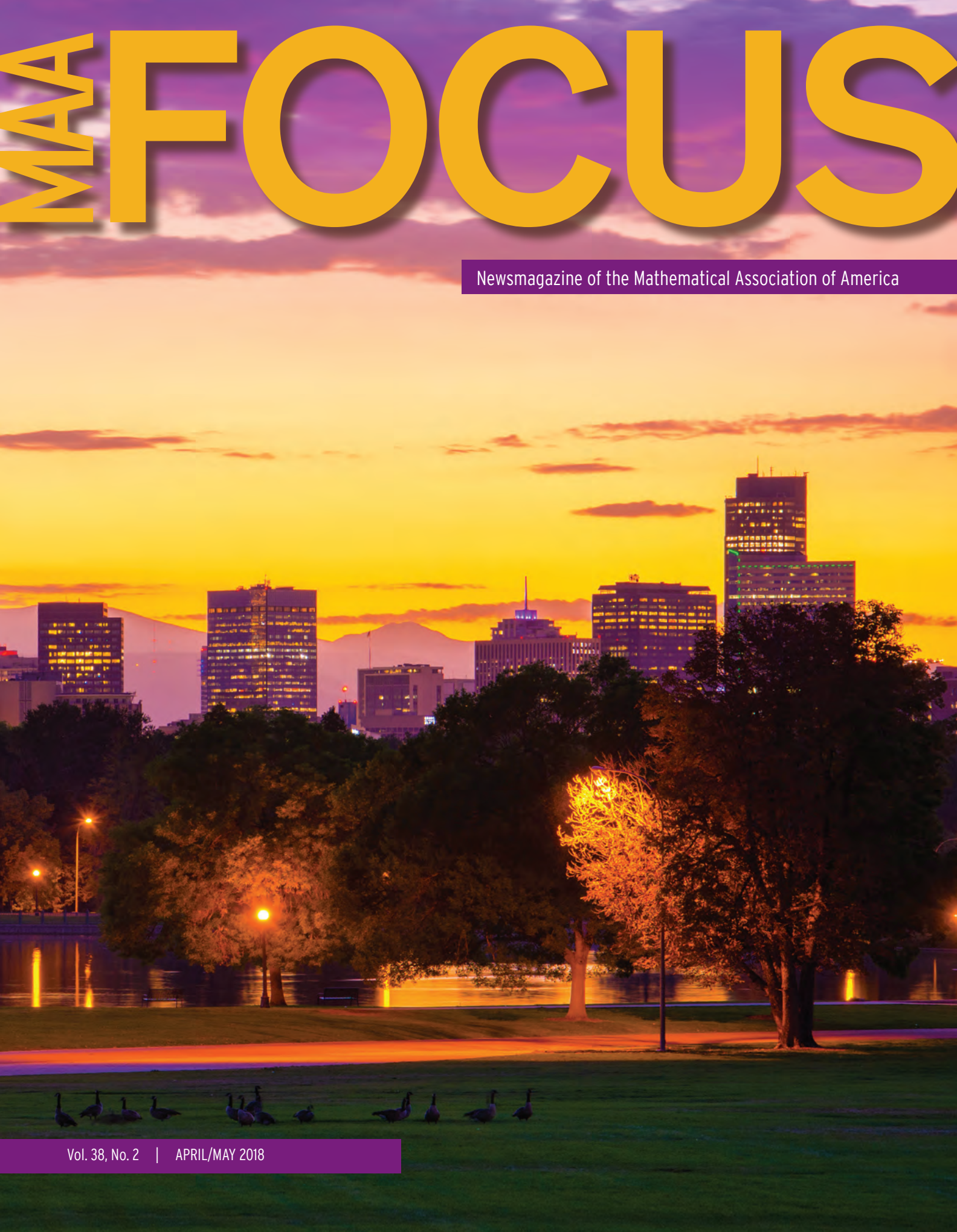
MAA FOCUS

Newsmagazine of the Mathematical Association of America



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Advertising inquiries: *advertising@maa.org*

Letters to the editor should be addressed to Jacqueline Jensen-Vallin, MAA, 1529 18th Street, NW, Washington, DC 20036, or, by email, to *maafocus@maa.org*.

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From the Editor

This spring I've been lucky to attend two section meetings (Florida and Louisiana/Mississippi), with another on the way (Texas)! One of my favorite things about attending other section meetings is getting to see how sections highlight different events and how they engage faculty and students differently. For some ideas from the Florida, Louisiana/Mississippi, and EPaDel sections, see the column in this issue.

I also get to meet faculty who don't always get to attend national meetings and to hear regional concerns. It also shows us how many issues are national and not local. It's so encouraging to meet faculty who are doing the same work all over the country—recruiting students; encouraging students from under-represented populations to persist in STEM careers; developing effective curriculum; navigating a changing higher education backdrop, where instructors and non-tenure-track lines are becoming more common; and working outside of the classroom environment to encourage students to engage in undergraduate research. While every section has some unique challenges (Texas has a house-bill-mandated co-requisite model for first year mathematics courses to get students into college-level mathematics quickly, and Florida has eliminated mandatory remediation for any students accepted to universities), we have many more commonalities than differences and we can learn so much from each other.

So, I hope that you've registered for or already had a chance to go to your section meeting (or a neighboring section meeting), that you've met some new people, and that you've learned something new this spring. We're looking forward to seeing you in Denver August 1–4 at MAA MathFest!

Jacqueline Jensen-Vallin

On the Cover

Downtown Denver skyline from City Park.

Getty Images: Davel5957. iSTock

MAA FOCUS

Mathematical Association of America

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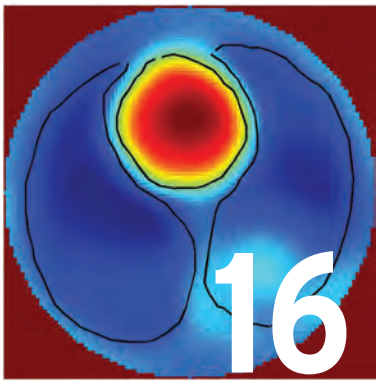

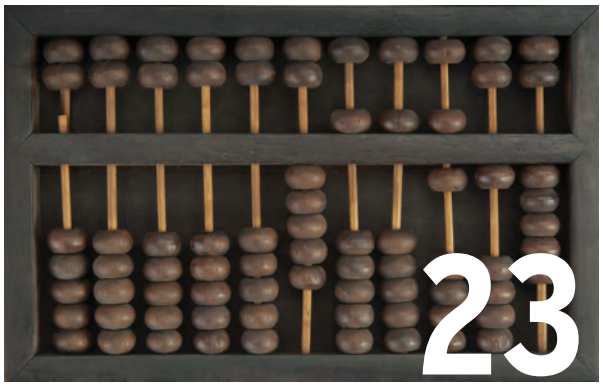

in this ISSUE

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departments

In Memoriam

Dr. Clarence Stephens died March 5, 2018 at the age of 100. Dr. Stephens was the ninth African-American to receive a PhD. He was chair of the Mathematics Department at SUNY - Geneseo from 1962–1969. He received the MAA Gung and Hu award for service in 2003.

He is perhaps best known for the Potsdam miracle—his method of engaging and teaching students by having them teach themselves. You can see more about Dr. Stephens' legacy at bit.ly/2FxmPsB and in the April/May 2017 MAA FOCUS article bit.ly/2GqvURa. ■

MAA Distinguished Lecture Series

Mathematical Card Tricks

Arthur Benjamin
April 7, 6:30 P.M.

MAA Carriage House
1781 Church St. NW
Washington, DC 20036

Abstract: Dr. Arthur Benjamin will amaze you with card tricks based on clever mathematical principles, and share the secrets with you.

A Glimpse at the Horizon

Deanna Haunsperger
April 26, 6:30 P.M.

MAA Carriage House
1781 Church St. NW
Washington, DC 20036

Abstract: What do a square-wheeled bicycle, a 17th-century French painting, and the Indiana legislature all have in common? They are among the many bright stars appearing in *Math Horizons*. Deanna Haunsperger presents an idiosyncratic tour of the early years of *Horizons*.

Check out bit.ly/2IBgbj1 for information on these and future lectures.

Spring MAA Section Meetings

KANSAS
April 20–21, Johnson County Community College

MD-DC-VA
April 13–14, VMI and Washington and Lee

METROPOLITAN NEW YORK
May 13, Hofstra University

NEBRASKA - SOUTHEAST SOUTH DAKOTA
April 20–21, University of Nebraska at Omaha

NORTH CENTRAL
April 20–21, Minnesota State University, Mankato

NORTHEASTERN
June 1–2 University of New Haven

OKLAHOMA ARKANSAS
April 13–14 Arkansas Tech University, Russellville

PACIFIC NORTHWEST
April 20–22, Seattle University

ROCKY MOUNTAIN
April 13–14, University of Northern Colorado

SEAWAY
April 13–14, SUNY Brockport

SOUTHERN CALIFORNIA - NEVADA
April 21–22, University of San Diego

For the most up-to-date information on your section's activities go to maa.org/sections and click on the link for your section. ■

Moon Duchin and her audience at her JMM talk.

Drawing Voting Districts and Partisan Gerrymandering

The MAA has been part of the recent conversation about partisan gerrymandering. MAA FOCUS highlighted the Geometry of Gerrymandering workshop, held at Tufts University during the summer of 2017 with Emille Davie Lawrence's article about her experiences at the workshop (bit.ly/2szzUvq). The MAA was also the co-sponsor of the AMS-MAA-SIAM Gerald and Judith Porter Public Lecture which, at the 2018 Joint Mathematics Meeting, was presented by Moon Duchin. Duchin's talk, *Political Geometry: Voting districts,"compactness," and ideas about fairness*, was touted by many attendees as the best talk of the conference. If you missed her talk, you can see it at bit.ly/2o4WQNy.

In response to concerns about partisan gerrymandering, the American Statistical Association (ASA) and the Council of the American Mathematical Society (AMS) endorsed the following statement in January:

> The act of drawing voting districts is vital to the functioning of American democracy. To comply with societal desires and legal mandates, voting districts must adhere to certain political and geographical requirements—such as geographic compactness, respect for city and county boundaries, and compliance with the Voting Rights Act—as well as one-person one-vote principles.

In their policy statement, the ASA and AMS make it clear that while setting the requirements for districts is a political matter, making sure that districts adhere to those requirements is "fundamentally a problem in mathematics and statistical science: one quantifies the requirements and ensures the drawn districts have acceptable values." They lay out the case for using mathematical and statistical methods to do exactly that. To read the entire policy statement go to bit.ly/2sBVob9. ■

Great Lakes Analytics in Sports Conference

June 21, 2018 at University of Wisconsin-Stevens Point

The Great Lakes Analytics in Sports Conference, sponsored by the University of Wisconsin-Stevens Point, is a one-day conference showcasing the latest concepts, research and innovations in the fast-growing field of sports analytics. Featuring speakers and presenters from professional and college sports organizations, the business sector and the academic community, the conference will cover innovations and evolutions in strategy, technology, training and more. For more information go to bit.ly/2pgabmK. ■

MAA MathFest Deadlines

April 15
- Early-bird Registration

April 30
- Abstracts for Contributed Paper Sessions
- Abstracts for Contributed Poster Sessions
- Abstracts for Graduate Student Paper Sessions

June 8
- Abstracts for MAA Student Paper Sessions
- Abstracts for PME Student Paper Sessions
- Abstracts for PosterFest 2018

Dusting Off Your Bookshelf: Recent Additions to BLL

—Darren Glass

Last time around I reminded MAA FOCUS readers of the existence and goals of the Basic Library List, which you and your librarians can consult to see what we recommend be in an undergraduate mathematics library. I also highlighted some books that the committee gave our highest rating of ***, many of which are true classics.

In this column, I point out some of the recent additions to the Basic Library List. All of these books have been published since 2015 and all earn the lowest level of inclusion in the BLL, meaning that the committee thinks that every library should consider whether they are appropriate for your students, but that (depending on the interests of your students and faculty) you may or may not find these titles worth purchasing. All included quotes are from a BLL reviewer's summary. See the full reviews at maa.org/maareviews.

- *Weapons of Math Destruction* by Cathy O'Neil is described as "an editorial on the various ways in which the author feels that 'big data' is being misused today… [that] provides a valuable service." It's worth noting that this book made the longlist for the National Book Award, in addition to the BLL.
- *Sourcebook in the Mathematics of Medieval Europe and North Africa* is a collection edited by Victor J. Katz, et al., which our reviewer says is "a very deep and detailed dive into the mathematics of the medieval era" in Europe, Africa, and the Middle East.
- *Vizualizing Mathematics with 3D Printing* by Henry Segerman, which is "bigger than a book … it is a portal into a new mathematical world … every student of geometry or topology should be required to interact with this book."
- *Iterative Methods for Sparse Linear Systems* by Yousef Saad looks at the sparse systems described in the title, particularly those that arise in the study of partial differential equations, and provides an overview of numerical methods for solving them.
- *Partial Differential Equations in Action: From Modelling to Theory* by Sandro Salsa "grows from modeling fundamental processes in applied science to a theoretical study of partial differential equations. It also provides a solid theoretical foundation for numerical methods, such as finite elements."
- *Game Theory: A Playful Introduction* by Matt DeVos and Deborah A. Kent provides an overview of both classical and combinatorial game theory at an advanced undergraduate level.
- *Calculus and Analysis in Euclidean Space* by Jerry Shurman covers the ground between multivariable calculus and a serious analysis course. Many other books cover the same ground, but "it is not easy to find other books that exhibit such care and clarity in the presentation of the subject … it is exceptionally well-motivated."
- *Making and Breaking Mathematical Sense* by Roi Wagner is a book about how mathematics is created and accepted that "expands the discourse on philosophy of mathematical practice using informed specifics from history of mathematics."
- *Mathematical Bridges* by Titu Andreescu, Cristinel Mortici, and Marian Tetiva purports to be full of problems that seem to be in one area of mathematics but can be solved using techniques from a different area and therefore bridge the two. This book is "unique … full of interesting problems and new viewpoints."
- *MVT: A Most Valuable Theorem* by Craig Smorynski discusses the history and pre-history of the Mean Value Theorem, starting with the Ancient Greeks and includes a full translation of Peano's paper on space-filling curves.
- *Dynamics Done with Your Bare Hands* is a collection of lecture notes from a 2015 summer school at Notre Dame which presents a variety of topics in dynamical systems that "has oodles of cool ideas … that could offer useful starting points for student projects."

How many of these books does your library have? As always, you can view the full Basic Library List at maa.org/bll. ■

Three New SIGMAAs Formed

—Jacqueline Jensen-Vallin

The MAA supports many subsets of its members with the Special Interest Groups of the MAA (SIGMAAs). These communities support a variety of research interests and provide the opportunity for focused networking with colleagues sharing similar interests. Some of these SIGMAAs include: SIGMAA-Art, SIGMAA-HOM (History of Mathematics), SIGMAA Stat-Ed (see SIGMAA column in this issue), and SIGMAA-IBL (inquiry-based learning), but with more than 15 active SIGMAA groups, there is something for everyone. For full details and contact information for the SIGMAAs, see www.maa.org/sigmaas.

This spring, three new SIGMAAs were approved by the MAA Board of Directors. Below is a description of each of the three SIGMAAs from their charter documents, and a short interview with the inaugural chairs of each. You can join any SIGMAA for a small fee when you renew your membership or by calling 1-800-331-1622.

Mathematical Knowledge for Teaching

The main focus of SIGMAA MKT is building a community for all who work on preparation or development for teaching K–12 mathematics. We support efforts to make strategic and informed decisions about what mathematics we teach to prospective and practicing K–12 teachers, and also how we teach this mathematics to them.

SIGMAA MKT members teach courses or conduct research that may involve examining, designing, developing, piloting, and revising tasks and curricula focused on mathematical knowledge for teaching in grades K–12. Mathematical knowledge for teaching refers to mathematical knowledge used in recognizing, understanding, and responding to the range of mathematics encountered

What are the first actions that the SIGMAA-MKT will take to support teaching of K–12 mathematics?

One of the most exciting features of a group like SIGMAA-MKT is that our group members' interests span K–16 (if not beyond). One of the things that the leadership team has thought about is how to understand how teaching looks the same or different across all these grades, and what this may mean for college and masters' level education for teaching K–12. We've teamed up with MAA's COMET to propose a panel at next year's JMM tentatively called "The Evolution of Listening and Responding to Students' Thinking, from Elementary to Undergraduate Mathematics," where we will have math teachers who span elementary through collegiate institutions, including community college, speak about their approaches to teaching and discuss how collegiate level teacher preparation and mathematical experiences more generally could build up from K–16 in stronger ways. We're also delighted that Gail Burrill has agreed to moderate this panel.

What supports will the SIGMAA-MKT be able to provide that MAA was not providing?

Currently there's no one designated place for those of us in math departments who teach K–12 teachers to form a strong community and learn from each other! Although there are plenty of fantastic resources for teaching undergraduate level in general, teaching prospective and practicing teachers comes with unique challenges, including getting a better handle on what to teach, namely, the mathematical knowledge and practices entailed in teaching K–12. The formation of the SIGMAA-MKT also comes at an opportune time, when there are a number of NSF-sponsored projects to support the teaching of teachers in mathematics courses (see bit.ly/2tdqTs0 for a likely incomplete list). So there›s plenty of interest in teacher education and professional development through mathematics courses, but no central place for faculty to gather and talk shop, not to mention connect with other professional communities interested in teacher education such as the Association of Mathematics Teacher Educators, whose membership is more likely to draw from schools of education than mathematics departments. Of course, mathematics education works best when mathematicians and mathematics educators can form strong communities around the teaching of mathematics courses and methods courses, and understanding the challenges each other faces. That's the hope we invest in SIGMAA-MKT.

—Yvonne Lai

in teaching practice, such as making sense of unusual student solutions, selecting examples to illustrate particular mathematical points, devising representations, or crafting definitions and explanations that are precise yet accessible.

These questions guide SIGMAA MKT: What evidence, experience, and values guide us in preparing and developing K–12 teachers? How do we improve the mathematical education of prospective and practicing K–12 teachers? How do we strengthen the professional community of mathematics faculty working on mathematical preparation or development for teaching K–12 mathematics? How do we strengthen connections and community among such mathematics faculty and practicing K–12 teachers?

The inaugural slate of officers is Yvonne Lai (University of Nebraska-Lincoln) as chair; Christina Eubanks-Turner (Loyola Marymount University) as past chair; Lisa Berger (SUNY Stonybrook) as chair elect, Maria Fung (Worcester State University) as secretary/treasurer; Priya Prasad (University of Texas – Arlington) as program coordinator, Cody Patternson (University of Texas – Arlington) as member-at-large; and Nicholas Chambers (High Tech High School) as K–12 liaison.

Mathematics and Sports

The purpose of this SIGMAA is to support, encourage, and disseminate MAA members' interests in connections between mathematics and sports, notably including those in the interdisciplinary field of sports analytics. Other relevant topics—across both individual and team sports, as well as Olympic and other international sports—include, but are not limited to, injury prevention, nutrition, training methodologies, biomechanics, athletic equipment, rules and scoring, tournament design, athletic facility architecture, marketing, and data visualization. The Sports SIGMAA will encourage an awareness of interdisciplinary research and pedagogy within areas of mathematics inspired by sports, the use and role of computational tools in sporting simulations, mathematical modeling and sports analytics, strategy development, tactical training, and performance. Because sports-related issues are often accessible and interesting to students, the group will support and promote the involvement of undergraduates in related research projects. The SIGMAA will also encourage the development of instructional and assessment tools for the learning of mathematics and statistics, and promote quantitative problem-solving in the context of sports.

The inaugural slate of officers is Drew Pasteur (College of Wooster) as chair; Diana Cheng (Towson University) as chair-elect; Roland Minton (Roanoke College) as past-chair; John David (Virginia Military Institute) program coordinator; Tetyana Berezovski (St. Joseph's University) as secretary/treasurer; and Kristin Frank (Towson University) as the communications officer.

What are the first actions that the SPORTS SIGMAA will take to promote the study of the mathematics of sports and support faculty working in those areas? What supports will this group be able to provide that MAA was not providing?

One of our early goals as the SPORTS SIGMAA is connection—bringing together those in the mathematical community who have research and/or pedagogical interests related to athletics. While participation and attendance in associated JMM sessions have been strong for quite some time, the MAA has not previously had a structure to facilitate year-round discussions. In that respect, we have lagged a bit behind our colleagues in statistics (the ASA formed such a group over 25 years ago) and operations research.

Because of their accessibility, sports-related topics can fit well for classroom, summer, or capstone projects, and the skills learned transfer to data-driven problems in science, health care, business, etc. After gaining inspiration from a journal article or something in the popular press, finding the right place to wade in can be challenging. Less than a decade ago, Joe Gallian and others helped me turn a pastime into a line of research, just as sports analytics was emerging as an academic subfield. Those of us forming this SIGMAA want to offer resources and support to undergraduates and their mentors, particularly at the early stages of forming research questions and locating (or constructing) data sets. At the other end of the process, we want to offer opportunities to present that work, whether at a large national meeting, or a smaller, more focused conference.

While topics involving the multi-billion dollar pro leagues may get the most media attention, there are also many opportunities related to Olympic, intercollegiate, scholastic, and youth sports. Our SIGMAA chair-elect, Diana Cheng, does research related to figure skating, and several of our charter members have worked with coaches at their own institutions. Others have found creative ways to integrate examples from sports into the undergraduate curriculum at all levels, and are happy to share their resources. We believe that broadening the horizons of math and sports can help attract and retain a more diverse group of students in the mathematical sciences.

—Drew Pasteur

Recreational Mathematics

Recreational mathematics is a broad term that covers many different areas including games, puzzles, magic, art, and more. Possibly the most well-known expositor of recreational mathematics was Martin Gardner, who wrote the Mathematical Games column for *Scientific American*. The purpose of SIGMAA-Rec is to bring together mathematicians and others who are interested in recreational topics and to promote the often-deep mathematics inside the subjects. We will also work with other organizations to promote recreational mathematics as a serious field of study.

The inaugural slate of officers is Robert Vallin (Lamar University) as chair; Brandy Wiegers (Central Washington University) as past-chair; Gail Kaplan (Towson University) as chair elect; Timothy Goldberg (Lenoir-Rhyne University) as secretary/treasurer; Darren Glass (Gettysburg College) as communications officer; and Paul Coe (Dominican University) as program committee chair. ■

What are the first actions that the SIGMAA-Rec will take to promote the study of recreational mathematics and support faculty working in those areas? What supports will this group be able to provide that MAA was not providing?

Recreational mathematics is not easily defined because it is more than mathematics done as a diversion or playing games that involve mathematics. Recreational mathematics is inspired by deep ideas that are hidden in puzzles, games, and other forms of play. The aim of the SIGMAA on Recreational Mathematics (SIGMAA-Rec) is to bring together enthusiasts and researchers in the myriad of topics that fall under recreational math. We will share results and ideas from our work; show that real, deep mathematics is there awaiting those who look; and welcome those who wish to become involved in this branch of mathematics. —Robert Vallin

SIGMAAs at MAA MathFest

SIGMAA on Mathematical and Computational Biology (BIO SIGMAA)

Contributed Paper Session: *Mathematics and the Life Sciences: Initiatives, Programs, Curricula*
Saturday afternoon, August 4

SIGMAA on Inquiry-Based Learning (IBL SIGMAA)

Minicourse: *Introduction to Inquiry-Based Learning*
Part A. Thursday, August 2, 4:00 P.M. – 6:00 P.M.
Part B. Saturday, August 4, 1:30 P.M. – 3:30 P.M.

Guest Lecture
Friday, August 3, 6:00 P.M. – 6:50 P.M.

Reception
Friday, August 3, 7:00 P.M. – 7:30 P.M.

SIGMAA on Teaching Advanced High School Mathematics (SIGMAA TAHSM)

Contributed Paper Session: *Priming the Calculus Pump: Fresh Approaches to Teaching First-Year Calculus*
Friday afternoon, August 3

Workshop: *Meeting the Challenge of Introducing Senior High School Students to Contemporary Mathematics*
Friday, August 3, 3:10 P.M. – 4:30 P.M.

SIGMAA on Math Circles for Students and Teachers (SIGMAA MCST)

Contributed Paper Session: *Great Circles, Great Problems*
Thursday afternoon, August 1

Business Meeting
Thursday, August 1, 6:00 P.M. – 6:50 P.M.

Other Mathematical Session: *Math Teachers' Circle Demonstration*
Saturday, August 4, 10:00 A.M. – 11:30 A.M.

Other Mathematical Session: *MATH Rumble*
Saturday, August 4, 3:00 P.M. – 4:30 P.M.

SIGMAA on Quantitative Literacy (SIGMAA QL)

Town Hall Meeting: *Quantitative Literacy Swap Session*
Saturday, August 4, 1:30 P.M. – 2:50 P.M.

Business Meeting
To be scheduled

To get further information, including descriptions and list of organizers, on all of these activities go to bit.ly/2pifvqC

STEM Inclusion Study

—Michael Pearson and Jacqueline Jensen-Vallin

In Fall 2017, MAA members were encouraged to complete the STEM Inclusion Study. The purpose of this study was to examine the extent to which women, people of color, members of the LGBTQ community, and members with disabilities felt about their inclusion into the STEM community.

The survey was completed by 900 MAA members. We received these results in early 2018. This article draws on that report, and shares some of the recommendations to the STEM community to improve the professional lives of segments of our community who have historically been underrepresented, and often marginalized through both intentional practices and unexamined cultural norms.

The MAA has a history of confronting these issues and developing policies and practices for inclusion. The MAA Welcoming Environment statement, updated recently, calls for "the free expression and exchange of ideas in an atmosphere of mutual respect and collegiality" and further notes that "MAA prohibits any conduct that is discriminatory, harassing, or threatening by any staff member to any other person engaged in MAA operations or activities," and calls on all members and others participating in MAA events to abide by these expectations as well.

More broadly, the Association supports programs to welcome historically marginalized populations into our professions, and publishes articles and organizes sessions at meetings to further the understanding of how we as a community can be more inclusive at all levels.

Math + Friends = Fun at MAA MathFest.

Results of the Study

According to the study's authors,

> The survey results pointed to several concerning trends regarding the marginalization and professional devaluation of under-represented members of this organization. We find pervasive gender differences in workplace experiences: women had significantly more negative experiences on nearly *every measure in our analysis*, net of variation by age, education level, employment sector, and other demographic factors. Similarly, persons with disabilities, LGBTQ respondents, and racial/ethnic minority respondents reported significantly more negative experiences than their peers across a number of different marginalization and professional devaluation measures.

In particular, the survey results indicated that "women are less likely than men to report that their work is respected, less likely to report that their supervisor treated them with respect, less likely to report that they are held to the same standard for promotion as others, more likely than men to report that their boss gives them less credit than they deserve, and more likely than men to report that they had to work harder than others to be viewed as a professional."

Similarly, "individuals with disabilities also frequently reported instances of professional devaluation. Respondents with disabilities were significantly less likely than counter-

parts without disabilities to report that their work is respected, more likely to report that their boss gives them less credit than they deserve, and more likely to report that they are held to a different standard than their colleagues and get less credit than they deserve for their work."

In addition, "Hispanic respondents, compared to white respondents, were more likely to report that their boss gives them less credit than they deserve. Furthermore, LGBTQ respondents were more likely than non-LGBTQ respondents to report that they have to work harder than their colleagues to be viewed as a legitimate professional and are less likely to report that they are held to the same standard for promotion as their peers. "

While these conclusions were drawn from self-reported data, evidence of bias was strongly suggested by the fact that "32% of respondents reported witnessing differential treatment by gender in their organizations in the past 3 years, and over 24% of respondents believed that women had to work harder than men to be perceived as competent."

Recommendations

The study included a number of strategies for the association, and our members' departments and institutions, to follow to continue to improve. Many of these build on existing activities, such as continuing to publish articles and hold sessions at meetings to raise awareness of the barriers faced by our colleagues from these populations.

While MAA headquarters in Washington has a diverse staff, and the MAA strives through its nominating processes for committees, members of Congress, and board of directors to identify diverse candidates for elected and appointed positions across the organization, the report noted that one mechanism to continue to make progress is to maintain "regular dialog with constituencies of disadvantaged groups (e.g., through focus groups and panels) to identify ongoing issues and ways the organization could provide support through programming, networking, and policy change."

Other recommendations include:

- Share and publicize MAA's diversity goals to increase accountability.
- Recommend dual/multi membership and other partnerships with minority-centered STEM professional organizations.
- Create an MAA scholarship fund specifically to help advance the education and careers of women, persons with disabilities, LGBTQ individuals, and people of color.

The MAA carries out activities in concert with many other organizations, such as the Association for Women in Mathematics and the National Association of Mathematicians. The study suggested that we strengthen and expand "partnerships with minority-centered STEM professional organizations."

Overall, the recommendations remind us that ongoing progress requires an ongoing, holistic approach for engaging disadvantaged groups to build understanding, provide effective accommodations for differences among groups at every opportunity, and continually seek to improve our understanding and practices to build the truly welcoming community we aspire to be. ■

Photos below and top of the facing page: Attendees enjoy talks at JMM.

GET MORE at MAA MathFest

MAA Invited Address
Inclusion-Exclusion in Mathematics: Who Stays in, Who Falls out, Why It Happens, and What We Should Do about It
Friday, August 3, 11:30 A.M. –12:20 P.M.
Eugenia Cheng

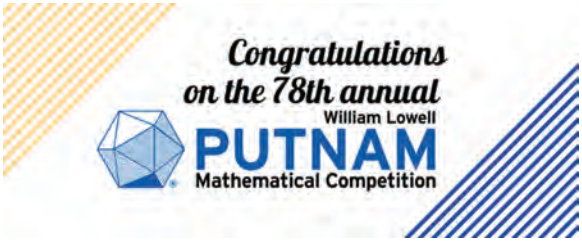
MAA James R.C. Leitzel Lecture
The Relationship between Culture and the Learning of Mathematics
Saturday, August 4, 9:00 A.M.–9:50 A.M.
Talitha Washington

Invited paper session
Strategies to Synergize Culture in the Learning and Doing of Mathematics
Saturday afternoon, August 4
Organizer: Talitha Washington

Contributed Paper Session
Advancing Women in Mathematics: On the Ground Initiatives
Thursday afternoon, August 2
Organizers: Della Dumbaugh and Heather Russell

Town Hall Meetings
Mathematical Mamas—Being Both Beautifully
Thursday, August 2, 3:00 P.M.–4:20 P.M.
Organizers: Jacqueline Jensen-Vallin, Emille Davie Lawrence, Erin Militzer,

Shaping and Fostering an Equitable Community in our Departments
Saturday, August 4, 3:00 P.M.–4:20 P.M.
Organizers: Alejandra Alvarado, Candice Price, Alissa Crans, Jacqueline Jensen-Vallin



Putnam Competition Names Top Students in College Mathematics

The results of the William Lowell Putnam Mathematical Competition, the preeminent undergraduate mathematics competition, were announced. The 78th annual Putnam Mathematical Competition, organized by the Mathematical Association of America, recognized the Massachusetts Institute of Technology as the top team and five undergraduate students were named Putnam Fellows for their high scores on the rigorous six-hour mathematics exam.

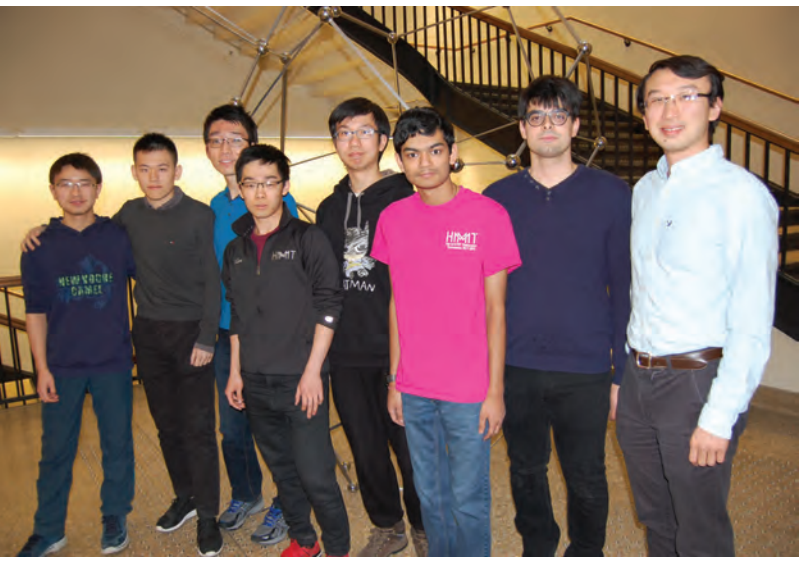
A list of top college and university teams and top student participants is available at bit.ly/2Gz0JC3. As the highest-ranked team, the Massachusetts Institute of Technology was awarded a cash prize of $25,000 for their mathematics department, each Putnam Fellow earned $2,500, and the winner of the Elizabeth Lowell Putnam prize was awarded $1,000. Cash prizes are also awarded to the mathematics departments of the next four highest-ranked Putnam Competition teams as well as the students on the top five teams.

"The Mathematical Association of America is proud to honor every student and institution that participated in the Putnam Competition," said Michael Pearson, the executive director of the MAA. "A special congratulations to the Putnam Fellows, Elizabeth Lowell Putnam prize winner, and the top scoring teams. You join many distinguished alumni of the competition and we look forward to your continued success."

"A heartfelt thank you to the almost 600 faculty members who donated their time to organize the Putnam Competition for their math students on campuses across the U.S. and Canada," said Daniel Ullman, director of the Putnam Competition.

4,638 students from 575 institutions participated in this highly competitive mathematics exam on December 2, 2017. The highest score on the six-hour exam was 89 out of a possible 120 points. Only 20% of participants earned a score above 13.

MIT Mathematics Professor Yufei Zhao, far right, stands with winners of the 78th Annual William Lowell Putnam Mathematical Competition. From left are MIT students Junyao Peng, Yunkun Zhou, Sammy Luo, Allen Liu, Jiyang Gao, Ashwin Sah, and Omer Cerrahoglu.



Top 5 Putnam Competition Teams: 2017

1. Massachusetts Institute of Technology
2. Harvard University
3. Princeton University
4. University of Toronto
5. University of California at Los Angeles

2017 Individual Putnam Fellows, listed in alphabetical order:

Omer Cerrahoglu, *Massachusetts Institute of Technology*
Jiyang Gao, *Massachusetts Institute of Technology*
Junyao Peng, *Massachusetts Institute of Technology*
Ashwin Sah, *Massachusetts Institute of Technology*
David Stoner, *Harvard University*
Yunkun Zhou, *Massachusetts Institute of Technology*

Elizabeth Lowell Putnam Prize Winner:

Ni Yan, *University of California at Los Angeles*

The Mathematical Association of America organizes the William Lowell Putnam Mathematical Competition with the generous support of the William Lowell Putnam Prize Fund. For more information about the Putnam Mathematical Competition go to maa.org/putnam, and follow the Mathematical Association of America on Twitter @maanow. ■

Interview with Dominic Klyve, Editor-elect of College Math Journal

The College Mathematics Journal (CMJ) publishes articles, classroom capsules, problems, solutions, and media reviews, all aimed at the college mathematics curriculum with emphasis on topics taught in the first two years. For instance, the March 2018 issue contains *Proof Without Words: Sum of Squares of Consecutive Fibonacci Numbers* and *Factoring Numbers with Conway's 150 Method*. Previous editors include Michael Henle, Lowell Beineke, Underwood Dudley, Ann Watkins and Bill Watkins, and Don Albers. Current editor Brian Hopkins finishes his term at the end of 2018, and Dominic Klyve of Central Washington University will be the editor beginning in 2019. Klyve is currently serving as editor-elect, and we introduce you to him here.

How did you first get involved with the MAA?

I first was aware that I was involved with MAA when as a college student at Hamline University, I went to an MAA section meeting (the North Central Section) with some of my professors. I loved it, and I knew immediately that this was an organization I wanted to join. Years later, I discovered that MAA ran the American Mathematics Competitions program. I had attended a small rural high school in Minnesota, and the AMC was one of my only ties to the larger mathematics community. I loved participating every year! So, in some sense, I've been involved with the MAA since the eighth grade.

What made you interested in serving on MAA committees and editorial boards?

Serving on committees seemed like an obvious way to give back to the MAA while simultaneously giving me an opportunity to meet people and to learn new things. I started with the Basic Library List, which watches for new and interesting mathematics books and makes recommendations concerning which should be purchased by university libraries. I soon realized that the part of the MAA's work that had the biggest regular impact on me was the books and journals it published. I love reading *The College Mathematics Journal*, *Mathematics Magazine*, and the *Monthly*; I love good mathematics exposition and new ideas, and I love interesting math. I spoke to an MAA representative (it was Frank Farris) at an MAA section meeting, and volunteered my services in any way I could be useful, and soon I had been asked to serve on editorial boards of both the Spectrum book series and *CMJ*.

What was your motivation for applying to be editor of CMJ? What about that project is exciting and fun?

I've written for *CMJ*, refereed quite a few papers for the journal, and served on the editorial board for a few years. The more I get involved, the more I find to like, and I was sure I'd find even more to like as editor. Because I'm interested in a wide range of mathematics and because I think good exposition is so important, I also believed that I could do a good job in carrying forward the legacy of the many exceptional editors who have served the journal in the past.

What is your vision for the future of CMJ? What elements do you hope continue very similarly? Any changes or evolutions that you are looking forward to implementing or exploring?

I don't want to make large changes to an enterprise that is already so successful, but new ideas can be helpful anywhere! One idea I'm really excited about is getting more undergraduate students and clubs involved in reading articles and interacting with authors. I've been talking about various ways to do this with my spectacular editorial board, and we're getting close to a good proposal. Maybe I'll have something else to announce in *MAA FOCUS* in the near future! ■

Get More

As editor-elect Klyve is already accepting submissions to the *CMJ*. Submissions are required via our Editorial Manager System (editorialmanager.com/collmathj/). For more information on submitting an article go to maa.org/pubs/submissions.

Sharing MAA Section Ideas

—Jacqueline Jensen-Vallin

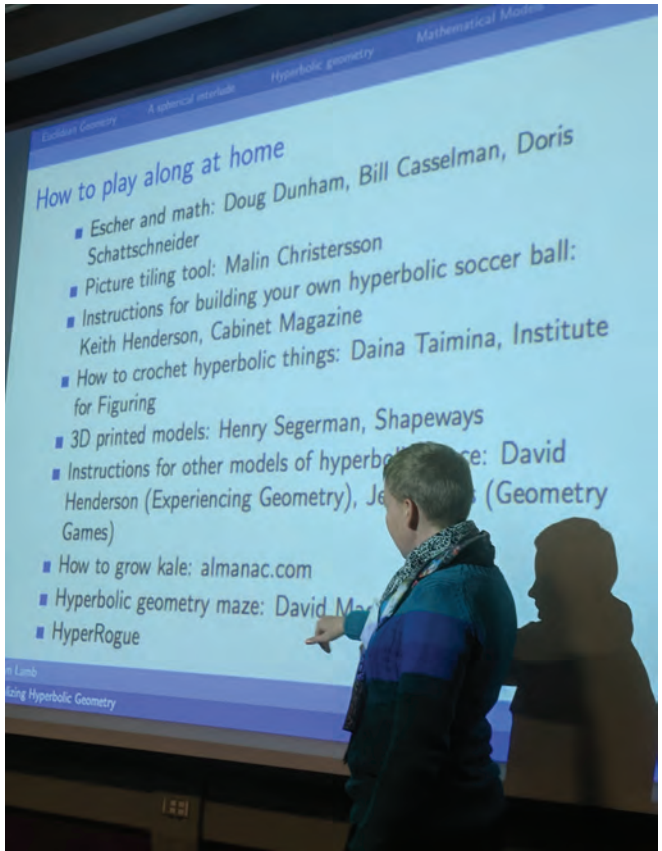
While we have a column for sections to submit interesting happenings, I wanted to highlight some "smaller" ideas that I've seen in the past year. In Fall 2017, I was at the Eastern Pennsylvania and Delaware section meeting at Shippensburg University, and this spring I've attended the Florida and Louisiana/Mississippi section meetings. Each of these meetings has it's own personality and creative ideas. Here are a few.

Group of students arriving for the Florida section meeting.

A Silent Book Auction

The EPaDel (Eastern Pennsylvania and Delaware) section hosts a silent auction featuring books. Each book is displayed in a central location with a silent auction sheet. Bids start as low as $1 and throughout the meeting people wander by, look at the books, and offer higher bids on interesting books. Some of the books are donated and signed by plenary speakers—last fall Frank Morgan donated and signed two of his books for this auction. At a designated end time (the start of the business meeting is one option or the end of the second plenary, or whatever might work for your group), the auction closes. Anyone holding a winning bid pays for their books and leaves with a book in hand! What a great way to have people donate to the section and receive a gift in return (and to reduce your stock of older books from when the section hosted book sales on site)!

Evelyn Lamb speaking at the EPaDel section meeting last fall.

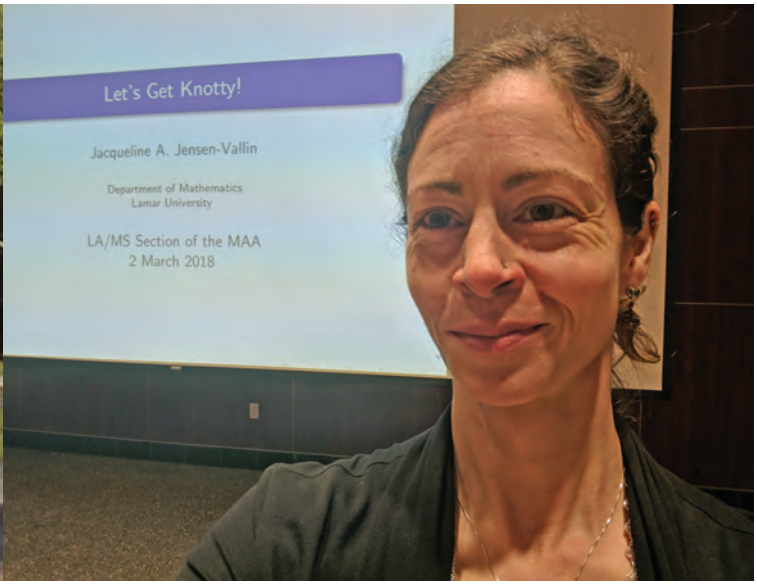


A Section Representative's Session

In Florida, the Section Representative to the MAA Congress has a session where she presents highlights of what's happening in MAA and answers questions about upcoming programs or other MAA opportunities. Instead of having this be a short report at the business meeting (EPaDel and Texas both do this), this session allows for questions to be raised and either answered or recorded. Since the new structure for MAA governance has the MAA Congress acting as an advisory body which can bring concerns from membership to the Board of Directors, this model is especially helpful to discover what your constituents are thinking, what they would like to see from MAA, and to encourage them to get involved.

A Different Book Sale Model

The Florida section meeting has a large back stock of books from when book sales were held at the section meeting. In response to all sales being online, the Florida section still sets out the books that they have and allows people to peruse them. The attendees can then see and hold the books that they are considering buying online later. Remember that under the new publishing agreements, all MAA members receive 40% off list price for both MAA Press and AMS books purchased in association



Jacqueline Jensen-Vallin before her talk at the LA/MS section meeting.

The alligator refuge at the University of Louisiana at Lafayette.

with a section meeting. It is important to note that for now MAA members must call the AMS to get the discount. The discount is good for two weeks after the meeting, but you will need the codes on the books to get the discount so make a note of those codes if you plan to order later.

A Student Luncheon

The Louisiana/Mississippi section has a plethora of events for students. On Thursday night, they host an Integration Bee and pizza dinner for student attendees. On Friday morning, there is a student Team Competition (winners are announced Saturday at the Business Meeting!), and, after that, there is a luncheon for students. The student luncheon is sponsored by a publisher, and student attendees are treated to a boxed lunch while hearing a student-focused talk. There are also scored student presentations Friday afternoon! Phew—what a lot of ways to involve students at a section meeting.

Institutional Partners

The Louisiana/Mississippi section allows for institutions to partner with the section, partially to sponsor the student activities at the conference, but also to allow them to bring faculty to the meeting. This year's institutional partners were Alcorn State University, Belhaven University, Jackson State University, McNeese State University, Mississippi College, the University of Mississippi, Northwestern State University, University of Louisiana at Lafayette, and the University of Southern Mississippi. For some suggestions about how to get colleges and universities in your section involved, see the Feb/Mar 2018 issue of MAA FOCUS (bit.ly/2D2l00x).

Other ideas?

What interesting and unique ways does your section encourage involvement of students and faculty? Send ideas to maafocus@maa.org or submit an entire article about your section to that same address! ■

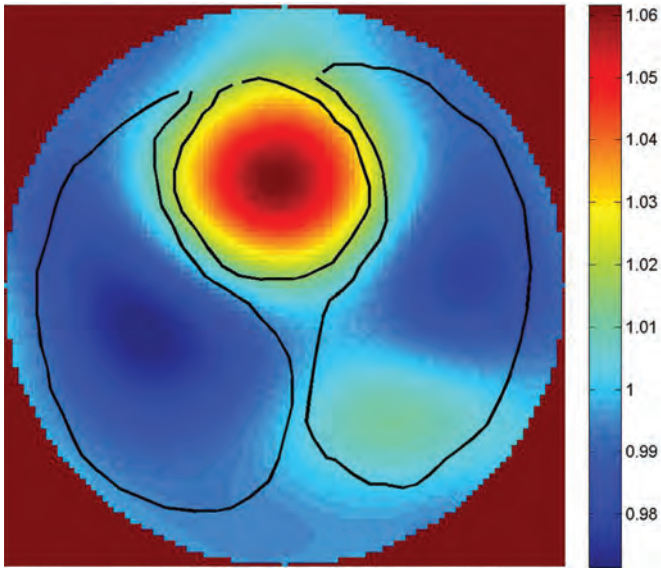
Medical Imaging: Learning About Electrical Impedance Tomography

Melissa Erdmann

Since 2001 I have been a mathematics professor at Nebraska Wesleyan University. Prior to that, I was a graduate student at Colorado State University (CSU). In Spring 2000 during her job interview in the mathematics department at CSU, Dr. Jennifer Mueller spoke about the mathematics involved in the medical imaging technique of electrical impedance tomography (EIT). She began work in this area during her postdoctoral experience at Rensselaer Polytechnic Institute. I was fascinated. More importantly, in Mueller I soon found a friend. She accepted a job at CSU in Autumn 2000 and since then has continued doing work in EIT there. When I asked Mueller if I might come and work for her while on sabbatical during the 2015–2016 academic year, she graciously replied, "You'll work with me." And so it came to pass that this professor from a teaching university became part of a research lab group in EIT.

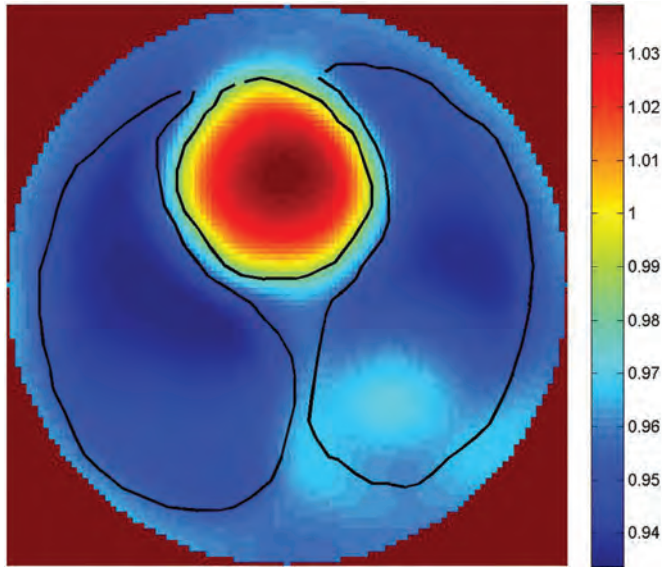
First, a brief introduction to electrical impedance tomography. In EIT electrodes are placed on the skin of a patient. An alternating current, which the patient cannot feel, is applied through the electrodes, and the surface voltages that result are then measured on the electrodes. We use this boundary data to approximate the conductivity distribution within the plane of the electrodes. Since the heart is more conductive than the lungs, for example, we are able to distinguish these organs. Approximating the conductivity distribution is an inverse problem; that is, we approximate the conductivity distribution that would yield the resulting voltages on the boundary. The mathematical formulation of this problem is due

ABOVE: Jennifer and Melissa in the lab. OPPOSITE: 32 electrodes surround a saline-filled tank with agar heart, agar lungs, and copper pipe blood clot, and images are made. See the images above.



Courtesy of Melody Alsaker, Gonzaga University.

Usual tBIE reconstruction on small truncation radius R_1.



Courtesy of Melody Alsaker, Gonzaga University.

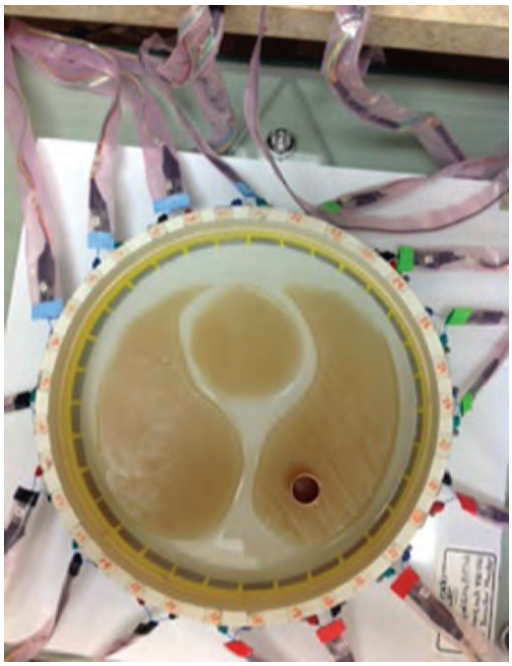
Reconstruction with a priori scheme.

to Alberto Calderón in his 1980 paper "On an Inverse Boundary Value Problem." This problem is non-linear and ill-posed; indeed, it is a challenge.

Why EIT?

The advantages of EIT are many, and EIT has been approved as a medical imaging technique for use in Brazil and Europe. Unlike X-rays and CT scans, EIT uses no ionizing radiation. EIT is low-cost and portable, so it may be done at a patient's bedside. EIT provides high contrast between the different regions in images. While EIT images provide excellent temporal resolution of the heart beating and lungs inflating and deflating, there is a continual quest to improve the resolution of the images.

Mueller's research lab at CSU is actively working to advance EIT in the area of pulmonary imaging; in fact, she has a wet laboratory in the mathematics building at CSU.



The EIT lab built the Active Complex Electrode (ACE1) EIT machine. Muellers's doctoral student, Dr. Michelle Mellenthin, is a biomedical engineer who played a vital role in this construction; the design and evaluation of the ACE1 EIT system was the topic of her dissertation. In the lab up to 32 electrodes are used to make images of a subject's heart and lungs. Also 32 electrodes surround a saline-filled tank, and images are made of objects in the tank. Mueller's group ventures outside of the wet lab as well. For research purposes, with patient consent they take images of cystic fibrosis patients at Children's Hospital Colorado and patients at the Medical Center of the Rockies.

Multifaceted Research

Working in EIT is a multifaceted investigation, both in terms of number of people and mathematical ideas involved. When I was at CSU on sabbatical, Mueller's lab was made up of a postdoctoral researcher, two fifth-year doctoral students who graduated while I was visiting, two fourth-year doctoral students, a first-year graduate student, and a highly-motivated undergraduate, Chase Ashby. Together we were all working to advance EIT, and I was pleased to be able to help contribute to the EIT

Get More

For the a priori image of the copper pipe, knowledge of the boundaries of the heart and lung regions, but not their conductivities or the presence of the pipe, was used in the reconstruction. The reader could learn more about how that was done in the article, "Use of a priori spatial information in D-bar reconstructions of EIT tank data," M. Alsaker and J. Mueller, which is to appear in the journal *Inverse Problems and Imaging*.

Putting electrodes on a subject in the lab.

puzzle. The mathematics of EIT involves partial differential equations, linear algebra, functional analysis, and computer programming.

My particular work in EIT during my time at CSU can be summarized as threefold. First, I studied partial differential equations and investigated the role of skin resistivity in the EIT process. Skin is very resistive and this affects how current flows through the body.

Second, Mueller, Ashby, and I investigated a four electrode-at-a-time, or tetrapolar, method for gathering EIT data. The ACE1 system was constructed to use a two electrode-at-a-time, or bipolar, method to collect data. We wanted to see if the tetrapolar gathering of data would improve images. I used Matlab to find current pattern matrices of maximum rank that would be helpful in applying alternating current in a tetrapolar manner. The hardware in the wet lab was modified, and Ashby wrote computer code to enable tetrapolar collection of data. This data was collected in summer 2016, after my sabbatical time at CSU. The analysis of the images from the tetrapolar data collection is pending.

Third, I was delighted to assist in the wet lab. For example, I helped place electrodes on people, took photos, and mixed agar for the tank to a specified salinity. The agar heart requires more salt than the agar lungs in order to be more conductive. In the lab I was ready to help and excited to learn.

I hope you are fascinated by EIT and inspired to pursue research opportunities outside of your university. And, Jennifer, thank you. ■

Melissa Erdmann is a professor of mathematics at Nebraska Wesleyan University.

MAA MATHFEST

Call for Abstracts PosterFest: An MAA Networking Event

Abstract submission deadline: June 8

Early career faculty and graduate students are encouraged to apply!

Sponsored by the MAA Committee on Early Career Mathematicians, MAA Committee on Graduate Students, and the Young Mathematicians' Network

Questions? Contact Lisa Driskell:
ldriskel@coloradomesa.edu

Register and submit an abstract at maa.org/mathfest

By Aleksandr Simonov

How to Maintain a Successful Research Program While Teaching 12 Credit-Hours per Semester

Jeremy F. Alm

The most important factor in doing original work is to do it before the errands, not after.
—Paul Graham @paulg 5 Oct 2017

Illinois College, where the author professed mathematics for nine years, is a small liberal arts college in Jacksonville, Illinois. At Illinois College, faculty outside of the lab sciences teach three 4-credit courses per semester, often three different preparations. Faculty usually serve on one or two committees each year. I earned tenure in my fifth year and was made department chair at the beginning of my eighth year. Having a successful research program under these conditions can be challenging, but it is possible. During those nine years, I submitted 20 different articles. Of those 20, 17 have been published and three are still under review. I have not been publishing in the* Annals *or* JAMS, *but in perfectly respectable journals:* Algebra Universalis, Discrete Applied Mathematics, Journal of Combinatorics, Review of Symbolic Logic, *and* American Mathematical Monthly, *to name a few.

The purpose of this note is to share some things that I learned over those nine years that facilitated my productivity and that may prove useful to young faculty starting their careers at teaching-intensive institutions. Of course, because of the intensely personal nature of working habits, these will not all resonate with everyone, but I hope that every new or mid-career faculty member will find something of value in the list below.

The List

Look for low-hanging fruit

While you are a graduate student, you and your adviser may have set an ambitious agenda with the aim of making a name for yourself and landing that dream job. Now that you have a faculty position, you must adjust to having 5–10 hours (or fewer) per week for research instead of 40. You are likely to need to set more modest goals for yourself; however, this does not mean reducing the quality of your work. Keep in mind that if you want to produce, say, one paper per year, you need a project that can be completed in 400–500 hours instead of 1500–2000 hours. This may involve changing, to some extent, what you choose to work on.

Have several problems on the back burner

It is very useful to have a handful of problems that you would like to solve lodged somewhere in the back of your mind. Even though you may think about them only rarely, they will be at hand if an opportunity arises.

I have solved two problems this way; one ruminated for about two years in my mind, and the other over 10 years. The latter was solved (more or less) over a coffee break at a meeting, when I suggested to someone that I wanted to prove X, as it would imply Y; he replied that Z would also imply Y and would be easier to prove, so we wrote a paper together.

Think every day

In addition to having problems on the back burner, you need one or two that you are tending carefully on the front burners as well. You should try to think about some problem every day, even if it is only for five minutes. This accomplishes two things. First, it reduces the amount of time needed to "get going" when you do find a block of time for research.

Second, and more importantly, it allows your subconscious to crunch on the problem while your conscious mind is preoccupied with other things. This is how, for example, it is possible to wake up at four in the morning with the solution to a problem in mind; this "gift" from your brain is the result of all that intentional thought you put in to that problem on a consistent basis.

Write code

Learning to write small pieces of code has been a tremendous boon to my research. It can provide a source of examples and counterexamples, allowing you to test ideas and avoid wasting time trying to prove false "theorems." It can allow you to find, by randomized search, objects that would be difficult to construct by hand. The process of writing the code can test your understanding of edge-cases. And it need not take much time to learn — I learned the basics of Python by doing an online tutorial for just a couple hours.

I grant that not everyone has problems amenable to computational support. If you don't, consider finding one (and see the first point)!

Set aside sacred time

It is very easy to allow all the little things in academic life to eat up all your time, so it is important to set aside some nonnegotiable time for your scholarship. For me, this was every Wednesday morning, when no classes met. For you, it might be Tuesday and Thursday afternoons at a coffeehouse, or every Sunday morning at home. But you need some uninterrupted time every week. Do not make the mistake of thinking that you can do all your research during the summer. If all you do during the academic year is teaching and service, then that is all you will do over the summer as well. This is a well-tested rule, and you are unlikely to be the exception to it.

We are all stewards of the discipline of mathematics; its care is entrusted to us. Even at a primarily-teaching institution, scholarship gives faculty the opportunity to change, and to be changed by, the modern state of the field.

Give yourself permission to prioritize your research

Do not let the naysayers tell you that research is not important. We are all stewards of the discipline of mathematics; its care is entrusted to us. Even at a primarily-teaching institution, scholarship gives faculty the opportunity to change, and to be changed by, the modern state of the field. In addition, scholarship with students involves them in this dynamic.

Grade less without shortchanging the students

Here is one idea: in upper-level courses, assign six problems per week, to be written up on separate sheets of paper. On the day they are due, roll a six-sided die in front of the students to determine which of the six is to

be collected. Discuss the other five during the first few minutes of class.

Try to inspire, but don't kill yourself trying

You have a job to do, and your students have a job to do. You need to find a way to have your students commit to doing their part while you provide guidance. Try to reach them, but realize that students have to be willing to do their part, also.

Research isn't supposed to feel like a chore! . . . I still find that basic research is the source to which I return for motivation, inspiration, and satisfaction.

Check the arXiv every day

It only takes a few minutes, but it will keep you in the loop in your field.

Publish your partial results, learn from failed attempts

Sometimes you learn a great deal because something you try unexpectedly does not work, and by investigating the obstacle you discover some unknown structure. Seek always to try to turn "failures" into successes in some other domain. Steve Krantz, former editor of *Notices of the American Mathematical Society*, says this: "One of the chief differences between a successful mathematician and an also-ran is that the former can take his/her partial results and his tries—and yes, even his/her failures—and turn them into an attractive tapestry of theorems and corollaries and partial results and conjectures; the latter instead takes two years of hard work and dumps it in the trash." (Krantz, Steven, *A Primer of Mathematical Writing*, American Mathematical Society, 2016.)

Have fun

Research isn't supposed to feel like a chore! If it does, find a different problem to work on, or find a (different?) collaborator. After more than 15 years of devoting myself full-time to mathematics, I still find that basic research is the source to which I return for motivation, inspiration, and satisfaction. ■

Jeremy F. Alm is a professor of mathematics and chair of the department at Lamar University.

Let History Be Your Guide

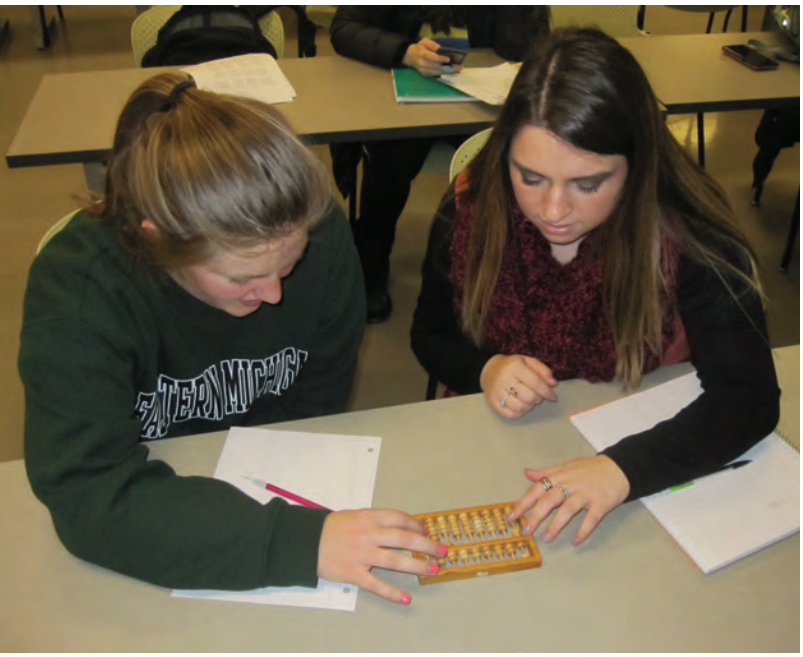
A New Option for General Education Mathematics Courses

Amy Shell-Gellasch and J. B. Thoo

In *Inviting All Students: Math for Liberal Arts Courses* (MAA FOCUS, February/March 2017, bit.ly/2CMAndv), Jennifer Nordstrom and Victor Piercey presented several options for general education mathematics courses for non-STEM (Science, Technology, Engineering and Mathematics) majors. These courses, whether they be survey courses that use books that provide a variety of topics such as probability and apportionment, or topical courses such as the mathematics of social justice or sports, aim to give students who do not have any specific mathematical requirement for their major a more relevant and interesting option to fulfill graduation requirements in mathematics and quantitative reasoning. Many of these courses are in keeping with the recommendations of the MAA CRAFTY (Curriculum Renewal Across the First Two Years) subcommittee. The types of courses highlighted in the above-mentioned article have been increasingly common in both four-year and two-year institutions. And there are many other options along these lines not specifically mentioned in the article.

Since the audiences for all of these courses are non-STEM students, and are often math-phobic, we feel it is important to try and give them an experience in mathematics that is interesting to them. We often see students who steered away from mathematics for as long as

This article is adapted from the article A New Look at General-Education Mathematics Courses, CSHPM Notes column, CMS Notes, Vol 48, No 1, Feb 2016.



possible leave these courses and admit that they did find something interesting in mathematics after all. But we also see many students who still struggle in these courses because their mathematical preparation is so limited or their aversion to the subject is so severe. So, even though a general education course that has ties to the humanities is a big step to bridging this gap, there is still work to be done.

Having taught these types of courses and still having many students struggle led us to consider an alternative that has significant mathematical content, but that does not feel like a mathematics course. Being historians of mathematics, an alternative was obvious to us. Given the large number of MAA members who belong to the History of Mathematics (HOM) SIGMAA, but who do not consider themselves practicing historians of mathematics, we feel the time is ripe for a general education history of mathematics course. Though history of mathematics courses are not uncommon, they are often associated with teacher education programs or are upper-level courses designed for mathematics majors. History of mathematics courses designed to fulfill a mathematics graduation requirement for liberal arts students are few and far between. So we have taken the bull by the horns and written a textbook to fill this niche—a history of mathematics written for a general education audience.

Our general education mathematics text, *Algebra in Context: Introductory Algebra from Origins to Applications* (Johns Hopkins University Press, 2015), covers the mathematics with the historical and contextual focus described below. A website for *Algebra in Context,* with the syllabus for John's course at Yuba College can be found at bit.ly/2HU2b39. See the upcoming MAA Notes volume *The Courses of History* for a description of the course Amy taught at Montgomery College.

The alternative we offer is a 100-level mathematics course that specifically leverages liberal arts students' often much stronger backgrounds and interests in language arts and the humanities. The course covers much of the mathematics to which they may have been exposed in high school, but it does so from a historical perspective. It is not a low-level history of mathematics course. Rather, it presents elementary mathematics and intermediate algebra as they were practiced historically. Like a special topic or theme in other general education courses, history is the vehicle that moves the mathematics forward. Such a course can not only fulfill a quantitative literacy requirement; it also can fulfill an algebra as well as diversity requirements.

Students benefit in several ways from encountering mathematics that they likely have seen before through a new perspective. First and foremost, the framework allows them to revisit the material outside of a remedial setting. Second, looking at the original context in which the mathematics was developed is often a much more holistic and intuitive approach than the polished and formulaic presentation of modern texts. An example of such mathematics is the method of false position and double false position to solve linear problems. In this problem-solving technique from the late Middle Ages, a "guess" is used that works easily with the problem, and then proportional reasoning is used to scale the guess up or down to arrive at the correct answer.

We have found over the years that students who are not comfortable with algebra often intuitively use ad hoc methods very similar to this. If students are shown these more intuitive approaches first, they can transition to the algebraic reasoning, and then more readily extend their understanding to the algebraic solution found in modern texts. The students not only are then able to solve the problem algebraically, they also have a much stronger sense of how one solves problems in general, as well as an affirmation that their intuitive approach is valid.

Get More

Don't miss the contributed paper session, *Teaching Undergraduate Mathematics with Primary Historical Sources* at MAA MathFest (August 1–4 in Denver).

The History of Mathematics SIGMAA (sigmaa.maa.org/hom) provides a forum where you can meet and exchange ideas with others interested in the history of mathematics.

Convergence (maa.org/convergence) offers a wealth of resources to help you teach mathematics using its history.

In addition to the historical methods mentioned above, hands-on projects can be used in class, such as making or using an abacus while discussing the different types of abaci, or making and using Napier's Bones to showcase the lattice method of multiplication. Bringing such objects or models into the classroom adds to the historical as well as the mathematical experience for the students.

As we mentioned earlier, a historical approach also leverages students' humanities and writing skills. This is possible through assignments that fit naturally into these non-STEM courses: discussions, readings, papers, presentations, projects, videos, performances, essay exams, and so on. Of course, mathematical homework and exam problems would still be assigned, but they can form a smaller part of the course.

Topics in a mathematics course in which history is the main thread can include number systems and number bases, leading up to the decimal place-value system; mathematical notation; methods from various times and cultures for arithmetic calculations (for instance, Greek, Babylonian, Chinese, European); solutions of polynomial equations up to the cubic; exponentiation and logarithms; Greek number theory; and set theory, to name a few possibilities. Including a fair amount of traditional history and discussion also showcases the interplay of tradition, religion, and societal beliefs that shape and often guide mathematical and scientific advances. This allows students to see the wider context of the mathematics and the cultural influences involved, which is now a requirement of many college curricula.

A historical approach can fulfill mathematical or quantitative literacy requirements while letting the students engage the bulk of the material in a manner with which they are more comfortable. We have seen students leave the course excited that they actually learned mathematics. They also leave realizing that they *do* understand basic mathematics, and possibly even know something about the subject that math majors might not. This course gives nonmathematical students a solid understanding of the subject's role, development, and uses in society in a form that is intrinsically interesting to them. ■

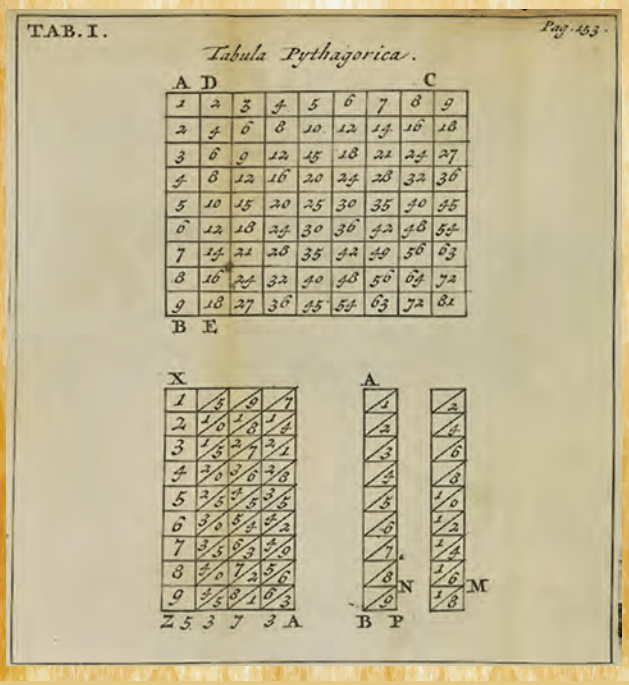
Amy Shell-Gellasch is the cofounder and chair of the History of Mathematics Special Interest Group of the MAA. She is also building course materials for the Smithsonian's Digital Learning Lab. John Thoo is a professor of mathematics at Yuba College in Marysville, California.

Mathematical Treasures

from Convergence

Chinese Abacus, ca 1925, Smithsonian Institution negative number DOR 2010-0104.

In a Chinese abacus, two beads above the cross-bar each represent five and those below it represent one. Five can be represented by five one-beads brought up to the cross-bar or by one five-bead brought down. Thus, the abacus above represents the number 555,615. Final answers are usually represented by the smallest possible number of beads—five one-beads would be replaced by one five-bead.



Images from a 1704 edition of Andrea Tacquet's 1656 *Practical and Theoretical Arithmetic*.

A "Pythagorean Table" of multiplication facts is used to demonstrate the process of carrying out the operation of multiplication using a set of Napier's rods. The illustration on the bottom left shows the rod arrangement to find the product: 597×9. The answer, 5373, is read across the bottom of the configuration.

The images above are presented courtesy of the University of Pennsylvania Libraries.

PRESIDENT'S MESSAGE

How did you become a member of the MAA?

—Deanna Haunsperger

I've read a few anecdotes over the years: **Bud Brown** became a member because Dave Roselle told him he'd "meet the nicest people." **George Pólya** said mathematicians were expected to be members of the MAA and AMS. Ed Begle told **Lida Barrett** and her husband exactly that. Leonard Gilman told **Martha Siegel** to be a member. **Barbara Faires**'s chair at Westminster suggested she join because he thought she'd like it, and, since she was joining anyway, she could help plan the spring section meeting.

I became a member of the MAA when I was in graduate school because one of my colleagues at the time said that if mathematics and the teaching of mathematics were what I cared about, then I should belong to and support the organization whose mission it is to support that work. That was one of the best decisions I've ever made.

But why did others join? Why do they remain? What's *your* story? I was curious, so I performed a very unscientific study—I emailed thirty-some of my friends and asked them.

Woody Dudley, a 63-year member, recalls needing to have his application approved by two current members of the MAA before he could become a member. **Harriett Pollatsek** no longer remembers *not* being a member of the MAA; **Alissa Crans** can't remember when she joined, either, but she remembers giving a poster as an undergraduate at the Southern California Section meeting and being star-struck by the famous mathematicians in her section.

James Tanton joined because he felt isolated as a young mathematician and wanted a "community of like-minded mathematicians passionate about both doing mathematics and sharing mathematics with the world." Similarly, **Betty Mayfield** stayed for the community.

Hortensia Soto's advisor said, "If you're going to teach at the college level, then you have to be a member of the MAA," and handed her a copy of MAA FOCUS. **David Bressoud**'s thesis advisor told him it was part of his obligation to the profession. **Colin Adams** said, "It never occurred to me not to." And **Matt Richey** responded, "I figured if you're going to call yourself a professional mathematics educator you should belong to the preeminent organization of professional mathematics educators."

Francis Su, **Judy Walker**, **Robin Wilson**, **Matt Boelkins**, and **Katie Kochalski** joined as participants in Project NExT, but stayed, as Judy said, "because of the incredible impact this program has had on my career." On attending his first MAA MathFest, Robin said, "I found a community that, like me, cared deeply about teaching as well as research and that somehow had been hidden from me. Until that point I didn't even know that it was okay to care deeply about both teaching and research and be taken seriously as a professional mathematician." **Ami Radunskaya** also joined because of Project NExT—she's wasn't a participant, but she respected what it was doing for junior faculty.

Ann Watkins joined because she got hooked on Ross Honsberger's *Ingenuity in Mathematics* from MAA Press; her husband **Bill Watkins** joined because his advisor told him that he expected his students to belong to both the AMS and the MAA.

When **Joe Gallian** "came up for promotion at UMD a senior faculty member who had just seen from my CV that I was not a member stopped me in the hall and commented that I should support my profes-

sional organizations," so Joe "just said yes" to membership.

Michael Dorff joined because Joe Gallian submitted his name to be a member on the MAA undergraduate research committee.

Su Dorée and **Carol Schumacher** joined as undergraduates when they were given memberships by their departments; Su kept up the membership for the problems in the journals, and Carol kept hers up because of "all the great things that MAA does to promote mathematics and the good teaching of mathematics." **Pam Richardson** gave a talk at a section meeting as an undergraduate and joined immediately because she loved the sense of community and felt she had found her people.

Allen Butler (Wagner and Associates) said, "I became a member of the MAA because I love teaching, especially teaching math, and the MAA is the organization that best represents that aspect of my life; I remain a member to this day, in spite of being a non-academic, because it provides me the opportunity to network with colleagues who share my love of teaching." **Kristin Lauter** (Microsoft) has remained a member because, "I love the MAA's focus on people: teachers, students, practitioners, and the community and societal impact and importance of mathematics." **Bill Satzer** (IBM) explained, "I remain with the MAA since I have thought that it might represent the "biggest tent" for mathematicians of all varieties."

The largest group of my respondents became members in graduate school, when memberships were prizes or gifts from graduate departments or because student memberships are inexpensive. **Julie Barnes**, **Emily Olson**, and **Robert Vallin** were looking for community and others who were interested in mathematics and its teaching. **Eric Egge** wanted to be a cool kid. **Paul Zorn** really liked that "the MAA publications offered interesting material that was both readable and mathematically serious . . . too rare a combination." **Jenny Quinn** had her first mathematical manuscript accepted for publication in the *College Math Journal*. **Dave Kung** took the free membership but stayed because he heard Ann Watkins explain that professional memberships were part of the expectations of the job. **Margaret Robinson** let her graduate student membership lapse until she had a conversation with her logician and computer scientist father-in-law, and they decided they needed to be supporting the MAA because they "cared about mathematics and the MAA was a force for good."

Members come to meetings to learn new things, network, and have fun!

Did you notice that the majority of these folks became members of the MAA because someone told them to or suggested they should? Whether that be an individual or a department chair or someone else, our association gets stronger one new member at a time.

The MAA is the right association for mathematical enthusiasts, for those who enjoy good mathematical exposition, and for current and future teachers of mathematics. Give MAA memberships to your students as prizes. Even better, become a departmental member and give all your students, both graduate and undergraduate, membership in the MAA. (You don't have to tell them student memberships come free with your departmental membership!) Tell your junior colleagues that their mathematical community will be exponentially larger and their futures exponentially brighter with membership in the MAA. We should let others know that it's an expectation of a career in mathematics or mathematics education to support the association that supports them, their work, and future generations. There's one other thing that's true about all of the people I talked to: every single one of them would thank the person who introduced them to the MAA for giving them a place to grow and learn and develop their careers. Reach out to others and share with them the benefits of MAA membership. They'll thank you for it. ■

Deanna Haunsperger is MAA president and professor of mathematics at Carleton College (email: dhaunspe@carleton.edu*).*

PUZZLE PAGE

Number Crosswords

—Vince Matsko

We are all used to crossword puzzles where words that are answers to various clues are inserted into a grid of white and black squares. Those of us interested in mathematics have likely come across similar puzzles where the answers are numbers which must similarly be inserted into a grid.

Below are a few puzzles for your enjoyment. In these puzzles, there are no black squares, so *all* squares must be filled in when the puzzle is completed. In this warm-up puzzle, all answers are perfect powers. Answers are entered in the usual crossword fashion.

Across		Down	
1	Perfect 3rd power	1	Perfect 6th power
3	Perfect 4th power	2	Perfect 11th power
5	Perfect 10th power	4	Perfect 9th power
6	Perfect 5th power		
7	Perfect 7th power		
8	Perfect 8th power		

1		2	3	4
5				
	6			
7				
	8			

In this more challenging puzzle, all answers are perfect cubes of three or four digits. But there's a twist: the clue number tells you only that the answer either begins *or* ends in that square. The answer may be positioned either vertically or horizontally. So if the answer to Clue 5 was 125, there would be six different ways it could be entered into the grid. Which way is for you to determine!

1	Digit sum is odd	4	Digit sum is 8
2	Palindrome	5	No clue needed
2	Digit sum is 18	6	An odd number
3	Digit sum is 8	7	Does not contain the digit 9
4	Digit sum is 18	8	No clue needed

	1	2		
	3			4
			5	
6				
7			8	

As a solving aid, here is a list of the three- and four-digit cubes, along with their digit sums in parentheses: 125(8), 216(9), 343(10), 512(8), 729(18), 1000(1), 1331(8), 1728(18), 2197(19), 2744(17), 3375(18), 4096(19), 4913(17), 5832(18), 6859(28), 8000(8), 9261(18).

As a final challenge, consider the five-by-five grid below.

1	4	4		6
		9	2	
		5		

Your task is to fill each square with a digit so that you can circle (word search style) as many two- and three-digit perfect squares as possible. In the example above, you would count both 144 *and* 441, but you would only count 49 once. You could also count the 25 as well as the 625. The best I could do was fill in the grid so I could circle 24 out of the 28 eligible perfect squares between 16 and 961. Can some solver do better? ■

Get More

Love puzzles? Check out the latest Partiti puzzle in the April *Mathematics Magazine*.

5 Reasons Students Should Go to MAA MathFest

MAA MATHFEST
August 1-4, 2018

1

Student members can register for MAA MathFest fo

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2

Get funding for your trip through the MAA Student Travel Grant.

If you are presenting at MAA MathFest, you can get a grant from the MAA to help cover your travel costs!

3

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Book a double room with your classmates and friends going to MAA MathFest. Be close to the action and save.

4

Network with the top mathematicians in your field.

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5

Free ice cream at the MAA Ice Cream Social for undergraduates.

I scream, you scream... need we say more?

maa.org/mathfest

SECTION HAPPENINGS

Mathematical Art Exhibits Enrich Sectional Meetings

—Shirley Yap

At the 2016 MAA Golden Section (Northern California, Nevada, and Hawaii) at UC Davis, nineteen artists exhibited works of mathematical beauty in a variety of media, including paintings, digital prints, and sculptures in wood, metal, and glass. The exhibit was scheduled to start at 1:00 PM and the line of people waiting at the exhibit hall doors at 12:45 indicated the attendees' level of enthusiasm to see the art.

My desire to start a local mathematical art exhibit began at the 2016 JMM where I exhibited a mathematical sculpture. Because it was an interactive piece, I really wanted to see how the audience would play with it. So, I spied on them. For a few hours, I circled around the exhibit tables, observing the observers. People of all ages and backgrounds looked at the art patiently and carefully, with appreciation and curiosity—exactly the way many of us hope they would approach a math problem.

Inspired by these observations as well as a belief that art could help attract a larger and more diverse group of people to mathematics, I wanted to organize something more local so that those who are not able to attend JMM or the Bridges conference could get a taste of the conceptual and visual beauty of mathematical art pieces. I also thought it was important to give mathematical artists an opportunity to show their work and meet each other. Here are some of their comments about the exhibit:

Maria Trkova: "... participation at the Math and Art exhibition was my dream.... and it stimulated me to work more in this direction."

Phillip Webster: "I found that the students were especially interested and engaged—they asked tons of questions, and many asked permission to take pictures to share the art with their friends. There are very few venues for the display of mathematical art, so every new opportunity that comes up in this field is exciting to a mathematical artist like me."

Frank Farris: "... there's mathematical beauty in a piece that's at least as wonderful as the surface beauty that everyone can see"

This year, we're holding our third Golden Section mathematical art exhibit and it is as popular as ever, particularly with the students. More importantly, more students are creating and exhibiting their work. Nearly half of the artwork submitted is by students and nearly half of the artists are women. ■

Organizing a Mathematical Art Exhibit

—Carolyn Yackel and Shirley Yap

In "Mathematical Art Exhibits Enrich Sectional Meetings" Professor Yap has explained a rationale for holding a mathematical art exhibit. In this article, we give tips for organizing such an exhibit. These tips are framed as questions for the organizer. They are listed in an order that is designed to aid the planning process.

How long do you want your exhibit to show? Having the exhibit span a few hours, a day, the length of the conference, or longer will determine the answer to many of the subsequent questions.

Where will your exhibit be held? If only during a conference, you will likely want it in an area of the conference space that can be secure. If you do not have a lockable room, you could also have volunteers take shifts guarding the works.

What is the scope of the exhibit? Are certain media, certain types of mathematics, or certain contributors favored over others? For example, do you prefer computer graphics, art related to the conference subject, or regional contributors? Any of these would give greater focus to the exhibit.

How will you elicit artwork? Will specific artists be invited? Will there be a public call for art? If you publicly ask for art, will you accept all submissions, or will your exhibit be juried (curated)? Who will determine which pieces are accepted? Likely you will want to identify active mathematical artists, which can be aided by obtaining the list of MAA-SIGMAA Arts members and perusing the Bridges Mathematical Art Galleries Website.

What is your budget? How will you allocate money between advertising, shipping, framing, and other staging? You may be able to avoid most or all of these costs, but it can be difficult for all artists to bring their pieces to the venue before set-up and leave late enough that take-down has occurred. You may choose not to frame, but you will likely need to borrow easels and have various hardware for affixing pieces. You will also want table covers to put the focus on the art. Increasing your budget can be as easy as asking your department chair or as difficult as applying for a grant.

How will you help your artists produce quality descriptions of their work? The descriptions for the pieces need to make it clear what mathematics the viewer is intended to observe in the piece. This description should be written at the level of the average intended viewer of the pieces. Even if the descriptions from the artists are beyond the requested level, suggesting a lower level helps the artist to step out of the perspective of a mathematical expert.

How long in advance should various constituencies be told of the exhibit? Advance warning for shows is important because:

- exhibiting artists need to complete pieces, to send pieces, and to write descriptions.
- the community needs to mark calendars and to attend the show.
- the mathematical community needs to make an extra effort to get to the show.
- students need to be alerted to the ending time of the show so that they realize their opportunity to see it will expire.
- some professors might include interaction with the exhibit as a course component.

How will you advertise the event? Frequently used avenues include social media, posters, postcards, newspaper, radio, TV, email, announcements, and the conference program.

Have you made plans to complete the task? This includes attending the show, giving a short welcome, photographing the show, taking down the show, carefully returning the art, and thanking everyone.

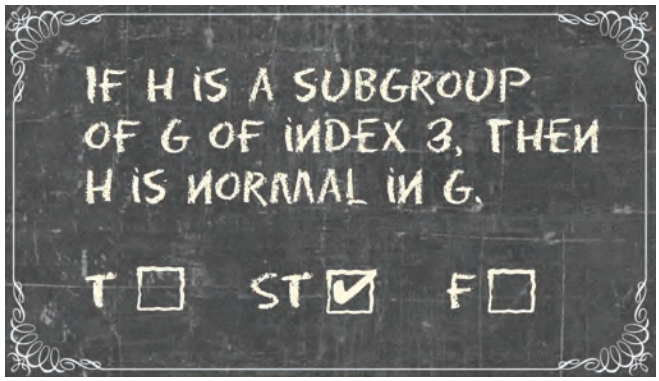
Are all of these tasks within your skill-set? Do you have time to complete them all yourself? Think carefully about who you might want to work with on this project, how you will divvy up the tasks, and how you will effectively communicate project status over time. Finding a collaborator with complementary strengths allows you to learn to be effective from one another while succeeding as a team.

We look forward to your stories of successful mathematical art exhibits. We believe that such exhibits enhance the mathematical experience. ■

TOOLKIT

Using Conceptual True/False Questions in Abstract Algebra

—Carolyn Yackel and Julie Beier



As teachers we desire to ask conceptual exam questions while giving exams that are efficient to grade. However, assessing complex mathematical thought appears to require time-intensive grading. The good news is that this is not always true! Conceptual True/False (T/F) questions are possible, and we have effectively used them in abstract algebra and linear algebra. Moreover, we believe that they have the potential to be useful throughout the upper level curriculum. Clearly, use of T/F questions must not supplant thorough training in proof writing, which we assess through homework and other exam questions, but these problems can evaluate mathematical thought without undue grading hardship.

Setting aside the major goal of teaching students to write clear, logical proofs, some of our goals for students in abstract algebra courses include gaining basic familiarity with the definitions and examples of the field, developing algebraic intuition, cultivating a rich set of examples and counterexamples relevant to definitions and theorems, and learning to think through arguments from an algebraic perspective. Asking T/F questions can assess all of these learning outcomes. Moreover, discussing with students the process of developing good T/F questions can greatly enhance student attention to and attainment of each of these goals. Including students in writing T/F questions before exams allows us to praise good problems and model how to rework others into better problems.

While students are not required to give justifications for their answers, one variant Beier uses is to further divide the logical category False into Sometimes True and (always) False yielding three categories (always) True/Sometimes True/(always) False (T/ST/F). In this variant, you may consider assigning partial credit for answers F or T when the answer is actually ST, which slightly increases the grading load. Despite the fact that written justifications are not required, we emphasize to students they should not expect to get the correct answer without working the problem. Because the students in these courses are sophisticated, and we have discussed how to create and think about these types of problems, they understand that we intend them to go through a potentially extensive mathematical process to determine the answer to a given problem.

Our T/ST/F problems come in several flavors: checking knowledge of a definition, applying a theorem, algebraic thinking, examples and counterexamples, and extensions of theorems. Here are a few sample problems:

- If $\phi: G \to G'$ is a monomorphism, then $\phi(G) = G'$. (ST)
- In $\mathbb{Z}_4[x]$, $2x + 1$ is a unit. (T)
- The ideal (n) is maximal in $\mathbb{Z}$. (ST)
- The group D_{4n} has $n - 1$ elements of order 4 when n is odd. (ST)
- Let R be a commutative ring with unity, 1, such that the order of 1 is a nonzero multiple of 3. Then R is a field. (ST)
- If H is a subgroup of G of index 3, then H is normal in G. (ST)

This last one is a natural generalization one asks about the theorem, "If H is a subgroup of G of index 2, then H is normal in G." Helping students learn to ask these questions themselves molds them into mathematicians.

We enjoy composing these problems and discussing them with each other, but are highly aware that the solution techniques available to the students are completely dependent on exactly what has transpired in class and homework. We must carefully think through each problem for each class, rather than simply reusing past problems. Moreover, a challenging problem at the time of an exam may become trivial several weeks later, which can lead to fruitful conversation with students. For this reason, we encourage collaboration with other faculty to write these types of problems but suggest that instructors be wary of compiling a large list of problems. Putting in some extra time up front on a task which is more entertaining than grading yields a pedagogically great set of questions that are substantially easier to grade! ■

Carolyn Yackel and Julie Beier are professors at Mercer University and Earlham College respectively. Beier-Yackel collaborations are driven by mathematical curiosity, intensity, joy, and laughter.

MAA MATHFEST

August 1–4, 2018

DENVER, COLORADO

SPEAKERS

Hedrick Lectures

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Massachusetts Institute of Technology

AMS-MAA Joint Invited Address

Arlie Petters
Duke University

MAA Invited Address

Eugenia Cheng
Art Institute of Chicago

MAA Invited Address

Joseph Teran
University of California, Los Angeles

Leitzel Lecture

Talitha Washington
Howard University and
National Science Foundation

Falconer Lecture

Pamela Gorkin
Bucknell University

Chan Stanek Lecture for Students

Laura Taalman
James Madison University

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Raegan Higgins
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SIGMAA SHOWCASE

Statistics Education Innovators Recognized for Their Impact in the Field

—Dianna J. Spence

The Special Interest Group of the Mathematical Association of America on Statistics Education is pleased to announce that Dr. Kari Lock Morgan of Penn State University is the recipient of the Robert V. Hogg Award for Excellence in Teaching Introductory Statistics, presented at the 2018 Joint Mathematics Meetings, San Diego, CA. The award recognizes Dr. Lock Morgan as an individual who exhibits both excellence and growth in teaching introductory statistics. She received her PhD in statistics at Harvard University in 2011 and, after three years as an Assistant Professor of the Practice at Duke University, joined the Department of Statistics at Penn State University in 2014. Dr. Lock Morgan is a nationally recognized leader in the use of simulation-based inference in introductory statistics, co-authoring the prominent simulation-based introductory statistics textbook, *Statistics: Unlocking the Power of Data*, and its collection of online applets, StatKey. As a Tombros Fellow of Penn State's Center of Excellence in Science Education, Dr. Lock Morgan transformed the Introduction to Biostatistics course at Penn State by including simulations as a way to introduce inference. Nationally, Dr. Lock Morgan served on the Executive Committee for the ASA Section on Statistics Education, served as Program Chair for the Electronic Conference on Teaching Statistics (ECOTS), and has been Co-editor of the *Chance* column, "Taking a Chance in the Classroom." Given these and many other accomplishments, we are pleased to recognize such a valuable member of the statistics education community with this award in honor of the prominent statistics educator Robert V. Hogg (1924–2014).

Stacey Hancock presents the Whittinghill Award to Patti Frazer Lock. Below: Kari Lock Morgan receives the Hogg Award.

The SIGMAA on Statistics Education is also pleased to announce that Dr. Patti Frazer Lock is the recipient of the 2017 Dexter C. Whittinghill III Award for the Best Contributed Paper on Statistics Education at the 2017 Joint Mathematics Meetings. The award was presented at the 2018 Joint Mathematics Meetings in San Diego, CA. Her presentation, titled "Big Data Visualization in Intro Stats (in 15 minutes!)" was selected through the evaluation of her peers at the conference based on the quality of the presentation and utility of the concepts presented for the advancement of statistics education and innovation in the field. Dr. Frazer Lock completed her PhD in mathematics at the University of Massachusetts at Amherst and is currently the Cummings Professor of Mathematics and Chair of the Department of Mathematics, Computer Science, and Statistics at St. Lawrence University (Canton, NY).

For more information on the nomination process for the Robert V. Hogg Award and other SIGMAA – Stat Ed news please visit our website: sigmaa.maa.org/stat-ed. ■

Dianna J. Spence is Secretary/Treasurer of the SIGMAA – Statistics Education and is a professor of mathematics at the University of North Georgia.

MEET A MEMBER

Jerrold Grossman

We have members involved in many MAA programs, SIGMAAs, and professional development opportunities. This column lets us get to know some of our members a little better.

What is your current job and how long have you been there?

I am retiring at the end of this year (2017–2018) from Oakland University, a regional state university near Detroit, Michigan, after 44 years on the faculty of the Department of Mathematics and Statistics.

How long have you been an MAA member, and why did you initially join?

I have been a member for 53 years, having joined in 1965, during my senior year of high school. I got my 50-year pin at the MAA's 100th anniversary celebration at MAA MathFest in 2015. I joined because I was really "into" mathematics at the time and planning to study it in college. I remember feeling a little intimidated when I found that I could understand very few of the articles in the *Monthly*.

What has kept you an MAA member since then?

Loyalty to the profession and the organization, wanting to feel a part of the community. I have been a member of the American Mathematical Society (AMS) for nearly as long, but the two groups have different emphases, both of them very important to me. I have attended the Joint Mathematics Meetings (JMM) most years since 1974, as well as many MAA section meetings and summer AMS/MAA meetings and MAA MathFests; these have always been fruitful, enjoyable, and educational. Early in my academic career I got involved in MAA activities, first at the state level and then at the national level, so naturally I continued my membership. Several years ago there was a "sale" on lifetime memberships in the MAA, and I took advantage of that offer, so I will be a member forever.

Describe the MAA in four words.

It makes mathematics fun!

You have been involved with the American Mathematics Competitions (AMC) for much of your career, including taking their precursor when you were a student. What has changed about the exams and why should they remain an MAA priority?

I think the exams have gotten harder over the years, as the students have gotten smarter and work harder at preparation. Encouraging the very best of our mathematically talented youth should continue to be one of MAA's primary goals.

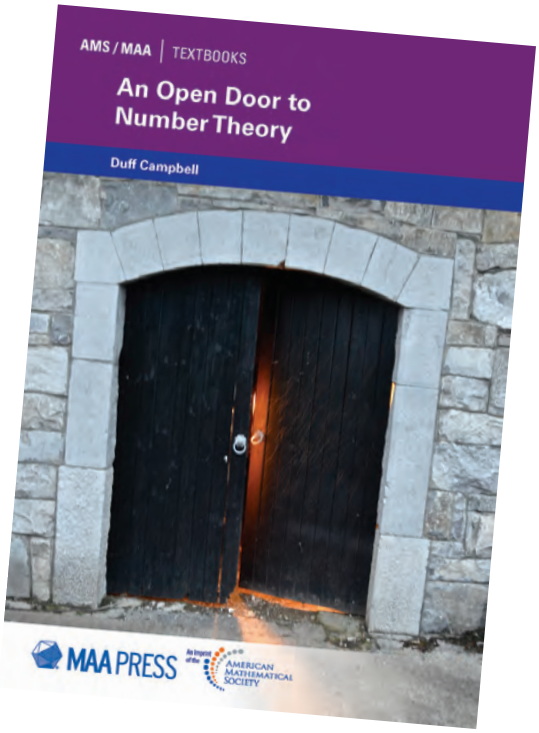
What would you like to see from the MAA in its second century?

Exactly the things that out-going president Francis Su spoke about at the JMM in 2017: the promotion of mathematics as play, beauty, truth, justice, and love in furtherance of human flourishing. Specifically, I hope it continues its emphasis on bringing students into the mathematical community, as well as devoting even more effort toward showing the true face of mathematics to the general public. The MAA should also make sure that the voice of mathematicians is heard in discussions of K–12 mathematics education. ■

MAA BOOKS BEAT

An Open Door to Number Theory

—Stephen Kennedy



I'm not a huge fan of abstraction for the sake of abstraction. I like to think about examples. One quick way for me to know if you and I are going to be friends is to ask you to explain the Euclidean algorithm. If you start by saying, "Suppose a and b are integers, use the division algorithm to find q_1 and r_1 such that. . . ." I'm probably going to walk away before you finish your sentence. If, on the other hand, you were to say, "Well, suppose you wanted to find the greatest common divisor of 94 and 34. Notice that anything that divides them both also divides $94-2\cdot 34$. So, the gcd of 94 and 34 is the same as the gcd of 34 and 26 . . . ." Well, then I would know instantly that we were kindred spirits. Duff Campbell, author of *An Open Door to Number Theory*, is my kind of mathematician.

An Open Door to Number Theory is the newest MAA Textbook and the first to appear under our new partnership with AMS. It's a book both societies can be proud of, and a fun book to use to teach the introductory number theory course. Duff gets it, he gets that examples should precede abstraction. And he gets that we can expect our students to have decent intuition about the integers. Nearly every topic in the book is presented first in the form of a perfectly apposite example or computation. Usually, after performing the computation, or presenting the example, Duff asks, "What do you notice?" Usually it is something beautiful or deep that is perfectly illuminated by the example. This is exactly the right way to write about mathematics, maybe especially to write about number theory. For most people watching the details of the Euclidean algorithm unfold in a particular example is about a thousand times more enlightening than the abstraction that proceeds with five variables, two of which are actually finite sequences of numbers indexed by one of the other variables. On the other hand, the abstraction is transparent—and most undergraduates in a number theory course could be expected to produce it themselves—after a couple of well-chosen examples like the ones Duff provides.

Let me show you a simple example of Duffian exposition. Use the Euclidean algorithm to compute gcd(29, 11).

$$\begin{aligned} 29 &= 2\cdot 11 + 7 \\ 11 &= 1\cdot 7 + 4 \\ 7 &= 1\cdot 4 + 3 \\ 4 &= 1\cdot 3 + 1 \\ 3 &= 1\cdot 3 \end{aligned}$$

Rewrite each of those equations, dividing both sides by the relevant quotient in the division algorithm.

$$\begin{aligned} \frac{29}{11} &= 2+\frac{7}{11} \\ \frac{11}{7} &= 1+\frac{4}{7} \\ \frac{7}{4} &= 1+\frac{3}{4} \\ \frac{4}{3} &= 1+\frac{1}{3} \\ \frac{3}{3} &= 1 \end{aligned}$$

Now, reading from the top down you can see the continued fraction expansion $\frac{29}{11}=[2:1,1,1,3]$. Which is, obviously, a beautiful way to introduce continued fractions; exactly the way Duff does it; and not the way I've ever seen continued fractions introduced before. The book is

Get More

MAA Press titles are now published as an imprint of the AMS Book Program and are available in the AMS Bookstore. MAA members will continue to save 25% on MAA Press titles as a member benefit.

full of stuff like this: at one point Duff exponentiates every element of $\mathbb{Z}/23\mathbb{Z}$ until the sequences starts repeating, he does the same for $\mathbb{Z}/19\mathbb{Z}$ and points out all the interesting patterns. This is the opening to lots of lovely stuff, including, of course, quadratic residues.

The bulk of the book addresses questions relating to quadratics. There is an extensive chapter on quadratic extensions of $\mathbb{Z}$. And a culminating chapter proving the law of quadratic reciprocity. I should point out that the book is intended as an introduction to algebraic number theory. Previous exposure to abstract algebra is not assumed, all necessary background is developed. Teaching number theory this way would be a terrific way to motivate your students to move on to the abstract algebra class, and this book would give them valuable insight into what happens in that course.

As is probably clear by now, the exposition in this book is beautifully plotted and exquisitely clear. There are lots of good exercises and several topics not always included in books at this level (factoring in the Gaussian integers, Minkowski's theorem, the existence of primitive roots). As a bonus there are eight extensive projects intended for student investigation in an appendix. The topics include Pick's Theorem, p-adic numbers, Dirichlet's theorem, the geometry of continued fraction convergence. It would fun to teach out of this book—consider giving it a look next time you teach number theory. ■

Stephen Kennedy (Carleton College) manages acquisitions for MAA Press. Contact him if you're interested in writing a book for the MAA: kennedy@maa.org.

MAA MathFest Sessions for Undergraduate Students

The MAA endeavors to ensure that all the mathematical sessions at MathFest are accessible to a broad audience and undergraduate students are invited and encouraged to attend any of them. The following sessions are aimed specifically at the interests of undergraduate students.

Invited Address
Pi Mu Epsilon J. Sutherland Frame Lecture
The Singular Uniformity of Large Random Systems
Wednesday, August 1, 8:00 P.M.–8:50 P.M.
Peter Winkler, Dartmouth College

MAA-PME Student Reception
Wednesday, August 1, 4:30 P.M.–5:30 P.M.

Math Jeopardy
Wednesday, August 1, 5:30 P.M.–6:15 P.M.

Undergraduate Student Paper Sessions
MAA Student Paper Sessions
Thursday, August 2, 8:30 A.M.–10:45 A.M. and 2:30 P.M.–6:05 P.M.
Friday, August 3, 8:30 A.M. – 12:05 P.M. and 2:30 P.M. – 6:05 P.M.

Pi Mu Epsilon Student Paper Sessions
Thursday, August 2, 8:30 A.M.–10:45 A.M. and 2:30 P.M. – 6:05 P.M.
Friday, August 3, 8:30 a.m. – 12:05 p.m. and 2:30 P.M. – 6:05 P.M.

MAA Chan Stanek Lecture for Students
FAIL: A Mathematician's Apology
Thursday, August 2, 1:30 P.M.–2:20 P.M.
Laura Taalman, James Madison University

Panel Session: Nonacademic Career Paths for Undergraduate Mathematics Majors
Friday, August 3, 3:00 P.M. – 4:20 p.m.

Estimathon!
Thursday, August 2, 4:30 P.M. – 6:15 P.M.

Pi Mu Epsilon Banquet
Friday, August 3, 6:00 P.M. – 7:45 P.M.

MAA Ice Cream Social
Friday, August 3, 9:00 p.m. – 10:00 p.m.

MAA Mathematical Competition in Modeling (MCM) Winners
Saturday, August 4, 9:00 A.M. – 10:15 A.M.

Student Problem Solving Competition
Saturday, August 4, 1:30 P.M. – 3:00 P.M

Graduate Student Paper Session: Great Talks for a General Audience: Coached Presentations by Graduate Students
Saturday, August 4, 1:00 P.M. – 5:00 P.M.

For more information on these activities go to bit.ly/2ICBHDK.

BOOK REVIEW

Behind the Legend

—Review by Fernando Gouvêa

When we read a biography, we expect to find answers to modern questions. What was the person's childhood and education like? Why did they do what they did? How would it have felt to meet with him or her? Would she have lost her temper at our inquisitiveness?

Ancient biographies hardly ever discuss such things. One doesn't find psychological information, and there is rarely any attempt at a disinterested evaluation of a person's life and achievements. Even when the sources are abundant, as in the cases of Jesus, Socrates, or Julius Caesar, attempts at biographies in the modern sense are usually both unsuccessful and controversial. All too often such biographies closely reflect the biographer's personality, as Albert Schweitzer famously observed about the early work on "the historical Jesus."

When it comes to Hypatia, for whom we have very few ancient sources, the difficulty is much greater. She remains a fascinating (and useful) figure nevertheless, so people keep writing about her. That a woman could become a prominent philosopher and influential public figure in late-antique Alexandria is surprising. Her manner of death—a philosopher in her sixties, killed in the streets by a mob led by monks, her body mutilated—shocked cultured people at the time and continues to be discussed today.

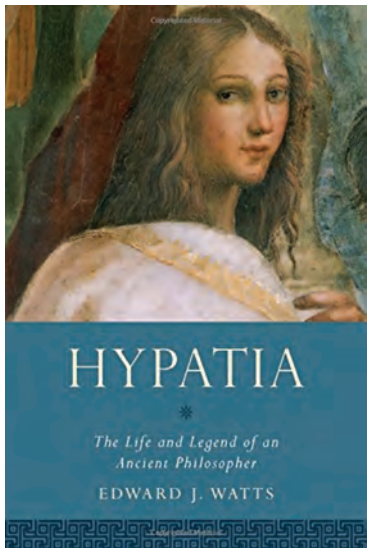
Edward J. Watts is a classicist working on Late Antiquity. His interests include the religious world of the period (for example, his book *The Last Pagan Generation)* and the philosophical schools (most notably in his book *on City and School in Late Antique Athens and Alexandria).* He is therefore thoroughly well informed on the context in which Hypatia lived and (most famously) died.

Most of the book is an attempt to write about Hypatia's life. This is very hard to do, as Watts points out on page 5:

Hypatia the symbol has shaded nearly all of what we know of Hypatia the person. But this person is not entirely lost. This book will tell her story.

Our evidence for Hypatia's life is scanty, it is almost entirely written by men, and it is interested in telling only the stories that appealed most directly to male authors… In Hypatia's case there is the additional challenge of distilling the details of her life out of the works of authors primarily interested in talking about her death…

The "almost entirely" is surprising. I am not aware of any ancient woman who wrote about Hypatia. But Watt's comment reflects one of his concerns. This book is very interested in how Hypatia became a philosopher, on the content of her philosophy, and on the fact that she seems to have been influential in Alexandrian politics. He describes a kind of feminist hero: Hypatia overcomes the biases of the male-dominated philosophical schools to become herself a respected teacher.



Hypatia: The Life and Legend of an Ancient Philosopher
Edward J. Watts
Oxford University Press, 2017
Hardcover, 205 pages
$29.95

Given the barest outline of Hypatia's life, how do we construct a biography? The idea here is to use information about what was typical of the time to reconstruct what "likely" happened in the case of Hypatia. This is tricky, of course, since there is nothing typical about a woman philosophical teacher. Nor was Hypatia's death the sort of thing that was supposed to happen.

The picture Watts paints is somewhat different from, say, the one drawn by Michael Deakins in his *Hypatia of Alexandria*. Watts's Hypatia learned mathematics and some philosophy from her father Theon, then replaced him as the main teacher in his school. She was a Neoplatonist, but one whose ideas were not incompatible with (sufficiently high-minded) Christianity, given that she had Christian students. She felt a responsibility to advise the city's rulers.

Watts does not say much about Hypatia's mathematical work, though he does mention that Theon says that she helped revise one of his works. Notably, Theon refers to her as "my daughter Hypatia, the philosopher". Indeed, the fact that her father was merely a mathematician may have been a difficulty Hypatia had to face, since in the ancient world one of the main ways to establish one's reputation was to have been a disciple of a reputable teacher. Watts thinks that while she did not "abandon" mathematics,

Hypatia quickly surpassed the level of philosophical teaching her father could provide, however, and she seems to have decided that her father wrongly subordinated philosophy to mathematics. (p. 34)

Watts makes much of Hypatia's sense of duty toward her city. This appears to be entirely speculative on his

part; he reaches that conclusion based on her relationship with Orestes, the Roman governor of Alexandria. She is said by some of the ancient sources to have been his adviser, and Watts portrays this as something expected from a respected philosopher.

Every biographer of Hypatia ends up having to give an account of her brutal murder. Watts calls our attention to the great divide between the sophisticated Alexandrian elite and the many poor and uneducated workers that also lived in the city. On page 19, for example:

When most intellectuals went out, they traveled the city in carriages or litters born by attendants so as to avoid the filth of the streets and the stench of the city air. Most of the time they probably thought little of the people whose shops they passed, whose labor they may not even have observed, and whose daily lives they did not really understand.

Ultimately it is this disconnect that Watts blames for the terrible outcome. The times had changed and the elite did not quite understand that. When "the two Alexandrias collided," violence was the result.

Unlike Deakins, Watts does not include the available source material (all the relevant texts in 21 pages in Deakins's book). He easily could have done that, and it would have made his book better, allowing the reader to see the basis on which Watts builds his narrative. Instead, he tells his story first, then turns to a discussion of what the sources actually say. In chapter 9, he summarizes the ancient sources, making the point that almost all of them are motivated to write about Hypatia by her death. One writes about her to make the point that religious controversies create political instability. Another wants to criticize Cyril of Alexandria because he belongs to a different wing of the church. Everyone agrees that Hypatia's death was a horrible disruption of expected norms, but the explanations differ according to the writer.

The last chapter looks at the images of Hypatia created since the Early Modern period. Again, she is discussed with a view to the points one can make. Hypatia's death marks the end of the glorious period of Ancient philosophy, or reveals the awfulness of the Catholic Church, or demonstrates the intolerance of the male-dominated world. Images begin to show her as young and beautiful. The accounts of her virginity are forgotten or ignored and Orestes becomes her sometime lover. And so on.

Anyone interested in Hypatia will want to read this book. Those committed to Hypatia the mathematician will probably be disappointed, but they will end up with a much deeper understanding of the culture of Late Antiquity. ■

Fernando Q. Gouvêa is Carter Professor of Mathematics at Colby College in Waterville, ME. This review first appeared on MAA Reviews *at* maa.org.

New at MAA MathFest

General Contributed Poster Session

The MAA is pleased to announce the inaugural General Contributed Poster Session (GCPS) at MAA MathFest 2018 in Denver. We will rotate the poster categories throughout the meeting and the number of rotations will depend on the number of accepted posters. The MAA will provide corkboards or trifolds for the posters—you just need to bring your poster.

Submitting an abstract for the poster session in the areas of mathematics, pedagogy, and undergraduate mathematics curriculum will be no different than when one submitted an abstract for the general contributed paper session. To submit an abstract for MAA MathFest 2018, go to maa.org/mathfest/abstracts and follow the instructions found there. Early submissions are encouraged.

Deadline for submission of abstracts: April 30

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