Judith Canner	California State University Monterey Bay (University Corporation at Monterey Bay (on behalf of the CSU Monterey Bay))	Seaside, CA
Southeastern Conference for Undergraduate Women in Mathematics	Sarah Schott	Duke University	Durham, NC
King University Women in STEM Club	Wendy Traynor	King University	Bristol, TN
"GEMS" Summer Day Camp for Middle School Girls - Girls Experience Muhlenberg Science	Linda McGuire	Muhlenberg College	Allentown, PA
Women Who Love Mathematics: Significant Writings on Women and Mathematics	Joanne Snow	Saint Mary's College	Notre Dame, IN
Girls Exploring Mathematics	Meghan De Witt	St. Thomas Aquinas College	Sparkill, NY
All Girls/All Math Summer Camp	Yu Jin	University of Nebraska-Lincoln	Lincoln, NE
Sonia Kovalevsky Middle School Mathematics Day	Theresa Martines	University of the Incarnate Word	San Antonio, TX
AWE+SUM	Carolyn Connell	Westminster College	Salt Lake City, UT
Westmont Encouraging Women in Mathematics	Patti Hunter	Westmont College	Santa Barbara, CA
Sonia Kovalevsky Mathematics Day	Jessica Hamm	Winthrop University	Rock Hill, SC

Solutions

In the April/May issue, we presented three Alcazar puzzles. The solutions are below.



Easy



Medium

Hard

Distinguished Lecture » Bubbly Mathematics

By Katharine Merow

Let's test your intuition about bubbles.

The standard "double bubble" consists of a little sphere and a big sphere, with a surface between them. Do you think that (a) the surface is flat, (b) the big bubble pushes into the little bubble, or (c) the little bubble pushes into the big bubble?

Frank Morgan (Williams College) asked his audience at the MAA Carriage House on April 28 eight such questions. Part of the MAA's NSA-funded Distinguished Lecture Series, Morgan's "Soap Bubbles and Mathematics" beguiled attendees with its gameshow flavor, its displays of bubble-blowing prowess, and its insights into the mathematical process.

The answer to that double-bubble question?

"The little bubble pushes into the big bubble," Morgan said. "And the reason is, there's more pressure in the little bubble."

Bubbles may seem like kid stuff, but they're everywhere: They make bread fluffy, mattresses supportive, fire extinguishers effective. They're also, Morgan emphasized, a topic of serious mathematical study. Morgan considers the proof of the double-bubble conjecture his greatest mathematical achievement, and he took pains in his talk to connect the work of both 2015 Abel Prize winners—John Nash Jr. and Louis Nirenberg—to soap bubble geometry.

Morgan traced the history of this mathematics all the way back to Zenodorus, who proved in the second century B.C. that a circle is the most efficient way to enclose a given area. It wasn't until 1884, however, that Hermann Schwarz established the analogous result in three dimensions, that a sphere has the least surface area for a given volume. Area minimization is the principle dictating soap bubble behavior, Morgan explained.

Frank Morgan used his prowess in manipulating soap films and bubbles to illuminate questions of mathematical interest in the study of minimal surfaces.

L. McHUGH

"When you have a cluster of soap bubbles coming together," Morgan said, "they look for the least area way to enclose and separate three . . . or more given volumes of air."

Analysis of such clusters turns out to require some sophisticated mathematics. As he indicated milestones in the development of strategies to understand bubbles, Morgan played video clips of the mathematicians involved.

One of these mathematicians was Jean Taylor, whose 1976 paper "The Structure of Singularities in Soap-Bubble-Like and Soap-Film-Like Minimal Surfaces" definitively answered the hardest question Morgan posed during his lecture: How many different ways can soap films come together?

"In math . . . the answer is always one, zero, or infinity," Morgan quipped, "but in this case the answer is two—what? two!—a very unanticipated kind of answer."

Indeed, what Taylor proved is that (1) soap bubbles meet in threes along a curve at an angle of 120 degrees and (2) these curves meet in fours at a vertex at the tetrahedral angle of approximately 109.47 degrees.

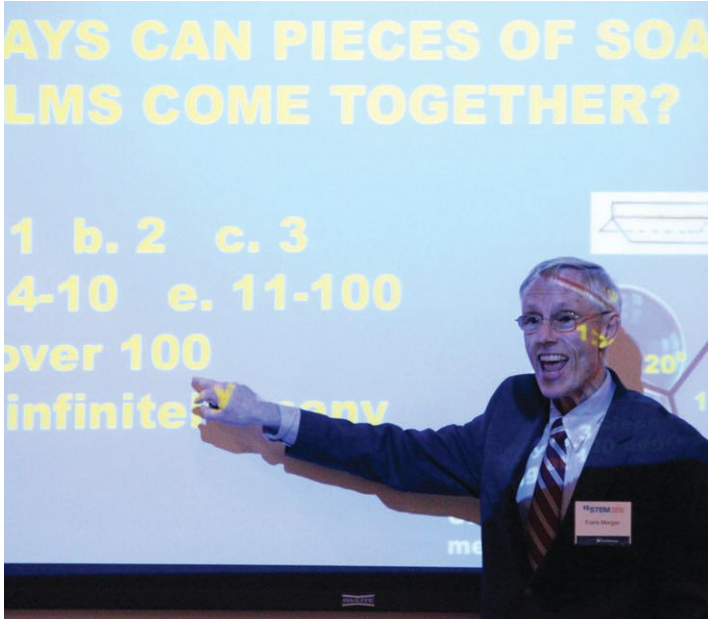
Though Morgan joked about spending the remainder of his talk "going over some of the technical details" of Taylor's paper, after only a brief overview of her argument, he moved on to other topics, among them the double bubble.

He floated some alternatives to the standard double bubble, which, until Morgan and his coauthors proved it in 2002, was merely suspected to be the most efficient way to enclose two volumes of air.

Two separate bubbles are wasteful, he noted; if they come together, they can share the common wall. A bubble inside a bubble also offers no advantage, since containing the smaller bubble makes the larger bubble unnecessarily—and inefficiently—large.

"So that's why you never see a bubble inside a bubble," Morgan said, even as he dipped a pair of wands into his bucket of soap solution and succeeded in blowing exactly that.

Within an instant, however, the smaller bubble popped out and glommed on to the outside of the larger one in



Morgan outlined the history of soap bubble geometry—including the inquiry into how many ways bubbles can come together.

that familiar double-bubble configuration. "It prefers that shape," Morgan said.

Proof of the double-bubble conjecture established the standard double bubble as the most efficient—more efficient than, say, John Sullivan's bubble-with-a-bubble-around-its-waist—but it leaves open the question of whether other arrangements are stable and therefore might occur in nature.

"I love this question because mathematicians have no idea how to solve it, but a kindergarten student could answer it tomorrow by just blowing a different double bubble," Morgan said.

Morgan ended his talk with a championship round of sorts. Attendees who had correctly answered more than two of Morgan's earlier questions tried to outdo one another in the identification of the best—that is, most perimeter-efficient—planar five-bubble, six-bubble, seven-bubble, and eight-bubble.

Even those finalists eliminated in the first round went home with prizes. "Good attempt," Morgan said as he handed each of them a miniature jar of bubble solution. "We have little research kits so you can get better at this."

Blowing bubbles may seem a frivolous pastime, but Morgan gave listeners choice words for anyone chiding them for production of soapy spheres.

"If you want to understand the universe," he said mid-talk, "you should start out by understanding the soap bubble."

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

Girls' Team Places Second at European Olympiad

Solving a mathematical Olympiad problem does not happen instantaneously. It takes hours of poking and prodding to extract an answer. Then there is an emotional rush when the problem is finally solved, describes Celine Liang, who won a gold medal at this year's European Girls' Mathematical Olympiad (EGMO).

"After finishing an EGMO problem, or any Olympiad problem, I get an amazing sense of fulfillment. Mainly because I spent many hours working towards a solution," says Liang. "Finally finishing a problem is a definite achievement every time."

The U.S. team claimed second overall at the EGMO, which took place April 14–20 in Minsk, Belarus. Every member of the U.S. team placed among the top scorers, winning either a gold or a silver medal. On the team were high school students Meghal Gupta (Monta Vista High School in Cupertino, California), Celine Liang (Saratoga High School in Saratoga, California), Danielle Wang (Andrew Hill High School in San Jose, California), and Rachel Zhang (Parkway South High in Ballwin, Missouri).

The exam is made up of six proof-style problems given over two days. The U.S. team score was 116 out of a possible 168 points, behind Ukraine's first-place 139. Wang was the only contestant in the entire event to receive a perfect score of 42 points. One of her proofs was so well done it was displayed as one of the example solutions, says Mark Saul, MAA director of competitions.

In its fourth year as an international competition, the 2015 EGMO contained problems at the perfect level of difficulty, says Jenny Iglesias (Carnegie Mellon University), who was the U.S. team leader.

"You want the girls to compete against each other, and if it is too easy, half of them get high scores and there is no distinguishing factor. Too hard and it is demoralizing," she says. The 2014 exam was an example of a demoralizing year, where high scorers received medals, but not a single contestant made it onto the list of honorable mentions, says Iglesias.

Finding the Fun

Like many teenagers, the U.S. contestants have preferences—in this case, about the types of problems on an exam. Some enjoy solving Euclidean geometry and combinatorics questions; others dislike algebra and number theory.

"I absolutely love geometry problems because the diagrams are so beautiful," says Liang. "There are just so many relationships between different lines, points, and angles that are hard to see initially but reveal themselves after some searching."

Fostering this joy of creative problem solving is a goal of the Olympiad. "When someone is going into a contest I say 'have fun' instead of 'good luck,'" says Sherry Gong (MIT), the U.S. deputy leader.

Aside from solving very challenging math problems, EGMO participants can bond over more than a mutual love of mathematics. In the week the international contestants were together, they played card games in the dorms, visited markets and shopping malls, tried new foods, and enjoyed a celebratory dance party at the end of the competition.

Wang says she will never forget the last night of the competition, when she realized, after receiving a bouquet of roses for winning first place, she could not bring the flowers on her flight home.

She says, "So Rachel [Zhang] and I knocked on people's doors and sang the song 'Finite Simple Group of Order Two,' a math love song, and gave them roses."

—Alexandra Branscombe

The U.S. team visited the U.S. Embassy in Minsk, Belarus, while competing in the European Girls' Mathematical Olympiad. From left: Mark Saul, Jenny Iglesias, Sherry Gong, Meghal Gupta, Rachel Zhang, Celine Liang, Danielle Wang, and Chargé d'Affaires Scott Rauland.

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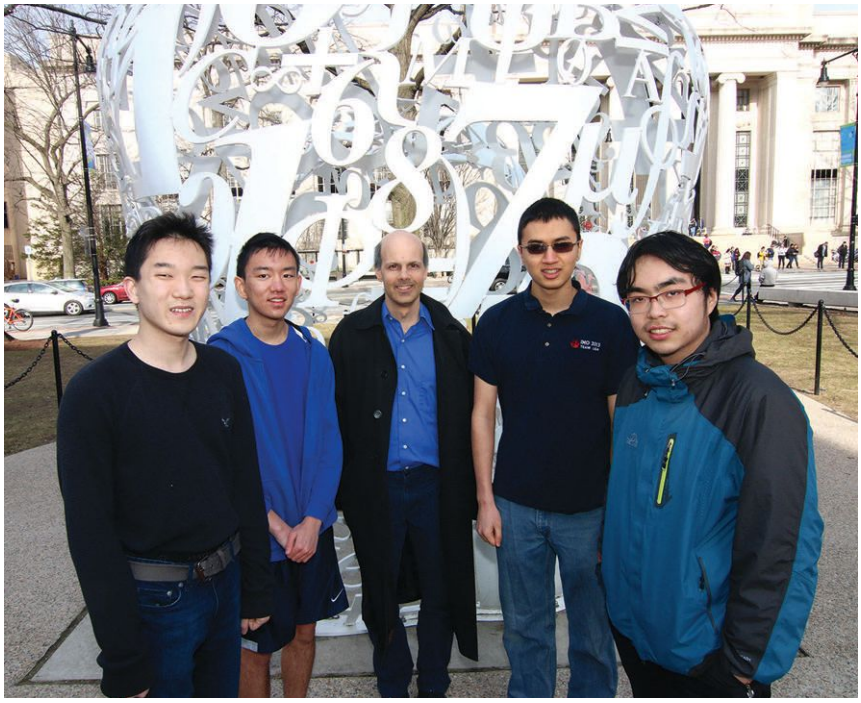
MIT Wins, Sets Record in Putnam Competition



(From left) MIT Junior Mitchell Lee, sophomore Bobby Shen, mathematics professor Bjorn Poonen, freshman Mark Sellke, and sophomore Lingfu Zhang.

ALLEGRA BOVERMAN

Competitors from Massachusetts Institute of Technology (MIT) at the 75th annual William Lowell Putnam Mathematical Competition swept up most of the highest scores. Not only did one of MIT's three-person teams claim first place in the competition, but MIT now holds the record for the number of individuals ranking in the top-five highest exam scores in a single year.

Exactly 4,320 students from 557 colleges and universities across the United States and Canada took the exam on December 6, 2014. This is the eighth team win for MIT, which includes a $25,000 prize and additional $1,000 awards for each team member (Mitchell M. Lee, Zipei Nie, and David H. Yang).

Harvard University's team (Calvin Deng, Malcolm Granville, and Xiaoyu He) took second place, and Rensselaer Polytechnic Institute (Theerawat Bhudisaksang, Owen Goff, and Wijit Yangjit) placed third. This is the first top-five finish for Rensselaer.

With an emphasis on speed, the six-hour Putnam consists of 12 problems designed by a Questions Committee: Hugh Montgomery (University of Michigan), Henry Cohn (Microsoft and MIT), and David Savitt (University of Arizona). The highest exam score was 96 out of a possible 120 points.

Participants who achieve the top five overall scores on the exam are named Putnam fellows and receive a $2,500 prize each. This year was distinctive because there are six Putnam fellows, thanks to a three-way tie for fourth place (a score of 81). The 2014 fellows, in alphabetical order, are Ravi Jagadeesan, Zipei Nie, Mark A. Sellke, Bobby C. Shen, David H. Yang, and Lingfu Zhang.

Five of this year's six Putnam fellows attend MIT—all except Jagadeesan (Harvard)—which sets a record for highest number of annual fellows to come from the same institution. Several of these same students have been Putnam fellows more than once. This is Nie's third year placing in the top five, and the second for classmates Shen and Yang.

The names will also be familiar to those who follow MAA's competitions. Of the 2014 fellows, four won gold medals on a U.S. team, which the MAA sponsors, at an IMO: Jagadeesan, Sellke, Shen, and Yang.

Statistically Speaking

Looking at the statistics, the 2014 Putnam competition may appear easier than past exams. The nationwide median score was 3, which is the highest median score since 2002, said Joseph Gallian, professor in the Department of Mathematics and Statistics at the University of Minnesota Duluth.

In addition, "34 percent of the participants had a score of zero, the lowest percentage since 2003," added Gallian, who served as president of the MAA from 2007 to 2008.

Gallian will present more interesting facts and history about the Putnam—and other MAA competitions—in his lecture "Seventy-Five Years of MAA Mathematics Competitions" at the 2015 MAA MathFest, which will be held in Washington, D.C., this August.

More details about the 2014 Putnam Mathematical Competition will appear in the October 2015 *American Mathematical Monthly*.

A complete list of Putnam winners can be found at http://kskedlaya.org/putnam-archive, and past IMO contestants can be found at http://imo-official.org/default.aspx.

—*Alexandra Branscombe*

To the Mathematical Beach

By Francis Edward Su

President's Message

I thought I had chosen the right book for the occasion. On this Saturday morning, I was volunteering with a program called Reading to Kids that seeks to inspire underserved youth in Los Angeles to enjoy reading. Assembled before me was a group of eager Latino and African American children from the neighborhood.

The book I chose was about going to the beach. It was at the right reading level, with playful illustrations I thought would be appealing. Nevertheless, after reading just a few pages in a most spirited voice, I could tell that the kids did not share my enthusiasm.

So I asked, "How many of you have ever been to the beach?"

To my surprise—though this part of LA is just 15 miles from the ocean—only one of the eight children raised a hand. Wasn't going to the beach a quintessentially Californian thing to do?

Some reflection supplied potential explanations. In a low-income neighborhood, parents often work multiple jobs to make ends meet, so they may not have had the time or resources to bring their kids to the beach. And when an African American friend of mine heard this story, he said, "Black families don't take their kids to the beach" and explained how this was a vestige of a segregated era when African Americans were not allowed in public pools and beaches.

Whatever the reason, I had missed something essential for connecting with my students: the historical, cultural, and economic context they brought to the classroom.

That episode helped me reflect on how I teach college students. What context am I missing that hinders my connection with my students? How often do I take the time to get to know their backgrounds? What are the primary experiences that shaped them, and do those present obstacles or opportunities for learning? And in what ways does the mathematical beach say "open to all" but still feel restricted?

These questions appear unrelated to mathematics, but if we ignore their effects, some of our students will not flourish.

We should try to know our students as whole people. Even as I write this, a Gallup-Purdue survey of 30,000 college graduates is making the news. It shows a strong correlation between certain college experiences and certain life outcomes—including employee engagement and multiple measures of well-being (purpose, social, financial, community, physical).

In particular, those who, as students, felt "supported" in college—defined as those who would affirm all three: (1) "my professors cared for me as a person"; (2) "I had at least one professor who made me excited about learning"; and (3) "I had a mentor who encouraged me to pursue my goals"—were twice as likely now to be engaged at work (57 percent vs. 25 percent) and three times as likely to be thriving in all areas of well-being (17 percent vs. 6 percent).

In what ways does the mathematical beach say "open to all" but still feel restricted?

Sadly, only a quarter of all college graduates could say their professors cared for them as a person, and only 14 percent said they felt supported in all three ways.

What can we as instructors do? I offer just a few ideas here and would love to hear yours.

- Show students you want to know their stories. A questionnaire, as part of a first assignment, could have thoughtful questions such as, What's your favorite book? Most important person in your life? A nonacademic obstacle you are facing right now? Make the questions optional or general so that students don't have to divulge much if they don't want to.

- Use your knowledge of student stories to craft examples that they can relate to. This includes using a variety of cultural names and the pronoun "she" in generic examples.

- Highlight contributions from diverse sources. Photos or stories from a diverse set of mathematicians offer our students multiple chances to identify with a role model and show that the mathematical beach can be enjoyed by everyone, regardless of economic or cultural background.

- Where possible, try to keep your course structure from placing undue barriers on various groups. For instance, I once realized that by scheduling office hours only in the late afternoon, athletes could not come see me. Be especially sensitive to disadvantaged groups, such as students with part-time jobs or those whose weekend is consumed with family obligations. Homework announced Friday and due Monday may not leave enough flexibility.

- Offer ample opportunities for students to express mathematical ideas in their own words, using their own examples. By inviting them to tell their own stories, you empower them to make math relevant in their cultural contexts.

- Open up about your own stories. What are some of the academic or nonacademic obstacles you have faced? Your students will appreciate them because stories of struggle are universal.

We should never lose sight of the fact that the ability to know our students, and be known, is one of the most important aspects of teaching. Our students, especially the most disadvantaged ones, will feel better supported, and the extra effort we take will enrich our own lives as well.

Even a failure to connect can break the ice and start a conversation. In my case, I put down the book about the beach and said to my kids with a smile, "Tell me stories about what *you* like to do for fun."

This August, MAA is celebrating its centennial MathFest in Washington, D.C. Over the last century, we have established a vibrant and inclusive community that nurtures the human side of mathematics and supports all aspects of a faculty member's life. Join us. Celebrate with us!

Francis Su can be reached at su@math.hmc.edu *and found on Twitter at @* mathyawp.

*Left: The beach at Port St. Johns, South Africa, the morning after a storm forced a partially anchored structure into tracing out concentric circles on the sand. The photo, by James Metz, appears in the MAA Found Math galleries (*http://bit.ly/YYN1T0*). Send your photos for possible inclusion to* foundmath@maa.org.

MAA Competitions Gets New Director

By Alexandra Branscombe

Director of Competitions Steve Dunbar has retired from the MAA American Mathematics Competitions (MAA AMC). Dunbar, who divided his time between MAA AMC and being a professor in the Department of Mathematics at the University of Nebraska–Lincoln (UNL), stepped away from both positions in mid-May. He had been working vigorously to transition the AMC program from Lincoln, Nebraska, to its new base in Washington, D.C., with his replacement, Mark Saul, who took over as director on June 1.

Dunbar has been an MAA member for more than 40 years, since he joined in 1974 on a student membership. Before joining the MAA leadership team, Dunbar was the director of an interdisciplinary computer science and business program at UNL, but realized he wanted to find a way back into mathematics.

A new position on a special projects assignment for the MAA AMC, which he accepted in 2001, offered the perfect fit for Dunbar to get his wish. While he continued to teach mathematics, his duties at MAA grew, and in 2004 he was appointed director of competitions.

Since then, Dunbar has developed the AMC program into what it is today: delivering high-quality math contests around the world. In its most basic description, the director's duties include making sure that six contest exams are created on time; schools and student teams are registered; the exams are scored; and prizes are awarded. The six exams are AMC 8, AMC 10, AMC 12, American Invitational Mathematics Examination (AIME), and the United States of America Mathematical Olympiad (USAMO) and Junior Mathematical Olympiad (USAJMO).

Successes

Dunbar judges the success of his leadership by the quality of each contest and how they all contribute to the MAA AMC's goal: strengthening the mathematical capabilities of young people.

"I think the thing that we have been able to do is create and expand a really smoothly running program," says Dunbar. "Expansion and diversification of the program are the two biggest accomplishments."

Today, more than 350,000 students in about 6,000 schools participate in the MAA AMC contests each year. From there, about 10,000 student qualify for the AIME, and then roughly 500 students continue on to the USAMO.

His hope for the future of MAA competitions—and for the new director—is the continued efficiency and growth of the program. "I would want to see

Steve Dunbar (left) has retired from MAA AMC. His replacement is Mark Saul. At right, Dunbar and the 2012 USAMO team.

L. McHUGH

[MAA AMC] continue to expand and that more students get an opportunity to participate," he says.

Accustomed to wearing multiple hats, Dunbar says that retirement means time to use his competition experiences to generate new projects.

"One of the things I have been able to observe over 15 years is the creation of mathematical contest problems," he says. "I'd like to think about the process of creating math questions. There are a lot of people who have written about how you solve problems, but not much written about how you pose problems," he said. Whether he ends up writing an article or a book, he's excited about delving into the issue as part of his future.

Lifetime of Experience

New director Saul has had a lifetime of experience in math competitions. He has been a contestant, acted as a math team coach, and served on MAA competitions committees to develop and distribute the contests. Outside of competitions, his experience includes being project director at the National Science Foundation and, most recently, serving as director of the Center for Mathematical Talent at the Courant Institute of Mathematical Sciences.

Teaching

Saul vividly remembers competing in his first MAA math competition. He was 15 years old on the Bronx High School of Science math team, a team he would later return to coach.

"At that time, there were not that many opportunities for mathematics outside the textbook," he says. "The kind of mathematics that actually uses your knowledge in creative ways—the MAA exam and local contests were the only things that did this."

With a craving for challenge and problem solving, Saul was drawn to teaching. He taught K-12 mathematics for 35 years at multiple schools, including his former high school. Saul's favorite classes to teach were advanced honors math and remedial math.

Teaching gifted students requires corralling their creative thoughts and relating them to more conventional mathematical thinking—you have to be a mind reader, says Saul. Teaching struggling students is similar. It's a matter of finding out where they went wrong and getting them back on track, he added.

"From working with gifted kids, you can learn how to reach the kids that everyone has given up on," he says.

Direction

This same principle reappears when Saul discusses his goals for the MAA AMC—bring more young people into math competitions and inspire creative problem solving.

Mark Saul.

L. McHUGH

Thanks to the work Dunbar put into creating an efficient and well-run program, Saul sees an opportunity to grow the program and motivate more students to join the community.

"I think we need to take a good look at who is taking our competitions, who is benefiting from them, and then widen the pool," he says. "There are many schools and many students against whom the deck is stacked. What is important about these contests is that it opens students up to a different way of thinking about mathematics."

In addition, Saul would like to explore ways to introduce new content to the system of exams, such as adding questions that require proofs, a style that is already commonly used in East European competitions. His goal is to get young people to challenge their misconceptions about what it means to do mathematics.

"Mathematical competitions expand their understanding of what mathematics is . . . It is a creative way to think from different angles," says Saul. These skills are important to students because it will influence how they use math in the future, even if it is not in a mathematical field.

"Mathematics is the heavy industry of the sciences," he says. "It's the foundation for everything we do."

Alexandra Branscombe is staff writer for MAA FOCUS.

Interview » T. Christine Stevens

Professor Emeritus, Saint Louis University
Associate Executive Director, American Mathematical Society

Interviewed by Kenneth A. Ross

Kenneth A. Ross is an emeritus professor in the Mathematics Department at the University of Oregon.

As a project for the 2015 centennial of the MAA, members of the history subcommittee of the MAA centennial committee have been interviewing prominent members of the mathematical community. The full interviews will be available on the MAA website; excerpts from selected interviews are appearing in MAA FOCUS.

The excerpts here are based on an interview that took place January 15, 2010.

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Where did you grow up and go to school?

I was born in Maryland, but lived on Long Island (in New York State) and in two cities in California, and I graduated from high school in Morristown, New Jersey. Except for three years, I attended public schools. Looking back at my schooling, I can see that moving around so much led to some problems in "articulation," but I managed to navigate the educational system. In the eighth grade, for example, I was taught a little algebra and then finished the material on my own. In the ninth grade, I started in a new school that used the SMSG [School Mathematics Study Group] material for algebra. Then, halfway through the year, my family moved, and I was back in a traditional algebra class. If I hadn't finished the eighth-grade algebra on my own, I would not have been able to make the transition back to a traditional algebra curriculum.

Earlier, in the sixth grade, a problem arose when I started in a new school and my mother was notified that I was weak in mathematics. When the teacher showed her my work, it turned out that my answers were correct, but I had given them in a format that the teacher had not expected.

When did you get interested in mathematics?

I had many interests, and mathematics was certainly one of them. I always enjoyed mathematics, and I thought about it a lot. When I did science projects in school, they were mathematics projects, involving the Klein bottle and the Möbius strip.

It may also be significant that, when I was in high school, I was hired to write the solutions manuals for several elementary and secondary mathematics textbooks. Although I didn't realize it at the time, the books on which I worked had been written by some of the leading figures in K-12 mathematics education, such as Steve Willoughby, who would later become president of NCTM [National Council of Teachers of Mathematics]. This was my first paying job, and perhaps it foreshadowed my later interest in educational issues.

I chose Smith College, among various good liberal arts colleges,

Christine Stevens in the mid-1980s.

because it seemed to me to be the strongest one in mathematics and science. I was a chemistry major at first. I switched to mathematics because of an undergraduate research experience after my sophomore year. It was a chemistry project supported by the National Science Foundation. I discovered that I enjoyed analyzing the data more than collecting them. So my interest shifted from chemistry to applied mathematics.

Between my junior and senior years at Smith, I worked at Bell Laboratories in Whippany, New Jersey, doing Fortran programming and working with the simplex algorithm. I was doing cost-benefit analyses for antiballistic missiles, and I was struck by the fact that every number in the programs I wrote represented a nuclear weapon. I began to wonder whether I wanted to focus all my energies on destruction. So my interest moved to pure mathematics in my senior year.

What was the special attraction of mathematics?

The logical structure of the subject made more sense to me. There was less memorizing, and I found the work in mathematics less frustrating than in the laboratory sciences. Also, the science applications with which I was familiar at that time seemed to be related to weaponry. Later, I realized that the applications of science were much more diverse than that, but by that time I had already chosen pure mathematics as my field of study.

Was the transition from Smith College to Harvard difficult?

I applied to Harvard, Cornell, and Princeton and was accepted by all three. However, my application to Princeton was for their program in the philosophy and history of mathematics, and I realized that I wanted a more mathematical program. I ended up choosing Harvard over Cornell.

The transition to Harvard was difficult, though Smith had a good liberal arts program and my senior project was an extremely valuable experience in which I had learned how to learn on my own. So I had a pretty good background, but still found myself on the "remedial track" at Harvard, since many of the incoming hotshots had already taken several graduate courses as undergraduates.

I've described some of my experiences with [my thesis adviser] Andy Gleason in a memorial article that appeared in the *Notices of the AMS* (November 2009). Even among Harvard people, Gleason was regarded as extra bright.

I didn't realize until later how broad his interests were, which included work with the MSEB [Mathematical Sciences Education Board] and with K-12 mathematics curricula.

I had started out working on manifolds with John Mather, but Mather left Harvard for Princeton, so I approached Gleason because I had taken a course with him on topological groups, during which he had posed some open questions that involved Lie groups. I thought my knowledge of manifolds might help with those questions. At first I was afraid to show Gleason how little I knew, so I was a little too eager to be independent. But when I really needed help, Gleason gave me good advice. Now that I have had PhD students of my own, I can see that he provided me with a good combination of encouragement and independence.

It's clear that good teaching has been important to you throughout your career, so it was natural for you to get involved in the MAA. How and when did that happen? I note that the Missouri Section honored you with its teaching award in 1996 and that you obtained the Haimo Award in 1997.

I had good teachers myself, and they were early models. I taught at Mount Holyoke College for four years, and this made a big difference because teaching at a liberal arts college leads you to think about the role of a teacher in a different way. For example, I taught a reform-style calculus course there long before the term "calculus reform" had even been invented. But teaching per se wasn't my entry to the MAA. In fact, my career path is much more complicated.

I should mention that I met my future husband, Thomas Moisan, at Harvard. In fact, I recruited him to work on the McGovern campaign in 1972. I had already been active in the antiwar movement. Tom and I were married in 1974. His degree was in English, and he obtained a teaching job at Middlebury College in Vermont.

While finishing up my degree, I taught at Lowell State College (now the University of Massachusetts Lowell). I then got a job at Mount Holyoke College in 1977, and for the next four years Tom and I had two apartments in two different states. Each of us kept looking for a job that would bring us geographically closer to the other, but without success.

Chris Stevens (center) with others who served on the Project NExT leadership team over the years: (from left) Judith Covington (Louisiana State University in Shreveport), Joe Gallian (University of Minnesota Duluth), Aparna Higgins (University of Dayton), and Gavin LaRose (University of Michigan).

L. McHUGH

Finally, we realized that we were more marketable as a couple. In 1981 we received two pairs of offers and took the one from Arkansas State University in Jonesboro. They had agreed to an unpaid sabbatical the next year, which we took in Cambridge, England.

When I attended my first Joint Mathematics Meetings in Biloxi, Mississippi, in 1979, women mathematicians were much less visible than they are now.

I spent the year in Cambridge working on some problems in topological groups and also on the history of Lie groups. It was my first trip outside North America, and it was great fun! The year in Cambridge was a productive one for both Tom and me.

We returned to Arkansas State in 1983-1984. The university's president at that time was Ray Thornton, who had represented an Arkansas district in the U.S. House of Representatives. With his help, I successfully applied to become the 1984-85 AMS/MAA/SIAM congressional science fellow in Washington, D.C., where I worked as a legislative assistant to Representative Ted Weiss of New York. Meanwhile, Tom did research at the Folger Shakespeare Library. After that, we returned to Jonesboro for the years 1985 to 1987. From 1987 until 1989, I was at the NSF as a program officer in teacher enhancement. During that period, Tom taught at Mary Washington College (now University of Mary Washington) in Fredericksburg, Virginia.

In 1989, Tom was hired as chair of the English Department at Saint Louis University. Fortunately, their Mathematics Department had an open position, and I was hired too. Later we were simultaneously chairs of our respective departments. I think that administrators were sometimes worried by the fact that these two large departments were "in bed with" each other.

Finally, I can explain my entry into the inner workings of the MAA.

It was undoubtedly my experiences in Washington that led to my appointment in the early 1990s to the MAA's Science Policy Committee, which I eventually chaired. While at the NSF, I had participated in some of the deliberations of the MAA's Task Force on Minorities in Mathematics, which was chaired by Louise Raphael. The report of the task force led to the establishment of SUMMA [Strengthening Underrepresented Minority Mathematics Achievement] and the Committee on Minority Participation in Mathematics, to which I was subsequently appointed. Then in 1993 Marcia Sward arranged for me to be a visiting mathematician at the MAA for a few months, while Tom had a research fellowship at the Folger Shakespeare Library.

This must be about the time you got involved with Project NExT [New Experiences in Teaching]. How did that program get started?

As a visiting mathematician at the MAA, I worked on strategic planning and learned a lot about the structure of the organization. In the spring of 1993 I had several conversations with Jim Leitzel, who had previously been a visiting mathematician at the MAA, and he suggested that the MAA sponsor a conference for new PhDs in mathematics about issues in teaching undergraduate mathematics.

Our original objective was to bring new faculty up to date on changes in curriculum and pedagogy that had been occurring while they were in graduate school. I discussed the concept with some people at the NSF, and they thought it was a good idea. When Jim Leitzel and I computed the budget for a week-long workshop, however, we decided that it was too expensive. Then we had the idea of piggy-backing on the summer meetings, with two or three days of sessions just before the meetings (which were still, at that time, joint meetings of the MAA and the AMS). Jim and I worked out the details and drafted a sample workshop program. Jim wrote up a proposal for the MAA, but we heard nothing back from the leaders.

During the summer, the Exxon Education Foundation approached Marcia Sward (who was the MAA executive director) about the possibility of expanding their mathematics program to include the undergraduate level. Marcia responded that there was a big need for professional development for faculty and mentioned, as an example, the conference that Jim and I had proposed for new PhDs in mathematics.

The Exxon Education Foundation liked this example and asked for a formal proposal within a month! Jim and I wrote the proposal together, with a lot of input from Marcia. Only six weeks after getting the Exxon Education Foundation's request for a proposal, Marcia received a letter telling her that they would fund the program. This led to 18 years of support for Project NExT from the Exxon Education Foundation and its successor, the ExxonMobil Foundation. Our program officer was Bob Witte, who was very knowledgeable about

mathematics education and a key supporter of Project NExT.

When the MAA received the request to submit a formal proposal for the program that would eventually be called Project NExT, Jim Leitzel invited me to codirect it with him. When I expressed some reservations about my availability, he said that he would go it alone if I declined. So I agreed to codirect the program with him. Sadly, Jim died in 1998, so I then became the director of Project NExT.

What other accomplishments in the MAA are you especially proud of?

My work with Project NExT is undoubtedly my most significant contribution to the MAA. Closely related to that was the role I played in helping to establish the James R. C. Leitzel Lecture at MathFest, which honors Jim's many contributions to the profession.

I also worked to broaden the scope of the mathematics community's advocacy for mathematics. When I became chair of the MAA Science Policy Committee, I realized that the Joint Policy Board for Mathematics (JPBM) focused exclusively on funding for mathematical research. I argued that funding for undergraduate mathematics education was also important and managed to get a concern for it voiced in JPBM's congressional testimony.

What changes have you seen in the mathematics world since you became involved?

I think I've witnessed a lot of changes in the world of mathematics. Substantively, it was exciting to be around for the classification of finite simple groups and the proofs of Fermat's last theorem and the Poincaré conjecture.

It has also been fun to observe the rapidly growing role of calculators and computers in mathematical research and applications.

There have been changes in the mathematical community, as well. When I attended my first Joint Mathematics Meetings in Biloxi, Mississippi, in January of 1979, women mathematicians were much less visible than they are now. I think that the program also paid less attention to undergraduate and graduate education than current programs do.

The meeting schedule itself was quite demanding. There were AMS contributed paper sessions in the evening, and my talk (about my dissertation) was scheduled at 7:45 at night!

Fortunately, one thing that has not changed is the friendliness of the mathematical community. Although I went to Biloxi knowing hardly any mathematicians at all, I met a lot of interesting people there, and I've continued to find mathematicians much more outgoing that the usual stereotype would suggest.

KenKen Variations

By Robert Fuhrer

Puzzle Page

KenKen® puzzles are a familiar sight in many worldwide publications, websites, and mobile apps, including the *New York Times,* NCTM's *Illuminations,* the *Times* (UK), *Der Spiegel,* and *USA Today* online. They are also used by more than 30,000 teachers in their classrooms to teach math skills, logical reasoning, problem solving, creative thinking, and perseverance. For this column, we will go one step further and explore some interesting variations of the game. The standard KenKen rules are simple:

- For an $n \times n$ grid, fill each row and column with the numbers 1 through n.
- Each heavily outlined set of cells, called a cage, contains a mathematical clue that consists of a number and an arithmetic operation. The numbers in the cage must combine (in any order) to produce the target number using the mathematical operation indicated.
- Cages with just one cell should be filled with the target number.
- Numbers can be repeated in a cage, as long as they are not repeated in any row or column.

See the example in the box below.

Puzzle 1: Standard but Challenging
This 9 × 9 KenKen puzzle follows the standard rules but is a real challenge!

3−		2−		360×	6−	11+	2−	
5−	5−		11+					216×
					3÷		21×	
3−		96×	12+		15+			
17+				60×			36×	9+
	9			3÷	1−			
6−		48×				1−	25×	
4−	3÷		22+	4−	288×			7+

Example: The 4x4 KenKen puzzle on the left has the solution shown on the right.

7+	4+	7+	2
7+	9+		2−

7+ 4	4+ 3	7+ 1	2 2
3	1	2	4
7+ 1	9+ 2	4	2− 3
2	4	3	1

Puzzle 2: KenKen Twist

If you've played a lot of KenKen puzzles, then you probably have certain strategies that are rooted in the fact that the numbers "1 through *n*" are what you have to work with. In KenKen Twist, we use a different set of numbers, to spice things up a bit. The numbers to be used are listed in the upper right corner of the puzzle.

KENKEN Twist 1 2 3 7 8 9

5−		7−		14×	
8+		6−			448×
3÷	6+				
	504×		6−		54×
1−			11+		
	1−		18×		

Puzzle 3: No-Op KenKen

In this puzzle you're back to using the standard "1 through *n*" set of numbers, but we've decided not to show you any of the operations. You must determine which operation needs to be applied in each cage. Good luck!

14		5		72	6
		5			
2		9	30		7
4	2			5	
		5		1	20
12		6			

The solutions to these three puzzles are at maa.org/focus/zenzen and will appear in the August/September issue.

At a basic level, solving KenKen puzzles requires not only simple arithmetic but also a combination of logic, algebra, number theory, and combinatorics. KenKen puzzles have also been used in the classroom to explore syllogisms and isomorphism, partitions and other topics from discrete math, and even geometry concepts. For example, see the National Council of Teachers of Mathematics article "Using KenKen to Build Reasoning Skills" (http://bit.ly/1zPsMZA). KenKen is also a good playground for undergraduate and faculty research projects in recreational mathematics.

To play unlimited KenKen puzzles of virtually any size or difficulty level, visit kenkenpuzzle.com. You can also download the KenKen Classic app from the Apple App Store, the Google Play store, or the Kindle App Store. Teachers can sign up for the free KenKen Classroom Program, which provides a set of weekly puzzles of varying sizes and levels, at kenkenpuzzle.com/teachers/classroom.

 Robert Fuhrer is the founder of Nextoy LLC and KenKen Puzzle Co.; rfuhrer@nextoy.com. *Laura Taalman is editor of the Puzzle Page column. To suggest puzzles for the column, contact her at* laurataalman@gmail.*com.*

BOOK REVIEWS » Math Books in the Kitchen

How to Bake π: An Edible Exploration of the Mathematics of Mathematics

Eugenia Cheng
Basic Books, 2015, 288 pages, Hardcover, $27.50

Reviewed by Darren Glass

If you think about it, mathematics is really just one big analogy. For one example, the very concept of the number three is drawing an analogy between a pile with three rocks, a collection of three books, and a plate with three carrots on it. For another, the idea of a group is drawing an analogy between adding real numbers, multiplying matrices, and many other mathematical structures. So much of what we do as mathematicians involves abstracting concrete things, and what is abstraction other than a big analogy?

It therefore isn't all that surprising that mathematicians seem fond of using analogies to describe mathematics itself. A quick Google search will show that many words have been written describing how doing mathematics is similar to playing a musical instrument, going to the gym, learning a foreign language, falling in love, climbing a ladder to the moon, and eating ice cream.

My personal favorite writing on this topic is an article from a 2003 issue of *The Believer,* in which Jordan Ellenberg describes how mathematics is analogous to mountain climbing but is not analogous to competitive hot dog eating. Eugenia Cheng's analogy of choice is that mathematics is similar to baking, and she has written a book about this analogy titled *How to Bake π: An Edible Exploration of the Mathematics of Mathematics,* recently published by Basic Books, which is almost certainly the first book ever written about baking and category theory.

Yes, you read that right. Baking and category theory. Cheng is a category theorist by training, but she is also deeply interested in the popularization of mathematics. In addition to a series of YouTube videos that she has made that give a semi-technical introduction to category theory for mathematicians, Cheng has gotten attention in the media for articles she has written about how to use math to make a perfect doughnut or to optimally combine jam, clotted cream, and scones.

How to Bake π is a book for general audiences. Although Cheng tackles lots of interesting ideas from mathematics in her book, she mostly does so at a pretty low level, and it is unlikely that many undergraduate math students, let alone professional mathematicians, will gain new mathematical insights from the book.

And although the meta-level ideas about the analogies between ideas in cooking and ideas in mathematics— as well as the more general thoughts about abstraction and mathematics—were interesting, I think most MAA members would think them more suited to a short article rather than a 250-page book. But we are not the target audience for Cheng's writing.

Each chapter begins with a recipe, which Cheng then uses to motivate the mathematics that follows. For example, a chapter that discusses

mathematical generalizations begins with a recipe that she developed for a gluten-free, dairy-free, sugar-free, paleo-diet-compatible Olive Oil Plum Cake. She writes that "it's not really a cake—it's a generalization of a cake. It has things in common with a cake . . . but is still somehow not quite the same as a cake." The chapter goes on to discuss how non-Euclidean geometries are generalizations of the geometry that the reader is familiar with and how our normal notions of distance can be generalized to scenarios that mathematicians might think of as Hamming distances and taxicab metrics.

This is the best book imaginable to introduce people who don't think they are interested in mathematics at all to some of the deep ideas of category theory, especially if they like to bake.

Another chapter discusses how some mathematics is created to solve a particular problem while other mathematics is developed on its own and applications are searched for after the fact. She refers to this as Internal-vs-External motivation and leans heavily on the analogy of how sometimes a chef goes shopping for ingredients for the recipe they want to cook and other times a dish is developed to use the ingredients one has in the pantry, such as the Chocolate and Prune Bread Pudding she developed, whose recipe is included in the book. Even from these limited descriptions you can probably tell that Cheng truly enjoys and is very thoughtful about her cooking, her mathematics, and her expository writing, and as a reader I enjoyed seeing where she would go next.

While the first two-thirds of the book introduces many different topics in mathematics and discusses Cheng's general philosophy of mathematics, the last third zeroes in on category theory, which Cheng describes as "the process of working out exactly which parts of math are easy, and the process of making as many parts of math easy as possible." She describes category theory as being more about the relationships between objects than about the objects themselves, which (it probably won't surprise you to learn) she compares to the idea that a lasagna is a certain relationship between noodles, sauces, and cheese despite the fact that your specific sauce recipes may be different from mine.

She goes on to discuss various notions of sameness, structure, and universal properties, and she manages to do so while keeping the book quite readable and light in tone even as the actual content gets increasingly technical. Again, I suspect that the lack of rigorous definitions or technical depth will probably leave most of you reading this review pretty unsatisfied with Cheng's book, but there are still some very interesting expository and philosophical ideas in the book.

Put another way: This is the best book imaginable to introduce people who don't think they are interested in mathematics at all to some of the deep ideas of category theory, especially if they like to bake. (Yes, Basic Books, you can use that quote as a blurb.)

However, I can't help but feel that the target audience for this book is very small (in particular, I cannot think of a specific person I would give it to as a gift) and that most people would rather keep their Julia Child separate from their Saunders Mac Lane.

Darren Glass is an associate professor of mathematics at Gettysburg College. Although he likes to cook Mexican food and Indian food, he has never been a very good baker. This review appeared originally in "MAA Reviews."

The Proof and the Pudding: What Mathematicians, Cooks, and You Have in Common

Jim Henle
Princeton University Press
2015, 176 pages, Hardcover, $26.95

Reviewed by Joel Haack

In the delightful book *The Proof and the Pudding: What Mathematicians, Cooks, and You Have in Common,* author Jim Henle shares exactly that. Henle provides evidence, directed to the "you," who is not necessarily either a mathematician or a cook, that the disciplines of mathematics and cooking share a number of common traits, as do their practitioners. There is no discussion of applications of mathematics to cooking (or for that matter, of cooking to mathematics).

The book is neither a cookbook nor a mathematics book. Rather, it is a book about cooking and about mathematics. Yes, there are mathematical ideas and problems presented, and recipes as well, but they are there to illustrate Henle's points about the commonalities in the two pursuits. I should say, however, that the puzzles presented (typically made up or extended by Henle) and the recipes presented (typically made up or extended by

Henle) are intriguing—the reader will want to grab a pencil and some mixing bowls and play along.

So, what are some of these commonalities? Here is just one example. Both mathematicians and cooks have to be arrogant, initially. Having the attitude that one can solve a problem or create a dish is critical to even making the attempt—on the mathematical side, how often have we implored a student or friend to try something, arguing that she or he can in fact make progress on a problem or puzzle? Similarly, many people are convinced they can't make bread. Try it!

This arrogance (or mock arrogance, or confidence) should in each case then be followed by doubt: Am I correct? How could the solution be improved; how could the bread be made better?

By my (likely incomplete) count, Henle provides 29 commonalities (actually, I arrived at 30, but no one would believe that was an actual count). He also admits that one could similarly link mathematics or cooking to most fields. I doubt, though, that many of the other comparisons would provide the same amount of fun!

Henle stresses the pleasure and sheer joy of both cooking and mathematics. He does mention the practicality of each, in two chapters, though these two chapters together occupy a mere one and one-half pages. If you too are a mathematician because of how much fun mathematics is, and you would like to share your joy with others in a way they might be able to understand your pleasure, give them this book.

Joel Haack is professor of mathematics at the University of Northern Iowa. This review appeared in "MAA Reviews."

Exploring the Heart of Calculus

By Steve Kennedy

MAA Books Beat

This business of teaching and learning mathematics is harder and more subtle than it seems. When I was younger, I thought I could lead my students to the promised land of mathematical enlightenment by giving crystal-clear, enthusiastic lectures. Gradually I came to believe that my lectures were not providing understanding and that the only role they served, if I did a good job with them, was to motivate the students to go home and do the hard mental work needed to figure out concepts on their own.

Once I started leaning this way—students understand only those things they discover for themselves—I was faced with the central dilemma confronting every advocate of inquiry-based learning: How on earth can I get my students to construct for themselves several centuries' worth of collective mathematical progress?

My answer: Asking them to solve really hard problems.

I admit to being influenced by my own teachers. As an undergraduate student in real analysis, I was asked on a take-home examination to prove that the set of real numbers in the unit interval with no threes in their decimal expansions is closed, perfect, and totally disconnected.

We had never seen the Cantor set. I didn't sleep for two days working on that problem. But, a few days later, when the instructor showed us the middle-thirds Cantor set, my understanding and engagement was at a level I've rarely achieved. That, and similar experiences, left an impression.

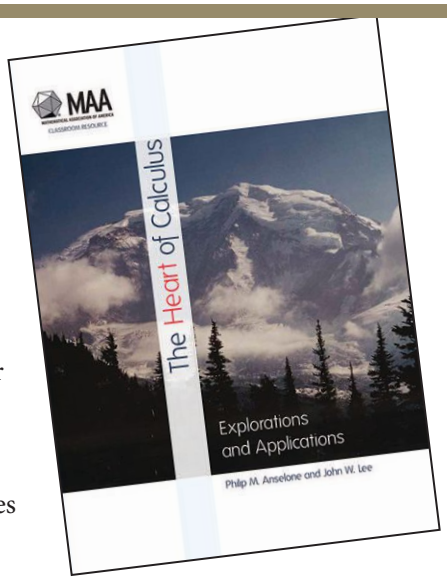
Struggling with challenging problems seems to be the essence of learning mathematics. With that exposed as my philosophical bias, you will have no trouble understanding my enthusiasm for Phil Anselone and John Lee's *The Heart of Calculus: Explorations and Applications.* This book came together as a collection of exercises assigned to students in Oregon State's honors calculus sequence.

Each of the book's 16 chapters is an extended exploration of a topic in calculus. Each ends with a themed collection of problems and project ideas.

Used as a text in a senior math-major capstone course, the experience would give your students a chance to look back at the material from the beginning of their math major from a more advanced perspective. Or, you could pick and choose challenging exercises and projects to really push your current calculus or ODE students. (That's my plan!)

Some examples: In a chapter meant to supplement, or amplify, the multivariable calculus discussion of curvature, the authors describe curvature in a very natural way as the rate of turning of the tangent vector. (Their description provides a nice unification of the 2D and 3D cases.) Then they derive all the usual formulas for curves in the plane and in three-space. Students are invited to explore some examples in the problems or to retrace the steps of Newton and Huygens, who, independently, discovered the notion of curvature.

The very next chapter contains a beautiful exposition of Ivan Niven's supremely clever proof that pi is irrational. If you've never seen that proof, this is the clearest explanation I've ever come across.



Philip M. Anselone and John W. Lee
The Heart of Calculus: Explorations and Applications, 245 pp., Hardbound, 2015; List Price: $60.00, Member Price: $48.00

(Essentially, the assumption that pi is rational allows you to build a polynomial that, when integrated against the sine function, provably yields an integer greater than zero and less than one. All you really need to know is integration by parts and some more or less elementary facts about polynomials.) Your students are then invited to prove that e and pi^2 are irrational.

There is a nice nonstandard discussion of the error in a Taylor series approximation. There are chapters on Newton's method, the Buffon needle problem, and simple harmonic motion. Also, you get extensive and detailed discussions of hanging cable and optimal location problems and three chapters devoted to celestial mechanics culminating in vector calculus proofs of Kepler's laws. Your students can't possibly fail to get excited by this. There is much here to enrich your calculus classes and to challenge your students.

Steve Kennedy is senior acquisitions editor at MAA. Contact him if you're interested in writing a book for the MAA, at kennedy@maa.org.

Call for Nominations: 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. This award is given annually at MAA MathFest. Nominations for the 2016 award should be sent by September 1, 2015, to the MAA Secretary, Barbara Faires, at secretary@maa.org. Guidelines for nominations and a nomination form can be found at the MAA website. A nominee must have received a PhD in pure or applied mathematics, have a record of published research in pure or applied mathematics, and have a record of distinguished contributions to K-16 mathematics education.

MAA Awards

A list of the awards given by the MAA is at *maa.org/awards*. The awards include these: Alder Award • Allendoerfer Award • Beckenbach Book Prize • Certificate of Merit • Chauvenet Prize • Dolciani Award • Euler Book Prize • Evans Award • Halmos-Ford Award • Gung and Hu Award for Distinguished Service • Hasse Prize • Haimo Award for Distinguished Teaching • Hedrick Lectures • High School Sliffe Awards • James R.C. Leitzel Lecture • JPBM Communications Award • MAA-NAM David Blackwell Lectures • Meritorious Service • Morgan Prize • Pólya Award • Pólya Lectures • Putnam • Robbins Prize • Selden Award

Can You Identify These People?

By Carol Mead

Archives Spotlight

It has been awhile since I last asked for your help in identifying people in photographs from the Paul Halmos Photograph Collection. Here are four more photos of people for you to identify. Thank you for your responses! With your help, the collection is closer than ever to being complete.

*Carol Mead is the archivist for the Archives of American Mathematics, located in the Research and Collections division of the Dolph Briscoe Center for American History on the University of Texas at Austin campus. Contact her by email (*carolmead@austin.utexas.edu*) or by phone (512-495-4539).*

4320: Halmos snapped this photograph in Tel Aviv in May 1985. He noted the man on the left as "Jakimowski" and the one on the right as Juday Eisenberg (Dean). Do you know Jakimowski's first name?

3828: Halmos wrote "Razak" on the back as well as "March 1983, Bloomington." I assume it is at the University of Indiana at Bloomington. Do you recognize the man?

3728: This is "Williams" at Oberwolfach in August 1980. There are many people named Williams—do you know which one this is?

3357: One of these men is another "Williams," while the other two are, I believe, James E. Brennan and Lee Albert Rubel. Can you help me identify who is who?

Search for an Executive Director for the American Mathematical Society

Position

The Trustees of the American Mathematical Society seek candidates for the position of Executive Director of the Society to replace Dr. Donald McClure, who plans to retire in the summer of 2016. This position offers the appropriate candidate the opportunity to have a strong positive influence on all activities of the Society, as well as the responsibility of overseeing a large, complex, and diverse spectrum of people, publications, and budgets. The desired starting date is July 1, 2016.

Duties and terms of appointment

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

The Executive Director is the principal executive officer of the Society and is responsible for the execution and administration of the policies of the Society as approved by the Board of Trustees and by the Council. The Executive Director is a full-time employee of the Society appointed by the Trustees and is responsible for the operation of the Society's offices in Providence and Pawtucket, RI; Ann Arbor, MI; and Washington, DC. The Executive Director is an ex-officio member of the policy committees of the Society and is often called upon to represent the Society in its dealings with other scientific and scholarly bodies.

The Society employs a staff of about 200 in the four offices. The directors of the various divisions report directly to the Executive Director. A major part of the Society's budget is related to publications. Almost all operations (including the printing) of the publications program are done in-house. Information about the operations and finances of the Society can be found in its Annual Reports, available at www.ams.org/annual-reports.

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

Qualifications

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

Applications

A search committee chaired by Robert Bryant (bryant@math.duke.edu) and Ruth Charney (charney@brandeis.edu) has been formed to seek and review applications. All communication with the committee will be held in confidence. Suggestions of suitable candidates are most welcome. Applicants can submit a CV and letter of interest to:

Executive Director Search Committee
c/o Carla D. Savage
Secretary, American Mathematical Society
Department of Computer Science
North Carolina State University
Raleigh, NC 27695-8206
ed-search@ams.org

The American Mathematical Society is an Affirmative Action/Equal Opportunity Employer.

SEATTLE MUNICIPAL ARCHIVES

Call for MAA Papers: 2016 Joint Mathematics Meetings

January 6–9, Seattle, Washington

The MAA Committee on Contributed Paper Sessions is soliciting contributed papers pertinent to the sessions listed below. Contributed paper session presentations are limited to 15 minutes, except in the general session where they are limited to 10 minutes.

Please note that the dates and times scheduled for these sessions remain tentative.

The deadline for submission of abstracts is Tuesday, September 22.

CONTRIBUTED PAPER SESSIONS WITH THEMES

Experiences and Innovations in Teaching Probability Theory

Wednesday (1/6) morning

We invite papers and scholarly presentations on improving the teaching of probability theory, at the undergraduate or beginning graduate level, by innovative methods. Possible topics could include inquiry-based learning, projects, mathematical writing, real-world applications, connections to other areas of mathematics, integration of technology, or simulation.

The focus of this session will be on the teaching of probability theory (the construction, analysis, and theoretical properties of probabilistic models) rather than statistics or data analysis. Reports on student outcomes, either anecdotal or empirical, are encouraged.

Organizers: Jonathon Peterson, Purdue University; and Nathaniel Eldredge, University of Northern Colorado

Topics and Techniques for Teaching Real Analysis

Wednesday (1/6) afternoon

Real analysis is a core component of the mathematics program. It has traditionally been considered difficult for students, but is also challenging to teach since the student body can be diverse and there are many choices in subject matter. Students may end up applying their knowledge of real analysis in differential equations, functional analysis, probability, even economics and physics. There are many exciting topics that can be covered and many possible strategies for success. Speakers at this session can present topics that could be added to real analysis courses and can discuss improved presentation techniques of traditional topics.

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 (1/7) morning

Courses in the philosophy of mathematics are rare, but philosophical questions frequently arise in the regular curriculum, often presenting difficulties to teachers who haven't prepared to respond to them. In recent years a growing number of teachers of mathematics are discovering that addressing philosophical issues deliberately in their courses not only eases the strain but also enhances students' ability to grasp difficult mathematical concepts. An upcoming MAA Notes volume, *Using the Philosophy of Mathematics in Teaching Collegiate Mathematics,*

illustrates the ways a wide variety of teachers have found to introduce philosophical questions as an exciting part of presenting standard mathematical material. This session invites teachers at all levels to discuss ways they have found to include philosophy in the mathematics classroom. Papers on other topics in the philosophy of mathematics will be considered as time permits.

Organizers: Carl Behrens, Alexandria, Virginia; and Dan Sloughter, 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

The Common Core State Standards for Mathematics have been widely adopted and implemented nationally. Mathematics departments share responsibility with teacher education programs to prepare future teachers to meet content and, especially, mathematical practices standards. Mathematics faculty also collaborate with the K-12 system to ensure a smooth transition from school to higher education, one of the primary purposes of the CCSS.

This session seeks reports of mathematics faculty experiences with their department's implementation of the CCSS mathematics standards with a focus on the requirements of new assessments. We invite contributed papers describing efforts, including evidence of their impact, that

(1) Investigate how well their math education candidates are prepared with the knowledge and skills necessary to assess that their students meet the CCSS for mathematics content and practices;

(2) Partner with K-12 educators to focus on the implications related to the assessments (such as PARCC and Smarter Balanced) being used;

(3) Discuss changes mathematics departments have made to their programs implementing the CCSS and assessments for the mathematical education of teachers, or

(4) Discuss departmental initiatives to ensure a smooth transition from school to higher education in light of the CCSS and associated assessments.

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 at 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

The teaching of undergraduate ordinary differential equations (ODEs) provides a unique way to introduce students to the beauty and applicative power of calculus. ODEs are also rich with aesthetically pleasing theory, which often can be communicated visually and explored numerically.

This session will feature talks that describe innovative teaching in the ODEs course as well as the description of either projects or pedagogy that can be used to engage students in their study of ODEs. Successful contributions could include but are not limited to: (1) innovative ways of teaching standard topics in the ODEs course; (2) strategies for teaching both differential equations and linear algebra simultaneously; (3) the inclusion of technology in the ODEs course; and (4) descriptions of applications or nonstandard topics and how such topics can lead to student engagement and interest.

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

Linear algebra is one of the most interesting and useful areas of mathematics because of its beautiful and multifaceted theory, as well as for the enormous importance it plays in understanding and solving many real-world problems. Consequently, many valuable and creative ways to teach its rich theory and its many applications are continually being developed and refined.

This session will serve as a forum in which to share and discuss new or improved teaching ideas and approaches. These innovative and effective ways to teach linear algebra include, but are not necessarily limited to: (1) hands-on, in-class demos; (2) effective use of technology, such as Matlab, Maple, Mathematica, Java Applets, or Flash; (3) interesting and enlightening connections between ideas that arise in linear algebra and ideas in other mathematical branches; (4) interesting and compelling examples and problems involving particular ideas being taught; (5) comparing and contrasting visual (geometric) and more abstract (algebraic) explanations of specific ideas; (6) other novel and useful approaches or pedagogical tools.

Organizers: David Strong, Pepperdine University; Gil Strang, MIT; and Megan Wawro, Virginia Tech

Helping Students See beyond Calculus

Saturday (1/9) afternoon

We need more and better-educated mathematics and science students. Too many high school and beginning college students think of mathematics merely as calculus and the topics leading to it. Many talented and promising students lose interest in mathematics—some never take a single math class in college, and some drop out of the math major soon after beginning—because they are never exposed to the beauty and usefulness of the many other areas of mathematics. Students—and society—would immensely benefit from the students' being exposed to other areas of mathematics before leaving high school or during their first semesters in college.

Papers submitted for this session should describe classroom presentations and materials that provide students with the exposure described above. Such classroom presentations and materials should be

- An introduction to a specific mathematical idea or application;
- Accessible to high school or early-college-level students;
- Self-contained (including information on how to most effectively use the presentation or materials);
- Composed of PowerPoints, video or audio clips, online or printed handouts, materials or tools for experimentation and visualization, and so on; and
- Interesting, entertaining, and possibly captivating.

The organizers hope that speakers will make their classroom presentations available online (on their own websites) for use by other educators.

Organizers: David Strong, Pepperdine University; James Tanton, MAA; Courtney Davis, Pepperdine University; and Angela Spalsbury, Youngstown State University

Sponsor: SIGMAA TAHSM

Mathematics and Sports

Saturday (1/9) morning

The expanding availability of play-by-play statistics and video-based spatial data for professional and some collegiate sports is leading to innovative kinds of research, using techniques from various areas of the mathematical sciences. By modeling the outcome distributions in certain situations, researchers can develop new metrics for player or team performance in various aspects of a sport, comparing actual results to expected values. Such work often has implications for strategic game management and personnel evaluation. Classic areas of study, such as tournament design, ranking methodology, forecasting performance, insight into rare or record events, and physics-based analysis, also remain of interest.

This session will include presentations of original research and expository talks; topics related to the use of sports applications in curriculum are welcome. With a broad audience in mind, all talks are requested to be accessible to mathematics majors. Undergraduates and their mentors are particularly encouraged to submit abstracts for consideration.

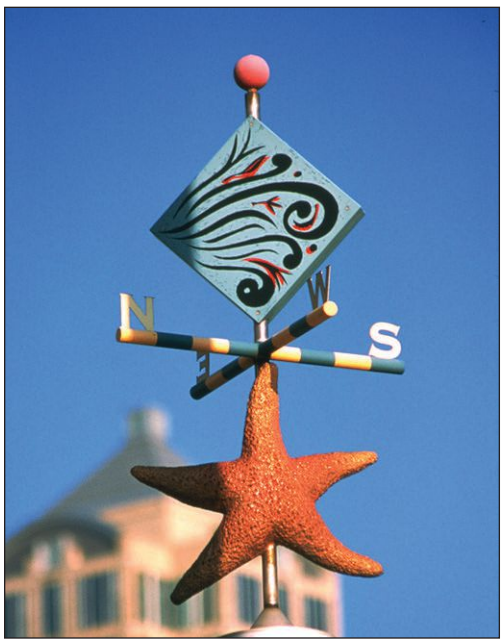
Organizers: Drew Pasteur, College of Wooster; and John David, Virginia Military Institute

Preparation, Placement, and Support of Elementary Mathematics Specialists

Thursday (1/7) morning

Over the last decade, there have been numerous calls for the use of mathematics specialists in elementary and middle schools. In 2013, the Association of Mathematics Teacher Educators (AMTE) created a set of Standards for Elementary Mathematics Specialists (amte.net/publications) to encourage states to address the urgent need to increase the mathematical knowledge and expertise of elementary school staff by establishing an elementary mathematics specialist license, certificate, or endorsement. Elementary mathematics specialists are teachers, teacher leaders, or coaches who are responsible for supporting effective mathematics instruction and student learning at the classroom, school, district, or state level.

Recently some institutions have begun degree or certificate programs to educate these elementary mathematics specialists. Papers will report on the preparation, placement, and support of mathematics specialists in the elementary grades as well as on the development of degree or certificate programs to educate these mathematics specialists. Papers may describe programs to prepare pre-service or in-service teachers to become elementary mathematics specialists, or they may describe efforts with school districts to create



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positions and support for these specialists. Reports on the successful installation and implementation of elementary mathematics specialists are also welcome. Papers should include evidence of success or the potential for application to other institutions or districts.

Organizers: Laurie J. Burton, Western Oregon University; Cheryl Beaver, Western Oregon University; and Klay Kruczek, Southern Connecticut State University

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

Trends in Undergraduate Mathematical Biology Education

Friday (1/8) morning

Several recent reports emphasize that aspects of biological research are becoming more quantitative and that life science students, including premed students, should be introduced to a greater array of mathematical, statistical, and computational techniques and to the integration of mathematics and biological content at the undergraduate level. Mathematics majors also benefit from coursework at the intersection of mathematics and biology because there are interesting, approachable research problems, and mathematics students need to be trained to collaborate with scientists in other disciplines, particularly biology.

Topics may include scholarly work addressing the issues related to the design of effective biomathematics course content, courses, and curricula; the integration of biology into mathematics courses, student recruitment efforts, the gearing of content toward premed students, undergraduate research projects, effective use of technology in bio-mathematics courses, preparation for graduate work in biomathematics and computational biology or for medical careers, and assessment issues.

Organizers: Timothy Comar, Benedictine University; and Daniel Hrozencik, Chicago State University

Sponsor: SIGMAA BIO, the SIGMAA on Mathematical and Computational Biology

Mathematics and the Arts

Wednesday (1/6) morning and afternoon

Presentations exploring connections between mathematics and the arts are invited from any of various perspectives, including mathematical aspects of traditional art, mathematical topics represented by or incorporated into art, and artistic and aesthetic aspects of mathematical topics. All artistic areas are welcome: visual, poetical, dramatic, musical, literary, dance, fiber arts, and so forth. Practitioners from anywhere along the spectrum of math and the arts, as well as educators with experience at this intersection, are invited to report on their experiences, whether primarily artistic, mathematical, pedagogical, or blended.

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

A mathematics circle is an enrichment activity for K-12 students or their teachers, which brings them into direct contact with mathematics professionals, fostering a passion and excitement for deep mathematics in the participants. Math circles provide a unique opportunity to reach a wide variety of audiences and have a lasting impact.

This session is focused on how math circles have served this variety of populations and the effect of this service. Talks are invited that address how math circles have served nonstandard or often-underrepresented audiences. Talks are also invited that describe the lasting impact of math circles on various audiences; for example, talks that describe how math circles affected you as a young mathematician are welcome.

Organizers: 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

The MAA Business, Industry, and Government Special Interest Group (BIG SIGMAA) provides resources and a forum for mathematicians working in business, industry, and government (BIG) to advance the mathematics profession by making connections, building partnerships, and sharing ideas. BIG SIGMAA consists of mathematicians in BIG as well as faculty and students in academia who are working on BIG problems. Mathematicians, including those in academia, with BIG experience are invited to present papers or discuss projects involving the application of mathematics to BIG problems.

The goal of this contributed paper session is to provide a venue for mathematicians with experience in business, industry, and government to share projects and mathematical ideas in this regard. Anyone interested in learning more about BIG practitioners, projects, and issues will find this session of interest.

Organizers: Carla D. Martin, Department of Defense; and Allen Butler, Wagner Associates

Sponsor: BIG SIGMAA, the SIGMAA on Business, Industry, and Government

JMM 2015 Exhibit Hall.

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The Scholarship of Teaching and Learning in Collegiate Mathematics

Wednesday (1/6) morning and afternoon

In the scholarship of teaching and learning, faculty bring disciplinary knowledge to bear on questions of teaching and learning and systematically gather evidence to support their conclusions. Work in this area includes investigations of the effectiveness of pedagogical methods, assignments, or technology, as well as probes of student understanding.

The goals of this session are to (1) feature scholarly work focused on the teaching of postsecondary mathematics; (2) provide a venue for teaching mathematicians to make public their scholarly investigations into teaching/learning; and (3) highlight evidence-based arguments for the value of teaching innovations or in support of new insights into student learning. Appropriate for this session are preliminary or final reports of postsecondary classroom-based investigations of teaching methods, student learning difficulties, curricular assessment, or insights into student (mis)understandings. Abstract submissions should have a clearly stated question that was or is under investigation and should indicate the type of evidence that has been gathered and will be presented. For example, papers might reference student work, participation or retention data, pre/post tests, interviews, surveys, think-alouds, and so on.

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

The Contributions of Minorities to Mathematics throughout History

Friday (1/8) morning

The history of mathematics is filled with inspiring stories of mathematicians. This session will focus on the stories of minority mathematicians (people of color, native peoples, women, and other peoples historically underrepresented in mathematics) of the distant and not-so-distant past and the impact they have had on mathematics and its teaching.

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

Developmental math courses and courses prerequisite to the calculus sequence such as college algebra and precalculus are challenging for many students. By incorporating the history of mathematics into these courses, a deeper level of understanding and interest may be achieved. This session seeks papers that offer ideas for incorporating the history of mathematics (generally or specifically) into these courses.

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

Undergraduate research is a high-impact practice that inspires student learning, builds crucial skills, boosts retention and graduation rates, and particularly benefits underrepresented and at-risk students. Although students often engage in undergraduate research outside of the classroom, incorporating research projects into the classroom can bring this impactful experience to even more students.

This session will focus on incorporating research into the undergraduate classroom, from introductory to upper-level mathematics courses. Presentations may describe a particular research project or activity, faculty experiences in mentoring undergraduate research in the classroom, or student experiences and feedback. All talks should emphasize why the project(s) being discussed is considered undergraduate research rather than a typical assignment. Participants are encouraged to share the impact on the students involved if possible.

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) morning

Graduate teaching assistants (GTAs) make up a nontrivial portion of the teaching workforce at many universities. Though their duties vary, most are responsible for teaching introductory general education courses in some capacity. In fact, a 2010 AMS survey of four-year colleges and universities suggests that roughly 8 percent of introductory math courses (15 percent for statistics) are taught fully by graduate students. This responsibility may seem straightforward at first glance; however, there is a growing movement toward accountability for general education outcomes in such courses. Students in these classes deserve a positive, engaging experience—one that not only permits them to take future math courses (if desired), but also fosters gains in numeracy. In light of a GTA's workload and background, such an experience can be challenging to create.

This session is designed to encourage dialogue among both graduate programs and graduate instructors. Talks might include reports on innovative preparation methods for new instructors, accountability measures for GTAs, means for infusing quantitative literacy into GTA-led courses, as well as novel ideas or reports from graduate students themselves.

Organizer: Samuel L. Tunstall, Michigan State University

Mathematical Modeling in the Undergraduate Curriculum

Saturday (1/9) morning

Both the MAA's 2015 CUPM Curriculum Guide and SIAM's Modeling Across the Curriculum Report emphasize the value in teaching mathematical modeling as a dynamic problem-solving process. In addition to courses specifically dedicated to mathematical modeling and applied mathematics, many undergraduate mathematics programs have made an effort to infuse modeling into courses across their existing curriculum.

This session welcomes papers concerning best practices, useful examples, or effective strategies in the design and teaching of undergraduate courses in which mathematical modeling makes up a significant activity or core learning objective. Collectively, the papers presented in this session will represent applications of mathematics to a broad range of fields.

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

This session presents research reports on undergraduate mathematics education. The session will feature research in a number of mathematical areas including calculus, linear algebra, advanced calculus, abstract algebra, and mathematical proof. The goals of this session are to foster high-quality research in undergraduate mathematics education, to disseminate well-designed educational studies to the greater mathematics community, and to transform theoretical work into practical consequences in college mathematics. Examples of such types of research include rigorous and scientific studies about students' mathematical cognition and reasoning, teaching practice in inquiry-oriented mathematics classrooms, design of research-based curricular materials, and professional development of mathematics teachers, with intention to support and advance college students' mathematical thinking and activities.

The presentation should report results of completed research that builds on the existing literature in mathematics education and employs contemporary educational theories of the teaching and learning of mathematics. The research should use well-established or innovative methodologies (e.g., design experiment, classroom teaching experiment, and clinical interview, with rigorous analytic methods) as they pertain to the study of undergraduate mathematics education. We also welcome preliminary reports on research projects in early stages of development or execution.

Organizer: Karen A. Keene, North Carolina State University

Sponsor: SIGMAA on RUME

Origami in the Mathematics K-12 Classroom

Saturday (1/9) afternoon

Programs that take advantage of paper folding to teach mathematics are thriving in many parts of the world. Presenters in this session will describe their innovative strategies for exploring mathematics in the K-12 classroom and/or with future/in-service teachers using paper folding/origami as the means to reach the goals established by the Common Core. The focus of the session will be on rich mathematical explorations that are based on or enhanced by paper folding. Presentations are expected to be scholarly.

Organizers: Roger Alperin, San Jose State University; and Perla Myers, University of San Diego

Contemplative Pedagogy and Mathematics

Friday (1/8) afternoon

Contemplative pedagogy aims to incorporate contemplative/introspective practices into the classroom in order to deepen the educational experience. Students are challenged to engage more fully with the material and their experience of learning. Common techniques include in-class mindfulness activities, deep listening or dialoguing, journaling, and beholding. As more and more data comes in showing the efficacy and benefits of such practices in all aspects of life, the Contemplative Education movement has been gaining momentum, strengthening connections with established good pedagogy, and expanding to departments outside the humanities and social sciences. This contributed paper session solicits presentations from college-level educators with hands-on experience of contemplative pedagogy or contemplative practices. We welcome reports on successful, or unsuccessful, attempts at contemplative pedagogy, whether anecdotal or systematic. We also invite educators with personal out-of-class contemplative practices, to reflect on how that practice has informed their teaching.

Organizers: Luke Wolcott, Lawrence University; and Justin Brody, Goucher College

Assessing Student Learning: Alternative Approaches

Wednesday (1/6) morning

Assessment is central to determining a student's level of mastery, yet traditional methods of assessment (such as exams, quizzes, and homework) may not accurately and robustly measure student understanding. With the recent increase in the popularity of non-lecture-based course structures, techniques that assess deeper learning are coming to the forefront. This session invites presenters to describe innovative methods of assessment with which they have experimented in the attempt to accurately reflect the diversity of ways students learn and understand course material. Presenters should focus on practical issues of implementation and discuss the level of success of the method in the college classroom. Presenters may also share methods to determine the validity of their assessments, advice for others looking to implement or create alternative assessment methods, or how these methods can help instructors evaluate the effectiveness of a nontraditional classroom.

Organizers: David Clark, Grand Valley State University; Jane Butterfield, University of Victoria; Robert Campbell, College of St. Benedict and St. John's University; and Cassie Williams, James Madison University

Quantitative Literacy in the K-16 Curriculum

Wednesday (1/6) afternoon

Because of its nature, quantitative literacy (QL) is referenced at almost all levels of the educational system. Traditional mathematical topics such as calculus have relatively well-defined prerequisites and outcomes and an established location in the traditional mathematical curriculum sequence. Quantitative literacy typically involves the use of a wide variety of precollegiate mathematics to enable a deeper understanding within a nonmathematical context. As a result, changing requirements for K-12 mathematics can have a significant impact on what we do at the collegiate level.

Papers in this session will focus on the interface between the K-12 curriculum and collegiate quantitative literacy. Given the breadth of this area, it is expected that papers with a variety of different focuses will be accepted. Papers that provide insights on the following questions are explicitly invited: requirements for K-12 that affect collegiate-level QL, QL requirements for two-year colleges, the distinction between K-12 quantitative literacy standards and collegiate quantitative literacy standards, and the impact of changing requirements at the K-12 and two-year schools on four-year school curricula.

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

Students who major in such fields as agriculture, architecture, biology, business, economics, and liberal arts and human sciences often take a one-semester, terminal calculus course with a focus on applications. One approach to these courses involves focused, targeted versions of calculus, such as applied calculus, business calculus, or calculus for the life sciences. Some schools cannot offer a wide range of calculus courses and must design a single course to meet the needs of these students.

This session invites presenters to share innovative course designs for a one-semester calculus course for students interested in a variety of disciplines, particularly those that involve mathematical modeling. Presenters are expected to report their course design, how it meets the needs of students, and evidence for the effectiveness of their approach.

Organizers: Joel Kilty and Alex M. McAllister, Centre College

Conversations with the Partner Disciplines: Collaborations to Improve the Mathematics Curriculum

Saturday (1/9) afternoon

The undergraduate mathematics curriculum is an essential component of the education of future scientists, health professionals, engineers, computer scientists, business professionals, and social scientists; and it supports the quantitative education of all students. Understanding and adapting to the evolving needs of the partner disciplines is critical to maintaining a vital and relevant mathematics curriculum. The 2013 NRC report *The Mathematical Sciences in 2025* revealed that "the educational offerings of typical departments in the mathematical sciences have not kept pace with the changes in how the mathematical sciences are used" and that a "community-wide effort is needed . . . to make undergraduate courses more compelling to students and better aligned with the needs of user departments." One national effort to improve such communication over the past decade has been the MAA's Curriculum Foundations Project: Voices of the Partner Disciplines.

This session presents successful collaborations with partner disciplines to revise mathematics courses or programs. Talks should identity the research basis for curricular change such as on-campus conversations, the Curriculum Foundations Project, or other professional reports or guidelines. Talks illustrating successful models for collaboration or interdisciplinary courses/programs developed from these partnerships are also welcome. Projects renewing mathematics courses in the first two years of the undergraduate curriculum are especially encouraged. Papers from the session may be considered for a special issue of *PRIMUS.*

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. Doree, Augsburg College; Jason Douma, University of Sioux Falls; and Susan Ganter, East Carolina University

JMM Employment Center.

Bringing the Community into the College Mathematics Classroom

Thursday (1/7) afternoon

Colleges and universities are often involved in the surrounding communities, typically through partnerships and outreach. But how often are communities present in college classrooms, in particular in mathematics classrooms? This session is concerned with collaborations between universities and the communities they serve that enhance student mathematical learning, while also building stronger ties with individuals and organizations in these communities. Such collaborations can happen in any mathematics course, from liberal arts mathematics to the capstone; they can be implemented at any level, of an individual course or program-wide; and they can take many forms. For example, community members may share their expertise during a class visit; students may serve as consultants to a community-based organization; or course meetings can take place on-site in the community, to name a few.

Proposals for this session should describe collaborations between mathematics courses (or programs) and community members or organizations. These collaborations should be more than simple attempts to "fix" the communities and should view communities as sources of knowledge rather than as deficient. All proposals must provide rich descriptions of the collaboration and the mathematics learning that took place, and they should provide evidence of the impact that the collaboration had on participants, both students and community members (if applicable). Accounts of internships will also be considered.

Organizer: Ksenija Simic-Muller, Pacific Lutheran University

Innovative Targeted Solutions in Teaching Introductory Statistics

Thursday (1/7) afternoon

Statistics is a very rapidly growing field and enrollments in introductory statistics courses are expanding. The 2015 MAA *Curriculum Guide* recommends that all math majors learn effective data analysis. This is also a time of great innovation and change in the way Introductory Statistics is taught. This session invites papers on successful methods used in Intro Stats. These methods can range from an innovative full-course curriculum overhaul to a single effective in-class activity. All papers should provide participants with a clear take-away idea for use in Introductory Statistics.

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

Much attention has been paid recently to improving student learning in the introductory statistics course. This session is focused on the rest of the undergraduate statistics curriculum.

We invite submissions that provide details about innovative learning activities, technologies, resources, or teaching methods that have been used effectively in Stat II, mathematical statistics, or other statistics courses beyond the intro stat course. Submissions may range from single effective activities used in these courses to major curricular revisions or completely new courses. We welcome submissions that include partnerships with other disciplines. Presentations should explicitly address the objectives and effectiveness of the described activities.

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

The needs of mathematics and computer science majors in discrete mathematics courses differ: Although a proof-based approach is typically desired for mathematics majors, computer science majors need to understand the connection between the mathematics and concepts they encounter in computer science coursework. Yet all students can benefit from both approaches: computer science majors from more mathematical rigor, and mathematics majors from more programming applications. One possible approach to making discrete mathematics courses more meaningful to all students is through the use of technology, especially as computer software becomes more freely available (e.g., SAGE or Wolfram Alpha) and easier to use (e.g., newer versions of Maple and Mathematica). Other approaches include meaningful projects and activities.For this session, we invite proposals that describe an activity, problem, assignment, or project that advanced the knowledge and engagement of students enrolled in a discrete mathematics course. Descriptions of entire courses are also welcome. Although we are especially interested in proposals about courses that simultaneously serve computer science and mathematics majors by implementing computer software or programming, proposals describing other innovative approaches to teaching discrete mathematics in general will also be considered. Talks in this session should also describe outcomes, giving evidence of the success of the intervention.

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

As more students begin their college education at a two-year college before transferring to a bachelor's degree program, it is increasingly important to ensure that students choosing to major in mathematics are adequately prepared for the rigor of advanced mathematics courses. In particular, they will need to read, comprehend, and write proofs. Most standard calculus sequences do not or cannot provide the needed preparation because they must serve a significantly diverse set of majors. Therefore, many bachelor degree programs in mathematics require an Introduction to Proofs–style course. This kind of course is not currently offered in most two-year college mathematics programs. We invite faculty from two- and four-year institutions to share

- Introduction to Proofs and Mathematical Reasoning courses for students who have had a year of calculus and intend to take upper-division mathematics courses especially as taught to students in two-year colleges;
- Methods of integrating the teaching and practice of proof-writing for mathematics majors into standard first- and second-year mathematics courses; or
- Collaborative efforts between two- and four-year institutions to create or facilitate transfer of Introduction to Proof and Mathematical Reasoning courses or course equivalents.

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

MAA has supported professional development activities that have enhanced the mathematics profession through the PRofessional Enhancement Program (MAA PREP), funded by the National Science Foundation. A variety of professional development workshops have been conducted under the MAA PREP umbrella, and it would be beneficial for workshop organizations and participants to share their experiences and insights. This session will provide a venue for organizers to share their ideas with one another and for


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participants to share their experiences.

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

The goal of inquiry-based learning (IBL) is to transform students from consumers to producers of mathematics. Inquiry-based methods aim to help students develop a deep understanding of mathematical concepts and the processes of doing mathematics by putting those students in direct contact with mathematical phenomena, questions, and communities. Within this context, IBL methods exhibit great variety. Activities can take place in single class meetings and span entire curricula for students of any age; students can be guided to reinvent mathematical concepts, to explore definitions and observe patterns, to justify core results, and to take the lead in asking new questions. There is a growing body of evidence that IBL methods are effective and important for teaching mathematics and for fostering positive attitudes toward the subject.

This session invites scholarly presentations on the use of inquiry-based methods for teaching and learning. We especially invite presentations that include successful IBL activities or assignments, that support observations about student outcomes with evidence, or that could help instructors who are new to IBL to try new methods.

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

Puzzles, card tricks, games, game shows, and gambling provide an excellent laboratory for testing mathematical strategy, probability, and enumeration. Pencil-and-paper puzzles, board games, game shows, card tricks, and card games all provide opportunities for mathematical and statistical analysis. Submissions to this session are encouraged that look at new problems as well as novel approaches to old problems. Submissions by undergraduates or examples of the use of the material in the undergraduate classroom are encouraged.

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

Revitalizing Complex Analysis

Saturday (1/9) morning

Complex analysis, despite its beauty and power, seems to have lost some of the prominence it once enjoyed in undergraduate mathematics, science, and engineering. Thanks to funding from NSF, a national dialogue has begun with the intention of remedying this situation. Two sessions at the 2015 San Antonio JMM focused on suggestions for curricular reform from a variety of perspectives: modifying the traditional course to include more modern ideas; including modules suitable for student investigation; and instituting a transitions course containing a meaty component of complex analysis.

Papers at this session should likewise be scholarly and focus on ways to enliven complex analysis as taught to undergraduates. The table is open to suggestions for technological innovation, pedagogical ideas, or other innovative approaches that seem promising.

Organizers: Russell Howell, Westmont 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

This session will showcase the increasing popularity of open educational resources (OER) for courses in mathematics and the sciences. Examples of this may include, but are not limited to, the development, enhancement, or adoption of open-source or

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open-access course texts and related materials, the creation and/or implementation of course technological enhancements, such as instructional apps and video tutorials, and experiences with the inclusion of low- or no-cost homework platforms or mathematics software systems in a particular course. Presenters should attempt to address the effectiveness (formally or informally assessed) of the adoption of such resources in their courses. Presenters from all educational levels and STEM-related fields are encouraged to submit abstracts, with preference awarded to those topics focusing on the high school, community college, and undergraduate levels.

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

GENERAL CONTRIBUTED PAPER SESSIONS

Wednesday (1/6), Thursday (1/7), Friday (1/8) , and Saturday (1/9), morning and afternoon

Organizers: Bem Cayco, San Jose State University; Timothy Comar, Benedictine University; and T. James Reid, University of Mississippi

The MAA's General Contributed Paper Session accepts contributions in all areas of mathematics, curriculum, and pedagogy. When you submit your abstract, you will be asked to classify it according to the following scheme.

- Assessment
- 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

Submission Procedures for MAA Contributed Paper Abstracts

Abstracts may be submitted electronically at http://jointmathematicsmeetings.org/meetings/abstracts/abstract.pl?type=jmm.

Fill in the number of authors, click "New Abstract," and then follow the step-by-step instructions.

The deadline for abstracts is Tuesday, September 22.

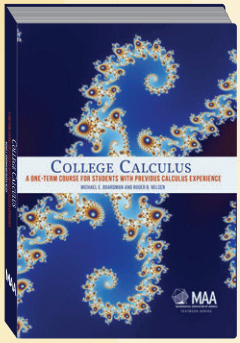
Each participant can give only one talk in the MAA contributed paper sessions, whether it is in one of the themed sessions or in the general session. If your paper cannot be accommodated in the session in which it is submitted, it will automatically be considered for the general session.

The organizer(s) of your session will automatically receive a copy of the abstract, so it is not necessary for you to send it directly to the organizer. All accepted abstracts are published in a book that is available to registered participants at the meeting. Questions concerning the submission of abstracts should be addressed to abs-coord@ams.org.

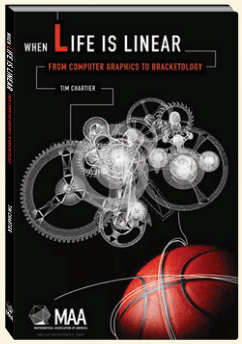
SEATTLE MUNICIPAL ARCHIVES

Attending MAA MathFest this August?

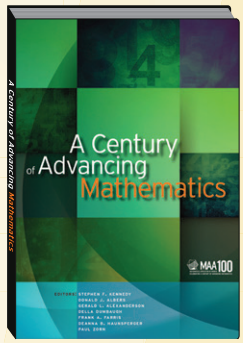
Visit the MAA Pavilion in the exhibit hall and browse our latest books.



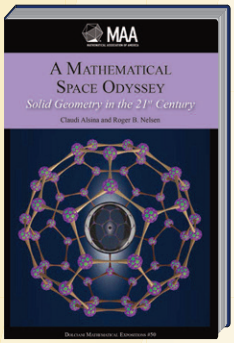
College Calculus: A One-Term Course for Students with Previous Calculus Experience
by M. Boardman and R. Nelsen
Meeting Price: $45.50



When Life is Linear: From Computer Graphics to Bracketology
by T. Chartier
Meeting Price: $38.00



A Century of Advancing Mathematics
S. Kennedy, et al, Editors
Meeting Price: $45.50



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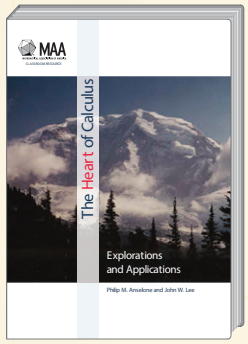

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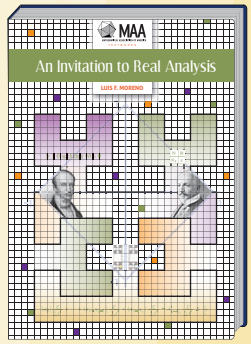

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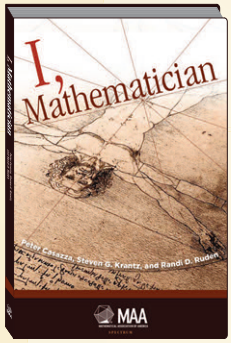

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