MAA FOCUS

NEWSMAGAZINE OF THE MATHEMATICAL ASSOCIATION OF AMERICA MAA

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MATHEMATICAL ASSOCIATION OF AMERICA

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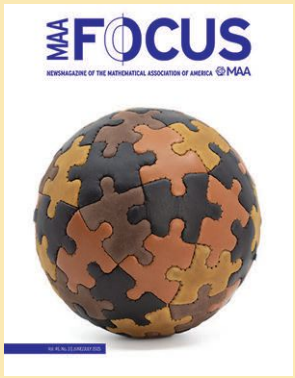
From the Editor

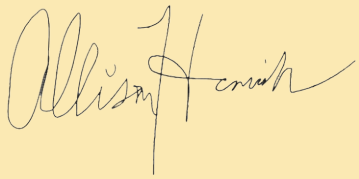
I am of two minds as I write today to introduce our beautiful June/July issue of *MAA FOCUS*. One mind is consumed by a persistent concern for our community. It was recently reported in *Science* magazine, a publication of the American Association for the Advancement of Science, that the National Science Foundation (NSF) is being fundamentally restructured, its budget slashed. According to the report, there will no longer be a Division of Mathematical Sciences at NSF, as its 37 divisions are being dismantled to support the president's efforts to shrink the agency by more than half while redirecting funding towards a few key areas.

Cuts to the NSF and other government organizations are already having an impact. As Wendy Smith predicted in our last issue of *MAA FOCUS*, a major grant she held (EDU-2201486)—along with many others funded by the STEM Education directorate—has been canceled. Meanwhile, some long standing Research Experiences for Undergraduates (REU) programs are shutting down, reducing their participant numbers, or scrambling to find creative ways to keep going without government funding (e.g., MPS-2243912). We keep watching (grant-watch.us/) as the number of grants being terminated continues to grow. I myself was expecting to travel to a conference for NSF ASCEND postdocs a couple of weeks ago only to learn—two days before my flight—that funding (MPS-2220322) for this exceptional professional development program was pulled. Karen Saxe, VP of Government Relations for the AMS, shared, "Our most effective strategy is for all members of congress to hear from their constituents, and in particular, to hear how the current grant cancellations and potential future funding cuts will have direct negative impact in their state/district." Take heed.

But, as I said, I come to you with two minds. My other mind is one of deep gratitude. On behalf of the STEM community, I'm grateful to the Spencer Foundation for its Rapid Response Bridge Program. This program was designed to provide some support for teams whose grants have been terminated by NSF. On a more personal level, I'm grateful to Amanda Harsy. She served as guest editor for our exciting Math + Sports feature in this issue of *MAA FOCUS*. She and all of the contributing authors featured in this issue did a tremendous job communicating about this vibrant area of applied math research and teaching. I'm excited to be able to share it with you.

Finally, I want to express my deepest gratitude to Bev Ruedi who has been the managing editor and art director of *MAA FOCUS* since long before I became editor. She'll be heading off to retirement just days after this issue comes out, having devoted so much of her life to the MAA. (She joined the MAA team when I was a baby!) I want to acknowledge Bev for being a tremendous partner in making *MAA FOCUS* over the last several years, teaching me so much and supporting me through professional and personal challenges with so much humanity. I will miss her dearly. On behalf of all of us, thank you, Bev, for everything you've done to make the MAA what it is today.





About the Cover. Puzzle Ball, by @jonpaulsballs. 60 identical panels. Read about Jon-Paul Wheatley and his art in the Art Department on p. 51.

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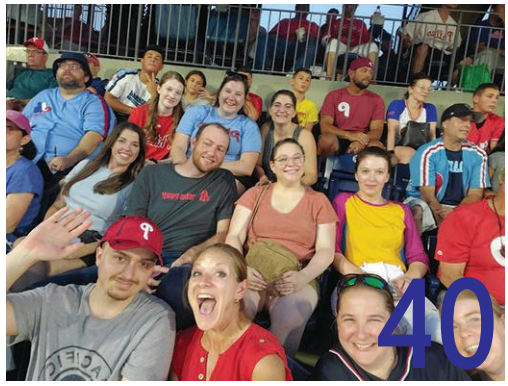


in this ISSUE

MAA MathFest 2025 information can be found on pages 4, 6, 10–11, 16–17, 19, 46–50. Up-to-date info can be found at maa/event/mathfest.

news

departments

pieceWISE

WANTED

MAA FOCUS cover art

Interested in revealing the beauty or community of mathematics on the cover of *MAA FOCUS*? Submit an image for consideration by our art committee!

bit.ly/maafocuscover

Recommendations for MAA Committee Members!

It's that time of year again, time to recommend a colleague (or yourself!) to serve on one of our many MAA committees beginning in 2025. The form is easy to complete. Just visit

surveymonkey.com/r/MAAcommitteesuggestions

to make a suggestion!

More information about the various MAA committees and the overall governance structure of the Association can be found at

maa.org/governance.

There are many ways to serve—committees exist with a focus on prizes, special lectures, meetings, publications, student activities, and continuing attention to the profession and all aspects of the curriculum and our community. So please take a moment to identify a niche and make a recommendation!

MAA MATHFEST August 6–9

2025 | SACRAMENTO, CA

Showcase your visual flair at MAA MathFest 2025 with MathArt at MathFest!

MAA MathFest this year will feature the exciting inclusion of Visual Art Exhibitions within the Exhibit Hall, during open hours Wednesday, August 6 through Friday, August 8, 2025, in Sacramento, CA.

The first MathFest Exhibition of Mathematical Art will include up to 50 artworks contributed by mathematical artists, as well as a group display organized by the SIGMAA on Environmental Mathematics (SIGMAA EM), with a critical mass of images contributed in advance highlighting mathematics and the environment, as well as an opportunity for MathFest 2025 visitors to make their own images and submit them to the display. The EM organizers have created a fun hexagonal template that invites participants to contribute to a honeycomb pattern of environmental math/art.

Submit your mathematical artwork to MathArt at MathFest here: forms.gle/k82bYVaYjR9iPVkr7

Submit to the SIGMAA EM display here: shorturl.at/Rz7fY

Register Now! **maa.org/event/mathfest**

MAA OPEN Math 2025 Workshops

The MAA OPEN Math program is returning. This NSF-funded summer program features 14 intensive, online professional development workshops designed to help college math faculty implement research-based strategies and enhance student engagement.

For $75, you'll join a small cohort of 28 participants, learn from experienced facilitators, and connect with a network of educators from across the country. Workshops have limited space, and deadlines vary, so early registration is encouraged.

July

- Critical Transformations in Mathematics: Using Data to Center Student Experiences and Identities
- Engaged Teaching and Learning with a Modeling Context in Differential Equations
- Designing Professional Development Programs for Graduate Teaching Assistants
- Fostering and Assessing Mathematical Communication Skills in Introductory-Level Courses
- A Dynamics Approach to Teaching Differential Equations with a Focus on Environmental Resilience

Fall Learning Communities

- The Harmony of Compassion and Rigor in Mathematical Spaces
- UR 4 ALL: Embedding Undergraduate Research into Courses in the First Two Years

OPEN Math is a collaborative project between the Mathematical Association of America (MAA) and the University of Colorado, Boulder (CU-B). The MAA is supported by National Science Foundation Award No. DUE-2111260 and University of Colorado, Boulder is supported by Award No. DUE-2111273.

For more info or to register go to maa.org/open-math.

MAA
MATHEMATICAL ASSOCIATION OF AMERICA

Mohammad K. Azarian Scholar Award

The Mathematical Association of America (MAA) is thrilled to announce the establishment of the Mohammad K. Azarian Scholar Award, a new honor celebrating excellence in mathematical problem creation. This award recognizes individuals whose original, thought-provoking problems challenge and inspire the mathematical community.

Honorees will be selected from contributors to MAA publications—T*he American Mathematical Monthly, Mathematics Magazine, The College Mathematics Journal,* and *Math Horizons*—as well as from problem creators featured in the American Mathematics Competitions (AMC), AIME, the Putnam Competition, and the Mathematical Olympiad Program (MOP). By spotlighting outstanding problem creators, this award reinforces the vital role of problem-solving in advancing mathematical thinking and education.

MAA MATHFEST August 6–9

2025 | SACRAMENTO, CA

Register now for MAA MathFest!

Check maa.org/event/mathfest for the latest details, as well as links to register, book your hotel, and preview the program.

Registration Category	2025 Advance April 16 - June 30	2025 Regular July 1 and after
Member	$515	$618
Nonmember[1]	$731	$788
Student Member[2]	$197	$220
Student Nonmember	$232	$254
Project NExT[3]	$456	$456
K–12 Teacher[4]	$277	$311
K–12 Student[4]	$232	$254
Retired Member[5]	$197	$220
One Day	$277	$311
Non-Mathematician Guest†	$197	$220
Minicourse (optional add-on)	$110	$120

Registration Notes

[1] All nonmember MAA MathFest '25 registrants will be entered into a weekly drawing for one complimentary MAA membership at the level an individual qualifies for. Offer is for new MAA members only and not valid for existing MAA membership renewals. If you would like to join or renew your membership, to take advantage of the member rate for MAA MathFest registration, please renew by logging into your member portal or join by creating your account.

[2] Departmental Member nominated students are eligible for "Student Member" rate.

[3] Project NExT—Blue '24 and Peach '25 cohorts only.

[4] May be eligible for up to 1 included guest registrations for parent/guardian/chaperone attendees†

[5] Retired Membership is a Member category that requires that the Member has 15+ years of membership and is no longer actively employed.

† A guest is a family member or friend and non-mathematician who is accompanied by a participant of MAA MathFest. Guests will receive a name badge and may attend all sessions and exhibits. You will have the opportunity to register your guest for any of the paid social events. However, if your guest would like to attend a paid minicourse, separate registration is required.

Register Now! **maa.org/event/mathfest**

MATHEMATICAL ASSOCIATION OF AMERICA

MAA Seeks Applicants for Executive Director

After serving as MAA Executive Director since 2012, Michael Pearson will be retiring effective August 31, 2026. Thus, the MAA seeks a visionary and strategic leader who can continue with the work started under Michael's leadership and lead the Association onto new, exciting, and impactful endeavors.

The MAA Executive Director has administrative responsibility for the Association, including its facilities and staff, and carries out other duties that may be assigned by the Board of Directors. The Executive Director is responsible for providing the legal and Board-mandated oversight of the MAA Sections and for allocating resources to the Sections as directed by the Board. The Executive Director works with the Board to provide leadership in advancing its mission of the Association.

Primary responsibilities of the the Executive Director include:

- Meeting the responsibilities described in the MAA Bylaws;
- Planning, formulating, and recommending to the Board policies and programs to advance the objectives of the Association as established by the Board and the Bylaws;
- Representing the Association, along with the President, to the press, the public, related organizations, and government agencies;
- Directing the Association's professional staff; serving as the chief operations officer overseeing budgets and forecasting, financial management, human resources, contracts, and legal compliance;
- Consulting with and assisting the national officers in the performance of their duties;
- Providing support for the key committees of the Association;
- Working to coordinate Section activities with national objectives; and
- Serving as chief development officer of the association, working closely with officers, committee chairs, and program directors in securing external funding.

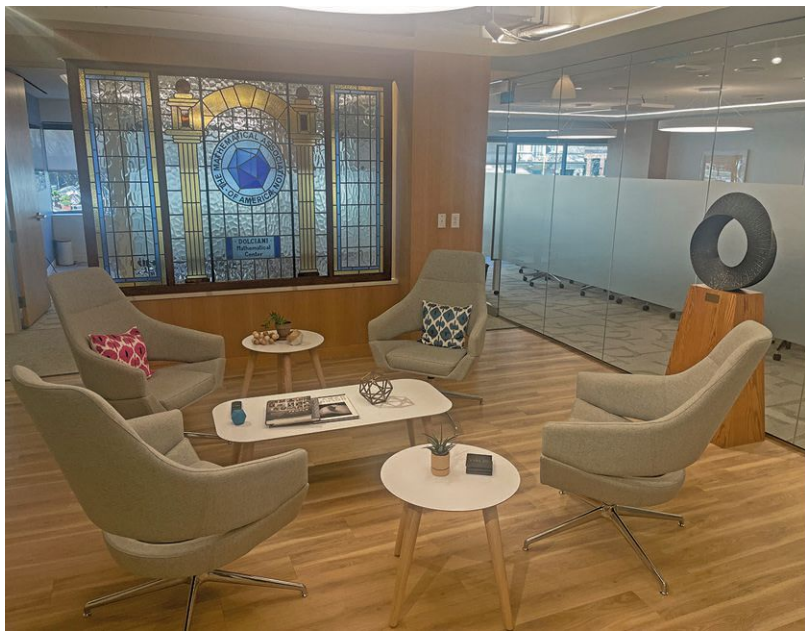
The search committee seeks candidates who have an advanced degree in the mathematical sciences or related field and who possess exceptional communication and interpersonal skills, demonstrate a proven track record of leadership, and meet the education and experience requirements listed below.

- Must have senior-level management experience;
- Must be highly networked within the mathematical sciences community;
- Must have significant experience obtaining and managing external funding in collaborative settings;
- Should have experience working with a membership association or non-profit organization with a Board of Directors; and
- Should have experience with MAA at either the Section or National level with an understanding of and commitment to the sense of community that is fundamental to the MAA.

To learn more about the position, please visit

maa.org/join-the-maa-team/.

To apply, send a cover letter indicating how you satisfy the qualifications along with a resume to shenze@tpo-inc.com. To ensure full consideration, applications should be received by June 30, 2025. The successful candidate will assume the role of MAA Executive Director on September 1, 2026. Questions about the position may be sent to the search committee chair Hortensia Soto at hortensia.soto@colostate.edu.



Lobby of the MAA headquarters.

Growing Up with the MAA

—Michael Pearson, Annie Petitt, and Bonnie Ponce

It is impossible to overstate the impact that Carol Baxter and Beverly (Bev) Ruedi have had on the MAA. Carol and Bev joined the staff of MAA in the fall of 1980. Dorothy Bernstein was MAA president (the first woman to hold the position), Dave Roselle was the secretary, Leonard Gillman was treasurer, and Ralph Boas was editor of the *American Mathematical Monthly.* While many of our members likely don't recall all (or even any) of those MAA officers, very few will not be familiar with Carol and Bev!

Over the years, Carol and Bev have served in various roles, from providing member services to supporting national meetings. However, both made their mark in publications early in their MAA careers.

In the 1980s, Peter Renz, the director of publications, introduced the LaTeX typesetting system for MAA's books. Bev Ruedi, the technical production manager, typeset *More Mathematical Morsels* by Ross Honsberger, marking it as the first book published by the MAA using the LaTeX typesetting system.

By 1990, Carol and Bev were involved in setting up initial computer systems for typesetting, long before authors were provided digital page proofs in the publication process. Bev honed her skills in graphic software like CorelDraw, Adobe Illustrator, and InDesign. She typeset hundreds of books and notes during her time at the MAA, often guiding authors through the book-writing process. Many authors have expressed their gratitude to Bev by name in their acknowledgements, and she generously shared her expertise in LaTeX, vector graphics, and production processes with colleagues and authors alike.

In the preface of his book, *Conics,* Keith Kendig shares the following antidote about working with Bev.

> I knew there would be many figures in my nascent opus, and I wanted to do things right: there had to be some "best way" to create all those figures. In writing short papers, I'd muse from time to time about that problem but had never encountered the right person to ask—that is, until I happened to mention it to Beverly Ruedi, manager of electronic production at MAA. I'll never forget the experience. After that very enlightening phone conversation, Joan and I dashed down to the university bookstore, arriving about ten minutes before closing, and got a copy of Adobe Illustrator 10.

Ross Honsberger, who worked with Bev on several books also thanks Bev in the preface of his book, *Mathematical Diamonds*: "It is again a pleasure to extend my warmest thanks to Elaine Pedreira and Beverly Ruedi for their unfailing geniality and technical expertise in seeing the manuscript through publication."

Bev's technical experience was paired with her generosity in sharing her knowledge with authors and co-workers. "When I began learning LaTeX, Bev was generous with her time, knowledge, and assistance to troubleshoot vague TeX error messages. I have so many emails from Bev with step-by-step instructions for various technical processes," says Bonnie Ponce.

In the early 1990s, Carol worked with Don Albers, the director of publications at that time to launch *Math Horizons.* Her initiative to help make the magazine visually appealing included walking into the Philippine embassy to obtain a photograph of former president Corazon Aquino for a gallery of math majors and going to the Pentagon to get a photograph of Secretary of Defense and math PhD William Perry for the September 1996 cover. While the managing editor changed a few times over the years, Carol Baxter once again became managing editor of *Math Horizons* in 2017. Bev Ruedi also managed *Math Horizons* between 1999–2003.

From April 1998 to July 2010, Carol served as the managing editor of *MAA FOCUS,* collaborating with various editors to keep members informed about the MAA's work. In 2017, Bev took over as the managing editor and art director of *MAA FOCUS.*

The year 2017 marked a significant transition in MAA publishing when the organization moved from in-house publishing to partnerships with other organizations. The MAA book program partnered with American Mathematical Society (AMS). While the book content remains under the control of the MAA's book editorial boards, the books are published, marketed, and sold by the AMS. The journals—*The American Mathematical Monthly, Mathematics Magazine, The College Mathematics Journal,* and *Math Horizons*—became part of a partnership with Taylor & Francis. Carol and Bev played

foundational roles in this transition, which ensured the continued success of the MAA's publications.

Carol was instrumental in launching the MAA's newest peer-reviewed, online-only journal, *Scatterplot*. From the outset, she was deeply invested in its success, collaborating with consultants to assess the need for the journal, developing its aims and scope, recruiting Rick Cleary as editor, and pitching the idea to Taylor & Francis. Carol considers launching *Scatterplot* one of her career highlights, stating, "The obvious highlights are helping create *Math Horizons* and *Scatterplot* as well as working with Bev on the book program for the last seven years we had it inhouse."

Beyond their roles in publications, Carol and Bev were familiar faces at MAA MathFest and the Joint Mathematics Meetings (JMM), where they sold MAA Press books and merchandise. It was common to see members enjoying miniature chocolate bars while chatting with Carol and Bev at the transaction counter, reflecting their popularity among the MAA community.

More than the publications that they have guided through the publication process, it is the people and members of the MAA that have meant the most to them. Reflecting on her career, Carol shared, "The two things I have really enjoyed are the people I work with and the opportunities I've been given. Both are what kept me at the MAA for almost 45 years."

Annie Petitt, who began as an intern in the MAA publications department while in college and was hired after graduation, offers, "I will never be able to thank Carol enough for taking a chance on me and bringing me on the team. The amount of knowledge I've learned from her and Bev is priceless, and I will forever treasure it. They both deserve a break after years of service, but they will be dearly missed."

During their tenure in the publications program, Carol and Bev have each played a role in the publication of hundreds of issues of MAA journals and essentially all of MAA books prior to our book partnership with AMS. They have worked with authors, editors, and boards to ensure the quality and integrity of the MAA publications programs and have contributed to innumerable national meetings. MAA staff members know that we can depend on Carol and Bev to support internal production efforts, as well.

Carol currently serves as Senior Director for Publications, and Bev serves as Electronic Production and Publishing Manager. In addition, Carol serves as managing editor of *Math Horizons,* while Bev acts as managing editor for *MAA FOCUS.* Both will retire in June of this year.

The MAA owes much to Carol and Bev, and we know that both staff and the many members who have contributed to our publications program over the years will say farewell with mixed emotions.

Thanks, Carol and Bev! You'll be missed.

Michael Pearson serves as the executive director of the MAA. Annie Petitt received her bachelors in journalism from the University of Texas at Arlington and is the current editorial coordinator for the MAA. Bonnie Ponce is the publications operations manager for the MAA and has been working with MAA journals since 2011.

MAA Joins National Call for Constructive Engagement on Campuses

Official MAA announcement:

The Mathematical Association of America has joined other leading professional societies and university presidents in signing *A Call for Constructive Engagement on America's Campuses,* a statement organized by the American Association of Colleges and Universities (AAC&U).

This statement affirms a shared commitment to free expression, respectful dialogue, and the essential role of higher education in fostering democratic engagement. By signing on, the MAA joins a coalition of organizations and institutions calling for environments where disagreement can be addressed with empathy, inquiry, and integrity.

We encourage our members to read the full statement and consider how the values expressed reflect the broader role of mathematics and the mathematical community in society.

From Michael Pearson on Connect:

I'm happy to share that MAA has joined university presidents and scholarly societies in signing *A Call for Constructive Engagement on America's Campuses.*

At a time when civil discourse is both urgent and necessary, this statement affirms the role of higher education, and organizations like ours, in fostering environments where diverse perspectives are heard, debated, and respected.

Mathematics teaches us the value of clarity, rigor, and dialogue. These same principles can guide us toward more thoughtful engagement in our communities and on our campuses.

Read the full AAC&U statement here:
www.aacu.org/newsroom/a-call-for-constructive-engagement.

MAA MATHFEST August 6–9

2025 | SACRAMENTO, CA

So Much Mathematics, So Little Time!

Looking for the math at MAA MathFest 2025?
Be sure to look out for these specially programmed sessions on specific mathematical topics!

Geometry and Analysis

Earle Raymond Hedrick Lecture

Second Lecture: Translational Tilings of Euclidean Space
Terence Tao, *University of California, Los Angeles*

Special Session

Looking at Complex Analysis and Geometry through the Lenses of Research, History, and Pedagogy

Workshop

Geometry for the 21st Century

Workshop

Flexagons – from the Basics to the Cutting Edge

Combinatorics and Cryptography

AMS-MAA Joint Invited Address

Combinatorial Approaches to Matrix Functions
Naiomi Cameron, *Spelman College*

MAA Invited Address

Intersection Theory and Combinatorics: Variations on a Theme
Federico Ardila-Mantilla, *San Francisco State University*

MAA Invited Address

Squaring the Quilting Circle
Beth Malmskog, *Colorado College*

Contributed Paper Session

Cryptology in Undergraduate Education

Minicourse

Integrating Cryptography into Undergraduate Math Courses

Invited Paper Session

Combinatorics and Computers

Game Theory, Games, and Recreational Mathematics

Invited Paper Session aligned with the Chan-Stanek-Ross Lecture

Lotteries in Math and Society

Organizer: Skip Garibaldi, *IDA Center for Communications Research, La Jolla*

Chan-Stanek-Ross Lecture for Students

A Better Way to Buy Lottery Scratch-off Tickets
Skip Garibaldi, *IDA Center for Communications Research, La Jolla*

Workshop

Mathematical Games and Puzzles: Fun for All!

Student Activity Speaker

Exponential Party Fun
Tim Chartrier, *Davidson College*

MAA Invited Address

Calculating with No Numbers, No Formulas
Tadashi Tokieda, *Stanford University*

Workshop

Game Theory: Activities Motivate Concepts

Special Session

Recreational Mathematics: Puzzles, Card Tricks, Games, and Gambling

Martin Gardner Lecture

The Magic of Charles Sanders Peirce
Persi Diaconis, *Stanford University*

Register Now!

Artificial Intelligence and Data Science

Earle Raymond Hedrick Lecture

First Lecture: Machine assisted proofs
Terence Tao, *University of California, Los Angeles*

Invited Paper Session

The Next Frontier: AI Innovations in Mathematics Research

Invited Paper Session

Bridging Disciplines Through Data Science

Workshop

Exploring the Use of AI to Translate Early Modern Mathematics from Latin to English

Other Mathematical Topics

Invited Paper Session

Early Career Research Initiatives from Project NExT—Blue'24

Workshop

Math Through Images: Draw, Deduce, Discuss!

Special Session

AMC/AIME/USAMO Editors' Favorite Problems

AWM-MAA Etta Zuber Falconer Lecture

Modeling malaria at multiple scales: implications for parasite diversity
Olivia Prosper Feldman, *University of Tennessee*

Christine Darden Lecture

PEIRE – A model for the transfer of information and decision making
Dawn Lott, *Delaware State University*

Special Session

10 Golden Years: Stories of Struggle and Success from the Gold'14 Project NExT Cohort

Poster Session

PosterFest 2025: Scholarship by Early Career Mathematicians

Panel on Calculus

Is everybody ready for Calculus?! Looking to keep up with policy effects on education? Be sure to see this panel at MAA MathFest!

Calculus without Prerequisites: The Implementation and Impacts of AB 1705 and Calculus Placement Changes in California

In 2022 the California Legislature approved Assembly Bill 1705, a bill which requires California Community Colleges to place most STEM students directly into Calculus 1 by Fall 2025, regardless of their previous coursework. The bill, its implementation, and the data used to support it have all become controversial, with mathematicians and educators discussing and debating online and in hallways within California colleges and across the nation. This panel will bring the conversation to the MAA MathFest community, a few short blocks from the Capitol building where the legislation was signed. Panelists will discuss the intent, implementation, and effect of this important new law. Anyone who teaches (or plans to teach) calculus or calculus-based courses may find the conversation valuable.

Panelists: Ben Richert, *Cal Poly, SLO*
David Bressoud, *Macalester College*
Tina Akers-Porter, *Modesto Junior College*
John Hetts, *California Community Colleges Chancellor's Office*
Ellen Cesaretti-Monroy, *California State Assembly, Committee on Higher Education*
Cortney Schultz, *California Mathematics Council Community Colleges*

Moderator: Corey Shanbrom, *California State University, Sacramento*

Organizers:
Matthew Krauel, *California State University, Sacramento*
Gabriel Martins, *California State University, Sacramento*
Vincent Pigno, *California State University, Sacramento*
Corey Shanbrom, *California State University, Sacramento*
Topaz Wiscons, *California State University, Sacramento*

Congratulations to MAA's Outreach Grant Recipients of 2025!

The MAA is proud to announce that we have funded 46 outreach projects, totaling over $310,000. Each year, through the generous support of our benefactors—the Mary P. Dolciani Halloran Foundation, the John & Mary Neff Foundation, the Tensor Foundation—the MAA funds projects across our Sections that provide mathematics enrichment, community-building, and more to students, teachers, and parents.

Dolciani Mathematics Enrichment Grants (DMEG)

These grants, funded by the Mary P. Dolciani Halloran Foundation, focus on projects that support enrichment activities for middle and high school students. The program's goal is to encourage and engage these students so that they can continue to thrive in their mathematics studies as they progress in their education.

- **Adelphi University**
  Adelphi Summer Institute of Mathematical Epidemiology (ASIME) Speaker Series
  Project Director: Josh Hiller
- **Baylor University**
  Baylor University's Math Circle
  Project Director: Christoph Fischbacher
- **Central Washington University**
  CWU Sonia Kovalevsky Day 2025
  Project Director: Chris Black
- **George Fox University**
  Project UNSOLVED: Unleash New Skills with Open-Ended Learning Ventures in Exploratory Discovery
  Project Director: Nicole Wessman-Enzinger

DMEG Awardee 2023: University of Guam, "The 13th Math Day at the University of Guam." Project Director: Hideo Nagahashi

- **McNeese State University**
  Rowdy's Math Rodeos for Grades 6–12 Students in Southwest Louisiana
  Project Director: Haile Gilroy
- **Northeastern University**
  Bridge to Calculus summer program
  Project Director: Bindu Veetel
- **Texas A&M University**
  PReMa Program
  Project Director: Kun Wang
- **The Citadel**
  Math Research Experience for Lowcountry High School Students and Teachers
  Project Director: Breeanne Swart
- **State University of New York, Oswego**
  Math Circle
  Project Director: Sarah Hanusch
- **University of Central Florida**
  Central Florida Math Circle
  Project Director: Seongchun Kwon
- **University of Guam**
  The 15th Math Day at the University of Guam
  Project Director: Hideo Nagahashi
- **University of Montana**
  UM Math Day 2025
  Project Director: Matt Roscoe
- **Utah Tech University**
  THRIVE Program at Utah Tech University
  Project Director: Vinodh Chellamuthu
- **Villanova University**
  Expanding Access to Mathematical Enrichment through the Main Line Math Circle
  Project Director: Kathryn Haymaker

Neff Outreach Fund Awardee 2024: The Math Movement, "The Math Movement Summer Camp." Project Director: Dionissi Aliprantis

Neff Outreach Fund

These grants, funded by the John and Mary Neff Foundation, support projects that engage K–12 students beyond the standard mathematical curriculum and encourage them to persist in their interest in mathematics—particularly those students from underserved communities, rural communities, and/or indigenous communities.

- **Hope College**
  Hope College Family Math Festivals
  Project Director: Gina Kling
- **Kansas State University**
  Math Camp at the Navajo Nation Museum
  Project Director: David Auckly
- **Macalester College**
  Math Corps @ Macalester
  Project Director: Will Mitchell
- **Montana State University**
  Navoʼestanemo (My Family): Summer Math Modeling and Family Math Nights
  Project Director: Elizabeth Arnold
- **University of Wisconsin-Milwaukee**
  Welcoming Math Together
  Project Director: Gabriella Pinter
- **West Virginia University Research Corporation**
  West Virginia Math Games
  Project Director: Cody Hood
- **X Academy**
  X Academy Summer Math Camp
  Project Director: Barbara Meister

MAA-Neff Middle School Partnerships Program

Funded by the John and Mary Neff Foundation, this new program funds projects that focus on the professional development of middle school math teachers. Projects will help these teachers improve their instructional practices and overcome specific instructional challenges.

- **Sacramento State: California State University, Sacramento**
  A 'Building Thinking' Math Teacher Circle
  Project Director: Sayonita Ghosh-Hajra
- **Defiance College**
  Supporting Mentor Teachers Selection and Implementation of High Cognitive Mathematical Tasks
  Project Director: Deependra Budhathoki
- **Salem State University**
  Teaching Mathematics for Social Justice in the Middle School
  Project Director: Christopher Yakes
- **University of Nebraska-Lincoln**
  Partnering with Teachers to Develop and Implement Accessible Math Modeling Tasks
  Project Director: Amy Bennett

Neff Outreach Fund Awardee 2023: West Virginia University, "West Virginia Math Game Days." Project Director: Vicki Sealey

Tensor Women Awardee 2024: The University of Texas at San Antonio, "Empowering Excellence: Women in Mathematics Workshop in San Antonio." Project Director: Zhuolin Qu

Tensor Women & Mathematics Grants

Funded by the Tensor Foundation, these grants support projects that focus on college/university women and pre-college girls, encouraging them to persist in their mathematical studies through engaging enrichment activities, mentorship, and preparation for continued studies in mathematics.

- **Canton Regional Chamber of Commerce Foundation**
  Youth Leadership Academy's Mathematics Excellence for Girls in STEM
  Project Director: Aloysius Bathi Kasturiarachi
- **Mississippi State University**
  CREATE Math—Cultivating Rehumanized Embodied Approaches To Education
  Project Director: Liza Bondurant
- **St. Lawrence University**
  Inspiring College Math Study in Women High School Students in Northern NY
  Project Director: Patti Frazer Lock
- **Temple University**
  Girls Talk Math
  Project Director: Katrina Morgan
- **University of Michigan-Dearborn**
  Girls Get Math @Dearborn
  Project Director: Yulia Hristova
- **University of Tennessee at Martin**
  Math+Craft Laboratory
  Project Director: Amanda Niedzialomski
- **Wake Forest University**
  WFU Girls Talk Math
  Project Director: Claudia Falcon
- **Wentworth Institute of Technology**
  Puzzles, pi, and Pathways to Mathematics: Empowering Future Mathematicians
  Project Director: Fariba Khoshnasib-Zeinabad

Tensor Strengthening Underrepresented Minority Mathematics Achievement (SUMMA) Grants

Funded by the Tensor Foundation, Tensor SUMMA Grants support projects that provide mathematics enrichment to middle school, high school, and undergraduate students from groups historically underrepresented in the field of mathematics. Projects aim to encourage the pursuit and enjoyment of mathematics amongst these students and prepare them for their continued studies in mathematics.

- **Central Connecticut State University**
  DEEP-MATH (Discover Enjoy Explore and Pactice Mathematics)
  Project Director: Viktoria Savatorova
- **College of Coastal Georgia**
  The Boys & Girls of Summer (BGOS)
  Project Director: Quinton Staples
- **Northeastern University**
  Cultural Capital: Creating A Bridge to Calculus And A Better World
  Project Director: Abby Williams
- **PROMYS: Program in Mathematics for Young Scientists**
  PROMYS Pathways Summer Program
  Project Director: Li-Mei Lim
- **Saint Louis University**
  Statistics and Research Summer Program at Saint Louis University
  Project Director: Ozlem Ugurlu
- **Tarleton State University**
  Tarleton Math Scholars
  Project Director: Claudia Rodriguez

Tensor Women Awardee 2023: University of Tennessee at Martin, "Math Craft Laboratory." Project Director: Amanda Niedzialomski

Art Benjamin Named MoMath Visiting Professor of Public Outreach

One of MAA's favorite mathemagicians, Art Benjamin, has just been named the National Museum of Mathematics (MoMath) 2025–2026 Visiting Professor for Public Outreach. In addition to being the Smallwood Family Professor of Mathematics at Harvey Mudd College, Art is a prolific author, a professional magician, and a passionate public communicator of mathematics. He is known around the world for his mental math presentations that combine mathematics and magic, and he has been featured on *The Colbert Report,* CNN, NPR, and *The Today Show.*

At MoMath, Art will offer three special minicourses: Games, Puzzles, and Magic in fall 2025, Backgammon in spring 2026, and Fibonacci Numbers and the Golden Ratio in summer 2026. In addition, he will conduct monthly online interviews with members of the mathematics and math education community; run a virtual book club; and host a discussion group on movies, plays, and other performance art that features mathematics.

Art is looking forward to involving MAA community members in his programming for MoMath! He shared with *MAA FOCUS,* "For my book club, I would love to have authors join me online. If there are MAA members who would like to discuss their book with me, please send me a note! I am especially interested in new books but would be happy to consider older ones, too. I will be doing an in-person book club for younger folks and would love to invite authors to participate in these events." We hope MAA members will take advantage of some of these exciting upcoming opportunities at MoMath.

MAA
MATHEMATICAL ASSOCIATION OF AMERICA

Nominations are now being accepted for

The Deborah and Franklin Tepper Haimo Award for Distinguished College or University Teaching of Mathematics

The Deborah and Franklin Tepper Haimo Award for Distinguished College or University Teaching of Mathematics honors college or university teachers who have been widely recognized as extraordinarily successful and whose teaching effectiveness has been shown to have had influence beyond their own institutions. Each year at most three college or university teachers are honored with this award. Recipients of the Haimo Award receive $1,000 and a certificate of recognition. All recipients must be members of the Association (teaching in the U.S. or Canada).

For more information go to maa.org/community/awards/or contact the MAA Secretary at secretary@maa.org.

Nominations are due by August 1.

MAA MATHFEST August 6–9 2025 | SACRAMENTO, CA

Minicourses

Navigating the AI Landscape: Practical and Ethical Integration in Mathematics Education

Explores integrating AI into mathematics education. Participants will engage with AI applications, ethical considerations, and develop meaningful assessments. Day one focuses on practical AI use, while day two emphasizes assessment design in an AI-driven environment. Activities include discussions, hands-on exercises, and group work to enhance teaching practices and foster deeper student engagement.

Organizers: Lew Ludwig, *Denison University*
Gizem Karaali, *Pomona College*

Implementing Alternative Grading

Grading practices have an all-encompassing effect on student learning and classroom environment. Participants will explore the destructive impact of "traditional" grading practices on student learning, equity, and student/instructor relationships. Participants will have hands-on time working through a scaffolded implementation plan with the facilitators to outline a plan for redesigning a course to use alternative grading.

Organizers: Drew Lewis, *Center for Grading Reform;* Sharona Krinsky, *California State University, Los Angeles / Center for Grading Reform*; Robert Bosley, *California State University, Los Angeles / Center for Grading Reform*

Introduction to Process Oriented Guided Inquiry Learning (POGIL) for Math and Stats Courses

Introduces participants to the fundamentals of Process Oriented Guided Inquiry Learning (POGIL), guided-inquiry learning that deliberately develops process skills such as communication, information processing, and metacognition. Participants will learn about team dynamics and the question learning cycle while completing POGIL activities. Participants will also investigate connections between POGIL and other interactive mathematics and statistics teaching methods.

Organizers: Chris Oehrlein, *Oklahoma City Community College;* Kayla Heffernan, *University of Pittsburgh at Greenburg;* Jessie Oehrlein, *Fitchburg State University*

Liberal Arts Math, Quantitative Literacy, College Algebra/ Precalculus: A Novel Hybrid Curriculum

We consider a novel hybrid curriculum for non-calculus-bound students, incorporating desirable aspects of liberal arts, quantitative literacy, and college algebra/precalculus courses. Focusing on discrete models defined by difference equations, and the continuous models they reveal, exposes standard pre-calculus topics in a new light, while painting a realistic picture of how math actually gets applied. We also discuss pedagogy and technology.

Organizers: Dan Kalman, *American University (Emeritus)*

Getting Started in the Scholarship of Teaching and Learning

Participants are introduced to the Scholarship of Teaching and Learning in mathematics. They will learn about framing a researchable question, literature searches, collecting/analyzing evidence, human subjects requirements, and presenting/publishing their work. Participants will interactively transform a teaching problem of their own choice into a researchable question and identify several types of evidence to gather. Resources for continuing will be provided.

Organizers: Jacqueline Dewar, *Loyola Marymount University*

Evidence-based Practices for Effective Mentoring Relationships

This interactive and evidence-based mini-course will lead participants to deepen their skills as culturally-responsive mentors based on the notion of mentorship as a network of sustained, intentional interpersonal relationships. Participants will co-construct an intellectual framework, experiment with various methods, and a develop a toolbox of strategies for building effective mentoring relationships.

Organizers: Abbe Herzig, *Sarah Lawrence College;* Aris Winger, *Georgia Gwinnett College;* Emily Moore, *University of Oregon*; Pamela Harris, *University of Wisconsin-Milwaukee*

Teaching Mathematics Through Games

This minicourse will present a variety of methods for engaging college mathematics and statistics students by playing or investigating games. These games run the gamut, from well-known favorites like blackjack to original games like playing Battleship with functions, and apply to all levels of college mathematics. Use the workshop as inspiration for your own way to teach mathematics through games!

Organizers: Mindy Capaldi, *James Madison University;* Marie Meyer, *Lewis University*; Jacob Heidenreich, *Loras College*

Integrating Cryptography into Undergraduate Math Courses

This is a practical introduction to incorporating cryptography into undergraduate mathematics courses. We will explore

Register Now!

well-known cryptosystems and discuss how cryptography can serve as motivating context for topics like linear algebra and number theory. Attendees will gain strategies for curriculum integration, enhancing student engagement and understanding of concepts through applications. It is designed for instructors seeking innovative ways to enrich their courses with cutting-edge content.

Organizers: Catie Adamo, *University of Notre Dame;* Claire Frechette, *Boston College*

Jumpstarting your Scholarship

Focuses on developing strategies to establish your research agenda and to pursue funding and support for this agenda. We will discuss numerous aspects of a scholarship program, including how to find possible problems and collaborators, presenting your research, writing up your results, and getting your work published. We will also set goals and priorities for the upcoming year or two and make a plan for how to achieve those goals. We will feature an overview of the NSF. There will be plenty of time for questions and discussion.

Organizers: Nancy Ann Neudauer, *Pacific University;* Adriana Salerno, *National Science Foundation*

Teaching Probability and Statistics: Technology and Active Learning Approaches

Today's world is full of readily available data and students are typically interested in how they can use course topics in future coursework, jobs, and/or in the real world. Outside of teaching proofs and written computations, students need to grasp the whole story of probability and statistics by understanding how useful it is. Without compromising the theoretical understanding of the subjects, instructors can implement coding activities in their course lectures that go hand in hand with the written lectures. Students can engage with the lectures while learning incredibly versatile skills, which promotes forward-thinking and innovation.

Organizers: Keisha Cook, *Clemson University*

Empowering Mathematics Mentorship: Personalized Undergraduate Research Experiences and Community Building

Tailored for mathematicians seeking to mentor undergraduate researchers and cultivate vibrant communities. We will explore strategies for launching and sustaining successful research projects focusing on guiding individual journeys and one-on-one mentoring dynamics, complemented by the integration of personalized "Willingness Agreements." We will engage in interactive community-building exercises for research teams that encourage building trust, rapport, and confidence. You will walk away empowered to mentor an academic research experience no matter the size of your research group.

Organizers: **Cynthia Flores,** *California State University Channel Islands*

Teaching Future Teachers

Students who are preparing to be teachers need to develop flexible understanding of advanced concepts that connects to their future teaching, to reflect on math-specific teaching challenges, and to begin critiquing our role in the education system. In this workshop, we will experience and discuss strategies that I use across math courses to to work toward these goals with future teachers [but that benefit all students]. Participants will leave with a large collection of classroom tasks and readings that they can use in their courses.

Organizers: Brian P Katz (BK), *California State University Long Beach*

Curiosity, Connections, and Creating Value: Leveraging the KEEN Framework in Undergraduate Mathematics Teaching

We will consider the KEEN Entrepreneurial Mindset, which asks us to accompany our students as they grow their curiosity, make connections between concepts, and seek to understand the value of learning (for us, mathematics). We will discuss the importance of changing *our* mindsets about teaching as we change our students' mindsets about learning. We will dig into the KEEN website to look at the over 5000 classroom activity and pedagogy cards created by STEM colleagues, and we will invite participants to dive into task creation. Our hope is that we can empower faculty to work with their colleagues in math-adjacent disciplines to better engage all students.

Organizers: Stephanie Anne Salomone, *University of Portland;* Wojciech Kossek, *University of Denver*

Math for Social Justice: Concrete Examples for the Classroom

This minicourse is for faculty interested in encouraging their students to consider issues of social justice in the context of the mathematics classroom. In *Mathematics and Democracy*, Lynn Steen and his collaborators set an inspiring goal, for curricula and instruction that: "empower people by giving them the tools to think for themselves, to ask intelligent questions of experts, and to confront authority confidently." We will pursue Steen's goal by featuring several examples of applications of mathematics and statistics to issues of social justice. All applications invite students to raise questions of their own. We'll share concrete examples and resources, including pointers to OER materials.

Organizers: Lily Khadjavi, *Loyola Marymount University*

Prices for minicourses are listed in the registration table on p. 6. Full and updated listings can be found online.

MAA Mourns the Passing of Tina H. Straley

The Mathematical Association of America (MAA) mourns the passing of Dr. Tina H. Straley, who served as Executive Director from 2000 to 2012. Dr. Straley led the Association through a transformative period of strategic growth, expanded programs, and strengthened ties with the broader mathematics community.

After earning degrees from Georgia State University and a PhD from Auburn University, Dr. Straley built a distinguished career as a mathematics educator and administrator. Her leadership at the MAA emphasized strategic planning, financial stewardship, and community building—hallmarks of a tenure that positioned the Association for a strong second century.

Dr. Straley was deeply committed to fostering collegiality, advancing opportunities for women in mathematics, and strengthening connections among members. Her service earned her numerous honors, including the Distinguished Service Award from the MAA Southeastern Section.

We extend our deepest condolences to Dr. Straley's family, her daughter Jessica, her son-in-law Richard, and her grandsons, Elliott and Julian. Her impact on the MAA and the broader mathematical community will continue to be felt for years to come.

In honor of Dr. Straley's enduring contributions to the MAA and the mathematics community, we invite you to make a gift in her memory at maa.org/donate. Your support will help continue the work and values she so passionately advanced.

Read Dr. Straley's reflections on her years with the MAA in her December 2011/January 2012 MAA FOCUS farewell message (bit.ly/Tina_Straley).

Submit a Nomination for the next Etta Zuber Falconer Lecture!

Nominations are open August 1 – September 15.

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

All nominations can be made at MathPrograms.org. To locate the nomination form in MathPrograms, click on "View Programs" at the top right of the page. Scroll down to the programs listed for "Association for Women in Mathematics" and click "Nominate" next to the AWM-MAA Falconer Lecture.

Any person can be a nominator! People of any gender can be a nominator, self-nominations are allowed, and you do not need to be an AWM member to nominate someone for this award. If this is a self-nomination, then you must have one additional letter of support.

Nominations materials for this award should be compiled into a single PDF file and include the following:

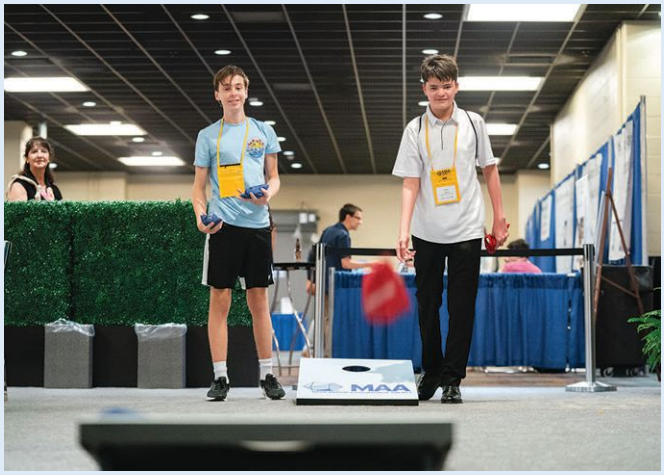
- A nomination letter that
  - outlines the nominee's distinguished contributions to the mathematical sciences or mathematics education;
  - addresses the nominee's ability to deliver an expository lecture;
- A curriculum vitae of the candidate not to exceed three pages.

All submitted materials become the property of the AWM.

MAA MATHFEST August 6–9
2025 | SACRAMENTO, CA

Visit the MAA Pavilion!

Renew your membership, ask questions, or purchase MAA merchandise!
Events in the MAA Pavilion include:



Backgammon with Grandmaster Art Benjamin

VITAL Faculty Meet and Greet

Committee on Minority Participation in Mathematics Community Hour

PRIDE Social Mixer

MAA Cornhole Competition

SIGMAA Social Mixer

Puppy Break Sponsored by HRT

AMC Problem of the Day

Exhibit Hall Block Party

A Tribute to Allen Butler

—Rick Cleary, with the help of the MAA Board of Directors

Allen Butler

We encourage the entire MAA community to join in an enthusiastic "Thank you!" to MAA Treasurer Allen Butler, whose term ends on July 1, 2025. Allen has worked during an exciting period for the Association that has seen some important changes in our organizational structure, our physical space and the way we provide services to our members. Those of us who have had the good fortune to work closely with Allen have come to appreciate his professionalism and dedication. Throughout his tenure, Allen's work has embodied the MAA's core values of community, inclusivity, communication and teaching and learning. We consider each of these in turn.

Allen's dedication to the mathematics community is evident in his concern for our members. The treasurer is a volunteer position, and yet Allen has been generous with his time and talent, attending meetings at both the national and section level, and always being responsive to inquiries. Allen spent most of his career as a research mathematician at Daniel H. Wagner Associates, Inc., starting in 1987 and eventually being promoted to president and CEO in 2008. MAA Executive Director Michael Pearson points out, "Allen's background in managing a consulting firm informed our discussions and provided a valuable outside perspective. As important, his partnership became a friendship as well that helped sustain me in my role."

Building an organization that embraces inclusivity is a challenge at any time. The MAA is justifiably proud of the steps it has taken in broadening participation, but the programs that we provide require funding and planning, so the treasurer's role is vital. Allen's thoughtful insights into our programming and outreach have made us more effective. In addition, Allen's enthusiastic participation in the MAA throughout a career spent in industry is a wonderful example of the breadth of our membership. Extending the mathematics community beyond academic boundaries by engaging our former students as they pursue careers in business, industry and government, is a wonderful opportunity for the Association.

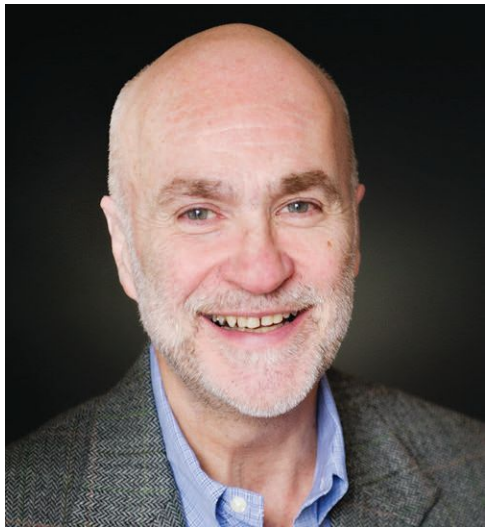
In his style of communication, Allen is direct and informative. MAA President Hortensia Soto captures this perfectly when she says, "What stands out to me about Allen is his straightforward approach. He never beats around the bush, yet he is careful with his words." A vital part of being a good communicator is understanding how to reach a particular audience. For the MAA, that audience is often the people who will decide who receives a grant. MAA Secretary Cindy Wyels notes, "We all rely on Allen's expertise in numerous ways. He has been an integral part of improving grant proposals prior to their submission."

When it comes to teaching and learning, Allen excels as an expositor of mathematics. With a broad background in the field in both pure and applied methods, he spent much of his career developing innovative mathematics to address problems in tracking, data fusion, and search optimization. He developed and implemented various optimal search algorithms, whose applications include the interdiction of narcotics smugglers in the Caribbean. To find out more, check out the excellent talk Allen gave earlier this year for the National Museum of Mathematics, see youtube.com/watch?v=edtLlFhz9Xk.

As Allen says in the video, mathematicians can add value by applying math tools to cases where we have imperfect information. The role of treasurer demands this sort of thinking, coming up with best responses when constraints prevent reaching the ideal. Allen filled the role of treasurer with grace and good sense, and we are very grateful for his service.

Introducing the Next MAA Treasurer

—Rick Cleary, for the Board of Directors



Paul Blanchard

The MAA Board of Directors has selected Paul Blanchard, Professor Emeritus of Mathematics at Boston University, to be the next Treasurer of the MAA, with his term beginning on July 1, 2025. Paul has had a distinguished career as a teacher, researcher and in service to the mathematics community. Since retiring from teaching, Paul has remained active in the study of complex dynamical systems and their applications. He is one of the organizers of an upcoming summer 2025 Open Math Workshop, "A Dynamics Approach to Teaching Differential Equations with a Focus on Environmental Resilience." (See bit.ly/4jSJuP6)

An MAA member for 45 years, Paul has been involved at both the sectional and national levels. He has published in the *College Math Journal,* served several terms on national committees and has given invited presentations at numerous section meetings. He received the Northeastern Section Award for Distinguished College and University Teaching in 2001 and hosted a section meeting at Boston University in May 2006. Graduates of his department praise Paul's work as Director of Graduate Studies over two distinct four-year terms. They especially note his tireless efforts to identify external funding and awards as well his fostering a diverse and welcoming environment within the program.

We congratulate Paul on his selection as MAA Treasurer and we thank the many excellent candidates who applied for the position.

math HORIZONS

The editor of *Math Horizons*, MAA's magazine for students, is soliciting questions from students for Hey Doc!, a new advice column.

Do your students have burning questions they have always wanted to ask a math professor (but were reluctant to ask)?

Students are welcome to remain anonymous, but if they leave a valid email, they will be contacted to let them know their question has been selected to be answered in an upcoming issue.

Please share the QR code or URL with your students. It will take them to an online form to submit their question.

Of course, all MAA members have online access to Hey Doc! (and all of *Math Horizons*).

bit.ly/MH_Hey_Doc

Departments

PRESIDENT'S MESSAGE

Change is in the Air

—Jenna Carpenter

As I start my term as MAA President, I have been thinking about what I hope to see in mathematics higher education and in the MAA in my short time in this role. For several years, we have been worried about the impact of the demographic cliff. It has finally arrived, with this fall's high school graduating class to be the first of decades of smaller cohorts. While recent estimates have shown perhaps a gentler initial drop-off than we were initially thinking, other forces (including wariness over college debt and the value of a college degree) have further eroded college-going among high school graduates in the last few years. In addition, I cannot help but reflect on the uncertainty that has enveloped higher education in recent months which is already forcing us to make changes that will make it even harder to attract and educate students. So, we must figure out how to keep our programs and institutions afloat with decades of fewer students to serve and a more challenging higher education environment in which to do so.

That means we must rethink what we do and how we do it. How can we do a better job of reaching non-traditional students? Students who have dropped out of college? Alumni and working professionals looking to reskill, upskill, or earn a certificate or online graduate degree? How can we do a better job of showing people why a college degree pays a lifetime of dividends? Moreover, how do we reach students from these many different demographics and socio-economic groups and support their success at a time when many of the programs and people who focused on doing so have been eliminated from our campuses and the higher education ecosystem in general?

But it's not just who we teach that we will have to rethink. We have to look at what we teach and how we teach it. Solving tons of rote problems (to which we already know the answer) with elaborate hand calculations can no longer be our instructional model. Don't get me wrong—students need strong math skills, and some level of hand calculations helps students understand the concepts. It's just that many (most?) math classes look pretty much the way they did 50 or more years ago (pre-modern technology) while our world's paradigm has shifted, and the skills and understanding that students need in today's workforce have changed dramatically. So how can we create new, more relevant content and instructional approaches, as well as repackage and deliver content in more effective ways? Do we have to be wedded to an in-person 3-credit class on Mondays, Wednesdays, and Fridays at 9 am or an online, asynchronous course with multiple choice tests as our only options?

Between falling enrollments and much uncertainty around grant funding, federal student support, and the ability to rely on endowments to support multiple sectors of campus, universities are already rethinking their budgets and financial models. These financial challenges will definitely impact the faculty. In general, the vast majority of any department or college budget is devoted to salaries and benefits. As a result, many institutions already run mathematics and other departments with heavy service course loads using VITAL faculty who are not tenure-stream or full-time because such is cheaper and doesn't commit the department to long-term obligations for employment. If we don't want AI teaching all of our classes, likely a lot sooner than we might imagine, faculty must use and create active, engaging course content and instructional models that AI cannot emulate.

I know what you are thinking. The mantra has long been that colleges and universities change at a glacial pace, if at all. But when we were faced with a sudden halt to business-as-usual during the pandemic, we all found out that the entire higher education machine can, in fact, turn on a dime if it must do so, painful and stressful as that was. I would argue that the combination of these and other present-day crises hitting higher education are poised to make the pandemic look bland—and temporary—by comparison.

Certainly, the overwhelming waves of recent changes are already doing real harm to real people, with (far) more likely to come. Moreover, most of these changes will be difficult if not impossible to undo or overturn later. So, if and until we can change these realities, what can we do? We will almost assuredly have to operate under conditions that are different from the status quo. We will have to figure out different ways to educate students and accomplish our goals. We will have to develop expertise and skills that we don't currently possess and which we were never taught.

But I have hope. STEM professionals are expert logical reasoners, problem solvers, and solution designers. I learned a long time ago that you should never let a good crisis go to waste. So, let's use these crises to dislodge the endemic inertia, if for no other reason than we have to do so. Let's rethink and re-envision our work. In the process, I hope we can create some new ways of being and doing that will outshine our long-held traditions and practices.

Fortunately, the MAA provides us with a great platform and community to do just that. We have thousands of dedicated members with a wide range of expertise, ideas, and energy who have already been thinking about (and generating solutions to) many of these issues. We just need to collectively embrace these and other innovations to ensure that mathematics higher education remains relevant, vibrant, and effective. Working together, we can find a way to not only survive but thrive. Let's make that our goal!

Jenna P. Carpenter is MAA President and Founding Dean and Professor of the School of Engineering at Campbell University.

MATHEMATICAL ASSOCIATION OF AMERICA

MAA Searches for Math Values Editor

The Mathematical Association of America (MAA) seeks a thoughtful and engaged individual to serve as the next **Editor of Math Values,** succeeding Kira Hamman when her term concludes in June 2025.

The Math Values Editor leads the editorial direction and daily operations of MAA's flagship blog, working in close collaboration with the Math Values editorial board. The editor is responsible for managing all blog submissions, overseeing the publication of two posts per week (Tuesdays and Thursdays), and guiding the content and quality of the blog's distinct columns and thematic streams.

Current recurring columns written by individual authors include:

- *Devlin's Angle*
- *Kung's Quarter*
- *Launchings*
- *There and Back Again*

Thematic streams contributed by multiple authors include:

- *DUE Point*
- *Mathematics through the Ranks*
- *Definitely Integral*

This role blends editorial oversight, community engagement, and strategic vision, offering a unique opportunity to shape conversations in the mathematical community. The editor reviews submissions, communicates with authors, edits content for style and clarity, sources and schedules posts, and coordinates with MAA staff on publishing logistics. They also maintain regular communication with the editorial board and participate in monthly virtual meetings.

The position requires a time commitment of approximately **3–5 hours per week,** with some seasonal flexibility. The editor receives support in the form of a **yearly stipend** and **travel reimbursement.**

Qualifications:

- Broad mathematical interests and familiarity with diverse areas of the mathematical community
- Excellent editorial, organizational, communication, and leadership skills
- Strong time-management and interpersonal abilities
- Prior editorial experience is helpful but not required

The editorial term will run from July 1, 2025, to December 31, 2027.

Nominations and Applications: The MAA welcomes nominations and applications from individuals with a passion for writing, editing, and advancing the mathematical conversation. Please send inquiries, nominations, and applications to hr@maa.org.

TOOLKIT

Learning Mathematics in a Digital Age

The Role of Math Learning Centers in Overcoming Student Challenges

— Alison Reddy, Ciarán Mac an Bhaird, and Michael Grove

The rise of technology in education has raised concerns about the potential erosion of the human element in the learning process. As students increasingly turn to digital platforms for mathematics support, there is a risk of diminishing opportunities for meaningful interaction and engagement with both instructors and their peers. Furthermore, the digital divide exacerbates existing disparities in access to technology and internet connectivity, further marginalizing some groups of learners and intensifying inequities in educational outcomes.

In light of these challenges, Math Learning Centers (MLCs) have reemerged as invaluable assets in nurturing student retention and advancement. Backed by international research highlighting their efficacy, MLCs provide a structured and supportive environment where students feel empowered to seek assistance without fear of judgment. Unlike online resources, which primarily provide solutions, MLCs help foster independent inquiry and offer personalized guidance, effectively scaffolding student learning. MLCs have traditionally supported students who are attempting to master their course material but have encountered difficulties with certain aspects of their lectures or learning resources. While students will undoubtedly continue to avail themselves of online supports, they should be encouraged to view MLCs as an ideal environment in which to properly interrogate online results. Used appropriately, online support can be an important part of the student educational journey.

MLCs allow student the opportunity to drop-in, often at times to suit them, to receive support with their mathematical learning. (Photo credit: sigma).

The greatest benefit of an MLC is the focused support that it offers to students, and this is predominantly via the role and actions of the tutors who work within it to establish a positive and student-centred learning environment. Tutors therefore play an important role in an effective MLC and ensuring their good initial training and development is key. Within the UK and Ireland at least[1], it was historically the case that such tutors often received little prior or ongoing training to support them in these roles. In more recent times, more structured, and now accredited, models of tutor training have become successfully established and are delivered by individuals working within the mathematical sciences, often through one-day workshops, and organised freely by their departments.

Tutors are not left to navigate their roles alone. Initial training helps equip them with communication skills and pedagogical strategies, coupled with regular workshops and access to mentoring from experienced educators. To recognize and validate the efforts of tutors, in some countries, most notably Ireland[2], tutors can earn badges that signify their expertise in areas such as peer mentoring, effective communication, and advanced content knowledge. These badges also serve as valuable additions to their CVs, demonstrating to future employers their commitment to teaching, leadership, and continuous learning.

Recruiting and training MLC tutors plays a key role in fostering both student success and the personal growth of the tutors themselves. The recruitment of MLC tutors is an intentional process aimed at identifying individuals who are not only proficient in mathematics but also passionate about teaching and mentorship. Tutors come from diverse academic backgrounds, bringing unique perspectives to their roles. This diversity enriches the learning environment and ensures that students receive support tailored to their needs.

While MLCs continue to be integral components of educational institutions in regions like Australia, Germany, Ireland and the UK, the United States is witnessing disparities in their implementation across academic settings. Despite a growing body of research on MLC effectiveness, concerns persist regarding accessibility and appeal to students. A re-

[1] Grove, M., Mac an Bhaird, C., & O'Sullivan, C. (2019). Professional development opportunities for tutors of mathematics learning support. *MSOR Connections,* 18(1).

[2] O'Sullivan, C., Grove, M., Mac an Bhaird, C., Mulligan, P., & Pfeiffer, K. (2024). Recognizing professional development of mathematics and statistics learning support staff. *Teaching Mathematics and its Applications: An International Journal of the IMA,* 43(3), 204–222.

cent survey focusing on flagship US universities has shed light on the ubiquitous presence of MLCs; while this is very encouraging, it has emerged that many institutions struggle to effectively promote these centers. MLC websites often lack compelling advertising, clear expectations, and testimonials showcasing student success stories, potentially deterring students from utilizing in-person MLC services. To effectively reach students, MLCs can leverage digital channels by creating and sharing engaging content, sending concise and visually appealing emails to all students enrolled in math courses, highlighting key resources and including links to more detailed information. Additionally, making MLC websites mobile-friendly, easy to navigate, and regularly updated could improve access to information and available resources for users.

To address these challenges proactively, it may be beneficial for institutions to prioritize the enhancement of MLCs as inclusive and inviting spaces for learning. This entails strategic plans with comprehensive advertising strategies, providing detailed information on available services, and showcasing testimonials from students who have benefitted from MLC support. Additionally, continuous training for tutors is imperative to ensure that MLCs evolve to meet the changing needs of students and maintain high standards of academic assistance.

By revitalizing and reimagining MLCs and fostering a culture of active learning and collaboration, institutions can bridge the gap between student challenges and academic success. Through concerted efforts to enhance MLCs, educators can empower students to navigate mathematical complexities with confidence, unlocking doors to future opportunities across diverse fields of study. This revitalization not only ensures equitable access to academic support but also cultivates a vibrant learning community where students thrive and excel, equipped with the skills and knowledge necessary for success in their academic and professional endeavors.

Our Shared Experiences

As co-authors, we're driven by a shared conviction: that effective MLCs can be transformative spaces for student success. This article is more than just a presentation of research; it's a reflection of our collective experiences and our dedication to enabling mathematical growth amongst students.

Our journey has been shaped by witnessing the impact of targeted support. Alison›s pioneering work with adaptive diagnostic testing at the University of Illinois has demonstrated the power of personalized learning. We've seen how accurately pinpointing individual needs allows us to tailor interventions for maximum impact, leading to tangible improvements in student placement and success rates. Michael's research at the University of Birmingham reinforces the crucial role of individualized support services. It is not simply about

MLCs are known to be valued by students as spaces where they can engage in informal peer learning (Photo credit: sigma).

providing extra help; it's about recognizing and addressing the unique challenges each student faces. We've observed how these tailored interventions build not only mathematical skills but also vital confidence, a key component often overlooked in traditional learning environments. Ciarán's contributions from Maynooth University highlight the immense value of peer-assisted learning. His work has shown us how collaborative environments foster a sense of community and deepen mathematical understanding. We've seen how students thrive when they learn from and support each other, creating a dynamic and engaging learning ecosystem.

This collaboration has allowed us to synthesize our diverse experiences and national perspectives into a comprehensive vision for optimizing MLCs. Building on the success of established national and international MLC communities of practice, many of whom use the annual CETL-MSOR Conference as a focal point for collaboration, we believe that by combining evidence-based practices with a deep understanding of individual student needs, we can create truly impactful learning environments. This article is a culmination of our shared passion and a call to action for educators to embrace the transformative potential of well-designed mathematics support provision.

Thank you to sigma, Coventry University's mathematics and statistics support centre for the photos.

Dr Alison Reddy, director of the Math Assessment and Placement Program and coordinator of Quantitative Reasoning Courses at the University of Illinois, leads efforts to improve student success in mathematics and contributes to global conversations on mathematics education and policy. Dr Ciarán Mac an Bhaird, associate professor in the Department of Mathematics and Statistics at Maynooth University (Ireland), has been involved with mathematics support initiatives and research on local, national, and international levels. Dr Michael Grove, deputy pro-vice-chancellor for Education Policy and Academic Standards at the University of Birmingham (UK), professor of mathematics and mathematics education, and a National Teaching Fellow, has made international contribution to furthering mathematics support provisions.

Credit: Jackie Niam
iStock illustration ID:1602712904

Math + Sports

Amanda Harsy

The desire to build and find community is one of humanity's most fundamental desires. Sports serve as a powerful cat-alyst for bringing people together—they entertain us, inspire us, and unite us. Similarly, mathematics offers a rich venue for building community, where exchanging ideas and solving problems together fosters a strong sense of connection. Just by reading this edition of *MAA FOCUS*, you are engaging in the mathematics community!

In this issue of *MAA FOCUS*, we provide a window into the vibrant community created within the intersection of mathematics and sports. There is a plethora of mathematics lying beneath the surface of sports just waiting to be explored. This issue highlights a few examples: How can topological data analysis be used to quantify the diversity of playing styles in basketball? How is mathematical modeling similar to ice skating choreography?

This Math + Sports feature also highlights innovative and accessible approaches to using sports as a fun and engaging entry point into mathematics, computer science, and data science, through pieces like "Rethinking Data-Oriented Education through Sports" and "Leveling the Playing Field: Advancing Inclusive Data Science Through Sports." Both articles showcase creative ways to spark student interest and participation in STEM.

Next, we'll take a peek into the world of sports analytics through the eyes of undergraduates conducting sports analytics research and also from the perspective of Will Cousins, vice president and assistant general manager of the Tampa Bay Rays. Finally, Rick Cleary offers practical advice for those curious about diving into sports analytics research.

We hope this special edition of *MAA FOCUS* sparks your curiosity and welcomes you into the exciting community of Math + Sports.

Amanda Harsy is a professor of mathematics at Lewis University and a former Chair of the SIGMAA on Mathematics and Sports. She has worked with many undergraduates on research projects within sports analytics, graph theoretical modeling of self-assembling DNA, and the scholarship of teaching and learning.

Diversity in Decline

An Analysis of Professional Basketball Using Topological Data Analysis

Jerome Roehm

In the ever-evolving world of professional basketball, understanding the diversity of playing styles is crucial for both team success and visual aesthetic. Although rules do not require players to be classified into positions, historically players have been grouped into positions based on physical attributes, skills, and playing styles. The position of center is traditionally occupied by the tallest player who plays close to the basket, rebounding missed shots, and blocking opponents' shots. The point guard is often the smallest player and handles the ball the most, recording assists and steals. In recent years, there has been growing concern for the aesthetic beauty of the game, as playing styles have become more homogeneous in pursuit of efficiency. Seemingly gone are the days of true specialist players—such as Dikembe Mutombo blocking shots or Steve Kerr sharp shooting three-pointers. We will use a mathematical tool known as topological data analysis (TDA) to explore several questions:

1. Can diversity of playing styles be quantified using TDA?
2. Is diversity of playing styles declining over time?
3. Is diversity correlated to success?
4. Can TDA be used to help teams fill holes in their rosters?

Topological Data Analysis to Quantify Diversity in Playing Styles

Topological data analysis studies the "shape of data." In this application, we assign players as points in space based on their statistics relative to the league averages. For example, Figure 1 shows the 1995–1996 Chicago Bulls point cloud based on players' Three-Point Attempt Ratio (how often a player shoots three-point shots vs. two-point shots) and Total Rebounding.

For example, Steve Kerr shot three-pointers over three and a half times as often as the average player that season while not getting many rebounds. Dennis Rodman grabbed nearly three times as many rebounds as the average player but shot few three-pointers. Michael Jordan was around the league average in both statistics.

To quantify the diversity of playing styles in the given statistics, we want to measure how spread out the points (players) are in space. To accomplish this, we grow larger and larger circles around each point, noting the radius of the circles each time one player or group becomes connected to another player or group. At the radius shown in Figure 1, $r = 0.41$, there are four connected components: Kerr, Longley, and Rodman are each on their own component, and the remaining four players form a single connected component. As the radius grows, Longley will soon merge into the larger component. Rodman and Kerr will require a larger radius to merge with another component. Each time a merger occurs, we record the radius.

If players do not have diverse playing styles, the point cloud is clumped together, and the components merge with smaller radii. This is seen in the 2019–2020 Los Angeles Lakers point cloud. In contrast, if players have diverse playing styles, the point cloud is spread out, and the average merger radius is high. Therefore, as a measure of playing style diversity within a team, we take the average of all the recorded radii. The '96 Bulls had an average of $\bar{r} = 0.57$, while the '20 Lakers had an average of $\bar{r} = 0.19$.

The *lifespan* or *persistence* (from the *birth* of a single point at $r = 0$ to the *death* of the component when it merges with another) is visualized by the green H_0 bars in the barcode. The average length of the green H_0 bars serves as a measure of the diversity of the playing styles within each team. The red

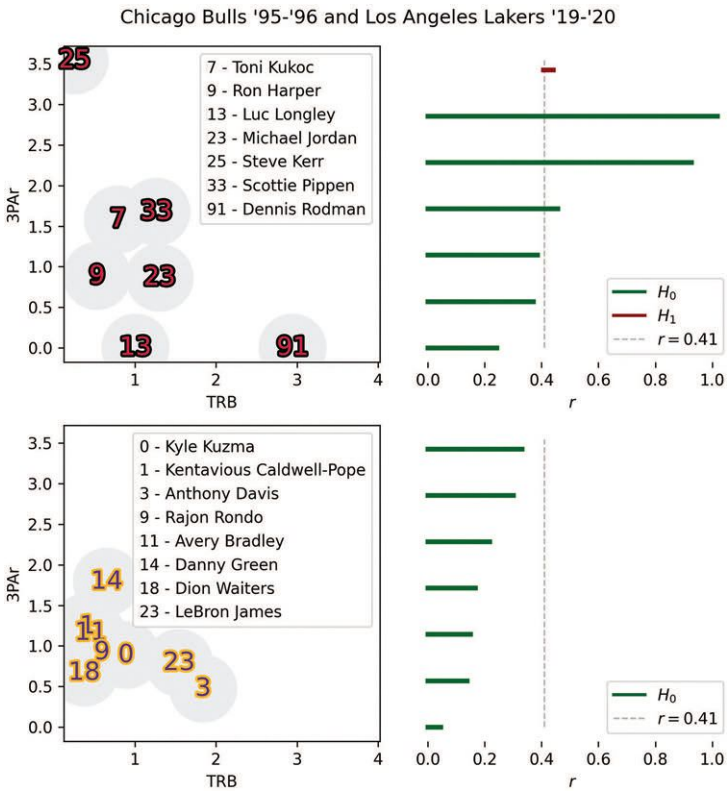


Figure 1. The '96 Bulls and '20 Lakers Point Clouds and barcodes for Three-Point Attempt rate and Total Rebounding with a radius of $r = 0.41$.

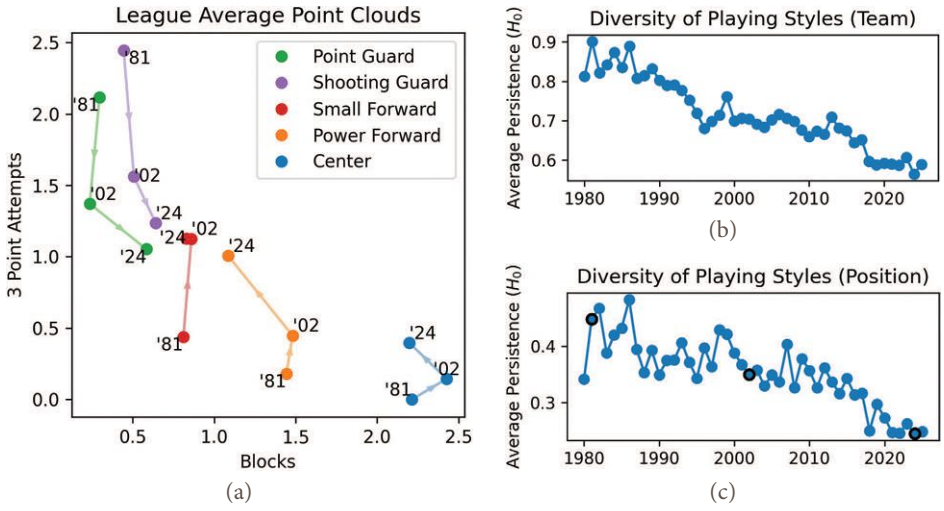


Figure 2. Visualizations summarizing the decrease of playing style diversity over time. Figure (b) uses 7 stylistic indicators, while (a) and (c) use only blocks and three-point attempts.

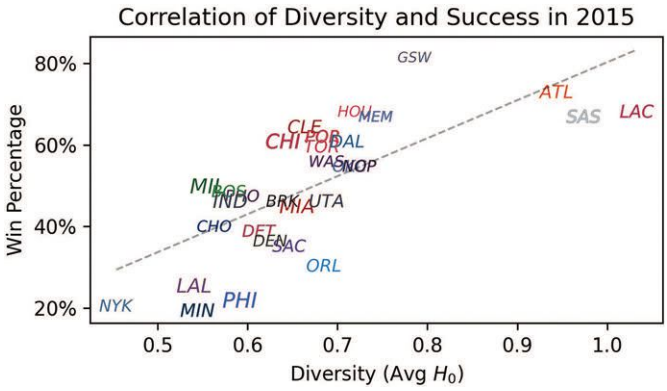


Figure 3. A scatter plot of diversity vs. success, where diversity is measured as average H_0 persistence using 7 stylistic indicators.

H_1 bars represent cycles or holes in the point cloud that occur when four or more players encircle an open area. Kukoc, Harper, Jordan, and Pippen form a cycle or hole in the point cloud at radius $r = 0.41$. This is a short-lived hole, born at $r = 0.407$ and dying at $r = 0.441$. Loosely speaking, a large hole in the team's point cloud can be thought of as a deficiency in the team's roster construction. A new player could fill a stylistic role within the team; more on this at the end of the article.

Playing Style Diversity Over Time

Over time, the NBA has seen shifts in playing styles, often influenced by rule changes or strategic trends. For instance, playing styles have adapted to the introduction and adjustment of the three-point line. Using the method above, we can examine how the diversity of playing styles has changed over time. We first analyze each team's point cloud season by season. For more comprehensiveness, we use a wider selection of statistics that indicate playing style: three-point attempt rate, free throw rate, rebounds, assists, steals, blocks, and turnovers. So, each team's point cloud will be in seven dimensions—making it difficult to visualize—but the computations remain the same. Figure 2b establishes a decrease in playing style diversity over time, with a sharp decrease in the mid 1990s due to the temporary movement of the three-point line closer to the basket. Not only has diversity within teams decreased, but diversity has also decreased when analyzing playing styles by position. Figure 2a shows how the league average point clouds changed across three selected years using blocks and three-point attempts. The playing styles of each position have homogenized over time. Figure 2c shows the average H_0 persistence, season by season, for the same two statistics. As teams pursue efficiency, playing styles are becoming less diverse. Some believe this decreases the aesthetic appeal of basketball.

Relationship between Diversity and Success

As we have seen, the diversity of playing styles has declined over time. Is this only a subjective decrease in the beauty of the game, or is there also a relationship to success? As teams use analytics to pursue efficiency, one might think that diversity would negatively correlate with success. However, we find the opposite: broadly speaking, more diverse teams are more successful. As a case study, consider the 2015 season. A scatter plot of diversity vs. win percentage is shown in Figure 3. While 2015 was a particularly strong year for correlation of diversity and success ($r = 0.72$), every season since 1980 except one has seen a positive correlation between diversity and success. Paradoxically, drafting and development practices are creating less diverse rosters despite this correlation.

Implications for Team Building

The insights gained from TDA may have practical implications for team building. By understanding the diversity of playing styles, coaches and managers can make more informed decisions about roster composition. The goal is to create a balanced team able to adapt to various game situations and exploit the weaknesses of opponents. When considering drafting or trading for a specific player, general managers could analyze how each player adds to the diversity of the roster, as measured by the average persistence in H_0. Another insight that TDA may offer is how teams can fill "holes" in their roster. As seen in the Bulls roster in Figure 1, a small hole or *cycle* formed, which closes by $r = 0.5$. Because of its small size, this hole may not be of concern.

However, in Figure 4, there is a larger hole in the Warriors '15–'16 roster. Although they were a great team, the 2016

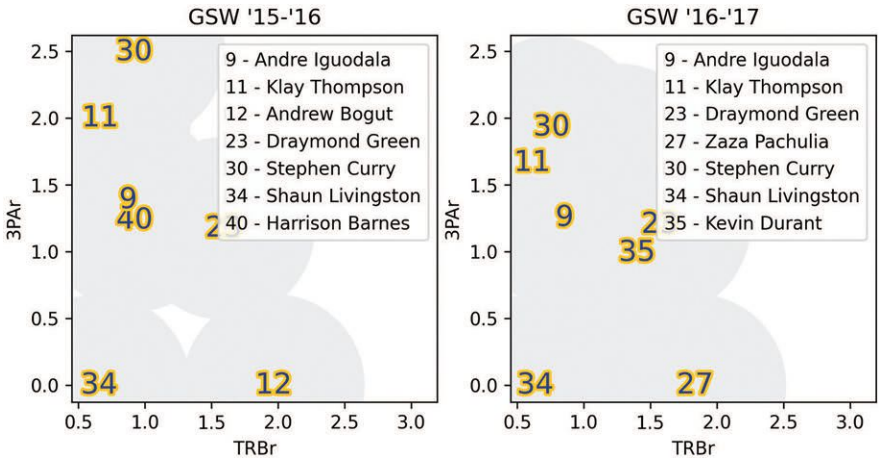


Figure 4. Kevin Durant fills a hole in the Warriors roster.

Get More

Sprawlball by Kirk Goldsberry is an excellent book on the topic of player specialization.

Video on "An Application of TDA to Professional Basketball" youtu.be/-cfp-tH-vIM?si=Je57ng114IZKwebB

Golden State Warriors did not win the championship. In the following off-season, however, the Warriors acquired Kevin Durant and went on to win the championship. Durant fills a roster hole by removing the cycle.

Topological Teamwork: Building Diversity for Court Success

This application of topological data analysis to basketball offers an example of how mathematics can enhance our understanding of sports. By quantifying the diversity of playing styles, TDA provides insight into team dynamics, success, and how basketball has developed over time. As the NBA continues to evolve, embracing diversity in playing styles may prove to be a key factor in achieving greatness on the court.

Jerome Roehm is an assistant professor of mathematics and data analytics at Doane University in Nebraska. He likes math, sports, and woodworking. He loves his wife and two children.

Figuring Out Ice Skating

Diana Cheng, John Hillenbrand, Jaya Kanal, Joy Thomas, and Janet Liu

Mathematical modeling and ice-skating choreography have a surprising number of similarities. A mathematician may be called on to make a model of a problem or process, and a choreographer is called upon to design the parts and the whole that make up a high-level skating performance. A mathematical model centers on a question to be answered. In the figure skating choreographic process, the focus is a storyline to be created on the ice.

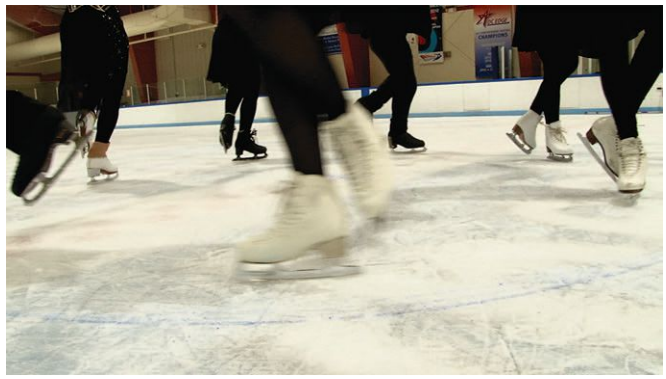
First, mathematicians identify possible constraints and relevant quantities. They may decide to create a simplified version of the situation in order to focus on the core of the problem. Then, mathematicians do research to learn about formulas that might be able to describe the situation.

Meanwhile, the choreographer assesses the skill sets of the skaters who will perform the program. Choreography builds on past performances and ideas found by research or pulled from experience. Math-inspired reflections, translations, and rotations help tell the story for the audience.

Final program pose in the "Calculated Figures" © 2025. Photo courtesy Stephen Fox – Everclear Video.

In the next step, mathematicians solve the equations and determine whether the results are sensible or realistic by relating them back to the original problem. Frequently, there is a need to revise the model multiple times to attain the most accurate answer.

Similarly, choreography will involve adding new elements, perhaps simplifying parts of the routine, and making a number of iterations before reaching the final performance.



Seven skaters rotate in a circle, with a close-up of the skates. Photos courtesy Stephen Fox – Everclear Video.

Figure skating skills and choreography are essentially formulas consisting of constants and variables that may not be obvious to a casual observer. Constants may include the ice, the blades, and the human body. Blades are curved lengthwise from heel to toe, and thus circular arcs form the building blocks of the majority of blade tracings.

From a broad perspective, we can look at the choices the choreographer has when designing elements to be skated as some combination of left or right foot, left or right edge, and forward and backward skating. Skating on edges creates curved patterns on the ice, unless the skater is on both blade edges at the same time, which creates a straight line. When the choreographer combines edges in different ways, it creates formulas that result in turns and other skating skills. For example, connecting a Left Forward Outside edge to a Right Backward Inside edge involves a change of foot, edge, direction, and circle/curve.

Additional possibilities come from specifications about body position, such as when the skater "faces" outside or inside the curve/circle, meaning the upper body rotates against or with the direction of the curve. An additional consideration is the desired size of the blade tracing or the amount of ice coverage intended; for some figures, there is a recommended size relative to the skater's height, and for group performances, there is usually a desired relative spacing between skaters.

Even very complex skills that have been carefully assembled to create a jaw-dropping performance have these fundamental components at their core. So, while skating enthusiasts—or even mathematicians—may never have considered these parallels before, the process of putting together a program is not so different from creating a mathematical model.

A Mathematical Performance

As an illustration of a mathematically-inspired group ensemble performance "Calculated Figures," we invite the reader to watch this annotated video—youtu.be/YK1fiexZhS4—of a group ensemble choreographed by Joy Thomas (and skated by Thomas, Haruka Miranda, Jaya Kanal, Anastasia Kushnareva, Shaun Rogers, Diana Cheng, Kirill Solovyev).

The props used in the performance are scribes, which are compass-like tools for skaters to draw circles on the ice. In the first part of the performance, skaters are presented with an equation and playfully discover ways to solve the problem

Diana Cheng & Kirill Solovyev trace a logarithmic spiral shaped path with a "death spiral." Photo courtesy Stephen Fox – Everclear Video.

Joy Thomas uses a scribe as a compass to trace a circle. Photo courtesy Stephen Fox – Everclear Video.

Five skaters completing translated moves. Photo courtesy Stephen Fox – Everclear Video.

Five skaters in a pose with reflection symmetry about the middle skater. Photo courtesy Stephen Fox – Everclear Video.

by establishing the X and Y axes and graphing coordinate points. As skaters are added into the performance, the skaters' layers of movement form sinusoidal and circular trajectories. Geometric transformations are demonstrated throughout the program. Translations of movement occur when skaters are side-by-side, performing choreography or repeated patterns in unison. Reflections occur when skaters are mirroring each other in their movements. Rotations occur during spins, pivots, and other circular motions. The text annotations on the video show how geometric patterns appear in a figure skating program through the aerial representations of blade trajectories and shapes formed by the skaters.

The authors are all adult figure skaters. Diana Cheng is a mathematics professor at Towson University and served as the chair of the MAA's Special Interest Group on Math & Sports in 2019-2020. John Hillenbrand has written everything from software to speeches for the US Federal Courts. Joy Thomas and Jaya Kanal are professional skaters and skating coaches, and Joy is a creator of groundbreaking Theater on Ice STEM performances. Janet Liu is a software engineer and co-author with Diana on figure skating data analytics projects.

Taking Coding to the Basketball Court

Rethinking Data-Oriented Education through Sports

Marcelo Worsley, Ashley Quiterio, Arianna Montas, and Sara Bouftas

If you tell someone that you are taking a computer science or data science class, they will probably picture you sitting in a giant lecture hall with the professor at the front of the room either writing on the whiteboard or live coding through an overhead projector. You and your classmates are sitting quietly as you diligently follow along, or watch TikTok videos, waiting for class to be over so you can get back to enjoying life as a college student, or get back to your problem sets. Northwestern's CS 397: Sports, Technology, and Learning class is designed to turn this image of computer science on its head. Instead of students sitting in a lecture hall, class sessions regularly meet on a basketball court, soccer field, or other athletic space. Students can almost never be found sitting quietly staring at their computers, the professor, or the board, because they work in teams to complete a variety of activities that involve physical movement, computer programming, and real-time data visualization, to name a few. In much the same way, individually completed problem sets have been replaced with shared viewing sessions of sports-re-

Students in the class work in teams to design a computer vision-enabled, embodied basketball training game using the Scratch programming platform.

lated events, TV shows and movies, sports-technology critiques, and creating sports-wearables. There is even an opportunity for students to get extra credit by competing against any member of the teaching staff in a sports competition of their choosing. The Sports, Technology, and Learning class enrolls approximately 100 students per term and includes students from a wide variety of majors. Since its first implementation in 2021, the course has served as the foundation for building out the IMPAC^{4}T (Infrastructure, Management of Scope, Policy, Assessment, Content, Collaborators, Context, Competition, and Tools) framework, which we position as a set of important considerations when designing expansive learning experiences in disciplines like computer science, data science, chemical engineering, or mathematics.

IMPAC^{4}T Framework

The components of the IMPAC^{4}T framework can help further articulate the conditions for effectively advancing innovations in CS education, both in higher education and at the K–12 level. Infrastructure considers the resources, spaces, and supports that might be needed to bring the experience to fruition. In the broadest sense, it could refer to things like transportation or access to appropriate facilities, for example. Management of Scope borrows from the business world and simply encourages people to be realistic about what they may or may not be able to accomplish within a given timeframe. In other words, it's about choosing a task or set of activities that can reasonably be finished in the time allotted so people can dream big, but still within reason. The Policy component asks individuals and organizations to carefully consider how classroom, school, or district policies might need to shift. For example, policies around how courses are graded can influence curriculum uptake. Similarly, policies around who is required to take computer science and who is eligible to teach it can also influence CS education innovations. The Assessment component intends to push individuals and organizations to adopt evaluation practices that align with the design principles of the learning experience. For instance, this might mean moving away from time-based true/false exams and instead using approaches that allow for students to test their work and iterate on it before having it officially graded. Content refers to the importance of choosing topics and curricular resources that students will find engaging and timely. Collaborators are explicitly named to highlight the important role that external organizations and individuals can provide to the learning experience. Context asks people to think about the salience of the learning location (classroom, laboratory, gymnasium) as well as thinking about in-school versus out-of-school spaces. Competition refers to opportunities for people to tap into their interest in competing, though there are seldom externally-driven high stakes involved with these competitions. Finally, Tools takes note of the central role that appropriately designed tools or technologies can play in supporting student learning. This might be the result of how a tool allows for multimodal input, or in the ways that tools might generally allow people to spend less time on the minutiae of syntax and instead focus on the overall substance of their work. We have found these considerations to be a useful starting point for the design of innovative computer science learning experiences. Moreover, failure to consider one or more of these dimensions can impede proper uptake.

The actual inner workings of Northwestern's CS 397 course probably still feels quite nebulous. To help you better understand the types of activities students complete, a copy of a previous syllabus can be found at bit.ly/NUSTLSYLLABUS. For now, we'll share another example of how the IMPAC^{4}T framework can be used. Let's take a look at a Jump Rope Hacker!

Jump Rope Hacker

At a high level, the Jump Rope Hacker activity involves participants working in groups to play with, conceptually deconstruct, model, and replicate a smart jump rope—a special kind of jump rope that uses sensors to count the participants' number of jumps. You can think of smart jump ropes like step counters, but for jumping rope, with many of them capable of connecting to a smart phone app. The Jump Rope Hacker activity includes elements of collaboration and competition, while also involving various tools that support play, data science, and computer science. For this activity, each team is given a smart jump rope and a micro:bit—a small electronics board that has several sensors—along with a micro:bit holder that uses coin cell batteries, and a strap.

The activity includes five parts. In Part 1, shortly after students form teams, participants in each team have an internal competition to see who can get the most jumps in 60 seconds. While their teammate jumps, participants are asked to start thinking about how the smart jump rope works.

Conceptualizing how the jump rope works can become extremely useful in Part 2, where students work together as a team to record the largest number of jumps on their jump rope over the next 20 minutes. Importantly, this task is not asking students to necessarily jump for 20 minutes, though

Part 2 of the Jump Rope Hacker activity: A group tries a collaborative approach with two teammates swinging the rope, one jumping, and the remaining two waiting to take over as jumper or rope spinner.

they are welcome to do so. Instead, this part of the activity challenges students to think about the mechanism at play within the jump rope that is causing the smart jump rope counter to increase. If they can determine how it works, they can potentially increase their score very quickly.

In Part 3, students record accelerometer and magnetometer data of jumping rope along three axes. In some versions of the class, students are required to program their own microcontroller, while in other versions, a data logging program is provided for them (or it is provided after they have spent at least ten minutes attempting to make their own).

During Part 4, students model their data using their preferred spreadsheet, graphing, or data visualization tool. Once they have collected and visualized the data, they can develop a heuristic or train a model to detect a jump. This heuristic or model is programmed onto their microcontroller.

Finally, in Part 5, they conduct a three-part test of their custom jump rope counter while jumping 10, 20, and 30 times. They compare their custom jump rope counter performance to the built-in counter, to their peers' custom devices, and to the number of jumps counted by a human. Time permitting, students also test other teams' custom jump rope counters. Students submit pictures of some of their work along with their program and their data as part of the assignment submission.

Benefits of This Model

Students consistently reflect upon these activities as some of the most engaging and memorable learning experiences of their collegiate journey. The activities, while still challenging students to practice critical thinking and to use appropriate data science approaches, also invite a level of playfulness, collaboration, competition, and embodied interaction that are seldom a part of the undergraduate curriculum. Many of these design components are motivated by the core mechanics of sports and aim to make for a more welcoming environment for current and former student-athletes.

Beyond this, however, the course serves as an example of authentically bridging athletics and technical disciplines. As we continue to push the boundaries of our respective academic disciplines, we should also think about ways that some of our existing practices might not be encouraging participation from certain communities. The IMPAC^{4}T framework is intended to be a guide in thinking about important design considerations in creating and implementing engaging interdisciplinary courses across the K–16 landscape.

Marcelo Worsley is the Karr Family Associate Professor of Computer Science and Learning Sciences at Northwestern University. Marcelo teaches the Sports, Technology, and Learning class and also received an NSF CAREER Award to design and study learning experiences that bridge sports and computer science. Ashley Quiterio is a PhD candidate in learning sciences at Northwestern University. Ashley's research focuses on designing and implementing data science curriculum in K–16 contexts and beyond. Arianna Montas is an undergraduate student in computer science at Northwestern University. She was a student in the Sports, Technology, and Learning class. Sara Bouftas is an undergraduate student in computer science at Northwestern who also took the Sports, Technology, and Learning class.

From Chalkboards to Scoreboards

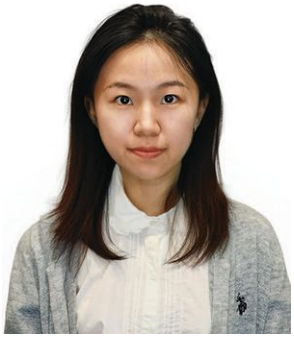
Applying Math to Sports at Summer@ICERM

Josh Brown, Audrey Bu, Tiffanie Ng, and Mia Adler

During the summer of 2024, we had the unique opportunity to participate in the Summer@ICERM undergraduate research program, where we explored the application of mathematics in sports analytics through two projects: analyzing professional rodeo and predicting soccer team performance. Though vastly different in subject matter, these projects challenged us to think creatively and demonstrated the far-reaching applications of applied mathematics.

Professional rodeo is a wacky subject for a math paper. Rodeo—a sport known for its chaos and unpredictability—felt inherently unmathematical. However, in the pursuit of analyzing bucking broncs and cowboys in batwing chaps, we gained invaluable experience in what it means to be applied mathematicians. After initial research into the subject, we discovered that there was little to no previously published work investigating analytical techniques in the sport of rodeo, meaning we were pursuing an unexplored application of sports analytics. Without a clean, consistent dataset or prior mathematical frameworks to guide us, we often felt lost in the early stages of our work. However, we became inspired by the different topics, perspectives, and interests of the various speakers and lectures that Summer@ICERM arranged for us. Our TAs and faculty mentors at Summer@ICERM helped us navigate the process while encouraging us to take full independence in conducting our research and in shaping the story we wanted to tell with our work. We ended the summer

Josh Brown



Audrey Bu

Tiffanie Ng

Mia Adler

as co-authors on a submitted paper, ready to present our novel research at the Joint Mathematics Meetings. Taking on such an unconventional project proved to be a valuable exercise in both getting comfortable with the uncertainty of research and developing an understanding of the extensive capabilities of our analytical tools.

On the other hand, our soccer project focused on applying existing models—such as linear algebra-based ranking systems and statistical regression—to predict team performance in lower-level English soccer leagues. We began by reviewing existing literature on soccer research, and we soon identified a lack of research on lower leagues like the Championship, League One, and League Two. Surprisingly, these lower leagues have an abundance of reported data from sources like Transfermarkt, which gave us the idea to run predictive models on this often-overlooked data. Our mentors suggested well-established ranking models, such as Colley ratings, Massey ratings, and their weighted variations, which we then implemented and evaluated for accuracy across each league.

Working at a program like Summer@ICERM allowed us to lean on our fellow undergraduate researchers, even those working on divergent research topics. As we all came from different mathematical backgrounds with a variety of skills and interests, building off and learning from each other's strengths was vital to helping us think more creatively about our projects. This exchange of knowledge from mathematical and other quantitative fields was an incredibly fulfilling learning experience, emphasizing the power of collaborative interdisciplinary research.

The exploration extended beyond our research at Summer@ICERM. At the 2025 Joint Mathematics Meetings (JMM), we presented our work through a poster presentation and a 20-minute talk at AMS Special Session on Mathematics and Sports. For many of us, this was our first experience at an academic conference, and it was both exhilarating and enlightening. Attending the poster presentation reinforced our understanding of our research and allowed us to practice delivering clear, concise explanations of our work. Though we all felt nervous about our talk, we were met with a welcoming and engaging atmosphere. Sharing our findings with a knowledgeable and passionate audience was an incredibly inspiring opportunity.

The JMM experience was not only about presenting but also about connecting with the broader mathematical community. We attended receptions and information sessions hosted by mathematical and graduate institutions from around the country, where we got to explore and connect with a variety of programs and gained more personal perspectives by talking to current graduate students and faculty. At the ICERM reception, we reconnected with our Summer@ICERM peers and met others who have learned from and contributed to the very community that brought us these opportunities.

Looking back on our journey from arriving at Summer@ICERM to presenting at JMM, we are grateful for the opportunities to grow as researchers and communicators. The collaborative environment at ICERM taught us how to build on each other's strengths, navigate challenges, and approach problems with an open mind. Presenting our work at JMM allowed us to share our passion for mathematics and sports while gaining valuable feedback and building connections within the mathematical community.

As we reflect on our experiences, one key takeaway stands out: the power of applied mathematics lies in its ability to adapt and thrive in any context. Whether analyzing rodeo performances or predicting soccer outcomes, the tools and techniques of mathematics allow us to uncover insights that are both meaningful and unexpected. This journey has not only strengthened our skills as researchers but also deepened our appreciation for the limitless possibilities of mathematical inquiry.

Josh Brown is an undergraduate student at Ursinus College, majoring in mathematics and computer science. His interests include sports analytics, researching indoor localization using LoRa, and software engineering. Audrey Bu is a senior undergraduate student at Emory University, majoring in mathematics and quantitative science. Her interest in mathematics lies in numerical analysis, scientific computing, and optimization. Tiffanie Ng is an undergraduate student at Kenyon College studying economics, mathematics, and computer science. She's passionate about data science and the applications of math modeling to behavioral economics. In her free time, she enjoys ceramics, cooking, and set theory. Mia Adler is an undergraduate student at Pomona College pursuing a major in applied mathematics and minors in music and cognitive science. She's especially interested in using mathematical modeling to investigate questions in medicine and public health.

Inside the Front Office

A Conversation with Will Cousins of the Tampa Bay Rays

Will Paz

Will Cousins

For as long as I can remember, I have been passionate about both baseball and mathematics. Having played baseball throughout my life and conducted research on predictive modeling through my work with Miami University Baseball, I have witnessed firsthand how analytics drive player development and strategy. Consequently, I was particularly excited to speak with Dr. Will Cousins, vice president and assistant general manager of the Tampa Bay Rays.

Dr. Cousins transitioned into his current role in November 2022 and is entering his tenth season with the Rays. He oversees baseball research and development and is responsible for reviewing and optimizing resources across the organization's baseball systems. Since joining the Rays as an analyst in research and development in June 2015, he has advanced through several leadership roles, including senior data scientist, director of baseball research and development, and vice president of baseball development. Prior to his tenure with the Rays, Dr. Cousins served as a postdoctoral associate in the Department of Mechanical Engineering at the Massachusetts Institute of Technology (MIT) from 2013 to 2015 after earning his PhD in applied mathematics from North Carolina State University in 2013.

Dr. Cousins represents a potential career path for aspiring professionals at the intersection of mathematics and sports. Our conversation, shared here, explores his transition from academia to professional sports, the enduring value of mathematical reasoning, and the evolving role of data in shaping the future of baseball.

Paz: How did you get to where you are today?

Cousins: I've always been a passionate baseball fan, and math was always something that I enjoyed as well. I went to Pepperdine University and majored in mathematics. After Pepperdine, I earned my PhD in applied math with a focus on numerical analysis, partial differential equations, and uncertainty quantification. I worked on a project that involved simulating blood flow in the brain. My initial career aspiration was academia and to go the professor route. So, I completed a two-year postdoc at MIT in Boston, where I worked on a collaborative project with the Navy. Our research focused on predicting extreme waves in advance to reduce potential damage to ships. This work involved partial differential equations (PDEs), numerical analysis, and uncertainty quantification. The idea of working in sports hadn't been on my radar until around this time. At the conclusion of my postdoc, I was looking for the next step, so I reached out to various baseball teams, one of which was the Tampa Bay Rays. I've been working with the Rays now for the past 10 years.

Paz: How much do you think your background in mathematics and your PhD in applied math have led you to where you are today, working in sports analytics?

Cousins: There are several areas where my background in mathematics has been especially valuable. One is the practical skill set it provides: data analysis, model building, and coding are all areas you gain exposure to through a math degree. Also, I believe a math degree truly teaches the fundamentals of the tools you're using. With math, you learn to question everything and take nothing for granted. That deeper understanding allows you to assess methods critically and recognize when they might not be the right fit. It helps you identify potential issues—whether due to the nature of the dataset or some nuanced aspect of the problem—that could make a particular approach less effective. All problems are much more nuanced than what you would find in a textbook. Nothing ever perfectly satisfies the assumptions being made for the method you're using. That foundation in mathematical thinking is especially useful for solving real-world problems.

Paz: Do you have a favorite project that you've worked on?

Cousins: One that comes to mind is a project involving defensive evaluation and defensive positioning. Starting around 10 years ago, Major League Baseball installed a system to track the exact location of every fielder on the field 30 times per second, and this lets you assess how difficult each play was. For example, consider a ground ball hit to the left of the shortstop. He fields it and throws to first base—but how

Will Paz

far did he have to move? Was that ball hit 15 feet to his left? Was it at 16? Was it at 18 and a half? All this matters for assessing how difficult that play was. Access to this level of granular, high-frequency tracking data enabled a degree of precision that we weren't able to do without that data.

Paz: What is one unforgettable story that you had on your journey, through math, sports, or in your life that you want to share with *MAA FOCUS*?

Cousins: The most unforgettable moment was undoubtedly our COVID season—for better and worse. I was in Port Charlotte, Florida when, all of a sudden, the world stopped. That was true for everybody, not just baseball teams, but our players were getting ready for a season in two weeks and had to hit pause on their preparation. The season eventually resumed in July, but most of our office operations instantly became remote. The in-person collaboration and spontaneous conversations that had long defined our work environment suddenly disappeared. Despite that, we had a great season. We came up a little short at the end, but fortunately, we made it to the World Series in Dallas. It was a season full of ups and downs, but it was certainly an unforgettable season. I was very proud of what the team did, and it was an incredible experience to be part of that journey.

Paz: Is there anything else that you want to say to the math and sports community?

Cousins: There has never been a better time to be part of the math and sports community. The openness to mathematical sports data from coaches, front offices, and players are at an all-time high, which presents a tremendous opportunity. I would encourage anyone who's part of that community to think innovatively. Some things have been figured out, but there's a lot that we still don't understand about how math can be applied to sports. So, there's a lot of fruit left to be picked, and there are many of discoveries still to be had. I would encourage anyone in the community to continue to be creative, continue to be bold with your ideas, and take some moon shots.

Will Paz is a third-year mathematics and data analytics double major at Miami University, also pursuing a master's in applied mathematics. He conducted research at Summer@ICERM on predictive modeling in sports and presented at the special session of Mathematics and Sports at the 2025 Joint Mathematics Meetings.

Getting Started in Mathematics and Sports

Rick Cleary

The intersection of students interested in mathematics and those interested in sports has always been large. What is new in recent years is that some students hope to build careers in this intersection. Many mathematicians and statisticians are responding by introducing sports-centric courses or programs. Here are some tips to help faculty get started, based on my experience teaching "Sports Applications of Mathematics" several times since I introduced it in 2012.


Rick Cleary

1. Start by looking into the many great resources available. First, join the SIGMAA on Mathematics and Sports. Our communications and programs keep our members up to date on conferences, workshops, and opportunities for faculty and students. Our community is also generous about sharing advice and course materials. Lots of popular websites provide data for projects and discussions. The SCORE Network (scorenetwork.org/) is a place to find class-tested data sets and to share new projects.
2. There are lots of important sports applications besides big data statistical models. Statistical models in sports are important, but we can introduce a wide range of mathe-

matical topics in a sports course. Tactical decisions can be studied with conditional probability and expected value. Efficient scheduling is an accessible operations research problem. Ranking, judging and voting are critical sports applications that can be connected to graph theory and matrix algebra. Many of these are illustrated at the 2010 Math Awareness Month website (ww2.amstat.org/mam/2010/essays/) and are collected in a book edited by Joe Gallian for the MAA (bookstore.ams.org/view?ProductCode=DOL/43).

3. Communication is vital, so encourage students to write, speak, and make a record of their work. The sports analytics job market is competitive, so good grades and expressed interest are not usually enough for a student looking for a career. Supplementing academic work with content online in the form of blogs, social media posts, or video recordings of project presentations will help students have a presence in the market. A former student of mine had a blog about hockey that was independent of our class, and it helped her land a position with the National Hockey League, where she works on growing fan engagement.

4. Consider exploring sports outside the mainstream. Students arrive with an awareness of how analytics have shaped tactical changes in football, baseball, and basketball. But our students are also on teams in field hockey, volleyball, lacrosse, rugby, and other sports that have been studied less thoroughly. These can be great places for students to explore, perhaps even working with the institution's athletic department and coaches.

A final brief tip: Many of us who teach sports courses got our start by doing independent study or honors projects. These can be a great first step into the world of sports.

Rick Cleary is vice-president of the MAA, editor of Scatterplot, *and a former chair of the SIGMAA on Mathematics and Sports. He has about 20 former students, including many women, working in the industry at all levels.*

Leveling the Playing Field

Advancing Inclusive Data Science Through Sports

Tim Chartier and Felesia Stukes

Data is everywhere, growing every moment. Teaching data analytics within STEM equips students with tools essential for research, industry, and everyday problem-solving. It sharpens questioning, supports evidence-based decisions, and gives students an early edge in an increasingly data-driven world.

In fall 2024, Dr. Felesia Stukes (Johnson C. Smith University) and Dr. Tim Chartier (Davidson College) hosted the NSF-funded virtual Sports Analytics Curriculum Conference (SACC). The event centered on developing evidence-based strategies to support undergraduate mathematics and computer science students from diverse backgrounds, using the engaging world of sports to foster inclusion in data science. What follows is a summary of key sessions and insights. Given the wide range of ways data science is taught and applied across institutions, this article takes a broad approach—offering a variety of takeaways in the hope that this potpourri of insights proves useful to your work.

The conference began with a keynote from Jessica Gelman (CEO, Kraft Analytics Group; co-founder, MIT Sloan Sports Analytics Conference). Gelman shared her journey integrating analytics in the sports industry and emphasized data's role in driving diversity, particularly through mentorship.

A panel of professionals—Steven Angel (NBA), Tyrone Brooks (MLB), Keith Goldner (FanDuel), and Danielle Shepherd (Chip Ganassi Racing)—underscored curiosity, passion, and hands-on experience. Showcasing personal projects and strong communication skills, they noted, can matter more than technical training alone.

In his keynote, Dr. Marcelo Worsley (Northwestern University) highlighted how aligning learning with student passions—like sports—can increase engagement. He encouraged using diverse assignment formats to better include underrepresented groups, including student-athletes.

Breakout sessions expanded on these ideas. One major theme was that ad-

dressing institutional and cultural barriers in data science requires a comprehensive approach. This includes interdisciplinary collaboration, removing entry barriers, supporting diversity, offering practical learning, and designing flexible, inclusive curricula. Faculty development and clear pathways for students from diverse backgrounds are key to accessibility and engagement.

Another theme focused on infrastructure for innovative sports analytics programs. Institutions must provide accessible tools and data while supporting the development of both technical and soft skills. Collaborations between academia and industry, alongside attention to financial constraints and real-world experiences, help build a strong educational ecosystem.

Patrick Lucey (Stats Perform) and Davyeon Ross (ShotTracker) echoed these ideas during a panel on academic-industry partnerships, emphasizing how real-world data and tools can enhance student learning and serve as a gateway into STEM—even for students not pursuing sports careers.

Curriculum integration was discussed by Dr. Rick Cleary (Babson College), Dr. Michael Schuckers (University of North Carolina at Charlotte), and Dr. Mario Giacomazzo (University of North Carolina at Chapel Hill), who advocated for project-based learning using student-collected or real sports data. "Just-in-time" teaching of foundational concepts can lower barriers for students from various backgrounds and foster inclusive, practical learning.

Breakout discussions also explored fairness, ethics, accountability, and transparency (FEAT) in analytics. Ensuring ethical and inclusive data practices requires diverse representation, bias awareness, legal compliance, and a careful balance between competitive advantage and privacy.

Finally, attendees acknowledged the challenges of implementing sports analytics programs—such as resource limitations, data access, and faculty recruitment—but also the opportunity they offer. Through interdisciplinary learning, inclusive mentoring, real-world applications, and strong professional networks, institutions can shape a more diverse and dynamic future in sports analytics.

For students looking to explore data analytics, sports provide a natural entry point. Sports data is familiar, widely available, and engaging—making it an accessible way for students to dive into asking questions, interpreting results, and getting into the game of data science.

Felesia Stukes is an associate professor in the Computer Science, Engineering, and Mathematics Department at Johnson C. Smith University and co-directs the HBCU-Data Science Consortium. Tim Chartier is the Joseph R. Morton Professor of Mathematics and Computer Science at Davidson College, where he collaborates with students on projects for professional sports teams and national media outlets.

MAA Searches for MAA Reviews Editor

The Mathematical Association of America (MAA) seeks a thoughtful and engaged individual to serve as the next Editor of MAA Reviews.

The MAA Reviews Editor leads the editorial direction of MAA's book review site, working in close collaboration with the MAA Reviews editorial board. The editor is responsible for managing all submissions from book publishers, overseeing the publication of reviews twice a month, and guiding the content and quality of the book reviews.

This role blends editorial oversight and a passion for books. The editor reviews submissions, communicates with authors, edits content for style and clarity, sources and schedules reviews, and coordinates with MAA staff on publishing logistics. They also maintain regular communication with the editorial board.

The position requires a time commitment of approximately 1–2 days per week, with some seasonal flexibility. The editor receives support in the form of a yearly stipend and travel reimbursement.

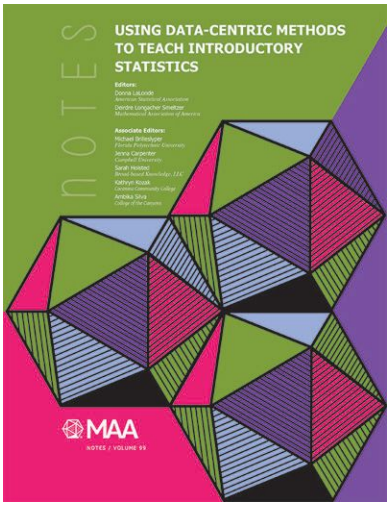
Qualifications:

- Broad mathematical interests and familiarity with diverse areas of mathematics
- Excellent editorial, organizational, communication, and leadership skills
- Strong time-management and interpersonal abilities
- Prior editorial experience is helpful but not required

The editorial term will run from July 1, 2025, to December 31, 2027.

Nominations and Applications: The MAA welcomes nominations and applications from individuals with a passion for writing, reading, and editing. Please send inquiries, nominations, and applications to hr@maa.org.

Check Out your MAA Member Library!

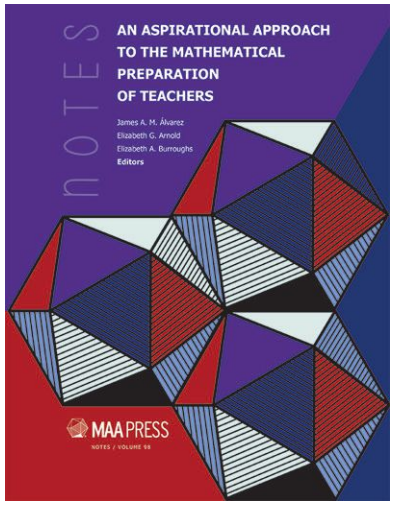


Using Data-Centric Methods to Teach Introductory Statistics

Edited by Donna LaLonde and Deirdre Longacher Smeltzer

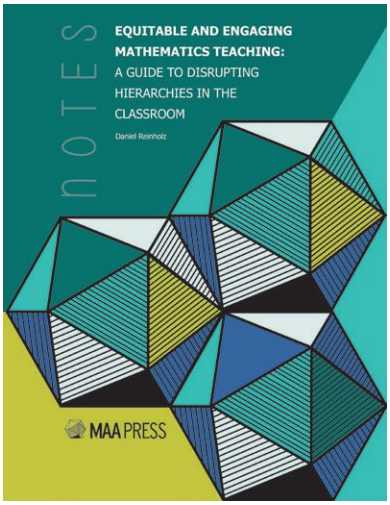
Discover a new way to teach statistics with *Using Data-Centric Methods to Teach Introductory Statistics.* This MAA Notes volume tells the story of StatPREP—an initiative designed to empower statistics instructors to create data-driven learning opportunities. Traditionally, teaching introductory statistics has emphasized procedural methods, formula-driven instruction, and small datasets. While these methods provide a foundation, they do not fully equip students with the skills and knowledge necessary to navigate today's data-centric world. The StatPREP approach reshapes traditional teaching methods, emphasizing real data and computational thinking. Whether you are looking to make a small change or fully transition to a data-centric approach, this resource offers guidance to make implementation seamless. Ready to transform your Introductory Statistics teaching? This Volume is your guide.

An Aspirational Approach to the Mathematical Preparation of Teachers



Edited by James A. M. Álvarez, Elizabeth G. Arnold, and Elizabeth A. Burroughs

An Aspirational Approach to the Mathematical Preparation of Teachers is the result of a collaborative effort between mathematics teacher educators and mathematicians to address secondary mathematics teaching in courses for undergraduate mathematics majors. This volume provides nine lessons, aligning with courses in single variable calculus, introduction to statistics, discrete mathematics or introduction to proof, and abstract algebra, that include applications to teaching to enhance prospective secondary teachers' understanding of connections between undergraduate mathematics and school mathematics. Our lessons aim for a robust blend of undergraduate mathematics, school mathematics, and teaching that does not privilege mathematics content over content for teaching or vice versa. The lessons attend to mathematics content suitable for inclusion in courses for mathematics majors, to mathematics content that is foundational to teaching secondary mathematics, and to learning experiences that are fostered by the teaching materials.



Equitable and Engaging Mathematics Teaching
A Guide to Disrupting Hierarchies in the Classroom

Daniel Reinholz

Equitable and Engaging Mathematics Teaching provides an extensive toolkit of equitable teaching strategies that have been tried and tested in college mathematics classrooms. These practices are brought to life with extensive examples and language that you can use in your own teaching. Whether your style is based primarily in lecture or collaborative group work, there are concrete strategies you can use today.

This book is designed to help you understand the root causes of how and why hierarchies emerge in mathematics classrooms. It discusses common equity issues that have been observed in hundreds of mathematics classrooms across the US, so that you can learn to identify and address these same equity issues that might arise in your classroom. As you take action, not only will you improve student learning, but teaching will become more enjoyable as you see measurable improvements in your classroom.

SPOTLIGHT ON SIGMAAS

Supporting Connections Between Mathematics and Sports

—Amanda Harsy

The Mathematics and Sports SIGMAA is a vibrant community of mathematicians and mathematics educators interested in the intersection of mathematics and sports, particularly in the interdisciplinary field of sports analytics. Members of this SIGMAA actively support, encourage, and promote MAA members' interests in these areas. They also work to develop instructional and assessment tools for teaching mathematics and statistics and foster quantitative problem-solving in the context of sports.

This SIGMAA offers numerous services to its members. We host webinars and panels on topics such as teaching sports analytics courses, getting started in sports analytics research, and more. Because sports-related issues are often engaging and accessible to students, the group also supports and encourages undergraduate involvement in sports and data-related research projects. We organize regular paper sessions at MAA MathFest and JMM focused on research in mathematics and sports, and we publish a biannual newsletter which keeps our readers up to date on what is happening with the SIGMAA and features our members and student researchers. Additionally, we allocate most of our SIGMAA funding to provide travel and research support for students and faculty members.

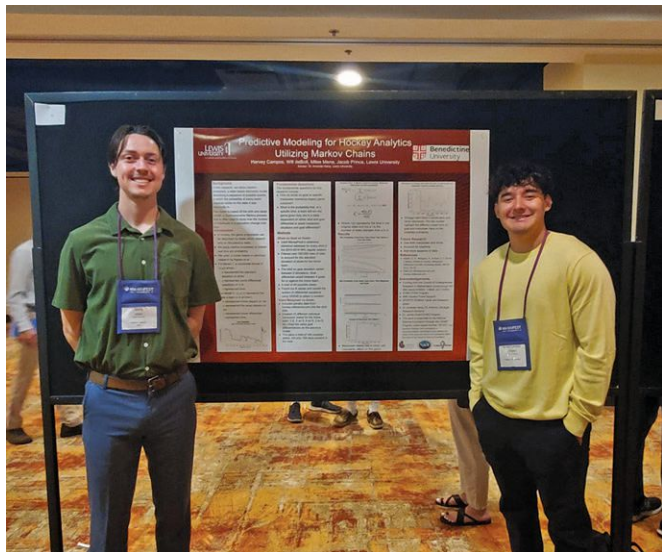
This community is incredibly supportive and collaborative. At the 2025 Joint Mathematics Meetings, our most recent paper session was scheduled for the last day of the conference, yet the room was full. The Q&A sessions following the talks at our paper sessions often turn into discussions where attendees share valuable resources and offer support to the speakers.

Beyond academic engagement, our community also organizes fun outings, often to sporting events. For example, at MAA MathFest 2022, we arranged a group trip to watch the Philadelphia Phillies play the Washington Nationals. In 2023, our business meeting featured a talk from Will Cousins, Vice President and Assistant General Manager of the Tampa Bay Rays. At MathFest 2024, we introduced a "3-minute drill" session, where members shared their current sports-related projects, fostering connections and collaborations.

My Experiences with the Math and Sports Community

The Mathematics and Sports SIGMAA played a crucial role in my development as an undergraduate research mentor. When I began my tenure-track position at Lewis University in 2014, the department sought to expand undergraduate research in mathematics. As an undergraduate, I had the

Philadelphia Phillies vs Washington Nationals. Go Phillies!



Lewis University graduates Miles Mena and Harvey Campos-Chavez present their CURM-funded sports analytics research at MAA MathFest 2022.

opportunity to conduct research with my professors, and I wanted to offer the same experience to my students. However, my dissertation area, geometric group theory, was not something I wished to continue researching—especially not with undergraduates. I felt at a crossroads and was looking to transition to a new research area.

Lightning struck when I attended a talk by Tim Chartier at an Association of Christians in the Mathematical Sciences conference. His linear algebra-based models in sports analytics intrigued me. I began exploring these models and integrating them into our linear algebra curriculum. The following summer, I collaborated with students on sports analytics research following some of these methods. Around this time, Drew Pasteur, Diana Cheng, and others were working to establish the Math and Sports SIGMAA. Drew invited me to get involved, first by serving on the nominating committee and later by running for secretary-treasurer. After two years in that role, I became chair-elect, and I am now finishing my term as past-chair.

I have had many of my student researchers present at the Math and Sports SIGMAA paper sessions at MAA MathFest and the Joint Mathematics Meetings. Having a clear venue where my student researchers could present on the national stage was a fantastic experience for my students and helped them feel connected to the broader mathematical community. This past summer, I collaborated with my colleague Adam Schultze on sports analytics research with 10 students, and this summer, we will be mentoring a Polymath Jr. virtual REU project on sports analytics. None of this would have been possible without the connections and encouragement of this SIGMAA.

Though we are a relatively new and smaller SIGMAA, we have been fortunate to have outstanding leadership, and I am honored to have served alongside and learned from such talented colleagues. Being part of this community provided me with collaborators, publishing opportunities, grants, and support for my work with students in sports analytics research. Stepping away from my dissertation area and into a new field was daunting, but this support system made it possible. It helped me grow, and I remain deeply grateful to my fellow SIGMAA members. Thanks to this community, my research has flourished.

Want to get involved?

If you are interested in the connection between mathematics and sports, using sports examples to enhance learning in your classes, teaching a sports analytics course, or even if you are not a sports enthusiast but are looking for an engaging way to involve students in research, consider joining the Math and Sports SIGMAA. Come to the Sports SIGMAA Annual Business Meeting where Arielle Dror (the Director of Data & Analytics for the Bay Football Club, an NWSL soccer team) will be speaking. Or stop by the Math and Sports Contributed Paper Session. Times and locations can be found at maa.org/event/mathfest.

Some of the SIGMAA leadership team with Will Cousins of the Tampa Bay Rays (3rd from the left).

Amanda Harsy is a professor of mathematics at Lewis University and a former Chair of the SIGMAA on Mathematics and Sports. She has worked with many undergraduates on research projects within sports analytics, graph theoretical modeling of self-assembling DNA, and the scholarship of teaching and learning.

Departments

TOOLKIT

Mathematics Reimagined

Unexpected Lessons from Teaching a First-Year Seminar

— Jennifer Schaefer

Over the last 40 years, first-year seminars (FYSs) have been integrated into the curricula of colleges and universities across the country with the aims of increasing student engagement and student retention and establishing a strong foundation for academic success. Through my experience teaching in the FYS program, I have found that FYSs are equally beneficial to mathematics faculty who teach them. Let me share a few of the ways teaching a FYS has impacted me, my teaching, and my interactions with students.

Teaching a FYS has offered me the opportunity to introduce students to topics, mathematical and not, that are of interest to me.

The theme of my most recent FYS was stereotypes of mathematicians in popular culture. (My first FYS was on sustainable agriculture and the small family farm!) As a woman mathematician, I have had many people over the years tell me that I don't look like a mathematician. Why do they say that? It's because I am not the older, white, male, eccentric-type that most non-mathematicians imagine when they think of a mathematician or scientist. Yes, there are mathematicians that fit that description, and these individuals are a valuable part of our community. But why is that "the" image that comes to mind when a layperson is asked to describe a mathematician?

I wanted to delve deeper into the answers to this question with students. So, I decided to develop a course to investigate how mathematicians are portrayed in popular culture and to understand what impact, if any, these portrayals have on who decides to go into mathematics and who is welcomed into the mathematics community. However, a course with this theme does not fit nicely into a typical mathematics program, but it fits perfectly in the FYS program. Teaching a FYS allowed me to explore this topic and discuss issues of gender, race, sexual identity/sexual orientation, and mental health in mathematics with an engaged group of students. We read books such as the *Housekeeper and the Professor* and chapters from *Mathematics in Popular Culture* and watched films including *A Beautiful Mind* and *The Imitation Game*. We performed scenes from *Arcadia* and *Proof* with a theatre professor and discussed research articles with experts in other fields to gain a better idea of how one's intersecting socio-cultural identities effect their experiences with mathematics. I learned a great deal, and my students did too. In fact, the most positive outcome my course was that our conversations encouraged my students to contemplate these important issues more broadly. One student in particular expressed the following:

> "Mathematical Identities was formative in helping me develop my personal identity as a mathematician and motivated me to examine how intersections of gender, race and personality impact people's experiences in all STEM fields. Starting my experience at college with such an interdisciplinary course encouraged me to find connections in my math and computer science courses and the material in my social science courses relating to bias and discrimination. Whether or not I continue directly in mathematics after college, I know that I will carry the lessons from the FYS regarding the importance of diverse representation in breaking barriers and unlocking individuals' full potential."

Teaching a FYS has completely changed the way I teach proof writing.

When I was a first-year professor, I taught Foundations of Higher Mathematics, the course where we introduce our students to mathematical proof writing. This course was designated writing-intensive by our institution which meant I needed to require a minimum of 15 pages of polished writing, teach the genres and conventions of the discipline, and build the writing process into my assignments. I had no idea how to teach proof writing using planning, drafting, revising, and editing to beginning proof writers in a legitimate and meaningful way, and many of my mentors I reached out to in the mathematical community didn't know either. Most of us had learned how to write proofs by watching our teachers write a proof and then trying to emulate this in our own work.

By utilizing writing pedagogies, such as prewriting activities, peer review, and journaling, in my FYS to teach the writing process for general academic writing, I began to understand how to use these concepts to teach proof writing. I worked with two of my colleagues to revamp Foundations of Higher Mathematics. I now have class discussions to emphasize the authentic nature of working in groups, writing for peers, reviewing peers' papers, reflecting on comments, and revising as it relates to writing in our discipline. I also updated the course structure so that it teaches proof writing using peer review, journaling, and portfolios alongside my usual course components. In peer-review groups, my students give feedback to each other on their proof writing, and in their journal, they reflect on this feedback. The purpose of the portfolio is to draw on all these components to provide a capstone piece, which serves as evidence of their thoughtful

reflections and showcases what they learned about proof writing in our course. Using this course structure, I am much more confident that I am teaching proof writing in a way that both mirrors the writing process in our discipline and is beneficial to first-time proof writers.

I have been reminded what it is like to be the non-expert in the classroom.

When I am teaching a mathematics course, I am the content expert in the classroom. After years of teaching, it can be easy to forget the foundational knowledge needed to learn a concept for the very first time—this is often called an "expert blind spot." Teaching a FYS quickly refreshed my memory! I was not trained to teach writing-intensive, discussion-based courses, especially on topics such as sustainable agriculture and stereotypes of mathematicians in pop culture. I felt a bit like an imposter and was constantly questioning myself. What do I do if a student asks a precise question about organic farming and I don't know the answer? How do I handle a situation where a student says something offensive, accidentally or purposely, in class when discussing structural racism in mathematics education? Do my writing assignment prompts clearly articulate what I wanted my students to write about? Does my rubric align with the grades my students deserve? Do I even know *how* to provide high quality feedback to help my students improve their writing? Ahhh!

The thought of not knowing all of the answers all of the time made me feel really anxious and uncomfortable. This experience reminded me of what it felt like to be a *student*. This insight has made me more mindful of how my students feel in my courses when learning something for the first time and of my assumptions regarding what my students know and do not know. This, in turn, has improved the way I explain new topics and construct assignments. For example, I assign a poster project in my abstract algebra course that is divided into several small, progressively linked assignments spaced accordingly throughout the semester. This concept, known as scaffolding, breaks the assignment down in a way that clearly outlines the process of developing a poster, a task new to most students, and it allows me to provide feedback at every stage of the assignment.

I have gained a better understanding of how my students' backgrounds and identities affect their learning experience.

The class discussions, writing assignments, and one-on-one advising meetings that accompanied my FYS allowed me to get to know my students on a deeper level than in a typical mathematics course. For example, I learned that the student who posed the most pensive questions was the child of two professors, while the most reticent student was a first-generation student who had been advised by their family to refrain from asking questions. In addition, I discovered one

First-year seminar class from 2015.

of my international students was confused by the stereotype of a "math person" presented in American books and films because, in their culture, one's ability to learn mathematics is viewed through a growth mindset. This new awareness made me realize I need to investigate a situation more thoroughly before I make judgements about a student's lack of class engagement or poor academic performance and has spurred me to further educate myself about how certain backgrounds and identities affect a student's college experience.

At the beginning of each semester, I now have my students complete a short questionnaire so I can gain a better understanding of their background, identities, and concerns about the course. I reach out to students via email or speak to them in office hours as soon as I notice an issue and connect them with resources, when appropriate. In addition, I have statements in my syllabus that describe what I do to try to cultivate a social environment conducive to learning for all students and what they should do if they encounter difficulties, academic or personal, during the semester. These efforts have definitely helped me address issues earlier, but more importantly, they have given my students the assurance that I care about them as individuals and students and that I am their partner in their education.

Jennifer Schaefer is a professor of mathematics at Dickinson College. She developed a contributed volume of FYSs with mathematical themes with co-editors Jennifer Bowen (The College of Wooster), Mark Kozek (Whittier College), and Pamela Pierce (The College of Wooster) that is available through the MAA Notes Series as a free download for MAA members. They hope this text will make the thought of teaching a FYS less daunting and serve as a resource for mathematics faculty tasked with teaching such a course.

Departments

BOOKS BEAT

Hands-On Learning

— Tom Sharland

***Active Learning*—an approach to teaching which emphasiz-**es student participation in the classroom—is an increasingly popular and important teaching technique. Rather than being talked at during class, students get to engage in activities where they create their own knowledge, discovering concepts for themselves. The instructor acts as more of a facilitator than an expounder of knowledge. In this column, I bring to you two recent books from the MAA Press's Classroom Resource Materials series which utilize this method of teaching.

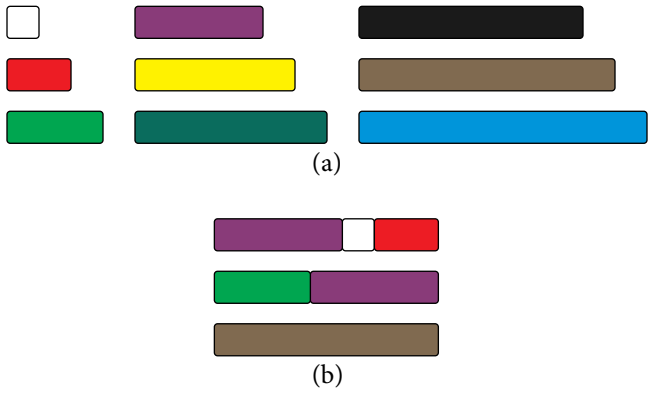
You will notice that both books contain "Hands-On" in the (sub)title, and so as you would expect, provide opportunities for students to learn the material through manipulating physical objects, as well as participating in group work, experimenting and exploring mathematical problems with their peers.

Combinatorial Trains

Hands-On Combinatorics is a textbook for a class in discrete mathematics, written by former editor of the *College Math Journal* and MAA's Haimo Award for Teaching winner, Brian Hopkins. Anyone (and Hopkins includes himself among such people) who enjoyed the classic MAA Press book *Proofs that Really Count* (2003) by Art Benjamin and Jenny Quinn will appreciate the emphasis placed on combinatorial proofs within this book. Since such arguments are (arguably) more natural than the standard (algebraic or inductive) proofs that are usually used to prove combinatorial identities, they can be used to teach students that are yet to take a class in formal proof writing.

The hands-on activities are inspired by Cuisenaire Rods. These are color-coded by length, as exhibited in the following diagram. Thus, length one is white, length two is red, and so on (see part (a) below). These are then combined to form "trains," with each individual rod being a "car"; part (b) of the diagram below shows some trains of length 7, made up of 3, 2 and 1 car(s) respectively.

The trains are visual—and physical—representations of integer compositions[1]. Such an intuitive description leads to

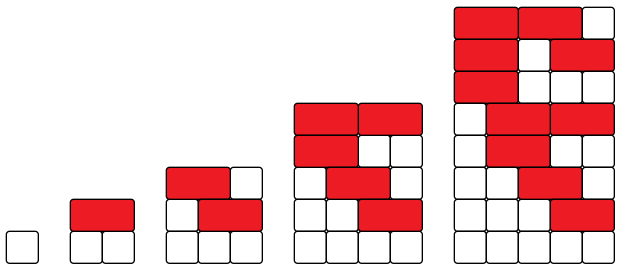


Cusenaire Rods.

the promised combinatorial proofs. For example—how many integer compositions are there of the integer n such that each term of the composition can only be 1 or 2? In the language of trains: how many ways can you construct a train of length n using only red and white cars? I'll let you think about it for a while…

There is another aspect of the book which sets it apart. It is written from the perspective of a student taking the class, obtained from the author's experience of teaching this material multiple times. This keeps the exposition lively—reflecting the excitement of the students as they discover the results for themselves—and provides the instructor with extra insights as to the thought-processes of those participating in the class. Each chapter also comes with a more formal "Notes" section, providing proofs and additional hints. This allows the material to be used in higher level classes, with more formalism.

The red and white cars? Well, after a little bit of experimentation, one can build the following sequence trains of length 1 to 5.



This gives the sequence 1, 2, 3, 5, 8, … which may seem familiar! In particular, each term in the sequence is the sum of the previous two terms. To see that the pattern continues, note that to make a train of length n, you can either append a red car to the end of a train of length $n-2$, or a white car to the end of a train of length $n-1$. Since this gives all possible trains of length n, we recover the usual Fibonacci recurrence relation[2].

[1] A composition is a way of splitting up the integer in a way that order matters, so that (1,2) and (2,1) are considered distinct compositions of 3.

[2] Some readers will recognize this construction as the combinatorial interpretation of the Fibonacci numbers given in *Proofs that Really Count.*

Hands-On Combinatorics: Building Colorful Trains to Manifest Pascal's Triangle, Fibonacci Numbers, and Much More

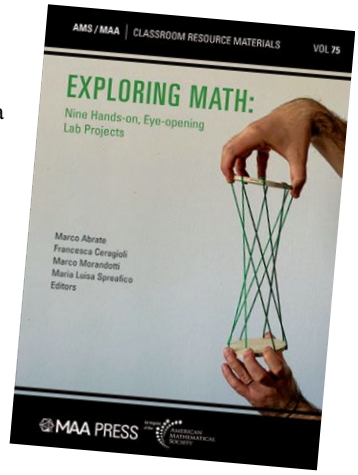
Brian Hopkins

2025; 191 pp, Softcover
ISBN: 978-1-4704-7757-8
Product Code: CLRM/74
eISBN: 978-1-4704-7960-2
Product Code: CLRM/74.E
List Price: $59.00
Member Price: $44.25

Exploring Math: Nine Hands-on, Eye-opening Lab Projects

Edited by Marco Abrate, Francesca Ceragioli, Marco Morandotti, and Maria Luisa Spreafico

2025; 144 pp, Softcover
ISBN: 978-1-4704-7703-5
Product Code: CLRM/75
eISBN: 978-1-4704-8023-3
Product Code: CLRM/75.E
List Price: $59.00
Member Price: $44.25



The book is replete with such arguments and their associated, vibrant, images. Moreover, Hopkins emphasizes the importance of having students struggle with the material, allowing them to recognize patterns and form their own conjectures. In short, a perfect example of active learning.

Experimental Mathematics

Another new book in the Classroom Resource Materials series is *The Mathematical Lab,* edited by Abrate, Ceragioli, Morandotti and Spreafico. The book arose from activities developed at the Laboratorio di Matematica del Politecnico di Torino in Italy, where the goal was to introduce beginning STEM majors to some fascinating, yet concrete, mathematical topics. The book contains nine in-depth projects, touching on a wide range of mathematical concepts. Each of these projects can be utilized as stand-alone modules in a related course, or the modules could be combined to form a semester-long course in experimental mathematics. To make the implementation easier, each module comes with a "Lab sheet," which describes the mathematical background and materials necessary to perform it.

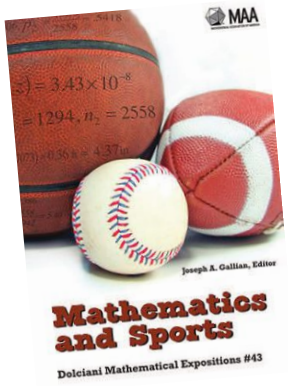
Some of the mathematics is relatively advanced; for example, there is one chapter which covers mathematical billiards, fractals and Julia sets! Others touch on things like plane curves, surfaces, and the four-color problem. But crucially, all the activities have that wonderful combination of *low floor, high ceiling*. The hands-on nature of the modules mean it is easy to start experimenting and exploring the topics at hand, but the advanced nature of the underlying mathematics gives students a glimpse of some delightful and interesting areas of study.

Tom Sharland is the acquisitions editor at the American Mathematical Society with responsibility for books under the MAA Press imprint. Contact him if you are interested in writing a book for MAA Press: tjs@ams.org.

An oldie but goody to go with our Math + Sports theme:

Mathematics and Sports

Edited by Joseph A. Gallian



Mathematics and Sports is an eclectic compendium of the essays solicited for the 2010 Mathematics Awareness Month web page on the theme of Mathematics and Sports. In keeping with the goal of promoting mathematics awareness to a broad audience, all of the articles are accessible to college level mathematics students and many are accessible to the general public.

The articles provide source material for classroom use and student projects. Many students will find mathematical ideas motivated by examples taken from sports more interesting than the examples selected from traditional sources.

2010; 329 pp Softcover
ISBN: 978-0-88385-349-8
Product Code: DOL/43
e ISBN: 978-1-61444-200-4
Product Code: DOL/43.E
List Price: $35.00 Member Price: $26.25

MAA MATHFEST August 6–9 2025 | SACRAMENTO, CA

SIGMAA Sponsored Events

SIGMAA ARTS

Invited Paper Session

Recent Developments in Math and the Arts

This invited paper session will feature leading researchers in the overlap of the fields of mathematics and the arts.

Organizers: Douglas Dunham, *University of Minnesota-Duluth*; Douglas Norton, *Villanova University*

MathArt at MathFest

A juried exhibition of mathematical art, including a participatory installation from SIGMAA EM.

Organizers: Frank Farris, *Santa Clara University;* Bronna Butler, *B.A. Baroque Arts, LLC;* Amanda Beecher, *Ramapo College of NJ;* Russ deForest, *Everly College of Science;* Chris Gott, *University of the Pacific;* Katy Franz, *Unaffiliated Mathematical Artists;* Jack Love, *San Francisco State University;* Jeff Venrtella, *Unaffiliated Mathematical Artists*

MathArt at MathFest Awards Ceremony and Reception

During a closing reception for the Art Exhibition, prizes will be awarded for exceptional artwork in the exhibit.

Organizers: Frank Farris, *Golden Section of the MAA;* Doug Dunham, *SIGMAA ARTS*

SIGMAA BIG

Contributed Paper Session

Applied Mathematical Solutions and Innovations in Business, Industry, and Government (BIG)

Presenters share real-world problem-solving examples, showcasing both successful applications and unresolved issues.

Organizers: Mihhail Berezovski, *Embry-Riddle Aeronautical University;* Vinodh Kumar Chellamuthu, *Utah Tech University;* Namyong Lee, *Minnesota State University Mankato*

SIGMAA BIO

Business Meeting and Guest Lecture

Reception and business meeting, followed by our guest lecture: Suzanne Sindi, of the University of California, Merced.

Organizers: Meredith Greer, *Bates College;* Tim Comar, *Self-employed*

Invited Paper Session

Trends in Mathematical and Computational Biolog

Our session will sample from a diversity of important questions from biology and medicine and their mathematical treatments, with a goal of maximizing the range of topics and research methods presented at the session.

Organizers: Timothy Comar, *Self-Employed;* Anne Yust, *University of Pittsburgh;* Erin Bodine, *Rhodes College*

Contributed Paper Session

Environmental and Biological Research in Mathematics, in and out of the Classroom

Two SIGMAAs join to host an important shared session. Environmental and biological challenges continue to play major roles in our society and students are increasingly concerned.

Organizers: Timothy Comar, *Self-Employed;* Rania Robeva, *Randolph-Macon College;* Anne Yust, *University of Pittsburgh;* Eric Marland Marland, *Appalachian State University*

SIGMAA EM

Business Meeting and Guest Lecture

Business meeting and guest lecture by Alan Hastings, UC Davis.

Organizers: Russ deForest, *Pennsylvania State University;* Eric Marland, *Appalachian State University;* Amanda Beecher, *Ramapo College of New Jersey;* Kevin Murphy, *Dominican University*

MathArt at MathFest

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Workshop

Communicating the Complex and the Conflicted

Through exercises and discussions that can enhance skills in communicating challenging topics, we will share and generate ideas for avoiding or dealing with classroom controversies.

Organizers: Eric Marland, *Appalachian State University;* Russ deForest, *Pennsylvania State University*

Contributed Paper Session

Environmental and Biological Research in Mathematics, in and out of the Classroom

Two SIGMAAs join to host an important shared session. En-

Register Now!

vironmental and biological challenges continue to play major roles in our society and students are increasingly concerned.

Organizers: Timothy Comar, *Self-Employed;* Rania Robeva, *Randolph-Macon College;* Anne Yust, *University of Pittsburgh;* Eric Marland Marland, *Appalachian State University*

SIGMAA HOM

Business Meeting and Guest Lecture

Annual business meeting and guest lecture.

Organizers: Abe Edwards, *Michigan State University;* Ximena Catepillan, *Millersville University*

Invited Paper Session

The Institute on the History of Mathematics and its Use in Teaching: 30 Years of Impact on Education and Research

Speakers will note IHMT's influence on their careers and discuss their own scholarship.

Organizers: Amy Ackerberg-Hastings, *MAA Convergence;* Daniel Otero, *Xavier University*

Special Session

Notable Events in the Histories of the 29 Sections of the MAA

Based on the success of Indiana's special session at MAA Mathfest 2024, this session is an opportunity for individuals from other sections to share historical events, significant individuals, and key programming that contributed to their section's development.

Organizers: Grace Cook, *Bloomfield College of Montclair State University;* Rick Gillman, *Valparaiso University*

Workshop

Engaging and Inspiring Students in the Mathematics Classroom by Teaching with Primary Source Projects

This workshop gives participants hands-on experience with classroom materials based on primary historical sources.

Organizers: Jennifer Clinkenbeard, *California State University Monterey Bay;* Abe Edwards, *Michigan State University;* Ken Monks, *College of Southern Nevada;* Daniel Otero, *Xavier University;* Adam Parker, *Wittenberg University;* Michael Saclolo, *St. Edwards University;* Janet Heine Barnett, *Colorado State University Pueblo*

History of Mathematics Trivia Contest

Come join fellow math enthusiasts for a fun time of team trivia. Undergraduates are especially encouraged to attend, but the contest is open to everyone!

Organizers: Ximena Catepillán, *Millersville University of Pennsylvania;* Abe Edwards, *Michigan State University;* Greg Coxson, *United States Naval Academy*

Read the Masters!: Weierstrass Formalizes the Limit Concept

Participants will engage in a common reading and discussion of selections (in English) from the 1861 lecture notes of Karl Weierstrass (1815–1897), who formalized the concept of limit with his representation in terms of "ε-δ" inequalities.

Organizer: Daniel Otero, *Xavier University (OH)*

SIGMAA IBL

Business Meeting

Meet with IBL SIGMAA leadership and connect with other IBL enthusiasts in this interactive forum. Learn about our current programming, share ideas for future offerings, and explore ways to sustain and grow our community.

Organizers: Rebekah Jones, *University of Colorado Boulder;* Lee Roberson, *University of Colorado Boulder;* Joseph Barrera, *Converse University;* Ana Wright, *Davidson College;* Vikram Kamat, *Villanova University*

Contributed Paper Session

Inquiry-Based Learning

This session invites scholarly presentations on the use of inquiry-based and Process-Oriented Guided Inquiry Learning methods for teaching and learning.

Organizers: Lee Roberson, *University of Colorado-Boulder;* Joseph Barrera, *Converse University;* Mel Henriksen, *Wentworth Institute of Technology;* Mami Wentworth, *Wentworth Institute of Technology;* Rebekah Jones, *University of Colorado-Boulder;* Jessie Oehrlein, *Fitchburg State University;* Chris Oehrlein, *Oklahoma City Community College;* Katie Johnson, *Florida Gulf Coast University;* Kayla Heffernan, *University of Pittsburgh at Greensburg*

SIGMAA MCST

Business Meeting

Organizers: Sayonita Ghosh Hajra, *California State University, Sacramento;* Tom Stojsavljevic, *Beloit College*

Contributed Paper Session

Community-Responsive Activities for Math Circles

Presenters will describe their intended audience and showcase engaging and enjoyable Math Circle activities that leverage their students' assets, highlighting the ways their activities are responsive to that audience.

Organizers: Cynthia Sanchez Tapia, *California State University Dominguez Hills;* Alessandra Pantano, *University of California Irvine;* David Crombecque, *American Institute of Mathematics;* Tom Stojsavljevic, *Beloit College;* Sayonita Ghosh Hajra, *California State University, Sacramento;* Nick Rauh, *Seattle Universal Math Museum;* Jeffrey Musyt, *Slippery Rock University;* Lauren Rose, *Bard College*

SIGMAA MKT

Business Meeting and Panel

Come meet and socialize with your fellow colleagues interested in mathematics teacher preparation.

Organizers: Elizabeth Arnold, *Montana State University;* Laurie Cavey, *Boise State University;* Eileen Faulkenberry, *Tarleton State University;* Younhee Lee, *Southern Connecticut State University;* Cody Patterson, *Texas State University*

Contributed Paper Session

Strengthening the Mathematical and Statistical Preparation of Secondary Mathematics Teachers through the Mathematical Knowledge for Teaching

This session brings together stakeholders invested in secondary teacher preparation to consider and learn about ways to strengthen the mathematical and statistical preparation of secondary mathematics teachers.

Organizers: Elizabeth Arnold, *Montana State University;* Eileen Faulkenberry, *Tarleton State University;* Matthew Haines, *Augsburg University;* Jay Jahangiri, *Kent State University;* Victor Oxman, *Western Galilee College, Israel;* Catherine Paolucci, *Mathematical Association of America*

SIGMAA POM

Guest Lecture, Reception and Business Meeting

After a reception and brief business meeting, Jared Warren, Philosophy Department, Stanford University, will discuss "Conventionalism and Mathematical Truth".

Organizers: Bonnie Gold, *Monmouth University (emerita);* Thomas Drucker, *University of Wisconsin Whitewater (emeritus)*

Invited Paper Session

Philosophy of Mathematics: The View from Paradox

Proposals are invited especially on the theme of paradox in mathematics, and how paradox has influenced the philosophy of mathematics, mathematics itself, and logic over the millennia.

Organizers: Steven Deckelman, *University of Wisconsin-Stout;* Bonnie Gold, *Monmouth University Retired;* Thomas Drucker, *University of Wisconsin-Whitewater Retired*

SIGMAA QL

Business Meeting (1 hour)

This meeting will include reports from the QL leadership.

Organizers: Rachael Lund, *Michigan State University;* Chloe Lewis, *University of Wisconsin Eau Claire;* Luke Tunstall, *Trinity University;* Catherine Crockett, *Point Loma Nazarene University;* Kathyrn Appenzeller, *The University of Texas at San Antonio*

Contributed Paper Session

Integrating Current Events into Quantitative Literacy: Adapting Curriculum to Reflect Today's World

This session invites educators to share lessons or projects that incorporate current events into quantitative literacy courses.

Organizers: Rachael Lund, *Michigan State University;* Luke Tunstall, *Trinity University;* Catherine Crockett, *Point Loma Nazarene University;* Katherine Appenzeller, *The University of Texas at Austin*

SIGMAA REC

Special Session

Recreational Mathematics: Puzzles, Card Tricks, Games, and Gambling

Puzzles, card tricks, board games, game shows, and gambling provide an excellent laboratory for testing mathematical strategy, probability, and enumeration.

Organizers: Paul Coe, *Dominican University;* Sara Quinn, *Dominican University;* Kristen Schemmerhorn, *Concordia University Chicago*

SIGMAA RUME

Invited Paper Session

Advancing Justice through Research in Undergraduate Mathematics

Speakers will share their research, explore mechanisms to overcome barriers faced by underrepresented groups in undergraduate mathematics, and highlight practices that promote inclusivity and equitable outcomes for students.

Organizers: Kaitlyn Serbin, *The University of Texas Rio Grande Valley;* Brian Katz, *California State University Long Beach;* Deborah Moore-Russo, *The University of Oklahoma;* Shandy Hauk, *San Francisco State University*

Contributed Paper Session

Research on Undergraduate Mathematics Education

This session aims to promote quality research in undergraduate mathematics education, to disseminate educational studies to the greater mathematics community, and to facilitate

the impact of research findings on mathematics pedagogy.

Organizers: Kaitlyn Serbin, *The University of Texas Rio Grande Valley;* Deborah Moore-Russo, *The University of Oklahoma;* Shandy Hauk, *San Francisco State University;* Brian Katz, *California State University Long Beach*

SIGMAA SDS-ED

Business Meeting

This session provides an opportunity to discuss ongoing initiatives, future plans, and ways to enhance statistics and data science education within the MAA community.

Organizers: Immanuel Williams, *California Polytechnic State University San Luis Obispo;* Troy Riggs, *Union University*

Contributed Paper Session

Advancing Data Science Education: Integrating Pedagogical Innovation with Ethical Practice

Share your experiences integrating AI tools, addressing data ethics, using culturally relevant datasets, and connecting statistical concepts to real-world applications.

Organizers: Helen Burn, *Highline College;* Mike LeVan, *Transylvania University;* Immanuel James Williams, *California Polytechnic State University San Luis Obispo*

Workshop

Leveraging APIs: Improving the Data We Bring to Students

This interactive, hands-on workshop teaches how to access dynamic, real-time data using Application Programming Interfaces (APIs).

Organizer: Immanuel Williams, *GATO365 Learning Center, California Polytechnic State University San Luis Obispo*

SIGMAA SPORTS

Business Meeting and Guest Speaker

Annual business meeting followed by an invited talk given by Arielle Dror from Bay FC.

Organizers: Paul von Dohlen, *William Paterson University;* Amanda Harsy, *Lewis University;* Filippo Posta, *Phoenix College;* Alyssa Hoofnagle, *Wittenberg University;* Kitty Yang, *University of North Carolina Asheville;* Michael Schuckers, *University of North Carolina Charlotte*

Contributed Paper Session

Mathematics and Sports

Availability of play-by-play statistics, video-based spatial data, and wearable technology data have led to innovative sports analytics studies. Research presentations, expository talks, preliminary reports, and pedagogical contributions are all welcome in this session.

Organizers: Filippo Posta, *Phoenix College;* Amanda Harsy, *Lewis University*

Workshop

Utilizing and Creating SCORE Network Materials for Data Science and Statistics Instructors

In this interactive and engaging workshop for instructors we introduce how to use materials from the SCORE Network (www.scorenetwork.org).

Organizers: Michael Schuckers, *UNC Charlotte;* Rachel Gidaro, *United States Military Academy at West Point*

SIGMAA TAHSM

Business Meeting

We will be discussing suggestions to re-invigorate the SIGMAA's activities going forward.

Organizer: Bill Shillito, *Oglethorpe University*

SIGMAA UR

Informal Business Meeting

Anyone interested in undergraduate research is welcome to join this meeting for discussion and community building. We will conclude with a business meeting to discuss plans for the upcoming year.

Organizers: Adam Schultze, *Lewis University;* Vinodh Chellamuthu, *Utah Tech University;* Brandy Wiegers, *The College of Idaho;* Violeta Vasilevska, *Utah Valley University;* Cara Sulyok, *Lewis University*

Contributed Paper Session

Building Undergraduate Research Programs as a New Faculty

Presenters share strategies for transitioning from dissertation research to manageable undergraduate projects, adapting complex topics, and creating sustainable research agendas.

Organizers: Vinodh Kumar Chellamuthu, *Utah Tech University;* Violeta Vasilevska, *Utah Valley University;* Cara Sulyok, *Lewis University;* Lauren L Rose, *Bard College;* Md Istiaq Hossain, *Stephen F. Austin State University;* Adam Schultze, *Lewis University*

Panel

Initiating Your Undergraduate Research and Mentoring: Strategies and Insights Across SIGMAAs

Through a panel and interactive follow-up workshop representatives from various SIGMAAs share insights and best practices for involving undergraduates in research.

Panelists: Amanda Harsy, *Lewis University;* Vinodh Chellamuthu, *Utah Tech University;* Shandy Hauk, *San Francisco State University;* Meredith Greer, *Bates College*

Moderator: Adam Schultze, *Lewis University*

Organizers: Adam Schultze, *Lewis University;* Lauren Rose, *Bard College;* Brandy Wiegers, *The College of Idaho;* Violeta

Vasilevska, *Utah Valley University;* Vinodh Chellamuthu, *Utah Tech University;* Cara Sulyok, *Lewis University*

SIGMAA WEB

Business Meeting and Interactive Showcase of Open Resources

Annual business meeting and reception of WEBSIGMAA followed by several short presentations centered on engaging with open tools and resources related to mathematics and mathematics education with time for discussion. Come meet with us and learn about about tools like Ximera, PreFigure, and WeBWork.

Organizer: Shanda Hood, *University of Arkansas;* Brian Walton, *James Madison University;* Bernd Sing, *University of the West Indies (Cave Hill campus, Barbados);* Joe Fields, *Southern Connecticut State University;* Josh Girshner, *University of Arkansas*

Contributed Paper Session

Redesigning Mathematics and Statistics Curricula in the Age of AI-Driven Computing

This session explores incorporating computational tools, particularly those facilitated by artificial intelligence or natural language models, in classroom practices and in programmatic curricular design.

Organizers: Yesim Demiroglu, *California State University, Sacramento;* Sayonita Ghosh Hajra, *California State University, Sacramento;* Santosh Kandel, *California State University, Sacramento;* Matthew Krauel, *California State University, Sacramento;* Jasdeep Pannu, *California State University, Sacramento;* Lauren Perry, *California State University, Sacramento;* Vardayani Ratti, *California State University, Sacramento;* D Brian Walton, *James Madison University;* Shanda Hood, *University of Arkansas;* Bernd Sing, *University of the West Indies (Cave Hill campus, Barbados);* Joe Fields, *Southern Connecticut State University*

Poster Abstracts Final Reminder

Last call to secure an opportunity to present a poster at MAA MathFest 2025! Poster presentations are a great way to get your work in front of the mathematical community and network with colleagues and industry professionals—you can get a platform to share the next great breakthrough! Abstract submissions are open until June 8, so make sure to submit your work today.

Check out some of these poster sessions in which you can still present:

- Strategies for Enhancing Retention and Graduation Rates of Underrepresented Minorities in STEM
- Poster Session for Projects Supported by the NSF Division of Undergraduate Education
- PosterFest 2025: Scholarship by Early Career Mathematicians
- Outreach Poster Session
- Research in Motion (Undergraduate Student Poster Session)

Visit maa.org/events/maa-mathfest-2025-abstract-submissions to read the Calls for Posters and to learn more.

Departments

ART DEPARTMENT

Interview with Jon-Paul Wheatley

—Edmund Harriss

How did you get into creating soccer ball designs?

I bought myself some leather working tools to keep myself busy during lockdown. The startup I was working on at the time had just fallen apart, and I wanted to do something that would take my mind off of everything that was going on. I played around for a while… I made myself a wallet, a new pencil case, a notebook cover (all terrible), then one day I decided to try and make a little ball.

It was about the size of a ping pong ball. Stuffed with offcuts that I had lying around. Made from 12 small hand cut pentagons… and it was really bad! Awful stitching and the ball wasn't round. The moment I was finished I thought to myself: "I reckon if I tried again, it would be a lot better," and I've been in that headspace ever since.

Do you feel like you have learnt more about geometry from making creative ball designs?

At the start, I didn't have much formal knowledge of geometry—I was simply using a brute force approach, making ball after ball until something started to click. Every attempt, even the really bad ones, taught me something about how flat shapes can work together to form a sphere. I learned firsthand about symmetry, curvature, and how even a little change in tension can make a big difference. It was all very hands-on: each failed stitch and misaligned panel gradually showed me the practical side of geometry in a way textbooks likely couldn't.

From a mathematical perspective, one of the interesting aspects of making a ball is that it takes flat pieces and combines them to make a sphere (the ball)? This involves a change of geometry. What considerations go into your designs to ensure that when inflated the resulting ball really is a sphere?

The process always starts with a story—a goal or message to be communicated through the design. Initial sketches lay the groundwork, followed by a 3D model that visualizes how flat panels will fit together. A paper model is then constructed to test the design, and refinements are made through multiple iterations until the geometry aligns perfectly. Once the design is solidified, a 2D pattern is created, the leather panels are laser cut, and they are finally hand stitched together. This method ensures that even though the panels begin as flat pieces, the inherent curvature is built into the design. For example, when constructing a ball from 12 pentagons, the process takes into account the curvature of each face, so that when the ball is inflated, it forms a true sphere.

This is the "badly drawn ball." Constructed from 32 irregular panels.

A related topic, made famous by Matt Parker is topological failure of British stadium signs that depict a grid of hexagons without any of the pentagons essential in a classic soccer ball design. You worked with Matt to make the impossiball that could look like the sign (at least from one direction). How did you go about creating the panel shapes for this, and did it feel like you were fighting the constraints?

Matt reached out with a really interesting idea. Would it be possible to create a ball that appeared to have the construction of the impossible ball that's depicted on the road signs? We had to cheat of course, because it isn't possible to construct a sphere with hexagons only, but perhaps we could fake it.

The ball appears to be constructed with hexagons only, but only when looked at from 2 specific angles. The panels of the balls are warped in such a way so they appear to be "flat" (only from the 2 specific angles). The process was similar to other balls, but during the modeling phase the camera position was fixed, then tweaks were made so that slowly the panels appeared to look like standard hexagons.

Do you think that practical design and making skills could be a powerful way to help build geometric intuition and help people explore mathematics?

Yes! When I started there wasn't much info out there explaining the process, but I've been working on trying to fix that. I made a step by step tutorial video that shows how to make your first ball, and we've started selling "make a ball kits" that include everything you need to get started.

The best thing is: once you're done learning and making your new toy you can play with it for years!

Have you ever thought about making American footballs, or rugby balls or other non-spherical shapes?

I've received requests over the years, but my answer is always no. Spheres are the superior ball, in my opinion.

Edmund Harriss is an assistant professor of mathematics and art at the University of Arkansas. He has created two coloring books based on advanced mathematics and Hello Numbers, What can you do? *a counting book encouraging play in mathematics from the start.*

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