JOINT MATHEMATICS MEETINGS
BALTIMORE • JAN 16–19, 2019
AMS • MAA

AMS AMERICAN MATHEMATICAL SOCIETY
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MAA MATHEMATICAL ASSOCIATION OF AMERICA

2019 Joint Mathematics Meetings

SECTION CONTENTS

Please note: The times listed herein were current as of press time. For the most up to date JMM 2019 scheduling information, please see: http://jointmathematicsmeetings.org/meetings/national/jmm2019/2217_timetable.html

The American Mathematical Society and the Mathematical Association of America invite you to join them at the largest mathematics meeting in the world when it returns to Baltimore in January!

See https://jointmathematicsmeetings.org/meetings/national/jmm2019/2217_intro for the latest on JMM 2019.

Baltimore, MD

Baltimore Convention Center, Hilton Baltimore, and Marriott Inner Harbor

January 16–19, 2019
Wednesday–Saturday

Meeting #1145
Joint Mathematics Meetings, including the 125th Annual Meeting of the AMS, 102nd Annual Meeting of the Mathematical Association of America (MAA), annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association of Symbolic Logic (ASL), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).
AMS Associate Secretary: Steven Weintraub
MAA Associate Secretary: Tensia Soto
Announcement issue of *Notices*: October 2018
Program first available on AMS website: To be announced

Deadlines
For organizers: Expired
For abstracts: September 25, 2018
The scientific information listed below may be dated. For the latest information, see www.ams.org/meetings/national.html.

Joint Invited Addresses
Sarah Koch, University of Michigan, *What is the shape of a rational map?* (AMS-MAA Invited Address); Wednesday, 11:10 am.
Cathy O'Neil, CEO of ORCAA, *Big data, inequality, and democracy,* (MAA-AMS-SIAM Gerald and Judith Porter Public Lecture); Saturday, 3:00 pm.

Daniel Spielman, Yale University, *Miracles of algebraic graph theory* (AMS-MAA Invited Address);Friday, 11:10 am.
Bryna Kra, Northwestern University, *Dynamics of systems with low complexity* (AWM-AMS Noether Lecture); Thursday, 10:05 am.

Joint Prize Session

In order to showcase the achievements of recipients of the various prizes, the AMS and MAA are co-sponsoring this event at 4:25 pm on Thursday. A cash bar reception will immediately follow. All participants are invited to attend. The AMS, MAA, and SIAM will announce the JPBM Communications Award winner. The AMS, MAA, and SIAM will award the Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student. The AMS and SIAM will announce the Norbert Wiener Prize in Applied Mathematics. The AMS will announce the Levi L. Conant Prize, Mary P. Dolciani Prize for Excellence in Research, AMS E.H. Moore Research Article, AMS David P. Robbins Prize, AMS Ruth Lyttle Satter Prize in Mathematics, the Leroy P. Steele Prizes, and the Oswald Veblen Prize in Geometry. The MAA will award the Chauvenet Prize, the Euler Book Prize, Deborah and Franklin Tepper Haimo Awards for Distinguished College or University Teaching of Mathematics, and the Yueh-Gin Gung and Dr. Charles Y. Hu Award for Distinguished Service to Mathematics. The AWM will present the Louise Hay Award for Contributions to Mathematics Education, the M. Gweneth Humphreys Award for Mentorship of Undergraduate Women in Mathematics, and the Birman Prize in Geometry and Topology.

125th Meeting of the AMS

AMS Invited Addresses

Jesus A. De Loera, University of California, Davis, *Algebraic, geometric, and topological methods in optimization*; Wednesday, 10:05 am.

Peter Oszvath, Princeton University, *Title to be announced,* Thursday, 2:15 pm.

Lior Pachter, University of California Berkeley, *Title to be announced*, Thursday, 3:20 pm.

Alan Perelson, Los Alamos National Laboratory, *Title to be announced* (AMS Josiah Willard Gibbs Lecture); Wednesday, 8:30 pm.

Benedict H. Gross, University of California San Diego, *Complex multiplication: past, present, future* (AMS Colloquium Lectures: Lecture I), Wednesday, 1:00 pm.

Benedict H. Gross, University of California San Diego, *Complex multiplication: past, present, future* (AMS Colloquium Lectures: Lecture II); Thursday, 1:00 pm.

Benedict H. Gross, University of California San Diego, *Complex multiplication: past, present, future* (AMS Colloquium Lectures: Lecture III); Friday, 1:00 pm.

Karen Hunger Parshall, University of Virginia, *The roaring twenties in American mathematics*, Friday, 10:05 am.

Lillian Pierce, Duke University, *Title to be announced*; Saturday, 9:00 am.

AMS Special Sessions

If you are volunteering to speak in a Special Session, you should send your abstract as early as possible via the abstract submission form found at jointmathematicsmeetings.org/meetings /abstracts/abstract.pl?type=jmm.

Some sessions are co-sponsored with other organizations. These are noted within the parenthesis at the end of each listing, where applicable.

25 years of Conferences for African-American Researchers in the Mathematical Sciences (CAARMS times 25) (Code: SS 82A), **William A. Massey**, Princeton University.

A Showcase of Number Theory at Undergraduate Institutions (Code: SS 76A), **Adriana Salerno**, Bates College, and **Lola Thompson**, Oberlin College.

Advances and Applications in Integral and Differential Equations (Code: SS 40A), **Jeffrey T. Neugebauer**, Eastern Kentucky University, and **Min Wang**, Kennesaw State University.

Advances by Early Career Women in Discrete Mathematics (Code: SS 75A), **Jessalyn Bolkema**, State University of New York at Oswego, and **Jessica De Silva**, California State University, Stanislaus.

Advances in Operator Theory, Operator Algebras, and Operator Semigroups (Code: SS 30A), **Joseph Ball**, Virginia Tech, **Marat Markin**, California State University, Fresno, **Igor Nikolaev**, St. John's University, and **Ilya Spitkovsky**, New York University, Abu Dhabi.

Advances in Quantum Walks, Quantum Simulations, and Related Quantum Theory (Code: SS 18A), **Radhakrishnan Balu**, US Army Research Lab, **Chaobin Liu**, Bowie State University, and **Takuya Machida**, Nihon University, Japan.

Agent-based Modeling in Biological and Social Systems(a Mathematics Research Communities Session) (Code: SS 15A).

Algebraic Structures Motivated by Knot Theory (Code: SS 51A), **Mikhail Khovanov**, Columbia University, and **Jozef H. Przytycki** and **Alexander Shumakovitch**, George Washington University.

Algebraic and Geometric Methods in Discrete Optimization (Code: SS 2A), **Amitabh Basu**, Johns Hopkins University, and **Jesus De Loera**, University of California, Davis.

Algebraic, Discrete, Topological and Stochastic Approaches to Modeling in Mathematical Biology (Code: SS 43A), **Olcay Akman**, Illinois State University, **Timothy D. Comar**, Benedictine University, **Daniel Hrozencik**, Chicago State University, and **Raina Robeva**, Sweet Briar College.

Algorithmic Dimensions and Fractal Geometry (Code: SS 37A), **Jack H. Lutz**, Iowa State University, and **Elvira Mayordomo**, University of Zaragoza, Spain (AMS-ASL).

Analysis and Geometry of Nonlinear Evolution Equations (Code: SS 65A), **Marius Beceanu**, University at Albany, State University of New York, and **Dan-Andrei Geba**, University of Rochester.

Analysis of Fractional, Stochastic, and Hybrid Dynamic Systems with Applications (Code: SS 19A), **John R. Graef**, University of Tennessee at Chattanooga, **G. S. Ladde**, University of South Florida, and **A. S. Vatsala**, University of Louisiana at Lafayette.

Analytic Number Theory (Code: SS 33A), **Thomas A. Hulse**, Boston College, **Angel V. Kumchev** and **Nathan McNew**, Towson University, and **John Miller**, The Johns Hopkins University.

Arithmetic Statistics (Code: SS 53A), **Michael Chou** and **Robert Lemke Oliver**, Tufts University, and **Ari Shnidman**, Center for Communications Research-Princeton.

Bifurcations of Difference Equations and Discrete Dynamical Systems with Applications (Code: SS 72A), **Arzu Bilgin**, Recep Tayyip Erdogan University, Turkey, and **Toufik Khyat**, Trinity College.

Commutative Ring Theory: Research for Undergraduate and Early Graduate Students (Code: SS 60A), **Nicholas Baeth**, Franklin and Marshall College, and **Branden Stone**, Hamilton College.

Continued Fractions (Code: SS 35A), **Geremías Polanco Encarnación**, Hampshire College, **James McLaughlin**, West Chester University, **Barry Smith**, Lebanon Valley College, and **Nancy J. Wyshinski**, Trinity College.

Counting Methods in Number Theory (Code: SS 6A), **Lillian Pierce**, Duke University, **Arindam Roy**, Rice University, and **Jiyua Wang**, University of Wisconsin.

Definability and Decidability Problems in Number Theory (Code: SS 24A), **Kirsten Eisenträger**, Pennsylvania State University, **Deidre Haskell**, McMaster University, Ontario, Canada, **Jennifer Park**, University of Michigan, and **Alexandra Shlapentokh**, East Carolina University (AMS-ASL).

Differential Equations on Fractals (Code: SS 87A), **Patricia Alonso-Ruiz**, University of Connecticut, **Joe Chen**, Colgate University, **Luke Rogers**, University of Connecticut, **Robert Strichartz**, Cornell University, and **Alexander Teplyaev**, University of Connecticut.

Enumerative Combinatorics (Code: SS 26A), **Miklos Bona**, University of Florida, and **Cheyne Homberger**, University of Maryland, Baltimore County.

Financial Mathematics (Code: SS 66A), **Maxim Bichuch**, Johns Hopkins University, **Anja Richter**, Baruch College, City University of New York, and **Stephan Sturm**, Worcester Polytechnic Institute.

Geometric and Topological Combinatorics (Code: SS 39A), **Anastasia Chavez** and **Jamie Haddock**, University of California, Davis, and **Annie Raymond**, University of Massachusetts, Amherst.

Geometric and Topological Generalization of Groups (Code: SS 74A), **Amrita Acharyya**, University of Toledo, and **Bikash C. Das**, University of North Georgia.

Geometry Labs United: Research, Visualization, and Outreach (Code: SS 57A), **Marianne Korten**, Kansas State University, and **Sean Lawton** and **Anton Lukyanenko**, George Mason University.

Geometry and Dynamics of Continued Fractions (Code: SS 47A), **Anton Lukyanenko**, George Mason University, and **Joseph Vandehey**, Ohio State University.

Geometry of Representation Spaces (Code: SS 58A), **Sean Lawton**, George Mason University, **Chris Manon**, University of Kentucky, and **Daniel Ramras**, Indiana University-Purdue University Indianapolis.

Group Representation Theory and Character Theory (Code: SS 38A), **Mohammad Reza Darafsheh**, University of Tehran, Iran, and **Manouchehr Misaghian**, Prairie View A&M University.

Harmonic Analysis, Partial Differential Equations, and Applications (Code: SS 44A), **Russell Brown**, University of Kentucky, and **Irina Mitrea**, Temple University.

Harmonic Analysis: New Developments in Oscillatory Integrals(a Mathematics Research Communities Session) (Code: SS 12A), .

History of Mathematics (Code: SS 42A), **Sloan Despeaux**, Western Carolina University, **Jemma Lorenat**, Pitzer College, **Daniel E. Otero**, Xavier University, and **Adrian Rice**, Randolph-Macon College (AMS-MAA-ICHM).

Hopf Algebras and Tensor Categories (Code: SS 62A), **Siu-Hung Ng**, Louisiana State University, **Julia Plavnik**, Texas A&M University, and **Henry Tucker**, University of California, San Diego.

How to Guard an Art Gallery and Other Discrete Mathematical Adventures (In Memory of T. S. Michael, 1960 to 2016) (Code: SS 16A), **Joseph Bonin**, The George Washington University, **Carolyn Chun**, US Naval Academy, and **Nancy Neudauer**, Pacific University.

If You Build It They Will Come: Presentations by Scholars in the National Alliance for Doctoral Studies in the Mathematical Sciences (Code: SS 54A), **David Goldberg**, Purdue University, and **Phil Kutzko**, University of Iowa.

Latinx in Math (Code: SS 34A), **Alexander Diaz-Lopez**, Villanova University, **Laura Escobar**, University of Illi-

nois, and **Juanita Pinzón-Caicedo**, North Carolina State University.

Lattice Path Combinatorics and Applications (Code: SS 68A), **Christian Krattenthaler**, University of Vienna, Austria, and **Alan Krinik** and **Randall J. Swift**, California State Polytechnic University.

Localization and Delocalization for Disordered Quantum Systems (Code: SS 83A), **Peter D. Hislop**, University of Kentucky, **Christoph A. Marx**, Oberlin College, and **Jeffery Schenker**, Michigan State University.

Low Complexity Models in Data Analysis and Machine Learning (Code: SS 55A), **Emily J. King**, University of Bremen, Germany, **Nate Strawn**, Georgetown University, and **Soledad Villar**, New York University.

Mappings on Metric and Banach Spaces with Applications to Fixed Point Theory (Code: SS 63A), **Torrey M. Gallagher**, Bucknell University, and **Christopher J. Lennard**, University of Pittsburgh.

Mathematical Analysis in Fluid Dynamics (Code: SS 31A), **Yanqiu Guo**, Florida International University, **Jinkai Li**, South China Normal University, **Jing Tian**, Towson University, and **Yuncheng You**, University of South Florida.

Mathematical Investigations of Spatial Ecology and Epidemiology (Code: SS 79A), **Leah Shaw** and **Junping Shi**, College of William and Mary, and **Zhisheng Shuai**, University of Central Florida.

Mathematical Models in Ecology, Epidemiology, and Medicine (Code: SS 85A), **Richard Schugart**, Western Kentucky University, and **Najat Ziyadi**, Morgan State University.

Mathematicians at Sea (in the Sky, or on Land): Defense Applications of Mathematics (Code: SS 21A), **Tegan Emerson**, **Timothy Doster**, and **George Stantchev**, Naval Research Laboratory.

Mathematics in the Realm of Cyber Research (Code: SS 22A), **Daniel Bennett**, Army Cyber Institute, **Paul Goethals**, United States Military Academy, and **Natalie Scala**, Towson University.

Mathematics of Coding Theory and Applications (Code: SS 78A), **Hiram Lopez-Valdez** and **Felice Manganiello**, Clemson University, and **Gretchen L. Matthews**, Virginia Tech.

Mathematics of Gravity and Light (a Mathematics Research Communities Session) (Code: SS 11A), .

Multiscale Problems in the Calculus of Variations (Code: SS 46A), **Elisa Davoli**, University of Vienna, Austria, and **Rita Ferreira**, King Abdullah University of Science and Technology, Saudi Arabia.

Natural Resources Modeling (Code: SS 56A), **Julie Blackwood**, Williams College, and **Shandelle M. Henson**, Andrews University.

Network Science (Code: SS 52A), **David Burstein**, Swarthmore College, **Franklin Kenter**, United States Naval Academy, and **Feng 'Bill' Shi**, University of North Carolina.

New Directions in the Theory of Complex Multiplication (Code: SS 1A), **Henri Darmon**, McGill University, **Samit Dasgupta**, University of California, Santa Cruz, and **Benedict Gross**, Harvard University.

Nonlinear Evolution Equations and Their Applications (Code: SS 20A), **Mingchao Cai**, Morgan State University,

Gisele Mophou Loudjom, University of French West Indies, Guadeloupe, France, and **Gaston N'Guerekata**, **Alexander Pankov**, **Xuming Xie**, and **Guoping Zhang**, Morgan State University.

Not KNerds: A Community for Knot Theory (Code: SS 77A), **Moshe Cohen**, Vassar College, **Elizabeth Denne**, Washington and Lee University, and **Adam Lowrance**, Vassar College.

Number Theoretic Methods in Hyperbolic Geometry(a Mathematics Research Communities Session) (Code: SS 14A), **Samantha Fairchild**, University of Washington, **Junxian Li**, University of Illinois Urbana Champaign, and **Richard Vradenburgh**, University of Virginia.

Number Theory, Arithmetic Geometry, and Computation (Code: SS 61A), **Brendan Hassett**, Brown University, **Drew Sutherland**, Massachusetts Institute of Technology, and **John Voight**, Dartmouth College.

Numerical Methods for PDEs and Applications (Code: SS 41A), **Wenrui Hao**, **Qingguo Hong**, and **Jinchao Xu**, Pennsylvania State University.

Optimal Methods in Applicable Analysis: Variational Inequalities, Low Rank Matrix Approximations, Systems Engineering, Cyber Security (Code: SS 81A), **Aritra Dutta**, King Abdullah University of Science and Technology, Saudi Arabia, **Ram Mohapatra**, University of Central Florida, **Gayatri Pany**, Singapore University of Technology and Design, Singapore, and **Nabin Kumar Sahu**, Dhirubhai Ambani Institute of Information and Communication Technology, India.

Orthogonal Polynomials, Quantum Probability, Harmonic and Stochastic Analysis (Code: SS 27A), **Nobuhiro Asai**, Aichi University of Education, Kariya, Japan, **Rodica Costin**, The Ohio State University, **Aurel I. Stan**, The Ohio State University at Marion, and **Hiroaki Yoshida**, Ochanomizu University, Tokyo, Japan.

Partition Theory and Related Topics (Code: SS 80A), **Dennis Eichhorn**, University of California, Irvine, **Tim Huber**, University of Texas, Rio Grande Valley, and **Amita Malik**, Rutgers University.

Problems in Partial Differential Equations (Code: SS 36A), **Alex Himonas**, University of Notre Dame, and **Curtis Holliman**, The Catholic University of America.

Quantum Symmetries: Subfactors and Fusion Categories (a Mathematics Research Communities Session) (Code: SS 13A), **Cain Edie-Michell**, Australian National University, **Lauren Ruth**, UC Riverside, and **Yilong Wang**, Ohio State University.

Quaternions (Code: SS 28A), **Terrence Blackman**, Medgar Evers College, City University of New York, and **Johannes Familton** and **Chris McCarthy**, Borough of Manhattan Community College, City University of New York.

Recent Advancements in Mathematical Modeling of Cancer (Code: SS 49A), **Kamila Larripa**, Humboldt State University, and **Hwayeon Ryu**, University of Hartford.

Recent Advances and Trends in Computable Structure Theory (in honor of J. Remmel) (Code: SS 64A), **Jennifer Chubb**, University of San Francisco, and **Tim McNicholl**, Iowa State University.

Recent Advances in Biological Modeling and Related Dynamical Analysis (Code: SS 69A), **Joshi Raj Hem**, Xavier University, and **Yanyu Xiao**, University of Cincinnati.

Recent Advances in Homological and Commutative Algebra (Code: SS 70A), **Neil Epstein**, George Mason University, **Claudiu Raicu**, Notre Dame University, and **Alexandra Seceleanu**, University of Nebraska.

Recent Advances in Inverse Problems and Imaging (Code: SS 25A), **Kui Ren**, University of Texas at Austin, and **Yang Yang**, Michigan State University.

Recent Advances in Regularity Lemmas (Code: SS 71A), **Gabriel Conant**, University of Notre Dame, **Rehana Patel**, and **Julia Wolf**, University of Bristol, UK.

Recent Progress in Multivariable Operator Theory (Code: SS 86A), **Dmitry Kaliuzhnyi-Verbovetsky** and **Hugo Woerdeman**, Drexel University.

Research in Mathematics by Early Career Graduate Students (Code: SS 84A), **Marat Markin**, **Morgan Rodgers**, **Khang Tran**, and **Oscar Vega**, California State University, Fresno.

Research in Mathematics by Undergraduates and Students in Post-Baccalaureate Programs (Code: SS 32A), **Darren A. Narayan**, Rochester Institute of Technology, **Khang Tran**, California State University, Fresno, **Mark David Ward**, Purdue University, and **John Wierman**, The Johns Hopkins University (AMS-MAA-SIAM).

Riordan Arrays (Code: SS 50A), **Alexander Burstein** and **Dennis Davenport**, Howard University, **Asamoah Nkwanta**, Morgan State University, **Lou Shapiro**, Howard University, and **Leon Woodson**, Morgan State University.

Statistical, Variational, and Learning Techniques in Image Analysis and their Applications to Biomedical, Hyperspectral, and Other Imaging (Code: SS 45A), **Justin Marks**, Gonzaga University, **Laramie Paxton**, Washington State University, and **Viktoria Taroudaki**, Eastern Washington University.

Stochastic Analysis and Applications in Finance, Actuarial Science and Related Fields (Code: SS 17A), **Julius N. Esunge**, University of Mary Washington, **See Keong Lee**, University of the Sciences, Malaysia, and **Aurel I. Stan**, The Ohio State University at Marion.

Stochastic Differential Equations and Applications (Code: SS 59A), **Carey Caginalp**, University of Pittsburgh.

Symbolic Dynamics (Code: SS 9A), **Van Cyr**, Bucknell University, and **Bryna Kra**, Northwestern University.

The Mathematics of Historically Black Colleges and Universities (HBCUs) in the Mid-Atlantic (Code: SS 88A), **Edray Goins**, Purdue University, **Janis Oldham**, North Carolina A&T, **Talitha Washington**, Howard University, and **Scott Williams**, University at Buffalo, State University of New York.

Topological Data Analysis: Theory and Applications (Code: SS 73A), **Justin Curry**, University at Albany, State University of New York, **Mikael Vejdemo-Johansson**, College of Staten Island, City University of New York, and **Sara Kalisnik Verovsek**, Wesleyan University.

Topology, Structure and Symmetry in Graph Theory (Code: SS 48A), **Lowell Abrams**, George Washington University, and **Mark Ellingham**, Vanderbilt University.

Using Modeling to Motivate the Study of Differential Equations (Code: SS 29A), **Robert Kennedy**, Centennial High School, Ellicott City MD, **Audrey Malagon**, Virginia Wesleyan University, **Brian Winkel**, SIMIODE, Cornwall NY, and **Dina Yagodich**, Frederick Community College.

Women in Topology (Code: SS 67A), **Jocelyn Bell**, Hobart and William Smith Colleges, **Rosemary Guzman**, University of Chicago, **Candice Price**, University of San Diego, and **Arunima Ray**, Max Planck Institute for Mathematics, Germany.

AMS Sessions for Contributed Papers

There will be sessions of ten-minute contributed talks. Although an individual may present only one contributed paper at a meeting, any combination of joint authorship may be accepted, provided no individual speaks more than once on the program. Contributed papers will be grouped together by related subject classifications into sessions.

Submission of Abstracts for AMS Sessions

Authors must submit abstracts of talks through `joint mathematicsmeetings.org/meetings/abstracts/ abstract.pl?type=jmm`. Indicate the number of authors for the paper, click on the "New Abstract" button, and you will be taken to the submission form. Simply follow the step-by-step instructions until you receive your unique abstract receipt number. No submission is complete until you are given this number. **The deadline for all submissions is September 25, 2018**. Late papers cannot be accommodated. Please e-mail `abs-coord@ams.org` if you have questions. If you make an inquiry about your specific abstract, please include your abstract receipt number.

Other AMS Sessions

AMS Committee on the Profession Panel Discussion: Permanent teaching faculty in research oriented departments, Wednesday, 4:30–6:00 pm. There is a traditional view of research departments in mathematics where all or almost all the permanent faculty are involved in both teaching and research. For various reasons, in particular financial pressures coming from increasing enrollments and decreasing support, this is not the case at many institutions. It is important for the mathematical community to acknowledge this fact and to see the implications for the profession. The purpose of this panel is to give different perspectives on this issue, both looking at what departments look like now and how we might hope that they should develop.

AMS Education and Diversity Department Panel: Bridge-to-PhD and Postbac Programs Working to Open Doors for Students from Underrepresented Groups, organized by **Helen G. Grundman**, American Mathematical Society; Thursday, 2:45–4:15 pm. Postbac and bridge-to-PhD programs in the mathematical sciences have been gaining popularity as a way to enable promising students who are not yet ready to enter a PhD program a pathway to successfully obtaining the degree. The panelists will describe four different currently-running one-semester to two-year bridge-to-PhD/postbac programs specifically designed to improve the diversity among Mathematics and Applied Mathematics PhDs. Although each of the programs offers students both advanced coursework and one-on-one mentoring in order to prepare them for success in graduate school, the programs differ in many other aspects. Discussion will include the strengths and weaknesses of each of these models, and any advice that the panelists or audience members have for mathematicians interested in starting new programs along these lines. Moderator for this panel will be **Helen G. Grundman**, American Mathematical Society. Panelists are Ruth Haas, University of Hawai'i, **Ryan Hynd**, University of Pennsylvania, and **Trachette Jackson**, University of Michigan, and **Michael Young**, Iowa State University.

AMS Committee on Education Panel Discussion, Thursday, 1:00–2:30 pm.

Grad School Fair, Friday, 8:30–10:30 am. Here is the opportunity for undergrads to meet representatives from mathematical sciences graduate programs from universities all over the country. January is a great time for juniors to learn more, and college seniors may still be able to refine their search. This is your chance for one-stop shopping in the graduate school market. At last year's meeting over 300 students met with representatives from more than 60 graduate programs. If your school has a graduate program and you are interested in participating, for US$125 a table will be provided for your posters and printed materials (**registration for this event must be made by a person already registered for the JMM**), and you are welcome to personally speak to interested students. Complimentary coffee will be served. Co-sponsored by the AMS and MAA.

Current Events Bulletin, organized by **David Eisenbud**, Mathematical Sciences Research Institute; Friday, 1:00 pm–5:00 pm. Speakers in this session follow the model of the Bourbaki Seminars in that mathematicians with strong expository skills speak on work not their own. Written versions of the talks will be distributed at the meeting and will also be available online at `www.ams.org/ams/current-events-bulletin.html` after the conclusion of the meeting.

AMS Committee on Science Policy Panel Discussion, organized by **Anna Mazzucato**, Pennsylvania State University, **Ravi Vakil**, Stanford University, and **Michael Vogelius**, Rutgers, The State University of New Jersey; Friday, 2:30–4:00 pm.

Congressional Fellowship Session, organized by **Karen Saxe**, American Mathematical Society; Friday, 4:30–6:30 pm. This fellowship provides a public policy learning experience, demonstrates the value of science-government interaction and brings a technical background and external perspective to the decision-making process in Congress. Learn more about this program and speak with current and former AMS Fellows. **James Ricci, AMS Congressional Fellow 2018–2019** will speak at this session. Application deadline for the 2018–19 AMS Congressional Fellowship is **February 15, 2019.**

Who Wants to Be a Mathematician Championship, organized by **Michael A. Breen**, American Mathematical Society, and **William T. Butterworth**, DePaul University; Saturday, 1:00 pm–2:45 pm. Show your support for top high school students from the US, Canada, and the UK in this international ***Who Wants to Be a Mathematician*** as they compete for a US$5,000 first prize for themselves and US$5,000 for their school's math department. Semifinals are at 1:00 pm and finals are at 2:00 pm. Come match wits with the contestants, support their mathematical achievement, and have tremendous fun at the same time.

Other AMS Events

Council, Tuesday, 1:30 pm.

Business Meeting, Saturday, 11:45 am. The secretary notes the following resolution of the Council: Each person who attends a business meeting of the Society shall be willing and able to identify himself as a member of the Society. In further explanation, it is noted that each person who is to vote at a meeting is thereby identifying himself as and claiming to be a member of the American Mathematical Society. The Society has a Committee on the Agenda for Business Meetings. The purpose is to make business meetings orderly and effective. The committee does not have legal or administrative power. It is intended that the committee consider what may be called "quasipolitical" motions. The committee has several possible courses of action on a proposed motion, including but not restricted to:

(a) doing nothing,

(b) conferring with supporters and opponents to arrive at a mutually accepted amended version to be circulated in advance of the meeting,

(c) recommending and planning a format for debate to suggest to a business meeting,

(d) recommending referral to a committee, and

(e) recommending debate followed by referral to a committee.

There is no mechanism that requires automatic submission of a motion to the committee. However, if a motion has not been submitted through the committee, it may be thought reasonable by a business meeting to refer it rather than to act on it without benefit of the advice of the committee.

In order that a motion for this business meeting receive the service offered by the committee in the most effective manner, it should be in the hands of the AMS Secretary by **December 13, 2018**.

AMS Short Course on Sum of Squares: Theory and Applications

This two-day course will take place on the Monday and Tuesday before the meeting actually begins. It is organized by **Pablo A. Parrilo**, Massachusetts Institute of Technology, and **Rekha R. Thomas**, University of Washington.

Interest in the theory and application of sums of squares (SOS) polynomials has exploded in the last two decades, spanning a wide spectrum of mathematical disciplines from real algebraic geometry to convex geometry, combinatorics, real analysis, theoretical computer science, quantum information and engineering. SOS theory and applications are accessible to well-prepared undergraduate or beginning graduate students, as well as academics who wish to learn this material.

The origins of SOS polynomials are anchored in the 19th century by Hilbert's famous characterization of nonnegative polynomials that are SOS. In 1924 Artin gave an affirmative answer to Hilbert's 17th problem on whether all nonnegative polynomials were SOS of rational functions. From this the field of real algebraic geometry was born—the study of real solutions to polynomial systems. While real solutions of polynomials equations are considerably more complicated than their complex counterpart, their role in applications cannot be overstated. SOS polynomials have experienced a renaissance in the last few years following the work of Shor, Nesterov, Lasserre, and Parrilo that connected them to modern optimization via semidefinite programming. A diverse interdisciplinary community now exists around SOS polynomials with an array of conferences and research programs at many of the top institutions worldwide. While the theory is rich and fascinating with many open questions, the large array of applications are equally enticing, allowing for many different angles and access points to the field.

Lecture topics will include an *Overview of SOS polynomials* by **Greg Blekherman**, Georgia Institute of Technology; *Lifts of Convex Sets*, **Hamza Fawzi**, University of Cambridge; *Engineering Applications*, **Georgina Hall**, Princeton University; *Theoretical Computer Science*, **Ankur Moitra**, Massachusetts Institute of Technology; *Algebraic Geometry*, **Mauricio Velasco**, Los Andes University, and *Geometry of Spectrahedra*, **Cynthia Vinzant**, North Carolina State University. Problem set sessions are planned for both days, and speakers and organizers will be available to assist participants with these exercises.

There are separate registration fees to participate in this course. Advanced registration fees for members: US$124; nonmember, US$190; student, unemployed, or emeritus members US$72. If you choose to register on-site, the fee for members will be US$158; nonmembers US$225, and student, unemployed, or emeritus members US$93. On-site registration will take place Monday, January 14, 2018 at the Hilton Baltimore. Please see the complete Short Course announcement on page 1131 of this issue, or go to www.ams.org/short-course.

Department Chairs Workshop

This annual one-day workshop for department chairs and leaders is held on Tuesday, 8:00 am–6:30 pm, the day before the JMM actually begins, and is lead by **Malcolm Adams**, University of Georgia, **Gloria Marí-Beffa**, University of Wisconsin-Madison, **Douglas Mupasiri**, University of Northern Iowa, and **Jennifer Zhao**, University of Michigan–Dearborn.

This workshop will examine the chair's role in leading a department. The day will be structured to include and encourage networking and sharing of ideas amongst participants.

There is a separate registration and fee to participate. For further information, please contact the AMS Washington Office at 401-455-4116 or amsdc@ams.org.

102nd Meeting of the MAA

MAA Invited Addresses

Amanda Folsom, Amherst College, *Symmetry, almost*, Wednesday, 2:15 pm.

Emmanuel Candes, Stanford University, S*ailing through data: discoveries and mirages,* Wednesday, 3:20 pm.

Edray Goins, Pomona College, *The past 50 years of African Americans in the mathematical sciences,* Thursday, 9:00 am.

David Bressoud, Macalester College, *Reflections on teaching calculus for the first time, 45 times,* Thursday, 11:10 am. (MAA Project NeXT Lecture on Teaching and Learning)

Pamela Harris, Williams College, *A mathematical journey of culture, community, and collaboration,* Friday, 9:00 am.

Annalisa Crannell, Franklin & Marshall College, *Drawing conclusions from drawing a square*, Friday, 1:00 pm (MAA Lecture for Students).

Deanna Haunsperger, Carlton College**,** *The Inclusion Principle: the importance of community in mathematics,* Saturday, 10:00 am (Retiring Presidential Address).

Presentations by MAA Teaching Award Recipients

Friday, 2:30–3:45 pm, organized by MAA President **Deanna Hausperger**, Carleton College and MAA Secretary **James Sellers**, Pennsylvania State University. Winners of the Deborah and Franklin Tepper Haimo Awards for Distinguished College or University Teaching will give presentations on the secrets of their success.

MAA Invited Paper Sessions

Trends in Mathematical and Computational Biology, organized by **Timothy Comar,** Benedictine University, **Alicia Prieto Langarcia,** Youngstown State University, and **Raina Robeva,** Sweet Briar College; Wednesday, 8:00–10:50 am. Mathematical and computational biology encompasses a diverse range of biological phenomena and quantitative methods for exploring those phenomena. The pace of research at this junction continues to accelerate and substantial advancements in problems from gene regulation, genomics, phylogenetics, RNA folding, evolution, infectious disease dynamics, neuroscience, growth and control of populations, ecological networks, drug resistance modeling, and medical breakthroughs related to cancer therapies have increasingly ensued from utilizing mathematical and computational approaches. Our session on current trends will sample from this 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. Mathematical approaches will include deterministic and stochastic continuous dynamical models, as well as finite dynamical systems and combinatorial and algebraic methods.

Building Successful Communities in Mathematics, organized by **Deanna Haunsperger,** Carlton College; Wednesday, 8:00–11:00 am. Mathematicians have always formed communities, but over the past couple decades, some groups have become more deliberate in the formation of communities to provide support and a mathematical home for their people. Whether those communities are structured around geographic area, mathematical field, gender, stage of career, or some other attribute, they can provide welcoming and supportive environments for their members and have become an important aspect of some folks' professional identities. Some of these programs have demonstrably aided in the persistence of members of underrepresented groups; examples of such programs will be featured in the session.

Using Research about Teaching and Learning to Inform the Preparation of Graduate Students to Teach, organized by **Jack Bookman,** Carlton College and **Teri J. Murphy**, University of Cincinnati; Wednesday, 2:15–3:15 pm. Many groups within the mathematics community have called for increased attention to the preparation we provide to graduate students for their teaching responsibilities. These efforts are especially important because of the roles graduate students play in introductory mathematics instruction and the impact of experiences in introductory courses on student outcomes, enrollment, and retention rates in STEM majors. To support these efforts, the College Mathematics Instructor Development Source (CoMInDS) project, which is based at MAA and funded by NSF (DUE Award #1432381), assists faculty in the design and implementation of professional development for mathematics graduate students. One component of this assistance has been a summer workshop at which mathematics faculty (who will be providing the professional development to mathematics graduate students) have opportunities to gain familiarity with research on the teaching and learning of mathematics, learn about available instructional materials and evaluation, and design their department's program.

As part of our efforts to provide this assistance to a wider audience in the mathematics community, this session will highlight key findings from research on the teaching and learning of mathematics and showcase activities for mathematics graduate student professional development. Presentations in the session will be tied to themes in the MAA's Instructional Practices (IP) Guide. Specifically, we will focus on information relevant to supporting mathematics graduate students to utilize approaches highlighted in the Classroom Practices section of the IP Guide: Fostering Student Engagement and Selecting Appropriate Mathematical Tasks.

Research in Improving Undergraduate Mathematical Sciences Education: Examples Supported by the National

Science Foundation's IUSE: EHR Program, organized by **Ron Buckmire**, **Karen Keene, Sandra Richardson, Talitha Washington,** and **Lee Zia**, National Science Foundation (NSF); Directorate for Education and Human Resources (EHR); Division of Undergraduate Education (DUE); Thursday, 8:00–11:00 am. In this Invited Paper Session, research and findings will be presented from projects funded by the National Science Foundation Division of Undergraduate Education's Improving Undergraduate STEM Education (IUSE) Program. The purpose of this session is to provide a venue for the mathematical sciences community to share recent research from innovations related to undergraduate mathematical sciences.

The session will highlight research from ongoing IUSE-funded projects, with a focus on the study of the teaching and learning of undergraduate mathematical sciences. Session topics will include research findings from one or more of the following themes related to undergraduate mathematical sciences education: (1) Systemic structures to support effective teaching and broadening participation; (2) Curricular and pedagogical innovations to strengthen student experiences in mathematical sciences learning; and (3) Effective use of digital tools and other sources as teaching and learning resources. Because some projects are in early stages of project development and analysis, research findings may be preliminary.

Inspiring Diversity in Mathematics: Culture, Community, and Collaboration, organized by **Pamela Harris**, Williams College, **Alicia Prieto Langarica**, Youngstown State University, and **Chad Topaz,** Williams College; Thursday, 8:00–12:00 pm. Due to the historical lack of visibility of minority mathematicians, students may continue to believe that they cannot pursue scientific careers nor belong in the mathematical community. This is an issue we must address in order to diversify the sciences. The goals of this session are twofold: to discuss some current statistics concerning under-representation in the mathematical community and to present programs, opportunities, and pedagogical techniques that aim to address this under-representation.

Modular Forms: Aesthetics and Applications, organized by **Amanda Folsom**, Amherst College; Thursday, 1:00–4:00 pm. Modular forms are seemingly ubiquitous. Their inherent symmetries have driven research directions for over a century, and have led to major theoretical advances in mathematics and number theory, as well as applications to many diverse areas including mathematical physics, combinatorics, representation theory, and more. This session will feature speakers whose research has emphasized aesthetics and applications of modular forms and related functions. In particular, the work of many speakers relates to the more recent theory of and applications of harmonic Maass forms (2002–present), which are rooted in both original theory due to Maass from the 1950s as well as the enigmatic work of Ramanujan from 1920 on his mock theta functions.

The Past 50 Years of African Americans in the Mathematical Sciences, organized by **Edray Goins**, Pomona College; Friday, 8:00–11:00 am. 2019 marks the 50th Anniversary of the founding of the National Association of Mathematicians. NAM seeks is to promote excellence in the mathematical sciences for underrepresented minorities in general and African-Americans in particular. In the 50 years since the founding of NAM, we have seen many milestones. In 1995, the annual Conference for African American Researchers in the Mathematical Sciences (CAARMS) began at MSRI. In 1997, Scott Williams started the website "Mathematicians of the African Diaspora," and Kate Okikiolu bacame the first African American to win a Sloan Research Fellowship. In 2000, three African American Women graduated from the University of Maryland — the first year any African American women had done so. In 2005, the bi-annual Infinite Possibilities Conference (IPC) began at Spelman College. In this session, we celebrate those African Americans who have advanced knowledge in the mathematical sciences through their research and commitment to community.

Mathematical Thinking for Modern Data Science Problems, organized by **Rick Cleary**, Babson College, and **Diana Thomas**, US Military Academy; Friday, 1:00–3:30 pm. With the increasing wealth of data obtained by sensors, internet, and smart phones, data analysis is filled with familiar terms like artificial intelligence and big data. Many schools have diversified their mathematics offerings to include modern topics like machine learning and big data analytics. But even with these tools available, real applications are challenging and typically require a mix of modern and traditional approaches. This is certainly the case when searching for rare events in large data sets. For example, how do we use big data to predict rare events that have huge impact, like a severe injury or a specific pregnancy complication? How do we identify individuals inside a noisy data environment who may want to stay hidden, like a terrorist? How does a pro sports franchise find the future all star currently not on the radar of scouts and coaches?

Speakers will detail the work they have done with subject area experts in fields like health, education, public policy, business, and sports science, our speakers present some unusual data science problems, describe why they are challenging, and propose solutions. We will show how fundamental mathematical concepts and problem solving skills relate to these important real world problems.

Beauty and Art from Research Mathematics, organized by **Diana Davis**, Swarthmore College; Saturday, 8:00–11:00 am. Research mathematics can produce beautiful pictures, beautiful objects, and even beautiful movies or other art forms. In this session, we will showcase some of the beautiful art that has been created as a byproduct of research mathematics. Each speaker will introduce their research, and then display the resulting art, explaining its mathematical significance and also allowing attendees to appreciate its beauty.

Research in Undergraduate Mathematics Education: Highlights from the Annual SIGMAA on RUME Conference, organized by **Megan Wawro,** Virginia Tech and **Aaron Weinberg**, Ithaca College; Saturday, 8:30–10:50 am. The purpose of the SIGMAA on Research in Undergraduate

Mathematics Education (RUME) is to foster research on the teaching and learning of undergraduate mathematics and to provide a support network for those who participate in this area of research. Current research foci include insights regarding: students' understanding of concepts in undergraduate mathematics courses such as calculus, differential equations, linear algebra, real analysis, or abstract algebra; student and instructor engagement in mathematical practices that transcend particular content, such as defining and proving; and the impact of various instructional methods on equity and student learning. The 2019 MAA Invited Paper Session on Research in Undergraduate Mathematics Education will highlight exemplary current research in the field. In particular, it will showcase 4–6 research papers that were presented at the 21st Annual SIGMAA on RUME Conference, which took place in San Diego, CA in February 2018.

Mathematics and Policy, organized by **Eric Marland** and **Rick Klima,** Appalachian State University; Saturday, 1:00–4:40 pm. Mathematics and policy meet at an awkward intersection, a conflict of simplicity and rigor, imposing practicality on impossibility, and making transparent decisions in an uncertain world. But the purpose of bringing policy and mathematics together is to find a balance and increase communication and discourse along a complex interface. Many times we find success simply from arranging to have the right people in the room together. Rather than focus on one aspect of this interface, we propose a broader look into the politics of mathematics and the mathematics of policy.

Bringing together several groups who are interested in a common topic, but who have very different ideas on what the topic really is, can spark innovation and conversations that would not otherwise take place. From working directly with policy makers to understanding policies; from developing policy to critiquing policy. How can the mathematics of gerrymandering influence practicing policy makers? How can insights in one arena help craft policy in another? How can the interaction between scientists and policy makers change the way we present our results?

MAA Minicourses

MAA Minicourses are open only to persons who register for the Joint Meetings and pay the Joint Meetings registration fee in addition to the appropriate minicourse fee. The MAA reserves the right to cancel any minicourse that is undersubscribed. Participants should read the descriptions of each minicourse thoroughly as some require participants to bring their own laptops and special software; laptops will not be provided in any minicourse. The enrollment in each minicourse is limited to 50; the cost is US$100.

Minicourse #1. *Mathematical Inquiry and Writing through Sports*, presented by **Eric Kahn**, Bloomsburg University, and **Tricia Muldoon Brown**, Georgia Southern University, ; Part A, Wednesday, 9:00–11:00 am, and Part B, Friday, 9:00–11:00 am. Two evidence-supported strategies to facilitate effective learning of undergraduate mathematics, topics introductory through advanced in nature, are in-quiry and writing. This minicourse introduces participants to these two techniques via the real-world framework of sports. Together, participants and moderators will work through sample in-class activities used in introductory mathematics courses such as Math for the Liberal Arts and Introduction to Statistics which utilize a variety of sports in order to demonstrate learning with a mathematical inquiry approach. We will provide a session guiding participants on finding and manipulating actual sports data for use in their own projects and outline possible solutions for sample writing projects provided by the moderators. Finally, participants will spend time collaboratively designing their own inquiry-based activities and writing projects using the medium of sports. The minicourse will be run as an interactive workshop, so for the greatest impact, participants should bring a laptop with wireless internet accessibility.

Minicourse #2. *Start Teaching Statistics using R and RStudio,* presented by **Randall Pruim,** Calvin College and **Shonda Kuiper,** Grinnell College; Part A, Wednesday, 9:00–11:00 am, and Part B, Thursday, 9:00–11:00 am. R is a freely available language and environment for statistical computing and graphics that has become popular in academia and in many industries. But can it be used with students? This mini-course will introduce participants to teaching applied statistics courses using computing in an integrated way. The presenters will share an approach and some favorite examples for using R to teach statistics to undergraduates at all levels.

Topics will include adopting a "Less Volume, More Creativity" approach to provide novices with a powerful but manageable set of tools, workflow in the RStudio environment, data visualization, basic statistical inference using R, and using R Markdown to create documents that include both text and R output. Much of this will be facilitated using packages developed by Project MOSAIC, an NSF-funded project seeking to increase the use of modeling and computation throughout the undergraduate curriculum. This minicourse is designed to be accessible to those with little or no experience teaching with R, and will provide participants with skills, examples, and resources that they can use in their own teaching. Participants should bring a laptop to the session. Each participant will be given access to an RStudio server account, so it is not necessary to have R or RStudio installed on the laptop. A web browser and internet capability should suffice. This course is sponsored by the SIGMAA on Statistics Education (SIGMAA STAT ED).

Minicourse #3. *Advanced Authoring in WeBWorK: Turn good math problems into great ones & submit them to the OpenProblemLibrary*, presented by **Marianna Bonanome**, NYC College of Technology, **Samar ElHitti,** NYC College of Technology, **Michael E. Gage**, University of Rochester, and **K. Andrew Parker,** NYC College of Technology; Part A, Wednesday, 2:15–4:15 pm, and Part B, Friday, 1:00–3:00 pm. This minicourse provides advanced training in authoring WeBWorK questions and submitting the results to the OpenProblemLibrary. After reviewing basic authoring, including PGML, participants will practice

customizing hints and error messages, creating scaffolded "classwork" problems, using "niceTables" for accessibility, creating "draggable proofs" and, customizing problems which interact with R, SageMath and/or Geogebra. We'll set up a local OPL and practice uploading problems and contributing them to the WeBWorK community OPL on github.com. We will also give directions for installing "WeBWorK-in-Docker" on your laptop thereby creating a private development site on your laptop, isolated from the rest of your work, which you can turn on or off at will. Anyone is welcome, but our focus is on those familiar with WeBWorK who want to strengthen their authoring ability and to contribute to WeBWorK's OpenProblemLibrary. This course is sponsored by MAA Committee on Technology in Mathematics Education.

Minicourse #4. *Teaching an Undergraduate Computational Science Course*, presented by **Joseph Eichholz** and **Allen Holder,** Rose–Hulman Insitute of Technology; Part A, Wednesday, 2:15–4:15 pm, and Part B, Friday, 1:00–3:00 pm. This minicourse is designed to help participants offer a computational science/modeling course at their home institution. The minicourse will have three segments: (1) a short overview of curricular goals, what is computational science, how a computational science is different from a numerical analysis course; (2) discussion of several different course projects, including modeling aeronautic lift, modeling radiotherapy, signal processing, portfolio optimization and stock pricing, and modeling fluid flows; and (3) a survey of resources that are available to instructors, and discussion of best practices. Throughout the minicourse participants will be actively engaged in discussions and completing portions of the projects. A background in computational science is not assumed.

Minicourse #5. *IBL SIGMAA Minicourse: Introduction to Inquiry-Based Learning*, presented by **Susan Crook,** Loras University, **Eric Kahn,** Bloomsberg University, **Brian Katz,** Augustana College, **Victor Piercey,** Ferris State University, **Candice Price,** University of San Diego, and **Xiao Xiao,** Utica College; Part A, Thursday, 9:00–11:00 am, and Part B, Saturday, 9:00–11:00 am. This minicourse will be a hands-on introduction to inquiry-based learning. Inquiry-based learning is a pedagogical approach that strongly emphasizes active learning and sense-making. During the minicourse, the facilitators and participants will model some typical IBL classroom modes as teachers and students and then reflect on and analyze these experiences. Discussion will include finding and using existing resources that support inquiry-based teaching and a variety of manners in which participants can use them to integrate some IBL practices into their classrooms. The minicourse is intended for new users of inquiry-based learning and for faculty who are interested in becoming new users. By the end, the participants will be familiar with resources and facilitation methods for using inquiry-based learning in the classroom.

Minicourse #6. *Visualizing Multivariable Calculus & Differential Equations using CalcPlot3D*, presented by **Paul E. Seeburger,** Monroe Community College, and **Monica VanDieren,** Robert Mor-

ris University; Part A, Friday, 9:00–11:00 am, and Part B, Saturday, 1:00–3:00 pm. This course explores the use of CalcPlot3D to visualize topics in multivariable calculus and differential equations. CalcPlot3D is a versatile JavaScript web app for use on phones, tablets and computers, developed by the presenter through NSF-IUSE #1524968. Participants will use the app to visually verify problems from a variety of topics in both courses including the plane through 3 points, the intersection of two surfaces, the domain of a function of two variables, the general solution of a first-order differential equation, and general solutions of systems of differential equations. We will also explore a series of hands-on concept explorations designed to facilitate student understanding through exploration and visualization of a series of dynamic examples. Exploration topics include: dot product, cross product, velocity & acceleration vectors, Lagrange multiplier optimization, planes and lines in space, translations and transformations of surfaces, and TNB frames. Participants will learn to customize this app to create dynamic demonstrations and guided exploration activities of their own for student use and create files for 3D printing surfaces from the app. Participants will receive 3D glasses. Bring a laptop. See https://sites.monroecc.edu/multivariablecalculus/. This course is sponsored by WebSIGMAA.

Minicourse #7. *Using Data Applications to Inspire Linear Algebra Topics in the Classroom*, presented by **Tom Asaki,** Washington State University, **Amanda Harsy**, Lewis University, **Heather A. Moon,** Lewis–Clark State College, and **Marie A. Snipes,** Kenyon College; Part A, Wednesday, 9:00–11:00 am, and Part B, Friday, 9:00–11:00 am. This minicourse is designed for participants who wish to incorporate data applications into their linear algebra courses. It provides a hands-on introduction to two data applications that inspire a host of linear algebra topics in the classroom: brain scan tomography (3d image reconstruction) and heat diffusion (diffusion welding and image warping). Participants will work with these applications using either Matlab or Octave, but no prior experience with these programs is required. There will also be time for pedagogical advice and group discussions regarding how to adapt the provided code and materials to one's own course.

Minicourse #8. *Dance and Mathematics*, presented by **Karl Schaffe**, De Anza College; Part A, Thursday, 9:00–11:00 am, and Part B, Saturday, 9:00–11:00 am. In this Minicourse we will present several activities which combine dance and mathematics content in nontrivial ways. The activities connect to a variety of dance forms, as well as to several areas of mathematics, including symmetry, number theory, combinatorics, dynamical systems, and topology. Participants will take away activities useful in a wide range of undergraduate math classes or math clubs. The activities are collaborative and physically comfortable, and easily performed by those with little or no dance experience. These include folk dances, improvisations, and choreographic exercises with specific mathematical content, as well as kinesthetic tasks involving explorations of

mathematical principles. In all cases, mathematics will illuminate the dance explorations, and the dance activity will realize, in kinesthetic form, the mathematical concepts.

Minicourse #9. *Mathematical Art from Complex Analysis*, presented by **Frank Farris,** Santa Clara University; Part A, Wednesday, 2:15–4:15 pm and Part B, Thursday, 1:00–3:00 pm. Learn the theory and practice of making art with the domain-coloring algorithm, a distinctive approach to creating patterns from continuous, complex-valued functions. Students will learn to use the open-source SymmetryWorks software package (Windows and Mac), written by students at Bowdoin College, to turn their own photographs into rosettes, friezes, and wallpaper patterns. We also connect to the theory of complex variables, with visual connections to analytic and nonanalytic functions. Being able to make your own images will enhance your teaching of abstract algebra, complex variables, and many other courses; besides, it's fun!

Minicourse #10. *Object Based Learning and the Smithsonian Learning Lab*, presented by **Amy Shell-Gellasch,** Eastern Michigan University; Part A, Thursday, 1:00–3:00 pm, and Part B, Allowing students to handle and study physical objects (object based learning) in the classroom enhances interest and understanding. However it is not always convenient or possible to bring physical objects into the classroom. In those cases, images, videos, even audio can provide the same pedagogical benefits. In particular, museum and library collections such as the vast Smithsonian holdings are a wealth of mostly untapped material for the classroom. In 2016 the Smithsonian Center for Learning and Digital Access launched the Smithsonian Learning Lab (SLL). The Learning Lab is a free online resource platform for educators and is ideal for objected based learning in and outside of class. College educators have used this platform in all courses of study. Choose from over 2 million images and resources at the Smithsonian or import materials from other sources. Create a collection of items and materials for your course that students then access in class or at home for discussion or assignments. Students can also create their own collections for assignments or portfolios.

In this four-hour minicourse, we will explore methods and resources for using object based learning in the classroom. Participants will then create a free Smithsonian Learning Lab login, learn how to access Smithsonian materials, and how to create a course collection of annotated materials from the Smithsonian collections and beyond for use in a class they teach.

Minicourse #11. *How to Run Successful Math Circles for Students and Teachers*, presented by **Jane H. Long,** Stephen F. Austin State University, **Gabriella Pinter,** University of Wisconsin Milwaukee, and **Diana White,** University of Colorado Denver and National Association of Math Circles; Part A, Thursday, 1:00–3:00 pm, and Part B, Saturday, 8:00–10:00 am. Math Circles are a unique form of outreach through which mathematics professionals share their passion for mathematics with K–12 students and teachers. During a Math Circle, participants explore, create and communicate substantive mathematics, increase their

problem-solving skills, and perhaps most importantly, develop a deeper enjoyment of the subject. Including all types of Math Circles, there are currently over 250 Math Circles across the United States. In this minicourse, participants will experience Math Circle activities and discuss related topics including effective facilitation of sessions, recruiting, logistics, and successful Math Circle models. Participants should be well on their way to starting their own Math Circle after this course. This course is sponsored by SIGMAA on Math Circles for Students and Teachers (SIGMAA-MCST).

Minicourse #12. *Keep Teaching Statistics using R and RStudio*, presented by presented by **Randall Pruim,** Calvin College and **Shonda Kuiper,** Grinnell College; Part A, Friday, 1:00–3:00 pm, and Part B, Saturday, 1:00–3:00 pm. This minicourse is intended for those who are already familiar with R and RStudio or who have co-registered for the Start Teaching Statistics using R and RStudio minicourse and will provide an introduction to additional aspects of R that are useful for teaching statistics and data science courses at a variety of levels. Topics will include data wrangling (obtaining data and transforming it into useful formats) using the tidyverse suite of tools, creating interactive instructional resources (e.g., with learnr tutorials or shiny documents), as well as additional modeling topics (such as simulation-based inference, machine learning, and visualizing models).

Participants should bring a laptop to the session. Each participant will be given access to an RStudio server account, so it is not necessary to have R or RStudio installed on the laptop. A web browser and internet capability should suffice. This course is sponsored by SIGMAA Stat Ed.

MAA Contributed Papers

The MAA Committee on Sessions of Contributed Papers solicits papers pertinent to the sessions listed below. Any paper that fits the subject of one of the themed sessions should be submitted directly to that session. All others should be submitted to the general sessions, which will accept abstracts in all areas of collegiate mathematics, mathematical pedagogy, and the undergraduate mathematics curriculum. Contributed Paper Session presentations in the themed sessions are limited to 15 minutes in length while presentations in the general sessions are limited to 10 minutes each. Potential submitters are advised to read the full descriptions of these sessions at `jointmathematicsmeetings` `.org/meetings/national/jmm2018/JMM2018_MAA` `_Call_for_Papers.pdf`.

The deadline for submission of abstracts is Tuesday, September 25, 2018.

MAA Contributed Paper Sessions with Themes

Approaches to Mathematics Remediation in Baccalaureate-Granting Institutions, organized by **Michael Boardman,** Pacific University, **Helen E. Burn,** Highline College,

and **Mary E. Pilgrim**, Colorado State University, Saturday morning.

Discrete Mathematics in the Undergraduate Curriculum—Ideas and Innovations in Teaching, organized by **John Caughman**, Portland State University, **Oscar Levin**, University of Northern Colorado, and **Elise Lockwood**, Oregon State University, Wednesday morning and afternoon.

The EDGE (Enhancing Diversity in Graduate Education) program: Pure and Applied talks by Women Math Warriors, organized by **Laurel Ohm**, University of Minnesota, and **Shanise Walker**, Iowa State University, Thursday afternoon.

Discrete Mathematics in the Undergraduate Curriculum – Ideas and Innovations in Teaching, organized by **Elise Lockwood**, Oregon State University, **John Caughman**, Portland State University, and **Art Duval**, University of Texas El Paso; Wednesday afternoon.

Ethnomathematics: Ideas and Innovations in the Classroom, organized by **Janet Beery**, University of Redlands, **Antonia Cardwell**, Millersville University of Pennsylvania, **Ximena Catepillan**, Millersville University of Pennsylvania, and **Amy Shell-Gellasch**, Eastern Michigan University, Friday morning. Sponsored by the History of Mathematics SIGMAA.

Formative and Summative Assessment of Mathematical Communication and Conceptual Understanding, organized by **Jessica OShaughnessy**, Shenandoah University, and **Jana Talley**, Jackson State University, Thursday afternoon.

Fostering Creativity in Undergraduate Mathematics Courses, organized by **Emily S. Cilli-Turner**, University of Washington Tacoma, **Houssein El Turkey**, University of New Haven, **Gulden Karakok**, University of Northern Colorado, **Milos Savic**, University of Oklahoma, and **Gail Tang**, University of La Verne, Saturday morning.

Good Math from Bad: Crackpots, Cranks, and Progress, organized by **Elizabeth T. Brown**, James Madison University, and **Samuel R. Kaplan**, University of North Carolina Asheville, Friday afternoon.

Humanistic Mathematics, organized by **Gizem Karaali**, Pomona College, and **Eric Marland**, Appalachian State University, Thursday morning. Sponsored by the MAA Curriculum Renewal Across the First Two Years (CRAFTY) and the Journal of Humanistic Mathematics.

Inclusive Excellence—Attracting, Involving, and Retaining Women and Underrepresented Groups in Mathematics, organized by **Francesca Bernardi**, University of North Carolina at Chapel Hill, **Meghan DeWitt**, St Thomas Aquinas College, **Semra Kilic-Bahi**, Colby–Sawyer College, and **Minah Oh**, James Madison University, Saturday morning. Sponsored by the MAA Committee on the Participation of Women in Mathematics.

Incorporating Programming and Computing in the Math Major Curriculum, organized by **Holly Peters Hirst**, Appalachian State University, and **Gregory S. Rhoads**, Appalachian State University, Saturday morning.

Inequalities and Their Applications, organized by **Titu Andreescu**, University of Texas at Dallas, and **Henry J. Ricardo**, Westchester Area Math Circle, Thursday morning.

Infusing Data Science and Big Data into the Statistics Classroom, organized by **Allen Harbaugh**, Boston University, Wednesday afternoon. Sponsored by the SIGMAA on Statistics Education (SIGMAA STAT ED).

Innovative Curricular Strategies for Increasing Mathematics Majors, organized by **Stuart Boersma**, Central Washington University, **Eric Marland**, Appalachian State University, **Victor Piercey**, Ferris State University, and **Frank Savina**, University of Texas at Austin, Wednesday morning. Sponsored by the MAA Curriculum Renewal Across the First Two Years (CRAFTY).

Innovative and Effective Ways to Teach Linear Algebra, organized by **Sepideh Stewart**, University of Oklahoma, **Gil Strang**, Massachusetts Institute of Technology, **David Strong**, Pepperdine University, and **Megan Wawro**, Virginia Tech, Thursday morning.

Innovative Pathways to Quantitative Literacy, organized by **Catherine Crockett**, Point Loma Nazarene University, **Keith Hubbard**, Stephen F. Austin State University, and **Jennifer Nordstrom**, Linfield College, Saturday morning. Sponsored by the MAA Committee on Articulation and Placement MAA Subcommittee on Curriculum Renewal Across the First Two Year SIGMAA on Quantitative Literacy.

Inquiry-Based Learning and Teaching, organized by **Susan Crook**, Loras College, **Eric Kahn**, Bloomsburg University, **Brian Katz**, Augustana College, **Amy Ksir**, United States Naval Academy, **Victor Piercey**, Ferris State University, **Candice Price**, University of San Diego, and **Xiao Xiao**, Utica College, Friday morning and afternoon. Sponsored by the SIGMAA on Inquiry-Based Learning (IBL SIGMAA).

Integrated STEM Instruction in Undergraduate Mathematics, organized by **Jeneva Clark**, University of Tennessee, Knoxville, and **Anant Godbole**, East Tennessee State University, Thursday afternoon.

Integrating Research into the Undergraduate Classroom, organized by **Timothy B. Flowers**, Indiana University of Pennsylvania, and **Shannon R. Lockard**, Bridgewater State University, Wednesday afternoon.

Introducing Mathematical Modeling through Competitions, organized by **Chris Arney**, United States Military Academy, **William C. Bauldry**, Appalachian State University, and **Amanda Beecher**, Ramapo College, Thursday morning. Sponsored by COMAP and SIMIODE.

It's Circular: Conjecture, Compute, Iterate, organized by **Thomas J. Clark**, Dordt College, and **James Taylor**, Math Circles Collaborative of New Mexico, Friday afternoon. Sponsored by SIGMAA-MCST.

Mathematical Experiences and Projects in Business, Industry, and Government (BIG), organized by **Robert Burks**, Naval Postgraduate School, and **Allen Butler**, Wagner Associates, Friday morning. This session is sponsored by the SIGMAA on Business, Industry, and Government. Sponsored by the Business Industry Government Special Interest Group of the Mathematical Association of America (BIG SIGMAA).

Mathematical Themes in a First-Year Seminar, organized by **Jennifer Bowen**, College of Wooster, **Mark Kozek**,

Whittier College, **Pamela Pierce**, College of Wooster, and **Jennifer Schaefer**, Dickinson College, Friday afternoon.

Mathematics and the Arts, organized by **Karl Kattchee**, University of Wisconsin–LaCrosse, **Douglas Norton**, Villanova University, and **Anil Venkatesh**, Ferris State, Wednesday morning and afternoon. Sponsored by SIGMAA-ARTS.

Mathematics and the Life Sciences: Initiatives, Programs, Curricula, organized by **Timothy D. Comar**, Benedictine University, **Carrie Diaz Eaton**, Unity College, and **Raina Robeva**, Sweet Briar College, Thursday morning. Sponsored by the SIGMAA on Mathematical and Computational Biology (BIO SIGMAA).

Mathematics and Sports, organized by **John David**, Virginia Military Institute, and Drew Pasteur, College of Wooster, Wednesday afternoon. Sponsored by the Sports SIGMAA.

Meaningful Modeling in the First Two Years of College, organized by **William C. Bauldry**, Appalachian State University, and **Mary R. Parker**, Austin Community College, Saturday afternoon. Sponsored by the MAA Mathematics Across the Disciplines (MAD) Subcommittee and the MAA Curriculum Renewal Across the First Two Years (CRAFTY) Subcommittee.

Open Educational Resources: Combining Technological Tools and Innovative Practices to Improve Student Learning, organized by **Benjamin Atchison**, Framingham State University, **Marianna Bonanome**, New York City College of Technology, **Margaret Dean**, Borough of Manhattan Community College, **Michael Gage**, University of Rochester, and **Annie Han**, Borough of Manhattan Community College, Friday morning. Sponsored by the MAA Committee on Technologies in Mathematics Education (CTiME).

Philosophy of Mathematics, organized by **Jeffrey Buechner**, Rutgers University – Newark, and **Bonnie Gold**, Monmouth University (retired), Friday morning. Sponsored by POMSIGMAA.

Research in Undergraduate Mathematics Education (RUME), organized by **Stacy Brown**, California State Polytechnic University, **Megan Wawro**, Virginia Tech, and **Aaron Weinberg**, Ithaca College, Thursday morning and afternoon, and Friday morning and afternoon. Sponsored by SIGMAA RUME.

Revitalizing Complex Analysis, organized by **Michael Brilleslyper**, United States Air Force Academy, **Russell Howell**, Westmont College, and **Beth Schaubroeck**, United States Air Force Academy, Thursday afternoon.

The Scholarship of Teaching and Learning in Collegiate Mathematics, organized by **Tom Banchoff**, Brown University, **Curtis Bennett**, California State University, Long Beach, **Pam Crawford**, Jacksonville University, **Jacqueline Dewar**, Loyola Marymount University, **Edwin Herman**, University of Wisconsin–Stevens Point, and **Lew Ludwig**, Denison University, Wednesday morning & afternoon.

The Teaching and Learning of Undergraduate Ordinary Differential Equations, organized by **Christopher S. Goodrich**, Creighton Preparatory School, and **Beverly H. West**, Cornell University, Friday afternoon. Sponsored by CODEE (Consortium of Ordinary Differential Equations Educators).

Technology and Resources in Statistics Education, organized by **Stacey Hancock**, Montana State University, and **Karl RB Schmitt**, Valparaiso University, Friday afternoon. Sponsored by the Committee on Technology in Mathematics Education SIGMAA-Statistics Education.

Touch it, Feel it, Learn it: Tactile learning activities in the undergraduate mathematics classroom, organized by **Chris Oehrlein**, Oklahoma City Community College, **Ann Trenk**, Wellesley College, and **Laura Watkins**, Glendale Community College, Thursday afternoon. Sponsored by the Professional Development committee and the Committee on Two-Year Colleges.

Undergraduate Student TAs in Mathematics, organized by **Aaron Peterson** and **Ursula Porod**, Northwestern University, Wednesday afternoon.

General Contributed Paper Sessions, organized by **Emelie Kenney**, Sienna College, and **Melvin Royer**, Indiana Wesleyan University; Wednesday, Thursday, Friday, and Saturday, mornings and afternoons. These sessions accept contributions in all areas of mathematics, curriculum, and pedagogy. When you submit your abstract you will be asked to classify it according to the following scheme: Assessment; History or Philosophy of Mathematics; Interdisciplinary Topics in Mathematics; Mathematics and Technology; Mentoring; Modeling and Applications; Outreach; Teaching and Learning Developmental Mathematics; Teaching and Learning Introductory Mathematics; Teaching and Learning Calculus; Teaching and Learning Advanced Mathematics; Algebra; Analysis; Applied Mathematics; Geometry; Graph Theory; Linear Algebra; Logic and Foundations; Number Theory; Probability and Statistics; Topology; and Other Topics.

See also the *AMS-MAA-SIAM Special Session on Research in Mathematics by Undergraduates and Students in Post-Baccalaureate Programs*, organized by **Darren A. Narayan,** Rochester Institute of Technology, **Khang Tran**, California State University, Fresno, **Mark David Ward**, Purdue University, and **John Wierman**, The Johns Hopkins University.

Submission Procedures for MAA Contributed Paper Abstracts

Abstracts may be submitted electronically at `joint-mathematicsmeetings.org/meetings/abstracts/abstract.pl?type=jmm`. Simply fill in the number of authors, click "New Abstract," and then follow the step-by-step instructions. **The deadline for abstracts submission is Tuesday, September 25, 2018.**

Each participant may make *at most* one presentation in an MAA Contributed Paper Session, either a presentation in one of the themed sessions or a presentation in one of the general sessions. If a paper cannot be accommodated in the themed session for which it was submitted, it will automatically be considered for the general contributed paper sessions. The organizer(s) of your session will automatically receive a copy of the abstract, so it is not necessary for you to send it directly to the organizer. The

session rooms are equipped with computer projectors and screens. Please note that the dates and times scheduled for these sessions remain tentative. Questions concerning the submission of abstracts should be addressed to `abs-coord@ams.org`.

MAA Panels

MAA Panel: Mathematics Placement Trends and Innovations that Increase Equitable Access & Success, organized by **James Ham**, Delta College, **Keith Hubbard**, Stephen F. Austin State University, and **Kathryn Lineham**, Montgomery College, Wednesday, 9:35–10:55 am. The placement of students into college-level mathematics classes has been the topic of interest for higher education systems and has resulted in fundamental policy changes from state legislatures. In Florida, all remedial classes have been deemed optional. In California, multiple measures are now required for placement. In Texas, 75 percent of remedial students must be placed into co-requisite credit-level courses. All of these trends are intended to increase equitable access and success in mathematics course work. Come join this discussion of the approaches that are sweeping the nation and the effects they are having on institutions and students. Panelists are **David Bressoud**, Macalester College, **Mary Margarita Legner**, Riverside Community College, **Jeremy Martin**, Charles A. Dana Center, UT Austin, and **Judith Scott-Clayton**, Columbia University. This event is sponsored by the MAA on Committee on Articulation and Placement.

MAA Panel: What Every Student Should Know about the JMM, organized by **Peri Shereen**, California State University, Monterey Bay **Violeta Vasilevska**, Utah Valley University; Wednesday, 9:00–10:20 am. Navigating a large conference can be overwhelming, even for those who have previously attended such an event. Panelists Joyati Debnath, Winona State University; Matt DeLong, Marian University, and Zsuzsanna Szaniszlo, Valparaiso University, will provide guidance for students attending the Joint Mathematics Meetings, including answers to some common questions: How do I get the most out of the program? What sessions are especially for students? What other events should I be on the lookout for? Will I understand any of the invited addresses or should I not bother attending them? If I am presenting a poster, where do I go to set it up? How can I get some cool, free math stuff? Students and their faculty mentors are encouraged to attend. Panelists are **Joyati Debnath**, Winona State University, **Matt DeLong,** Marian University, and **Zsuzsanna Szaniszlo,** Valparaiso University. This panel is sponsored by the MAA Committee for Undergraduate Student Activities and Chapters (CUSAC).

MAA Panel: Mental Health in the Mathematics Profession, organized by **Justin Curry,** SUNY Albany, and **Mikael Vejdemo-Johansson**, CUNY College of Staten Island; Wednesday, 2:15–3:35 pm. Mental health problems — depression, anxiety, to mention some of the most common — strike about 18.5% of the population at large in any given year — chances are good that most mathematicians have had, or have colleagues who have had struggles.

The numbers only rise after including neurodivergences that often produce these as symptoms. The pressures of academia can exacerbate or cause such problems, causing distress and derailinbg careers. Visibility is low — we often hide or minimize our struggles, so as to not impact careers or the impressions we make on everyone else — and this further isolates anyone struggling: it can often feel like nobody else has any similar problems to overcome, and many issues get harder to handle with this isolation and added pressure. As a first step in building up visibility and creating a more supportive community for ourselves, we have gathered mathematicians at different stages of their careers with immediate personal experiences to a panel discussion on what life in mathematics with mental health problems is like, how we are handling it, what works and what doesn't. Panelists are **Julie Corrigan,** Charleston, **Justin Curry,** SUNY Albany, **Kate Farinholt,** National Alliance on Mental Illness, **Rachel Levanger,** University of Pennsylvania, and **Mikael Vejdemo-Johansson,** CUNY College of Staten Island.

MAA Panel: Pursuing New Directions in Your Academic Career, organized by **Louis Deaett**, Quinnipiac University, **Linda McGuire**, Muhlenberg College, **Steven Schlicker**, Grand Valley State University, and **David Torain,** Montgomery College, Wednesday, 2:15–3:35 pm. This panel is for faculty members who are looking for new directions to pursue within their academic careers. Panelists will share lessons learned from navigating new directions in their own careers, including adopting new teaching methodologies, exploring new areas of scholarship, engaging in service outside of one's institution, and changing academic positions (e.g., to administration or to another institution). Panelists are **Curtis Bennett**, California State University, Long Beach, **Jill Guerra,** University of Arkansas at Fort Smith, **Ron Taylor,** Berry College, and **Suzanne Weekes**, Worcester Polytechnic Institute. This event is sponsored by the MAA Committee on Professional Development.

MAA Panel: Impacting Mathematics Instruction Through Meaningful Collaboration with Partner Discipline Faculty, organized by **Janet Bowers**, San Diego State University; Wednesday, 4:15–5:35 pm. Mathematics is used throughout the undergraduate curriculum. Introductory mathematics courses, as well as the use of mathematics in other courses, would benefit from collaboration among faculty from mathematics and partner disciplines. Yet, how often do faculty from mathematics and the partner disciplines engage in meaningful conversation about the mathematics taught and used in the undergraduate curriculum? In the Curriculum Foundations Project (CFP), the Mathematical Association of America conducted a series of 22 workshops to facilitate such discussions. Reports of their findings appear in two volumes: `tinyurl.com/CFPVoices` and `/tinyurl.com /CFPPartners`. In the ongoing NSF supported SUMMIT-P project, ten institutions are successfully revising their introductory mathematics curriculum by building partnerships with partner disciplines using CFP findings. Panelists include two mathematicians and one faculty member each

from engineering, chemistry and social science, each of whom has successfully collaborated through SUMMIT-P to improve instruction and student learning. Attendees will learn more about CFP findings, experience a "Fishbowl" discussion, and learn strategies for using these findings and facilitating cross-disciplinary conversations on their campus. Panelists are **Susan L. Ganter**, Embry-Riddle Aeronautical University, **Rosalyn H. Hargraves**, Virginia Commonwealth University, **Stella Hofrenning**, Augsburg University, **Victor I. Piercey**, Ferris State University, and **Kathy Williams**, San Diego State University.

MAA Panel: Connecting High School and Post High School Mathematics, organized by **Gail Burrill**, Michigan State University; Thursday, 9:00–10:20 am. NCTM's recently released document Catalyst for Change contains recommendations for the essential mathematical concepts that should be in the curriculum for all students and potential curricular pathways through four years of high school mathematics. The session will consider the implications of these recommendations for college intending students, how the recommendations intersect with the changing landscape of introductory courses in mathematics at an increasing number of post high school institutions, and ways to promote dialogue between instructors at these institutions that will help make the transition from high school mathematics to college mathematics one that is supportive of students and their goals. Time will be allocated to engage the audience in a discussion of important themes and next steps. Panelists are **Dave Barnes**, National Council of Teachers of Mathematics, **Gail Burrill**, Michigan State University, **Karen Graham**, University of New Hampshire, **Yvonne Lai**, University of Nebraska, **Dan Teague**, North Carolina School of Science and Mathematics, and **Francis Su**, Harvey Mudd College.

MAA Panel: Preparing Math and Stats Students for Industry Careers, organized by **Namyong Lee**, Minnesota State University, Mankato, **Debra Mimbs**, Lee University, and **Thomas Wakefield**, Youngstown State University; Thursday, 9:00–10:20 am. There are hundreds of nonacademic jobs for math majors. However, most faculty members have little to no experience with or background in nonacademic careers. Panelists will discuss their experiences in preparing and advising students for nonacademic careers including some who participated in the MAA and NSF funded program known as PIC Math. Topics could include how to organize a semester course centered on solving research problems from industry, how to prepare students for nonacademic careers, how to initiate contact and develop relationships with local industries to get research problems and internships for students, how to effectively advise students for internship and career opportunities, examples of specific research problems from industry for students, as well as insights from former faculty now working in industry. Panelists include former faculty members who now work in business, industry or government as well as current faculty members who advise student projects in these areas. Panelists are **Allen Butler,** Daniel H. Wagner Associates, Inc, **Michael Dorff**, Brigham Young University, **Gretchen**

Koch-Noble, Federal Government, **Aaron Luttman,** Department of Energy, and **Debra Mimbs**, Lee University.

MAA Panel: Coping Professionally with Unprofessional Behavior, organized by **Zsuzsanna Szaniszlo**, Valparaiso University,and **Jennifer Beineke,** Western New England University; Thursday, 1:00–2:20 pm. Academia reflects real life in most aspects. Unfortunately, this also includes instances of unprofessional behavior among colleagues and administration. This panel will address strategies for dealing with such behavior. What could/ should you do when you witness a young colleague being bullied by an older colleague who wields power at your institution? What can you do if you are on the receiving end of such behavior? How can you navigate institutional politics if you feel your ideas are unfairly shut down by your chair/dean? How can you improve a bad situation created by an uncooperative colleague in your department? How can you help foster healing and growth in your department following negative interpersonal dynamics? This topic is of concern to mathematicians at all stages of their career. Panelists are **Amy Cohen-Corwin,** Rutgers, The State University of New Jersey, **Lloyd Douglas**, Independent Consultant, **Rick Gillman**, Valparaiso University, and **Paula Russo,** Trinity College. This session is sponsored by Project NExT Peach Dots.

MAA Panel: Advising and Mentorship: Fostering Successful Students, organized by **Ashley Johnson**, University of North Alabama, and **Alicia Prieto-Langarica**, Youngstown State University; Thursday, 1:00–2:20 pm. As all faculty members know, there is more to teaching students than just what happens in a classroom two or three times per week. Some students look to faculty members for advice on which graduate programs to apply to, which conferences to attend, where to search for jobs, what kind of jobs to apply to, which summer programs to apply to, etc. Other students might not be aware of the opportunities that await them and it falls to the advisor to inform them. On top of the advice, we're very often asked to write letters of recommendation for all of these opportunities as well. The goal of this panel is to have experienced faculty members share their advising and mentorship experiences, as well as tips on successfully transitioning students into graduate school, summer programs, or the workforce, and writing effective letters of recommendation. Panelists are **Jacqueline Jensen-Vallin**, Lamar University, **Hristo Kojouharov**, University of Texas at Arlington, **Marianne Korten**, Kansas State University, **Calandra Tate Moore**, Department of Defense and **Michael Young**, Iowa State University.

MAA Panel: Pathways to Leadership, organized by **Gretchen L. Matthews**, Virginia Tech and **Cynthia Curtis**, The College of New Jersey; Thursday, 2:35–3:55 pm. This panel discusses a variety of pathways to leadership, addressing leadership in academic institutions at a variety of levels, in industry, and in professional societies. According to the AAUP report So Few Women Leaders, "women's paths to leadership often involve directing academic programs, chairing committees, or leading research centers or institutes that they initiate and for which they often

obtain funding themselves." One finding demonstrates that traditional paths to leadership are slower and often blocked. The same is thought to be true for others from minorities underrepresented in STEM disciplines. The panel will discuss traditional routes through the well-defined hierarchy in academia along with alternative avenues mentioned above. Panelists are **Jenna Carpenter**, Campbell University, **Barbara Faires**, Westminster College, **Susan Ganter**, Embry–Riddle Aeronautical University, **Kristin Lauter**, Microsoft Research, **Maura Mast**, Fordham College at Rose Hill, **Semra Skilic Bahi**, Colby Sawyer College, and **Judy Walker**, University of Nebraska. This panel is sponsored by the MAA Committee on the Participation of Women in Mathematics.

MAA Panel: Advanced Placement Calculus and Student Understanding, organized by **Gail Burrill,** Michigan State University; Friday, 8:00–9:20 am. Each spring thousands of high school students take part in the Advanced Placement Calculus AB and BC examinations. This session will provide details on how the exams are graded and on student performance, in particular some of the key conceptual misunderstandings suggested in their responses to problems related to particluar calculus topics as well as areas in which they demonstrate competence. The panel will include representatives from the College Board, the college professor in charge of scoring these exams (aka, the Chief Reader), and some of the members of the Exam Development Committee who also serve as graders for the exam. There will be time in the session for the panelists to answer questions from the audience. Questions posed to the audience will be to consider how the areas of misconceptions are similar to or different from those evidenced by undergraduates in intro college calculus courses and what are possible strategies to address these misconceptions. Panelists are **Gail Burrill**, Michigan State University, **Stephen Davis**, Davidson University, **Brendan Murphy**, John Bapst High School, and **Stephanie Odgen**, College Board.

MAA Panel: Increasing Diversity and Retention in STEM Through Math-Focused First-Year Seminars, organized by **Laramie Paxton,** Washington State University; Friday, 9:35–10:55 am. It is often cited that students abandon or avoid STEM disciplines due to difficulties with mathematics. While many colleges and universities have implemented first-year seminars, research studies specifically addressing the ability of math-focused seminars to address these barriers are not common. This Q & A session will bring together diverse panelists to discuss the ability of math-focused first-year seminars and related programming to increase student interest and confidence in STEM disciplines. A special focus will be on students from underrepresented groups, increasing STEM retention rates, and diversifying STEM enrollments by reaching students who are otherwise not traditionally entering STEM fields. Panelists are **Carlos Castillo-Garsow,** Eastern Washington University**, Maria Fung,** Worcester State University, **Guadalupe Lozano**, University of Arizona, **Shahriar Shahriari**, Pomona College, and **Francis Su**, Harvey Mudd College.

MAA Panel: MAA Instructional Practices Guide's Value for Your Department, organized by **Linda Braddy**, Tarrant County College—Northwest campus, **Kevin Charlwood,** Washburn University, **Daniel Maki**, Indiana University Bloomington, and **Catherine Murphy**, Purdue University Northwest; Friday, 1:00–2:20 pm. The MAA's recently published Instructional Practices Guide (IPG) `https://www.dropbox.com/s/42oiptp46i0g2w2/MAA_IP_Guide_V1-2.pdf?dl=0` contains a wealth of information of value to mathematical sciences departments. It includes sections on classroom practices, assessment practices, design practices, technology, and equity and inclusion. Each section is rich with information and examples. You as Chair and your faculty may have questions you would like answered about some or all of these sections in order to address your interests. Our panel of leadership and IPG writing team members will provide insights into the construction of the Guide as well as answer the questions of importance to you and your faculty. Panelists are **Martha Abell,** Georgia Southern University, **Linda Braddy**, Tarrant County College—Northwest campus, **Rick Cleary**, Babson College, **Doug Ensley**, Mathematical Association of America, and **Lew Ludwig**, Denison University.

MAA Panel: Advising Actuarial Science Students, organized by **Kevin Charlwood**, Washburn University, **Michelle Guan**, Indiana University Northwest, **Steve Paris**, Florida State University, **Barry Smith**, Lebanon Valley College, and **Sue Staples**, Texas Christian University; Friday, 5:00–7:00 pm. A panel session dedicated to the concerns of faculty at institutions with actuarial science programs, designed to keep participants abreast of SOA/CAS curriculum and exam series changes that impact actuarial students and actuarial programs.Panelists are **Kevin Charlwood**, Washburn University, **Rick Gorvett**, Casualty Actuary Society (CASACT),**Michelle Guan**, Indiana University Northwest, **Stuart Klugman**, Society of Actuaries, **Steve Paris**, Florida State University, **Barry Smith**, Lebanon Valley College and **Sue Staples**, Texas Christian University. This panel is sponsored by the MAA Committee on Actuarial Science Education.

MAA Panel: Calculus before the Senior Year of High School: Issues and Options, organized by **David Bressoud,** Macalester College; Saturday, 9:00–10:20 am. In spring 2017, 144,000 students took an AP Calculus exam before their senior year of high school. Of these, 44,000 took the BC exam. What should these students go on to take while still in high school? What mathematics will be most useful for those interested in pursuing biology, engineering, statistics, or pure mathematics? And this push of the post-secondary mathematics curriculum into ever earlier grades creates a host of other issues including preparing high school faculty to teach these courses, determining appropriate placement when these students get to college, and creating college courses and supports that articulate with their high school experience. This panel will explore these issues and examine some of the options. Panelists are **Colin Adams**, Williams College, **Stephanie Ogden**, College Board, **Alison Reddy**, University of Illinois, Urbana—Champaign, and **Dan Teague**, North

Carolina School of Science and Mathematics. Sponsored by the College Board-MAA Committee on Mutual Concern.

MAA Panel: Listening and Responding to Students' Thinking, from Elementary to Undergraduate Mathematics, organized by **Brad Ballinger,** Humboldt State University, **Christina Eubanks-Turner,** Loyola Marymount University, **Yvonne Lai**, University of Nebraska— Lincoln, **Cody L. Patterson**, University of Texas at San Antonio, **Priya V. Prasad**, University of Texas at San Antonio, and **April Strom**, Scottsdale Community College; Saturday, 10:30 –11:50 am. One of the great joys and challenges in orchestrating mathematical discussions with undergraduate students is finding ways for students to build on each other's thinking. In teacher education and professional development settings, discussions also give future and current teachers the chance to learn in ways similar to how they would like to teach. But what are the differences and similarities across educational levels in mathematics discussions? How can we use knowledge of these differences and similarities productively in our own teaching? Join our discussion session on eliciting, representing, and responding to students' thinking. Our panelists—who span K–12, community college, and undergraduate levels—will each showcase an example of building on students' thinking from their own teaching. We will then as a group analyze how these examples compare, and what this may mean for our own teaching. Panelists are **Gail Burrill**, Michigan State University, **Ted Coe**, Achieve, and **Brian Katz**, Augustana College. This panel is sponsored by COMET (MAA's Committee on the Mathematical Education of Teachers) and SIGMAA-MKT (Special Interest Group of the MAA on Mathematical Knowledge for Teaching).

MAA Poster and Other Sessions

MAA Hrabowski–Gates–Tapia–McBay Session, organized by **Ricardo Cortez,** Tulane University; Wednesday, 9:00–10:20 am. The Hrabowski–Gates–Tapia–McBay Session is named after four influential scientists of color: (1) Freeman Hrabowski, President of the University of Maryland at Baltimore County; (2) James S. Gates, University of Maryland, College Park; (3) Richard Tapia, Rice University; and (4) Shirley McBay, President of Quality Education for Minorities (QEM). Through multiple mechanisms, these Sessions expect to facilitate and accelerate the participation of scientists in the building of sustainable communities of mathematicians and mathematical scientists. In particular, the intention is to systematically recruit, welcome, encourage, mentor, and support individuals from underrepresented groups in the USA. This year the session will consist of a lecture from 9:00–9:50 am given by Rodrigo Bañuelos, Purdue University, title to be annnounced, and a short panel discussion, Actions to increase the participation of underrepresented minority groups in mathematics, from 9:50–10:20 am. The 2019 panel will focus on Actions to increase the participation of minority groups in mathematics. Panelists will include **Minerva Cordero**, University of Texas at Arlington; **Pamela Harris**, Williams College, and **Rodrigo Bañuelos**, Purdue University.

Town Hall Meeting: Spectra: Identifying Workplace Best Practices for LGBTQ Mathematicians, organized by **David Crombecque**, University of Southern California, **Ron Buckmire,** Division of Undergraduate Education, NSF, **Christopher Goff**, University of the Pacific, **Alexander Hoover**, Tulane University, and **Douglas Lind**, University of Washington, Seattle; Wednesday, 4:30–5:50 pm. The goal of this Town Hall Meeting is to learn from the audience examples of actions mathematical sciences departments are taking now to support LGBTQ mathematicians as well as to solicit suggestions of things departments can do in the future. In particular, how can departments be more inclusive and welcoming to LGBTQ individuals (undergraduate and graduate students, postdocs, adjuncts, tenured and non-tenured faculty)? In the second part of the Meeting the audience will be asked to brainstorm and provide suggestions on how SPECTRA can contribute to make these best practices known to the mathematical sciences community and to help departments implement them. During the meeting the audience will split into groups focused on specific topics, such as: Supporting transgender mathematicians in the work place; LGBTQ Mathematicians balancing work choices with family responsibilities; best practices for recruitment and retention of LGBTQ faculty. Other discussion topics can be suggested by the audience during the first part of the meeting. Each group will include a facilitator who will also serve as scribe to record the discussion. This town hall meeting is being organized by Spectra, the Association for LGBTQ Mathematicians.

Estimathon!, organized by **Andy Niedermaier**, Jane Street Capital; Thursday, 10:00 am–12 noon. They're called Fermi problems...

- How heavy is the Eiffel Tower?
- How many prime numbers have distinct digits?
- How many calories would you be eating if you had "one of everything" at the Cheesecake Factory?

If you're looking for a mind-bending mixture of math and trivia, look no further! Jane Street Capital presents The Estimathon contest: Teams will have 30 minutes to work on 13 problems, ranging from totally trivial to positively Putnamesque. Can your team beat the all-time best score? The top teams will receive prizes!

We will run 2 contests. Feel free to show up to either one!

(Please show up 15 minutes before the start time of the contest you want to join.)

Our target schedule is as follows:

10:0 am Welcome, overview of rules and scoring.

10:15 am Estimathon contest #1

11:00 am Estimathon contest #2

This event is sponsored by Jane Street Capital and the MAA Committee on Undergraduate Students (CUS).

The Dolciani Award Lectures, organized by **Herbert A. Medina**, Loyola Marymount University, and **Tina Straley**; Thursday, 1:00–2:00 pm. The MAA's Mary P. Dolciani Award recognizes a pure or applied mathematician who is making a distinguished contribution to the mathematical education of K–16 students in the US or Canada. This

session will feature two recent recipients who will give overviews of the work that resulted in their nomination and subsequent prize.

MAA Poster Session: Mathematical Outreach Programs, organized by **Betsy Yanik**, Emporia State University; Friday, 10:00 am–12 noon. This poster session is designed to highlight special programs which have been developed to encourage students to maintain an interest in and commitment to succeeding in mathematics. These programs might include such activities as after school clubs, weekend activities, one day conferences, mentoring opportunities, summer camps, etc. This poster session encompasses a wide variety of outreach efforts for a variety of age groups. For example, programs might be designed to reach out to underrepresented groups. The projects supported by MAA Tensor and Summa grants will find this an ideal venue in which to share the progress of their funded projects. Another possible type of outreach might involve mathematical enrichment programs. Other examples might include innovative programs to motivate undergraduates to study mathematics. We encourage everyone involved with offering mathematical outreach activities to consider submitting an abstract to the session organizer, Betsy Yanik, eyanik@emporia.edu.

MAA Poster Session: Recreational Mathematics: Puzzles, Card Tricks, Games, and Gambling, organized by **Paul R. Coe**, Dominican University, **Darren Glass**, Gettysburg College, and **Robert Vallin**, Lamar University; Friday, 10:00 am–12 noon. Puzzles, card tricks, board games, game shows, gambling, and sports provide an excellent laboratory for testing mathematical strategy, probability, and enumeration. The analysis of such diversions is fertile ground for the application of mathematical and statistical theory. Solutions to new problems as well as novel solutions to old problems are welcome. Submissions by undergraduates or examples of the use of the solutions of these problems in the undergraduate classroom are encouraged. This session is sponsored by the SIGMAA on Recreational Mathematics.

MAA Poster Session: Activities for Teaching Multivariable Thinking through Data Visualization in Introductory Statistics, organized by **Gregg Harbaugh**, Boston University, and **Soma Roy**, California Polytechnic State University; Friday, 1:30–3:30 pm. The recently revised Guidelines for Assessment and Instruction in Statistics Education (GAISE) encourages statistics educators to teach multivariable thinking in introductory statistics classes, and a step towards this goal is to help students create and interpret graphical displays of data comprised of more than two variables. We invite proposals for poster presentations that showcase activities, datasets, and/or contexts that statistics teachers can use to motivate multivariable statistical thinking through data visualization and interpretation. Presentations should be based on activities that have actually been used in class, and accompanied by some evidence of the effectiveness of the activities in improving student understanding and interpretation of graphs and multivariable statistical thinking. A focus on

modern approaches to teaching from a simulation-based perspective and incorporating data science ideas into the course are particularly encouraged. This session is sponsored by the SIGMAA Stat Ed.

MAA Poster Session: Projects Supported by the NSF Division of Undergraduate Education, organized by **Jon Scott**, Montgomery College, jon.scott@montgomery college.edu; Friday, 2:00–4:00 pm. This session will feature principal investigators (PIs) presenting progress and outcomes from various NSF funded projects in the Division of Undergraduate Education. The poster session format will permit ample opportunity for attendees to engage in small group discussions with the PIs and to network with each other. Information about presenters and their projects will appear in the program.

MAA Student Poster Session, organized by **Chasen Smith**, Georgia Southern University, and **Eric Ruggieri**, College of the Holy Cross; Friday, 4:30–6:00 pm. This session features research done by undergraduate students. First-year graduate students are eligible to present if their research was completed while they were still undergraduates. Research by high school students can be accepted if the research was conducted under the supervision of a faculty member at a post-secondary institution.

Appropriate content for a poster includes, but is not limited to, a new result, a new proof of a known result, a new mathematical model, an innovative solution to a Putnam problem, or a method of solution to an applied problem. Purely expository material is not appropriate for this session.

Participants should submit an abstract describing their research in 250 words or less by midnight, Friday, **October 5, 2018.** Notification of acceptance or rejection will be sent in early November. See www.maa.org/programs /students/undergraduate-research/jmm-student -poster-session for further information on what should be included in the abstract and a link to the abstract submission form.

Posters will be judged during the session, and certificates will be sent to presenters afterwards. Trifold, self-standing 48" by 36" tabletop poster boards will be provided. Additional materials and equipment are the responsibility of the presenters. Participants must set up posters between 2:30 and 3:30 pm and must be available at their posters from 3:30 to 6:00 pm. Judging will begin at 3:30 pm and general viewing will begin at 4:30 pm. Judges' feedback will be available at the MAA Pavilion in the Exhibit Hall on Saturday. Questions regarding this session should be directed to Eric Ruggieri eruggier@holycross .edu and Chasen Smith csmith@georgiasouthern.edu. This session is sponsored by the MAA Committee on Undergraduate Students (CUS).

Mathematically Bent Theater, featuring **Colin Adams** and **The Mobiusbandaid Players**; Friday, 6:00–7:00 pm. Which is funnier, homology or cohomology? Are there math humor receptors located in the brain and if not, why do we find math so funny? Did you key my car

at Mathfest last summer? These are just a few of the questions we will not answer during this theatrical presentation of several short humorous mathematically inclined pieces.

Poetry Reading, organized by **JoAnne Growney**, **Gizem Karaali**, **Lawrence M. Lesser**, and **Doug Norton**; Friday, 7:00–8:30 pm. "Math poets, come help us resume our recent tradition of eclectic JMM poetry readings!" In 2019, we hope to especially feature poetry about math people—famous or not—including teachers, students, math-anxious characters, etc. All interested in mathematical poetry/art are welcome—come to share your poetry or simply enjoy the evening's offerings! Though we do not discourage last-minute decisions to participate, we encourage poets to submit poetry (no more than 3 poems, no longer than 5 minutes) and a 40-word bio in advance so that those selected can be listed in our printed program. Submit submissions (by **November 1, 2018**) or inquiries to Gizem Karaali (`gizem.karaali@pomona.edu`). This event is sponsored by Journal of Humanistic Mathematics and SIGMAA ARTS.

Backgammon! organized by **Arthur Benjamin**, Harvey Mudd College; Friday, 8:00–10:00 pm. Learn to play backgammon from expert players. It's a fun and exciting game where players with a good mathematics background have a decisive advantage. Boards and free lessons will be provided by members of the US Backgammon Federation. Stop by anytime!

Interactive Lecture for Students and Teachers, **Ben Orlin,** Math and Bad Drawings, *Tic-Tac-Toe (or, What is Mathematics),* Saturday, 10:00–10:50 am.

Math Circle Demonstration, organized by **Lance Bryant,** Shippensburg University, **Sarah Bryant**, Dickinson College, and **Thomas J. Clark**, Dordt College; Saturday morning. A math circle is an enrichment experience that brings mathematics professionals in direct contact with pre-college students and/or their teachers. Circles foster passion and excitement for deep mathematics. This demonstration session offers the opportunity for conference attendees to observe and then discuss a math circle experience designed for local students. While students are engaged in a mathematical investigation, mathematicians will have a discussion focused on appreciating and better understanding the organic and creative process of learning that circles offer, and on the logistics and dynamics of running an effective circle. The sponsor for this demonstration is SIGMAA MCST.

Math Wrangle, organized by **Ed Keppelmann**, University of Nevada–Reno, and **Phil Yasskin**, Texas A&M University, Saturday afternoon. The Math Wrangle will pit teams of students against each other, the clock, and a slate of great math problems. The format of a Math Wrangle is designed to engage students in mathematical problem solving, promote effective teamwork, provide a venue for oral presentations, and develop critical listening skills. A Math Wrangle incorporates elements of team sports and debate, with a dose of strategy tossed in for good measure. The intention of the Math Wrangle demonstration at the Joint Math Meetings is to show how teachers, schools, circles, and clubs can get students started in this exciting combination of mathematical problem solving with careful argumentation via public speaking, strategy and rebuttal. ponsors for this event is SIGMAA for Math Circles for Students and Teachers (SIGMAA-MCST).

Special Interest Groups of the MAA (SIGMAAs)

SIGMAAs will be hosting a number of activities, sessions, and guest lectures. There are currently fourteen such focus groups in the MAA offering members opportunities to interact, not only at meetings, but throughout the year, via newsletters and email-based communications. For more information visit `www.maa.org/community/sigmaas`.

SIGMAA Officers Meeting, Thursday, 10:30–12:00 noon, chaired by **Andrew Miller**, Belmont University.

SIGMAA on Mathematics and the Arts (SIGMAA ARTS)
Mathematics and the Arts, Wednesday morning and afternoon (see MAA Contributed Paper Sessions).
　　Poetry Reading, Friday, 7:00–8:30 pm

SIGMAA on Business, Industry, and Government (BIG SIGMAA)
Mathematics Experiences and Projects in Business, Industry, and Government, Friday morning (see MAA Contributed Paper Sessions).
　　Guest Lecture, Friday, 4:30–5:15 pm.
　　Reception, Friday 5:15–6:00 pm.
　　Business Meeting, Thursday 9:00–10:00 am.

SIGMAA on Mathematical and Computational Biology (BIO SIGMAA)
　　Business Meeting and Reception, Friday, 6:00–7:00 pm.
　　Guest Lecture, Friday, 7:00–7:50 pm, **Reinhard Laubenbacher**, University of Connecticut, School of Medicine.
　　Mathematics & the Life Sciences: Initiatives, Programs, Curricula, Thursday morning (see MAA Contributed Papers Section).
　　Trends in Mathematical and Computational Biology, Wednesday afternoon (see MAA Invited Paper Sessions).

SIGMAA on the History of Mathematics (HOM SIGMAA)
　　Reception and Business Meeting, Wednesday, 6:15–7:15 pm.
　　Guest Lecture, Wednesday, 7:15–8:15 pm, **Karen Parshall**, University of Virginia, *Crossing the Pond: European Mathematicians in 1920s America*.
　　Ethnomathematics: Ideas & Innovations in the Classroom, Friday morning (see MAA Contributed Papers Section).

SIGMAA on Inquiry Based Learning (SIGMAA IBL)
　　Inquiry-Based Teaching and Learning, Friday morning and afternoon (see MAA Contributed Paper Sessions).
　　Business Meeting, Friday, 6:30–7:30 pm.

MAA Minicourse: Introduction to IBL, Part A: Thursday 9:00–11:00 am and Part B: Saturday 9:00–11:00 am (see MAA Minicourses).

SIGMAA on Mathematical Knowledge for Teaching

MAA Panel: Listening and Responding to Students' Thinking, from Elementary to Undergraduate Mathematics, Thursday afternoon (see MAA Panels).

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

MAA Panel: Listening and Responding to Students' Thinking, from Elementary to Undergraduate Mathematics, Friday, 8:00–9:20 am (see MAA Panels).

It's Circular: Conjecture, Compute, Iterate, Friday afternoon (see MAA Contributed Paper Sessions).

Math Circle Demonstration, Saturday.

Math Wrangle, Saturday.

MAA Minicourse: How to Run Successful Math Circles for Students and Teachers, Part A: Thursday 1:00–3:00 pm and Part B: Saturday 1:00–3:00 pm (see MAA Minicourses).

SIGMAA on the Philosophy of Mathematics (POM SIGMAA)

Reception, Thursday, 5:30–6:00 pm.

Business Meeting, Thursday, 6:00–6:15 pm.

Guest Lecture, Thursday, 6:15–7:05 pm, **Michele Friend**, George Washington University.

Philosophy of Mathematics, Friday morning (see MAA Contributed Paper Sessions).

SIGMAA on Quantitative Literacy (SIGMAA QL)

Innovative Pathways to Quantitative Literacy, Saturday morning (see MAA Contributed Paper Sessions).

Joint Guest Lecture & Reception, Thursday, 6:00–7:30 pm, **Dave Kung**, St. Mary's College of Maryland and **Kira Hamman**, Penn State University.

SIGMAA on Recreational Mathematics

MAA Poster Session: Recreational Mathematics: Puzzles, Card Tricks, Games, & Gambling, Friday, 10:00 am–12 noon (See MAA Poster Sessions).

SIGMAA on Research in Undergraduate Mathematics Education (SIGMAA on RUME)

Research in Undergraduate Mathematics Education, Thursday morning and Friday morning (see MAA Contributed Paper Sessions).

Research in Undergraduate Mathematics Education: Highlights from the Annual SIGMAA on RUME Conference, Saturday morning (see MAA Invited Paper Sessions).

SIGMAA on Sports

Mathematics & Sports, Wednesday afternoon (see MAA Contributed Paper Sessions).

SIGMAA on Statistics Education (SIGMAA Stat Ed)

MAA Minicourse: Teaching Statistics using R and RStudio, Part A: Wednesday 1:00–3:00 pm and Part B: Friday 1:00–3:00 pm (see MAA Minicourses).

MAA Minicourse: Keep Teaching Statistics using R and RStudio, Part A: Thursday 1:00–3:00 pm and Part B: Saturday 1:00–3:00 pm (see MAA Minicourses).

Infusing Data Science & Big Data into the Statistics, Wednesday afternoon (see MAA Contributed Paper Sessions).

Technology & Resources in Statistics Education, Friday afternoon (see MAA Contributed Paper Sessions).

MAA Poster Session: Activities for Teaching Multivariable Thinking through Data Visualization in Introductory Statistics, Friday, 1:30–3:30 pm (See MAA Poster Sessions).

Business Meeting, Friday, 6:30–7:30 pm.

Guest Lecture, Friday, 7:30–8:30 pm.

SIGMAA on Mathematics Instruction Using the Web (WEB SIGMAA)

Business Meeting, Reception, and Guest Lecture, Friday, 6:00–7:30 pm, **Paul Seeberger**, Monroe Community College, *CalcPlot3D to Create Dynamic Figures for OER Textbooks and to 3D Print Surfaces for Multivariable Calculus and Beyond*

MAA Minicourse: Visualizing Multivariable Calculus & Differential Equations using CalcPlot3D, Part A: Thursday 9:00–11:00 am and Part B: Saturday, 9:00–11:00 am (see MAA Minicourses).

MAA Sessions for Students

Radical Dash! organized by **Stacey Muir**, University of Scranton, and **Janine Janoski**, Kings College; **Radical Dash Kickoff Meeting:** Wednesday, 10:20–10:50 am and **Radical Dash Prize Session:** Friday, 10:30–11:00 am. The Radical Dash is a multi-day scavenger hunt for teams of undergraduates filled with math challenges and creative activities. Clues will be released periodically via Instagram (follow us now @MAARadicalDash) tasking teams with doing things such as solving math problems, finding mathematical objects in everyday life, and hunting down locations throughout the conference. Team posts will be judged based on completion of tasks as well as creativity. Join us for the Radical Dash Kickoff on Wednesday, January 16, 10:20–10:50 am where team sign ups take place and more details will be provided. Individuals are welcome and encouraged to participate; they will be formed into teams on site at our Kickoff. Winners and prizes will be announced at the Radical Dash Prize Session on Friday, January 18, 10:30–11:00 am Questions? Email us at MAARadicalDash@gmail.com. Can't make the Kickoff? Email us by Tuesday, January 15. The Radical Dash! is sponsored by MAA Committee on Undergraduate Student Activities and Sections (CUSAC).

MAA Panel: What Every Student Should Know about the JMM, organized by **Peri Shereen**, California State University, Monterey Bay, **Violeta Vasilevska**, Utah Valley University; Wednesday, 9:00–10:20 am. Navigating a

large conference can be overwhelming, even for those who have previously attended such an event. Panelists Joyati Debnath, Winona State University; Matt DeLong, Marian University, and Zsuzsanna Szaniszlo, Valparaiso University, will provide guidance for students attending the Joint Mathematics Meetings, including answers to some common questions: How do I get the most out of the program? What sessions are especially for students? What other events should I be on the lookout for? Will I understand any of the invited addresses or should I not bother attending them? If I am presenting a poster, where do I go to set it up? How can I get some cool, free math stuff? Students and their faculty mentors are encouraged to attend. Panelists are: **Joyati Debnath**, Winona State University, **Matt DeLong,** Marian University, and **Zsuzsanna Szaniszlo**, Valparaiso University. This panel is sponsored by the MAA Committee for Undergraduate Student Activities and Chapters (CUSAC).

Estimathon!, organized by **Andy Niedermaier**, Jane Street Capital; Thursday, 10:00 am–12 noon. They're called Fermi problems...

- How heavy is the Eiffel Tower?

- How many prime numbers have distinct digits?

- How many calories would you be eating if you had "one of everything" at the Cheesecake Factory?

If you're looking for a mindbending mixture of math and trivia, look no further! Jane Street Capital presents The Estimathon contest: teams will have 30 minutes to work on 13 problems, ranging from totally trivial to positively Putnamesque. Can your team beat the all-time best score? The top teams will receive prizes!

We will run 2 contests. Feel free to show up to either one!

(Please show up 15 minutes before the start time of the contest you want to join.)

Our target schedule is as follows:

10:0 am Welcome, overview of rules and scoring.

10:15 am Estimathon contest #1

11:00 am Estimathon contest #2

This event is sponsored by Jane Street Capital and the MAA Committee on Undergraduate Students (CUS).

Grad School Fair, Friday, 8:30–10:30 am. Here is the opportunity for undergrads to meet representatives from mathematical sciences graduate programs from universities all over the country. January is a great time for juniors to learn more, and college seniors may still be able to refine their search. This is your chance for one-stop shopping in the graduate school market. At last year's meeting over 300 students met with representatives from more than 60 graduate programs. If your school has a graduate program and you are interested in participating, for US$125 a table will be provided for your posters and printed materials (**registration for this event must be made by a person already registered for the JMM**), and you are welcome to personally speak to interested students. Complimentary coffee will be served. Co-sponsored by the AMS and MAA.

MAA Lecture for Students, will be given by **Annalisa Crannell**, Franklin & Marshall College, *Drawing conclusions from drawing a square*, Friday, 1:00 pm.

MAA Student Poster Session, organized by **Chasen Smith**, Georgia Southern University, and **Eric Ruggieri**, College of the Holy Cross; Friday, 4:30–6:00 pm. This session features research done by undergraduate students. First-year graduate students are eligible to present if their research was completed while they were still undergraduates. Research by high school students can be accepted if the research was conducted under the supervision of a faculty member at a post-secondary institution.

Appropriate content for a poster includes, but is not limited to, a new result, a new proof of a known result, a new mathematical model, an innovative solution to a Putnam problem, or a method of solution to an applied problem. Purely expository material is not appropriate for this session.

Participants should submit an abstract describing their research in 250 words or less by midnight, **Friday, October 5, 2018.** Notification of acceptance or rejection will be sent in early November. See `www.maa.org/programs /students/undergraduate-research/jmm-student -poster-session` for further information on what should be included in the abstract and a link to the abstract submission form.

Posters will be judged during the session, and certificates will be sent to presenters afterwards. Trifold, self-standing 48" by 36" tabletop poster boards will be provided. Additional materials and equipment are the responsibility of the presenters. Participants must set up posters between 2:30 and 3:30 pm and must be available at their posters from 3:30 to 6:00 pm. Judging will begin at 3:30 pm, and general viewing will begin at 4:30 pm. Judges' feedback will be available at the MAA Pavilion in the Exhibit Hall on Saturday. Questions regarding this session should be directed to Eric Ruggieri `eruggier@holycross .edu` and Chasen Smith `csmith@georgiasouthern.edu.` This session is sponsored by the MAA Committee on Undergraduate Students (CUS).

MAA Interactive Lecture for Students and Teachers, will be given by **Ben Orlin**, Math and Bad Drawings, *Tic-Tac-Toe (or, What is Mathematics?),* Saturday, 10:00–10:50 am,

Project NExT

Project NExT Workshop, Wednesday–Saturday, 8:00–6:00 pm.

Project NExT Lecture on Teaching, will be given by **David Bressoud,** Macalester College, *Reflections on teaching calculus for the first time, 45 times*, Thursday, 11:10–12 noon.

See details about the reception on Friday in Social Events.

Other MAA Events

MAA Section Officers Meeting, Wednesday, 4:00–5:00 pm, chaired by **Lisa Marano**, Westchester University of Pennsylvania. Section officers will meet with members of the Committee on Sections and MAA staff to share information and discuss current initiatives.

SIGMAA Officers Meeting, Thursday, 10:30–12:00 noon, chaired by **Andrew Miller**, Belmont University.

MAA Business Meeting, Saturday, 11:10–11:40 am, chaired by MAA President **Deanna Hausperger**, Carleton College, and organized by MAA Secretary **James Sellers**, Pennsylvania State University.

MAA Workshops

MAA Workshop: NSF Funding Opportunities in the Education and Human Resources Directorate and the Division of Mathematical Sciences, organized by **Karen Allen Keene**, NSF, Division of Research on Learning; Wednesday, 9:35–10:55 am. A number of NSF divisions offer a variety of grant programs that promote innovations in learning and teaching and/or infrastructural support in the mathematical sciences. Following a short presentation about these programs (15 minutes), the remainder of the session will feature opportunities to engage in small group discussions with NSF staff about program features, current NSF policy changes, proposal preparation guidance, and other related topics. Presenters are **Karen Allen Keene**, **Sandra Richardson**, **Talitha Washington**, and **Lee Zia**, NSF, Division of Undergraduate Education, **Karen King**, NSF, Division of Research on Learning, **Tara Smith**, NSF, Division of Graduate Education, and **Matt Douglass** and **Swatee Naik**, NSF, Division of Mathematical Sciences. This workshop is sponsored by the MAA Subcommittee on Professional Development.

MAA Workshop: Discussing Project Ideas with NSF/EHR Program Officers, Parts I and II, organized by **Karen Allen Keene**, NSF, Division of Research on Learning; Part I: Wednesday, 2:15–3:25 pm and Part II: Friday, 9:45–10:55 am. NSF program officers in the Directorate for Education and Human Resources will be available to talk with prospective Principal Investigators about potential project ideas. Following a very brief (5 minute) overview of NSF, participants may sign up for short (10 minute) time slots to speak one-on-one with program officers about the specifics of their ideas. (Participants are encouraged to bring a one-page description.) If you believe you have an idea, project or program worthy of NSF support that will positively impact pre-K–12, undergraduate, or graduate education in the mathematical sciences you should attend one of these two sessions. Presenters are **Karen King**, NSF, Division of Research on Learning, **Tara Smith**, NSF, Division of Graduate Education, and **Karen Allen Keene**, **Sandra Richardson**, **Talitha Washington**, and **Lee Zia**, NSF, Division of Undergraduate Education. This workshop is sponsored by the MAA Subcommittee on Professional Development.

MAA Workshop: Making it Happen: Modeling in Your Differential Equations Course, organized by **Brian Winkel**, SIMIODE; Thursday, 9:00–10:20 am. Workshop participants experience modeling with differential equations in a way they can bring into their own classroom. Modeling activities are used so teachers can experience, as students, what it is like to learn and teach in a modeling-based differential equations environment. We do this with engaging examples, situations in which modeling gives rise to mathematics. Modeling Scenarios from the SIMIODE––Systemic Initiative for Modeling Investigations and Opportunities with Differential Equations community at www.simiode.org will serve as example opportunities. Participants generate and collect data through experiments, build a mathematical model, estimate parameters, validate the model, and create the need for learning about differential equations as a direct result of the modeling activity. Examples will involve collecting data and using data from sources, modeling, and parameter estimation. The demonstrations of the effective use of modeling to motivate the study of differential equations will be suitable for different school settings, high schools, two-year colleges, and four-year institutions. Workshop participants will leave with a large collection of materials they can use to offer a modeling-based approach in their own differential equations courses. Presenters are **Audrey Malagon**, West Virginia University, **Rachel Rossetti**, Agnes Scott University, **Brian Winkel**, SIMIODE, and **Dina Yagodich,** Frederick University.

MAA Workshop: For Faculty on Fostering Student Engagement: Experience Classroom Practices from the MAA IP Guide, organized by **Carolyn Yackel**, Mercer University; Thursday, 10:35–11:55 am. This workshop will help faculty gain experience with classroom practices promoted in MAA's new Instructional Practices (IP) Guide, focused on fostering student engagement and selecting appropriate mathematical tasks to facilitate active learning. Strom and Alvarez, the lead writers of the Classroom Practices section of the IP guide, will involve participants in investigating two techniques: (1) paired board work and (2) engaging students in mathematical critique and justification. First, participants will experience these techniques as students in the leaders' classroom, after which they will collectively debrief the experience from instructors' standpoints. Presenters are **April Strom**, Scottsdale Community College and **James Alvarez**, University of Texas at Arlington. This session is sponsored by the MAA Committee on the Teaching of Undergraduate Mathematics.

MAA Workshop: Calculus: Near-Numbers, organized by **Frank Swenton,** Middlebury College; Saturday, 9:45–10:55 am. What is infinity? Why isn't zero times infinity zero? Why is infinity minus infinity indeterminate? A large proportion of student misapprehension of the core concepts of calculus (limits, convergence, divergence, etc.) derives from a single cause: that the classical (and outdated) mathematical language we use to talk about these concepts doesn't allow us to express them accurately and fully, particularly when it comes to their more subtle or troublesome (and often interesting) aspects. In this work-

shop, aimed at both instructors and students of calculus, we'll preview and demonstrate videos and interactive instructional tools, freely available online, that can be used to shed new light on convergence, divergence, and limits by accurately animating these concepts and providing a language for teachers and students that allows them to say precisely what they mean to. In the process, we'll see straightforward, direct answers both to the sample questions above and to as many participant-suggested questions as time permits. The presenter is **Frank Swenton,** Middlebury College.

MAA Workshop: **How to Talk about Math So People Want to Listen,** organized by **Paul Zorn**, St. Olaf College; Thursday, 2:35-3:55 pm. Join podcast host, director and science writer Flora Lichtman and avid math communicator Rachel Levy for a workshop to help you practice communicating about mathematics to the audience of your choice. Previous attendees of our workshops have successfully engaged the popular press about their research. In this workshop we will focus on communicating about the value of mathematics to the general public, policy-makers and administrators. Presenters are Flora Lichtman, Gimlet Media, and Rachel Levy, Mathematical Association of America. This workshop is sponsored by the MAA Science Policy Committee.

Activities of Other Organizations

This section includes scientific sessions. Several organizations or special groups are having receptions or other social events. Please see the "Social Events" section of this announcement for those details.

Association for Symbolic Logic (ASL)

This two-day program on Friday and Saturday will include sessions of contributed papers as well as Invited Addresses by **Douglas Cenzer**, University of Florida, **Natasha Dobrinen**, University of Denver, **Sergey Goncharov**, Novosibirsk State University, **John Krueger**, University of North Texas, **Michael C. Laskowski**, University of Maryland, **Jana Marikova**, Western Illinois University and **David Marker**, University of Illinois at Chicago.

See also the sessions co-sponsored by the ASL in the "AMS Special Sessions" listings. These sessions include *Definability and Decidability Problems in Number Theory* on Thursday. Organizers for this session are **Kirsten Eisenträger**, Pennsylvania State University, **Deidre Haskell**, McMaster University, **Jennifer Park**, University of Michigan, and **Alexandra Shlapentokh**, East Carolina University. Also co-sponsored by the ASL is the session on *Algorithmic Dimensions and Fractal Geometry* on Wednesday. The organizers for this session are **Jack H. Lutz**, Iowa State University, and **Elvira Mayordomo**, University of Zaragoza, Spain.

Association for Women in Mathematics (AWM)

Fortieth Annual Noether Lecture, Thursday, 10:05 am, will be given by **Bryna Kra**, Northwestern University, *Dynamics of systems with low complexity.*

Association for Women in Mathematics Panel: Promoting Inclusion in STEM, organized by **Talia Fernos**, University of North Carolina Greensboro; Wednesday, 2:15-3:40 pm. The #metoo movement has underscored the magnitude and prevalence of sexual harassment and how it impacts women's lives and careers. This topic is too often left out of conversations about attrition rates of women in STEM. In this panel discussion, we will examine what kinds of persistent issues contribute to underrepresentation in STEM, and brainstorm what measures can be taken to effectively overcome them.

Examples of underrepresented groups in STEM fields are cis and trans women, and gender minorities; racial and ethnic minorities, particularly people with African, Latin, and Native America descent; lesbian, gay, bisexual, transgender, and queer people; people coming from economically disadvantaged backgrounds; people with disabilities.

Attendees of the panel are expected to be respectful and sensitive to the issues faced by such individuals. Furthermore, because social stigmas and prejudice are major contributing factors to underrepresentation, attendees shall refrain from propagating stereotypes, or disparaging these groups. Everyone is encouraged to participate, independent of gender identity or expression, race, ethnicity, color, religion, age, national origin, sexual orientation, or disability.

This session is open to all JMM attendees. Panelists include **Pamela Barnett**, University of Pennsylvania. **Harrison Bray**, University of Michigan, Ann Arbor, **Piper Harron**, University of Hawaii, Manoa, **Autumn Kent**, University of Wisconsin, Madison, and other panelists to be announced. **Talia Fernos**, University of North Carolina Greensboro will be the panel moderator. `https://sites.google.com/site/awmpanel2019/`

Business Meeting, Wednesday, 3:45-4:15 pm. Chairs, *Ami Radunskaya*, AWM President and **Ruth Hass**, AWM President Elect.

Workshop Poster Presentations and Reception, Friday, 5:00-6:15 pm. AWM will conduct its workshop poster presentations by women graduate students. AWM seeks volunteers to serve as mentors for workshop participants. If you are interested, please contact the AWM office at `awm@awm-math.org`. This session is open to all JMM attendees. Organizers for these presentations are **Sarah Witherspoon**, Texas A&M University, **Liz Vivas**, Ohio State University, and **Matilde Lalin**, Université de Montréal. The Posting Judging Coordinator is **Emilie Wiesner**, Ithaca College.

AWM Workshop: Special Session on WinCompTop: Applied and Computational Topology, Saturday, 8:00 am–5:00 pm, AWM will conduct its workshop with presentations by senior and junior women researchers. Updated information about the workshop is available at `www.awm-math.org`. All JMM attendees are invited to atend the program. Organizers for this workshop are **Radmila Sazdanovic**, North Carolina State University, and **Yusu Wang**, The Ohio State University.

Reception, Wednesday, 9:30–11:00 pm. See the listing in the Social Events, section of the announcement.

National Association of Mathematicians (NAM)

Haynes–Granville–Browne Session of Presentations by Recent Doctoral Recipients in the Mathematical Sciences, Friday, 1:00–4:00 pm. Organized by **Edray Goins**, Purdue University/NAM.

Cox–Talbot Address, to be given Friday after the banquet by **Talithia Williams**, Harvey Mudd College, *A Seat at the Table: Equity and Social Justice in Mathematics Education*. See details about the banquet on Friday in the "Social Events" section.

Panel Discussion: *NAM 2019–2069: Where Do We Go from Here?*, Saturday, 9:00–9:50 am. The moderator for this panel will be **Duane Cooper**, Morehouse College. Panelists are **Robert Bozeman**, Morehouse College, **Shea Burns**, North Carolina A&T State University, **Robin Wilson**, California State Polytechnic University, Pomona, and **Shelby Wilson**, Morehouse College.

Business Meeting, Saturday, 10:00–10:50 am.

Claytor-Woodward Lecture, Saturday, 1:00 pm, **Henok Mawi**, Howard University, *On Mathematical Problems in Geometric Optics*.

National Science Foundation (NSF)

The NSF will be represented at a booth in the exhibit area. NSF staff members will be available to provide counsel and information on NSF programs of interest to mathematicians. The booth is open the same days as the exhibits. Times that staff will be available will be posted at the booth. National Science Foundation (NSF)

MAA Workshop: NSF Funding Opportunities in the Education and Human Resources Directorate and the Division of Mathematical Sciences, organized by **Karen Allen Keene**, NSF, Division of Research on Learning; Wednesday, 9:35–10:55 am. (see MAA workshops).

AMS Special Event: Activities in NSF's Division of Mathematical Sciences (NSF-DMS), Wednesday, 2:15–4:30 pm. Organized by **Henry Warchall**, and **Catherine Paolucci**, National Science Foundation, Division of Mathematical Sciences. Come learn everything you always wanted to know about the National Science Foundation Division of Mathematical Sciences (DMS), which provides more than 60% of the federal support for basic mathematics research in the United States. What happens after my proposal is submitted? How much funding does DMS distribute, anyway? How is it allocated? What is this Merit Review Process of which you speak? How do I get involved? What funding programs can I apply to? What funding opportunities are available for students and postdocs?

DMS invites JMM 2019 attendees to get to know more about the Division's ongoing activities. This two-hour special event offers participants informal opportunities to meet and interact with DMS program directors as well as panel discussions on a variety of NSF-supported funding opportunities. It also provides updates on DMS events, such as the NSF-sponsored "We Are Mathematics" video contest. Undergraduate students, graduate students, and postdoctoral fellows are especially encouraged to attend.

MAA Workshop: Discussing Project Ideas with NSF/EHR Program Officers, Parts I and II, organized by **Karen Allen Keene**, NSF, Division of Research on Learning; Part I: Wednesday, 2:15–3:25 pm and Part II: Friday, 9:45–10:55 am. (see MAA workshops).

Pi M Epsilon (PME)

Council Meeting, Thursday, 8:00–11:00 am.

Rocky Mountain Consortium

Board Meeting, Friday, 2:15–4:00 pm.

Society for Industrial and Applied Mathematics (SIAM)

This program consists of an Invited Address, **Development of Mathematical Methods for Next Generation Stent Design**, at 11:10 am on Thursday given by **Suncica Canic**, University of California, Berkeley, and a series of Minisymposia to include **Advances in mathematical modeling of complex materials systems**, **Maria Emilianenko**, George Mason University; **Mathematical Models in Cancer**, **Doron Levy**, University of Maryland, College Park; **Data Assimilation: Theory and Practice**, **John Harlim**, Pennsylvania State University; **Human Factors in Mathematics Education**, **Suzanne L. Weekes**, Worcester Polytechnic Institute, **Ron Buckmire**, Occidental College, and **Rachel Levy**, Mathematical Association of America; **Recent advances in mathematical theory and scientific computation for biological fluids**, **Suncica Canic**, University of California, Berkeley; **Recent Developments in numerical methods for fluids**, Leo Rebholz, Clemson University; **Analytical techniques in imaging electrical properties of tissue in coupled physics models**, **Alexandru Tamasan**, University of Central Florida and **Amir Moradifam**, University of California, Riverside; F**low-Induced (In)Stability of Elastic Structures**, **Justin Webster**, University of Maryland Baltimore.

See also the session co-sponsored by SIAM in the "AMS Special Sessions" listings *AMS-MAA-SIAM Special Session on Research in Mathematics by Undergraduates and Students in Post-Baccalaureate Programs*, organized by **Darren A. Narayan**, Rochester Institute of Technology, **Khang Tran**, California State University, Fresno, **Mark David Ward**, Purdue University, and **John Wierman**, The Johns Hopkins University.

Other events

Mathematical Art Exhibition, organized by **Robert Fathauer**, Tessellations Company; **Nathan Selikoff**, Digital Awakening Studios, and supported by the Special Interest Group of the MAA for Mathematics and the Arts, and the Bridges Organization. A popular feature at the Joint Mathematics Meetings, this exhibition provides a break in your day. On display are works in various media by artists who are inspired by mathematics and by mathematicians who use visual art to express their findings. Topology, fractals, polyhedra, and tiling are some of the ideas at play here. Do not miss this unique opportunity for a different

perspective on mathematics. The exhibition will be located inside the Joint Mathematics Exhibits and open during the same exhibit hours.

Summer Program for Women in Mathematics (SPWM) Reunion, organized by **Murli M. Gupta**, George Washington University; Thursday, 1:00–3:00 pm. This is a reunion of the summer program participants from all 19 years (1995–2013) who are in various states of their mathematical careers: some are students and, others are in various jobs, both in academia as well as government and industry. The participants will describe their experiences relating to all aspects of their careers. There will also be a discussion on the increasing participation of women in mathematics over the past two decades and the national impact of SPWM and similar programs. See `www.gwu.edu/~spwm`.

Mathemati-Con

Events will take place on Saturday, January 19 between 9:00 am and 4:00 pm in a variety of locations at the JMM.

Some special presentations slated to be included in this program are the ***Who Wants to Be a Mathematician Championship***, demonstrations of both Math Circles and Math Wrangles provided by the MAA SIGMAA on Math Circles for Students and Teachers, an Interactive Lecture for Teachers and Students presented by **Ben Orlin**, Math and Bad Drawings, the 2019 Mathematical Art Exhibition, a ***Showtime!*** presentation by the JPBM Communications Award recipient, and much more, concluding with the MAA-AMS-SIAM Gerald and Judith Porter Public Lecture, *Big Data, Inequality, and Democracy*, by **Cathy O'Neil**, CEO of ORCAA. All events on the Mathemati-Con program are open to the public.

Mathematical Art Exhibition, organized by **Robert Fathauer**, Tessellations Company; **Nathan Selikoff**, Digital Awakening Studios; and **Elizabeth Whiteley**, studio artist, Washington, DC, and supported by the Special Interest Group of the MAA for Mathematics and the Arts, and the Bridges Organization. A popular feature at the Joint Mathematics Meetings, this exhibition provides a break in your day. On display are works in various media by artists who are inspired by mathematics and by mathematicians who use visual art to express their love of mathematics. Topology, fractals, polyhedra, and tiling are some of the ideas at play here. Do not miss this unique opportunity for a different perspective on mathematics. The exhibition will be located inside the Joint Mathematics Exhibits and open during the same exhibit hours.

Interactive Lecture for Students and Teachers, Saturday, 10:00–10:50 am, **Ben Orlin**, Math and Bad Drawings, *Tic-Tac-Toe (or, What is Mathematics?)*.

Who Wants to Be a Mathematician Championship, organized by **Michael A. Breen**, American Mathematical Society, and **William T. Butterworth**, DePaul University; Saturday, 1:00 pm–2:45 pm. Show your support for top high school students from the US, Canada, and the UK in this international ***Who Wants to Be a Mathematician*** as they compete for a US$5,000 first prize for themselves and US$5,000 for their school's math department. Semifinals are at 1:00 pm and finals are at 2:00 pm. Come match wits with the contestants, support their mathematical achievement, and have tremendous fun at the same time.

Math Circle Demonstration, organized by **Lance Bryant,** Shippensburg University, **Sarah Bryant**, Dickinson College, and **Thomas J. Clark**, Dordt College; Saturday morning. A math circle is an enrichment experience that brings mathematics professionals in direct contact with pre-college students and/or their teachers. Circles foster passion and excitement for deep mathematics. This demonstration session offers the opportunity for conference attendees to observe and then discuss a math circle experience designed for local students. While students are engaged in a mathematical investigation, mathematicians will have a discussion focused on appreciating and better understanding the organic and creative process of learning that circles offer, and on the logistics and dynamics of running an effective circle. The sponsor for this demonstration is SIGMAA MCST.

Math Wrangle, organized by **Ed Keppelmann**, University of Nevada Reno, and **Phil Yasskin**, Texas A&M University, Saturday afternoon. The Math Wrangle will pit teams of students against each other, the clock, and a slate of great math problems. The format of a Math Wrangle is designed to engage students in mathematical problem solving, promote effective teamwork, provide a venue for oral presentations, and develop critical listening skills. A Math Wrangle incorporates elements of team sports and debate, with a dose of strategy tossed in for good measure. The intention of the Math Wrangle demonstration at the Joint Math Meetings is to show how teachers, schools, circles, and clubs can get students started in this exciting combination of mathematical problem solving with careful argumentation via public speaking, strategy and rebuttal. Sponsors for this event is SIGMAA for Math Circles for Students and Teachers (SIGMAA-MCST).

Cathy O'Neil, CEO of ORCAA, *Big data, inequality, and democracy*, (MAA-AMS-SIAM Gerald and Judith Porter Public Lecture); Saturday, 3:00 pm.

Welcoming Environment Policy

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

Harassment is a form of misconduct that undermines the integrity of the AMS and MAA, and their activities and missions.

The AMS and MAA will make every effort to maintain an environment that is free of harassment, even though it does not control the behavior of third parties. A commitment to a welcoming environment is expected of all participants of JMM activities, including mathematicians, students, guests, staff, contractors and exhibitors, and participants in scientific sessions and social events. To

this end, the AMS and MAA will include a statement concerning its expectations towards maintaining a welcoming environment in registration materials for the JMM, and has put in place a mechanism for reporting violations. Violations may be reported confidentially and anonymously to 855-282-5703 or at www.mathsociety.ethicspoint.com. The reporting mechanism ensures the respect of privacy while alerting the AMS and MAA to the situation. Violations may also be brought to the attention of the AMS Director of Meetings & Conferences (who is usually at the meeting registration desk), and that person can provide advice about how to proceed.

Exhibits

The Joint Mathematics Meetings Exhibits include the country's leading scientific publishers, professional organizations, companies that offer mathematics-enrichment products and services, computer hardware and software companies, and the Mathematical Art Exhibit. It will be open to all registered participants on Wednesday (starting with the Grand Opening) 12:15 pm–5:30 pm, on Thursday and Friday 9:30 am–5:30 pm and on Saturday 9:00 am–noon. See more details at jointmathematicsmeetings.org.

AMS Book Sales and Membership: The American Mathematical Society booth, located in the Exhibit Hall, is where attendees will find the latest AMS titles (up to 40% off list price), fun giveaways, mathematics awareness materials, and information about programs available to the mathematical community. Make sure to visit the booth to track your Mathematical Genealogy, learn about Mathematics Research Communities, or attend a demonstration of MathSciNet.

If you join the AMS or renew your membership during the meeting, you will receive a complimentary gift and will be able to start using your member discount on AMS titles right away. Make sure to ask about our new membership benefit, free shipping on all purchases, not just at meetings but also on orders placed online, phoned in, faxed, or sent via postal mail. Back by popular demand, the AMS Membership Department has once again arranged for a photographer to take AMS member's professional portraits. Visit amermathsoc.simplybook.me to schedule an appointment.

MAA Pavilion: Join us in the Mathematical Association of America (MAA) Pavilion, booths 424–431, for new networking events. It's the perfect opportunity to connect with the MAA and the mathematical community. You can also use this occasion to learn more about the MAA Career Resource Center, talk to staff about programs and resources for your research and classroom, renew your membership, and learn how MAA advances the understanding of mathematics, and its impact on our world.

Mathematical Art Exhibition, organized by **Robert Fathauer**, Tessellations Company; **Nathan Selikoff**, Digital

Awakening Studios; and **Elizabeth Whiteley**, studio artist, Washington, DC, and supported by the Special Interest Group of the MAA for Mathematics and the Arts, and the Bridges Organization. A popular feature at the Joint Mathematics Meetings, this exhibition provides a break in your day. On display are works in various media by artists who are inspired by mathematics and by mathematicians who use visual art to express their love of mathematics. Topology, fractals, polyhedra, and tiling are some of the ideas at play here. Do not miss this unique opportunity for a different perspective on mathematics. The exhibition will be located inside the Joint Mathematics Exhibits and open during the same exhibit hours.

Hotel Accommodations

The importance of reserving a hotel room at one of the official Joint Mathematics Meetings (JMM) hotels cannot be stressed enough. The AMS and the MAA make every effort to keep participants' expenses at the meeting, registration fees, and hotel rooms for the meeting as low as possible. They work hard to negotiate the most affordable hotel rates and to maximize the best use of your registration dollars. The AMS and MAA encourage all participants to register for the meeting. When anyone pays the registration fee and reserves a room with an official JMM hotel, he or she is helping to support not only the 2019 JMM, but future meetings as well.

General: Participants are encouraged to register for the JMM in order to reserve hotel rooms at the contracted JMM rates. If a participant needs to reserve a hotel room before they are registered for the JMM, he or she must contact the Mathematics Meetings Services Bureau (MMSB) at mmsb@ams.org or 1-800-321-4267 ext. 4137 or ext. 4144 for further instructions.

Special rates have been negotiated exclusively for this meeting at the following hotels: Hilton Baltimore, Baltimore Marriott Inner Harbor, Sheraton Inner Harbor, Renaissance Harborplace Hotel, Hyatt Regency Baltimore, Royal Sonesta, Lord Baltimore Hotel, Hotel Monaco, Days Inn Inner Harbor, and Holiday Inn Inner Harbor. (See details on these hotels below.)

To receive the JMM rates, reservations for these hotels must be made through the MMSB. The hotels will not be able to accept reservations directly until after **December 13, 2018.** At that time, rooms and rates will be based on availability only. Any rooms reserved directly with the hotels after **December 14, 2018** are subject to rates higher than the JMM rates.

A link to the 2019 JMM housing site will be included in the email confirmations of all registrations. If a participant needs to have the link emailed to him or her, please send the request to mmsb@ams.org. If anyone is having problems reserving a hotel room, please send email to mmsb@ams.org.

Any participant who needs to reserve a hotel room and does not have a credit card, he or she should contact the MMSB at mmsb@ams.org for further instructions. If a check is being used to reserve a hotel room, the reserva-

tion and check must be received by the MMSB no later than **December 1, 2018**.

ADA Accessibility: We strive to take the appropriate steps required to ensure that no individual with a disability is excluded, denied services, segregated, or otherwise treated differently. If special assistance, auxiliary aids, or other reasonable accommodations to fully participate in this meeting is required, it should be indicated in the appropriate section on the Registration and Housing Form or emailed to the MMSB at mmsb@ams.org. Requests for ADA-accessible rooms should also be clearly indicated when making hotel reservations. All requests for special accommodations under the Americans with Disabilities Act of 1990 (ADA) must be made allowing enough time for evaluation and appropriate action by the AMS and MAA. Any information obtained about any disability will remain confidential.

Cancellation Policies:
- 24-hour cancellation policy: Sheraton Inner Harbor, Lord Baltimore Hotel, Days Inn Inner Harbor, and Holiday Inn Inner Harbor
- 48-hour cancellation policy: Baltimore Marriott Inner Harbor and Hotel Monaco
- 72-hour cancellation policy: Hilton Baltimore, Renaissance Harborplace Hotel, Hyatt Regency Baltimore, and Royal Sonesta

Check-in/Checkout:
- Check-in at 3:00 pm and checkout at 11:00 am: Days Inn Inner Harbor
- Check-in at 3:00 pm and checkout at noon: Hilton Baltimore, Sheraton Inner Harbor, Hotel Monaco, and Holiday Inn Inner Harbor
- Check-in at 4:00 pm and checkout at 11:00 am: Hyatt Regency Baltimore and Lord Baltimore Hotel
- Check-in at 4:00 pm and checkout at noon: Baltimore Marriott Inner Harbor, Renaissance Harborplace Hotel, and Royal Sonesta

Complimentary Room Drawing: Participants who register and reserve a hotel room by **October 30, 2018**, will be included in a lottery for complimentary hotel room nights during the meeting. Rooms with multiple occupants will be included. The winners will be notified by phone and/or email prior to **December 19, 2018**.

Confirmations: An email confirmation number will be provided for each hotel reservation made online. This confirmation number will give participants direct access to edit their reservations, up to **December 13, 2018**. Those who did not receive a confirmation number or who have any questions about the reservation process should contact the MMSB at mmsb@ams.org or 1-800-321-4267, ext. 4137 or 4144.

Deadlines:
- Chance to win complimentary hotel nights: **October 30**
- In time to have program mailed in December: **November 20**
- Hotel Reservation Changes, and Cancellations through the MMSB: **December 13**

Environmental Policies: All of the hotels listed have environmental-friendly programs in place.

Internet Access/Wireless: All of the hotels listed offer complimentary wireless internet in all public areas, the lobby, and all sleeping rooms.

Looking for a Roommate? An interactive search board is available for participants looking for a roommate. See bboards.jointmathematicsmeetings.org for more details.

Location: The Hilton Baltimore and the Baltimore Marriott Inner Harbor will be the co-headquarter hotels for this meeting. The JMM Registration Desk, exhibits, poster sessions, scientific sessions, and AMS Employment Center will be located in the Baltimore Convention Center. The AMS Short Course, MAA Minicourses, Committee meetings, social events and affiliate events will be held in the Hilton Baltimore, the Baltimore Marriott Inner Harbor, and the Baltimore Convention Center.

Hilton Baltimore (co-headquarter), 401 West Pratt Street Baltimore, MD 2120. Room rates are US$179 for a single/double room and US$149 for a student rate single/double room. Smoke-free hotel; restaurants: *Diamond Tavern*, *Lobby Bar*, and *The Coffee Bean & Tea Leaf*; fitness center; indoor pool; 24-hour business center available to registered guests; full amenities in guest rooms; laptop-sized safes in guest rooms; windows do not open; children under 12 are free in room with an adult; cribs available upon request at no charge; rollaways available only in king-bedded rooms; pets allowed; self-parking available for US$33 per day with in/out privileges; valet parking available for US$43 per day with in/out privileges; parking rates subject to change. The hotel does not offer an airport shuttle.

Baltimore Marriott Inner Harbor (co-headquarter), 110 South Eutaw Street, Baltimore, MD 21201. Room rates for this property are US$169 single/double room and US$160 for a student rate single/double room. Smoke-free hotel; restaurants: *The Yard*, *BricknFire Pizza Company*, *Fresh Bites*; fitness center; 24-hour business center available to registered guests; full amenities in guest rooms; laptop-sized safes in guest rooms; windows do not open; children under 12 are free in room with an adult; cribs available upon request at no charge; rollaways available only in king-bedded rooms; no pets allowed; self-parking available for US$30 per day with in/out privileges; parking rates subject to change. The hotel does not offer an airport shuttle.

Sheraton Inner Harbor, 300 South Charles Street Baltimore, MD 21201. Room rates at this property are US$159 single/double room and US$145 for a student rate single/double room. Smoke-free hotel; restaurants: *Orioles Grille*

Bar and *Morton's The Steakhouse*; fitness center; 24-hour business center available to registered guests; full amenities in guest rooms; laptop-sized safes in guest rooms; windows do not open; children under 12 free in room with an adult; cribs available upon request at no charge; rollaways available in king-bedded rooms only at no cost; dogs are allowed; valet parking available for US$42 per day with in/out privileges; self-parking available for US$28.50 per day with in/out privileges; parking rates subject to change. The hotel does not offer an airport shuttle.

Renaissance Harborplace Hotel, 202 East Pratt Street, Baltimore, MD 21201. Room rates are US$155 for a single/double room and US$138 for a student rate single/double room. Smoke-free hotel; restaurants: *Watertable*, *Watertable Lounge*, and *The Ground Floor Café & Bar*; Indoor pool; fitness center; 24-hour business center available to registered guests; full amenities in guest rooms; laptop-sized safes in guest rooms; windows open in some rooms; children under 12 free in room with an adult; cribs available upon request at no charge; rollaways available in king-bedded rooms only for US$25 per stay; no pets allowed; self-parking available for US$33 per day with in/out privileges; valet parking available for US$43 per day with in/out privileges; parking rates subject to change. The hotel does not offer an airport shuttle.

Hyatt Regency Baltimore, 300 Light Street, Baltimore, MD 21201. Room rates are US$150 for a single/double room and US$140 for a student rate single/double room. Smoke-free hotel; restaurants: *Bistro*, *Market*, and *Bistro 300 Lounge*; fitness center; 24-hour business center available to registered guests; full amenities in guest rooms; laptop-sized safes in guest rooms; windows open in some rooms; children under 12 free in room with an adult; cribs available upon request at no charge; rollaways available in king-bedded rooms only at US$25 per stay; pets are allowed; self-parking available for US$30 per day with in/out privileges; valet parking available for US$42 per day with in/out privileges; parking rates subject to change. The hotel does not offer an airport shuttle.

Royal Sonesta, 550 Light Street Baltimore, MD 21201. Room rates are US$149 for a single/double room and US$134 for a student rate single/double room. Smoke-free hotel; restaurants: *Explorer's Restaurant* and *Formula Espresso*; indoor pool; fitness center; 24-hour business center available to registered guests; full amenities in guest rooms; laptop-sized safes in guest rooms; windows open in suites only; children under 12 free in room with an adult; cribs available upon request at no charge; rollaways available in king-bedded rooms only for US$30 per night; pets are allowed—one dog per room, up to 35 pounds with a US$75 non-refundable deposit; self-parking available for US$24 per day with in/out privileges; valet parking available for US$39 per day with in/out privileges; parking rates subject to change. The hotel does not offer an airport shuttle.

Lord Baltimore Hotel, 20 West Baltimore Street Baltimore, MD 21201. Room rates are US$139 for a single/double room and US$129 for a student rate single/double room. Smoke-free hotel; restaurants: *LB Tavern* and *LB Bakery*; fitness center; 24-hour business center available to registered guests; full amenities in guest rooms; laptop-sized safes in guest rooms; windows open in some rooms; children under 12 free in room with an adult; cribs available upon request at no charge; rollaways available in king-bedded rooms only for US$20 per night; pets are allowed with a deposit of US$50; self-parking available for US$15 per day with in/out privileges; valet parking available for US$31 per day with in/out privileges; parking rates subject to change. The hotel does not offer an airport shuttle.

Hotel Monaco, 2 North Charles Street, Baltimore, MD 21201. Room rates are US$135 for a single/double and US$125 for a student rate single/double room. Smoke-free hotel; restaurant: *B&O American Brasserie*; fitness center; 24-hour business center available to registered guests; full amenities in guest rooms; laptop-sized safes in guest rooms; windows do not open; children under 12 free in room with an adult; cribs available upon request at no charge; rollaways available in king-bedded rooms only for US$25 each; pets allowed—contact the hotel for specific costs, limitations, and instructions; valet parking available for US$40 per day with in/out privileges; parking rates subject to change. The hotel does not offer an airport shuttle.

Days Inn Inner Harbor, 100 Hopkins Place, Baltimore, MD 21201. Room rates are US$139 for a single/double room and US$129 for a student rate single/double room. Smoke-free hotel; restaurant: *Harbor Grill and Lounge*; fitness center; outdoor pool; 24-hour business center available to registered guests; full amenities in guest rooms; laptop-sized safes in guest rooms; windows do not open; up to 2 children under 12 free in room with an adult, 3 or more children will be charged an additional fee; cribs available upon request at no charge; pets are allowed at US$100 per stay; self-parking is available for US$30 per day with in/out privileges; parking rates subject to change. The hotel does not offer an airport shuttle.

Holiday Inn Inner Harbor, 301 West Lombard Street, Baltimore, MD 21201. Room rates are US$139 for a single/double room and US$129 for a student rate single/double room. Smoke-free hotel; restaurants: *Eden West Restaurant*, *Dottie's Café*, and *Pappas Sports Bar*; fitness center; indoor heated pool; 24-hour business center available to registered guests; full amenities in guest rooms; safe deposit boxes available behind the front desk; windows do not open; children under 18 free in room with an adult; cribs available upon request at no charge; rollaways available in king-bedded rooms only; pets are allowed - US$50 deposit per pet; self-parking available for US$30 per day

with in/out privileges; parking rates subject to change. The hotel does not offer an airport shuttle.

Parking: Please see the Parking section under "Travel" for any additional parking options. Parking information for each hotel is listed.

Rates: All rates are subject to applicable local and state taxes in effect at the time of check-in; currently 15.5% state tax.

Miscellaneous

Audio-Visual Equipment: AMS Special Sessions and Contributed Papers, and MAA Invited and Contributed Paper Sessions, are provided with a screen and a LCD projector for projecting presentation slides. Blackboards, white boards, and transparency projectors are not available. Session rooms do not include an Internet connection or sound connection for videos or sound clips. For presentations using MAC computers, speakers are advised to bring the proper adaptors and equipment needed. LCD projectors are equipped with adapters to accept both VGA & HDMI cables

Invited address talks (50-minutes long) are provided with a lectern, PC Laptop with Microsoft Office Suite including PowerPoint, wireless microphone, laser pointer, wireless slide advancer "clicker," document camera (for print materials and transparencies), and LCD projector for projecting presentation slides on large stage flanking screens. For presentations using MAC materials, speakers are advised to bring the proper adaptors and equipment needed. The Invited Address room does not include an Internet connection. Speakers that are planning to show videos should save them to their computers or USB drives prior to the meeting.

Overhead projectors are no longer provided as part of the standard audio-visual setup in any room. Any request for additional equipment should be sent to `meet@ams.org` and received by **October 1.**

Child Care: The AMS and the MAA will provide a limited number of reimbursement grants of US$250 per family to help with the cost of child care for registered participants at JMM 2019. The funds may be used for child care that frees a parent to participate more fully in JMM. Registration for the JMM as well as membership in the AMS or MAA is required to apply for this program.

Information about applying for child care grants will be available prior to the opening of advance registration in September; watch the JMM website for details. Applications will be accepted on a first-come, first-served basis until **November 12, 2018**. Final decisions on recipients will be made on or before **November 28, 2018**. All grant funds will provided in the form a check which will be issued at the JMM.

Email Services: Limited email access for all Joint Meetings participants will be available in an email center located adjacent to the JMM Registration Desk, in the Pratt St Lobby, on the 300 level of the Baltimore Convention Center. The hours of operation will be published in the program. Participants should be aware that **complimen-**

tary wireless internet access will also be available in specific, designated areas of the Convention Center. These locations will be identified in the program.

Information Distribution: Tables are set up in the exhibit area for dissemination of general information of possible interest to the members and for the dissemination of information of a mathematical nature not promoting a product or program for sale. Information must be approved by the AMS Director of Meetings and Conferences prior to being placed on these tables.

If a person or group wishes to display information of a mathematical nature promoting a product or program for sale, they may do so in the exhibit area at the Joint Books, Journals, and Promotional Materials exhibit for a fee of US$50 (posters are slightly higher) per item. Please contact the exhibits coordinator, MMSB, P.O. Box 6887, Providence, RI 02940, or by email at `cpd@ams.org` for further details.

The administration of these tables is in the hands of the AMS-MAA Joint Meetings Committee, as are all arrangements for Joint Mathematics Meetings.

Local Information: For information about the city, see `https://baltimore.org/`

Broadcasting, Photographing, and Videotaping Policy: Each invited address (50+minutes long) that takes place in the Invited Address room will be recorded, with the permission of the speaker, and posted online on a web page hosted by the Joint Mathematics Meetings. These recordings will be taken by a professional videographer hired by the Joint Mathematics Meetings.

The recording or broadcasting of any AMS or joint-sponsored event, talk, and session by any other party is strictly forbidden without the explicit written permission of the AMS Executive Director or AMS Director of Meetings and Conferences. To obtain permission, send your request by email to `meet@ams.org` to the attention of the AMS Director of Meetings and Conferences. Having submitted a request form does not constitute temporary authority, and approval will not be given orally. Please allow sufficient time for the approval process to be completed. Allow at least two weeks from time of receipt of request by the AMS.

The recording or broadcasting of any MAA sponsored event by any other party is strictly forbidden without the explicit written permission of the Mathematical Association of America. To obtain permission to record and/or broadcast an MAA event or activity, complete the information requested in the *Request to Record or Broadcast* form on `maa.org` and send your request to the MAA Executive Director. You must have received a signed form granting approval for recording and/or broadcasting an MAA event before the event takes place. Having submitted a request form does not constitute temporary authority, and approval will not be given orally. Please allow sufficient time for the approval process to be completed. Allow at least two weeks from time of receipt of request by the MAA office.

Photographs and videos of meeting interactions will be taken by professional photographers hired by the Joint Mathematics Meetings or by AMS and MAA staff. These

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

Under no circumstances will anyone be permitted to take pictures or videos of a single person without that person's permission. Under no circumstances will anyone be permitted to take pictures or videos of an exhibitor's product or display without that exhibitor's permission.

Telephone Messages: It will be possible to leave a message for any registered participant at the meetings registration desk from January 16 through 19 during the hours that the desk is open. These messages will be posted on the Mathematics Meetings Message Board in the networking center; however, staff at the desk will try to locate a participant in the event of a bona fide emergency. The telephone number will be published in the program and daily newsletter.

Registration

The AMS and the MAA encourage all participants to register for the Joint Mathematics Meetings (JMM). The importance of registering for the meeting, especially before the meeting, cannot be overemphasized. Advanced registration fees are considerably lower than on-site registration fees and paying a registration fee helps to support a wide range of activities associated with planning, organizing, and executing the meetings.

All participants who wish to attend sessions are expected to register for the JMM and should be prepared to show their badges, if so requested. Badges are required to enter the Exhibits, the Employment Center, to obtain discounts at the AMS and MAA Book Sales, and to cash a check with the Joint Meetings cashier. The Mathematics Meetings Service Bureau (MMSB) is the official registration and housing bureau for the JMM and they will be processing all registrations.

Online Registration: To register and reserve a hotel room online, visit www.jointmathematicsmeetings.org/register. VISA, MasterCard, Discover, and American Express are the only methods of payment accepted for online registrations, and charges to credit cards will be made in US funds. Registration acknowledgments will be sent by email to the email addresses provided.

Paper Form Registration: For the convenience of those who do not have access to the internet or who prefer to not use the internet to register and reserve a hotel room, a paper copy of the registration form is located at the back of this issue. It is also located at www.jointmathematicsmeetings.org/meetings/national/jmm2019/JMM19_regform.pdf. If you are using this method to register for the meeting and do not have a credit card, please contact the MMSB at mmsb@ams.org for further instructions. If you are using a check to reserve your hotel room, your reservation and check must be received by the MMSB no later than **December 1, 2018** to ensure that your check is validated and reaches the hotel in time to hold your room.

Forms must be mailed or faxed to the MMSB at MMSB, P.O. Box 6887, Providence, RI 02940 or 401-455-4004. For security reasons, credit card numbers by postal mail, email or fax cannot be accepted. If a participant is registering by paper form and would like to pay for his or her registration via credit card, he or she should indicate this on the form. MMSB staff will then contact that person.

NEW! Program Books: In order to keep registration fees as low as possible, save on postage, and make the JMM more environmentally friendly, **program books will no longer be distributed or mailed in advance without your request**. If you would like to receive a program book and pick it up at the meeting, please check the appropriate "YES" box on the Registration/Housing Form and pay a nominal fee of US$5. If you would like to receive a program book and have it mailed to you before the meeting, please check the appropriate "YES" box on the Registration/Housing Form by **November 20, 2018** and pay a nominal fee of US$10. **Programs can only be mailed via US Mail.** Programs cannot be mailed to Canada, Mexico, or other countries outside of the US If you do not want to receive a program book (either before the meeting or at the meeting), please check the appropriate "NO" box on the Registration/Housing Form. Note that extra copies of the program book will be available on-site at the meeting for those that inadvertently checked the wrong box, while supplies last.

Updates and corrections received too late to be included in the program books will be included in the online program on the JMM website and in the JMM mobile app.

Badges and Tickets: As part of our efforts to keep registration fees as low as possible and save on postage, all other registration materials must be picked up at the meeting only. This includes badges, tickets, and promotional flyers. **Badges will not be mailed before the meeting.** All registration materials will be available at the Joint Mathematics Meetings Registration Desk, which will be located in the Pratt Street Lobby of the Baltimore Convention Center.

Participant Lists and Mailing Lists: To be included on the list of participants or the mailing list that is generated for the JMM, you must opt-in by checking the appropriate boxes on the Registration/Housing Form. All who **do not opt-in** on a category, **will not be included** in that category.

The list of participants will be included on the JMM daily newsletter, which is distributed during the meeting, and on the JMM mobile app. The mailing list will be used: a) by AMS and MAA staff to send marketing and promotional information by email, and b) by exhibitors and sponsors to send marketing and promotional information by US Mail. The AMS and MAA do not disseminate the email addresses of JMM participants to outside parties.

Cancellation Policy: Participants who cancel their registrations for the meetings, minicourses, short course,

or banquet tickets by **January 8, 2019**, will be eligible to receive a 50% refund of fees paid. No refunds will be issued after this date.

Joint Mathematics Meetings Registration Fees

	Advanced	At Meeting (by Dec. 27)
Member of AMS, ASL, CMS, MAA, SIAM	US$345	US$455
Non-member	548	699
Graduate Student Member of AMS, ASL, CMS, MAA, SIAM	78	90
Graduate Student Non-member	124	137
Undergraduate Student Member of AMS, ASL, CMS, MAA, PME, KME, SIAM	78	90
Undergraduate Student Non-member	124	137
Temporarily Employed	281	322
Emeritus Member of AMS, MAA; Unemployed; High School Teacher; Developing Countries; Librarian	78	90
High School Student	7	15
One-Day Member of AMS, ASL, CMS, MAA, SIAM	N/A	247
One-Day Non-member	N/A	385
Non-mathematician Guest	22	22
Commercial Exhibitor	0	0
Art Exhibitor	0	0
MAA Minicourses	100	100
Grad School Fair Table	125	125

AMS Short Course:

	Advanced	At Meeting
Member of AMS	124	158
Non-member	190	225
Student/Unemployed/Emeritus	72	93

Registration Category Definitions

Full-Time Students: Any person who is currently working toward a degree or diploma is eligible for this category. Students are asked to determine whether their status can be described as a graduate (working toward a degree beyond the bachelor's), an undergraduate (working toward a bachelor's degree), or high school (working toward a high school diploma) and to mark the Registration/Housing Form accordingly. See membership distinctions below.

Graduate Student Member: Any person who is currently working toward a degree or diploma is eligible for this category. Students are asked to determine whether their status can be described as a graduate (working toward a degree beyond the bachelor's), an undergraduate (working toward a bachelor's degree), or high school (working toward a high school diploma) and to mark the Registration/Housing Form accordingly. See membership distinctions below.

Undergraduate Student Member: Any undergraduate student who is a member of the AMS, ASL, CMS, MAA, SIAM, PME, or KME is eligible for this category. Students

should check with their department administrator to check their membership status.

Emeritus: Any person who has been a member of the AMS for twenty years or more and who retired because of age or long-term disability from his or her latest position is eligible for this category. Anyone person who has been a member of the MAA for 25 years and who is 70+ years of age is also eligible for this category.

Librarian: Any librarian who is not a professional mathematician is eligible for this category.

Unemployed: Any person who is currently unemployed, actively seeking employment, and is not a student is eligible for this category. This category is not intended to include any person who has voluntarily resigned or retired from his or her latest position.

Developing Country Participant: Any person who is employed in developing countries where salary levels are radically not commensurate with those in the US is eligible for this category. See the most recent list of countries in this category at isge2018.isgesociety.com/registration /list-of-developing-countries.

Temporarily Employed: Any person currently employed but who will become unemployed by **June 1, 2019**, and who is actively seeking employment is eligible for this category.

Non-mathematician Guest: Any family member or friend, who is not a mathematician, and who is accompanied by a participant in the meetings is eligible for this category. Guests will receive a badge and may accompany a mathematician to a session or talk and enter the exhibit area.

Commercial Exhibitor: Any person who is exhibiting in the Joint Mathematics Meetings Exhibits is eligible for this category. This does not include anyone participating in a poster session. Any exhibitor who is a mathematician and is participating in the scientific program and/or wants to attend sessions, talks, etc. is expected to register separately for the meeting.

Art Exhibitor: Any person who is exhibiting in the Mathematical Art Exhibition is eligible for this category. This does not include anyone participating in a poster session. Any exhibitor who is a mathematician and is participating in the scientific program and/or wants to attend sessions, talks, etc. is expected to register separately for the meeting.

Registration Deadlines

There are three registration deadlines, each with its own benefits :

- ROOM LOTTERY (to qualify for hotel room lottery)— **October 30**
- ORDINARY (to qualify to have program book mailed) —**November 20**
- FINAL (advanced registration, short course, minicourses, banquets)—**December 27**

Room Lottery: Participants who register by **October 30** will be included in a random drawing to select winners of complimentary hotel room nights during the meeting.

Rooms with multiple occupants will be included in the drawing. The location of these rooms will be based on the number of complimentary room nights earned in the various hotels. Therefore, a free room will not necessarily be in winner's first-choice hotel. All winners will be notified by phone and email prior to **December 19.**

Ordinary Registration: Participants who register by **November 20** can choose to receive their materials before the meeting by mail. **Badges will be distributed at the meeting only.**

Final Registration: Participants who register after **November 20** and by **December 27** must pick up their badges, programs, and any tickets for social events at the meeting. After **December 27**, participants may register at the meeting, at higher fees.

Social Events

All events listed are open to all registered participants. It is strongly recommended that for any event requiring a ticket, tickets should be purchased through advance registration. Only a very limited number of tickets, if any, will be available for sale on site. If you must cancel your participation in a ticketed event, you may request a 50% refund by returning your tickets to the Mathematics Meetings Service Bureau (MMSB) by **January 8, 2019.** After that date, no refunds can be made. Special meals are available at banquets upon advance request, but this must be indicated on the Advanced Registration/Housing Form.

2019 AMS "Until Next Time" Social, Saturday, 7:00–9:30 pm. Join your colleagues on the last evening of JMM 2019 as we say "until next time!" This year's AMS closing event will be held on Saturday, January 19, 2019 from 7:00 pm–9:30 pm at the Maryland Science Center, 601 Light Street, Baltimore, MD, located in Baltimore's Inner Harbor just 0.6 miles away from the Baltimore Convention Center. Guests will enjoy the evening at this Baltimore destination with access to exhibits and hands-on displays. Join us for live music, various food stations, interactive activities and learning opportunities, and a chance to wish your colleagues well "until next time!"

While guests are welcome to choose their transportation method, we are pleased to provide a free shuttle service. Shuttle service will pick up guests every 10–15 minutes beginning at 6:45 pm from both the Hilton Baltimore and Baltimore Convention Center and dropping off at the venue. Return shuttle service will pick up guests at the Maryland Science Center beginning at 7:30 pm and return guests to the Baltimore Convention Center and Hilton Baltimore. Accessible shuttle service will be available.

Purchase your tickets when registering for the 2019 Joint Mathematics Meetings at: jointmathematicsmeetings.org. Regular Tickets: US$75; Student Tickets: US$35. *A limited number of tickets will be available at the special students rate.*

Association of Christians in the Mathematical Sciences (ACMS) Reception and Lecture, Thursday, 5:30–7:30 pm. The reception will take place between 5:30 and 6:30 pm, followed by a short program and 20 minute talk at 6:30 pm. Students are encouraged to attend, and

opportunity will be provided afterwards for delegates to go to dinner at a local restaurant. The talk will be given by **Sloan Despeaux**.

Association for Women in Mathematics Reception and Awards Presentation, the AWM Reception which is open to all JMM participants will be held on Wednesday at 9:30 pm after the AMS Gibbs Lecture. The AWM President at 10:00 pm will recognize all of the honorees of the AWM Alice T. Schafer Prize for Excellence in Mathematics by an Undergraduate Woman, the recipients of the AWM Dissertation Prize, the AWM Service Awards, and the AWM Fellows.

Backgammon! organized by **Arthur Benjamin**, Harvey Mudd College; Friday, 8:00–10:00 pm. Learn to play backgammon from expert players. It's a fun and exciting game where players with a good mathematics background have a decisive advantage. Boards and free lessons will be provided by members of the US Backgammon Federation. Stop by anytime!

Budapest Semesters in Mathematics Annual Alumni Reunion, Thursday, 5:30–6:30 pm.

BSME Information Session, Friday, 12:00–1:00 pm. BSME (Budapest Semesters in Mathematics Education) is a study abroad program in Budapest, Hungary, designed for undergraduates (and recent graduates) interested in teaching middle school or high school mathematics. Participants will study the Hungarian approach to learning and teaching, in which a strong and explicit emphasis is placed on problem solving, mathematical creativity, and communication. Come learn more about this exciting new program. bsmeducation .com

University of California, San Diego Reception, Thursday, 6:00–8:00 pm. Reception for Mathematics alumni.

Reception for Graduate Students and First-Time Participants, Wednesday, 5:30–6:30 pm. The AMS and MAA cosponsor this social hour. Graduate students and first-timers are especially encouraged to come and meet some old-timers to pick up a few tips on how to survive the environment of a large meeting. Light refreshments will be served.

ICERM Mixer, Friday, 6:00–8:00 pm. ICERM welcomes all past and future participants of our semester programs, workshops, collaborations and Summer@ICERM undergraduate programs to come together for its annual mixer Those interested in the Simons collaboration 'Arithmetic Geometry, Number Theory, and Computation' are also invited. Refreshments will be served.

University of Illinois at Urbana–Champaign, Friday, 6:00–7:30 pm. Department of Mathematics Reception. Everyone ever connected with the Department is encouraged to get together for conversation and to hear about mathematics at the University of Illinois.

Joint Prize Reception, Thursday 5:30–6:30 pm.

Knitting Circle, Thursday, 8:15–9:45 pm. Bring a project (knitting/crochet/tatting/beading/etc.) and chat with other mathematical crafters!

MAA/Project NExT Reception, Friday, 8:00–10:00 pm. All Project NExT Fellows, consultants, and other friends of MAA Project NExT are invited. Organizers: **Julia Barnes**, West Carolina University, **Alissa Crans,** Loyola Marymount University, **Matt DeLong**, Taylor University and **David Kung**, St Mary's College of Maryland.

MAA Two-Year College Reception, Wednesday, 5:30–7:00 pm, is open to all meeting participants, particularly two-year faculty members. This is a great opportunity to meet old friends and make some new ones.

Mathematical Reviews Reception, Friday, 6:00–7:00 pm. All friends of the Mathematical Reviews (MathSciNet) are invited to join reviewers and MR editors and staff (past and present) for a reception in honor of all of the efforts that go into the creation and publication of the Mathematical Reviews database. Refreshments will be served.

Mathematical Institutes Open House, Wednesday, 5:30–8:00 pm. Please join us at the Mathematical Institutes Open House reception to learn about the latest programs and workshops being held by a number of institutes. Hope to see you there.

The Mathematical Sciences Research Institute (MSRI) Reception for Current and Future Donors, Thursday, 6:30–8:00 pm. MSRI invites current and prospective donors to an informal reception with appetizers and drinks. Directors David Eisenbud and Hélène Barcelo will speak about present and upcoming events and programs, as well as the impact of private support on the Institute.

MSRI thanks and acknowledges mathematicians who support MSRI's programs and workshops through membership in the Archimedes Society or the Gauss Society. Archimedes Society members support MSRI with annual gifts. Gauss Society members support MSRI with planned gifts through arrangements in their wills and estates.

For more information about the event and how to join the Archimedes or Gauss Societies, please contact, Annie Averitt, Director for Advancement and External Relations, `aaveritt@msri.org`; 510-643-6056. `www.msri.org`.

{MathILy, MathILy-Er} Yearly Gather, Wednesday, 7:00–8:30 pm. Come one, come all, and play a recently created mathematical game or solve a new puzzle! And learn about the {MathILy, MathILy-Er} summer programs for high-school students, then hang out with {MathILy, MathILy-Er} alumnus and instructors.

University of Michigan Mathematics Alumni and Friends Reception, Thursday, 5:30–7:00 pm.

National Association of Mathematicians Banquet, Friday, 6:00–8:40 pm. A cash bar reception will be held at 6:00 pm, and dinner will be served at 6:30 pm. Tickets are US$65 each, including tax and gratuity. The Cox–Talbot Invited Address will be given after the dinner.

NSA Women in Mathematics Society Networking Session, Thursday, 6:00–8:00 pm.

PROMYS and Ross Reception for Alumni and Friends, Thursday, 6:30–8:30 pm. There will be hors d'oeuvres, a cash bar, and interesting conversations!

SCUDEM Gathering and Reunion, Friday, 7:00–8:30 pm. SIMIODE is holding an information Gathering for SCUDEM IV 2019 – Student Competition Using Differential Equations Modeling for those interested in learning about hosting and participating in this team event for high school and undergraduate students scheduled for October 2019. This will be an opportunitiy for past participants (local site host coordinators, coaches, and students) to reunite and share their experiences and for colleagues who want to learn more about SCUDEM.

Spectra Reception for LGBT Mathematicians and Allies, Thursday, 6:00–8:00 pm. Annual reception for lesbian, gay, bisexual, and transgender mathematicians and their allies. Begun in 1996, this event is organized by Spectra, a volunteer association for LGBT mathematicians that is affiliated with NOGLSTP, the National Organization of Gay and Lesbian Scientists and Technical Professionals.

University of Tennessee Mathematics Department Alumni and Friends Reception, Thursday, 5:30–7:30 pm. Alumni and other friends of the University of Tennessee Mathematics Department, including prospective graduate students, are welcome to come and enjoy snacks, renew old friendships and make new ones.

Texas A&M University Mathematics Department Reception for Alumni, Students, and Faculty, Friday, 5:30–7:30 pm. All alumni, current students, faculty, and current and former post-docs are encouraged to join us for this reception.

Reception for Undergraduates, Wednesday, 4:30–5:30 pm.

University of Waterloo Faculty of Mathematics Reception, Thursday, 6:00–8:00 pm. Join the University of Waterloo Faculty of Mathematics for a cocktail reception celebrating the accomplishments of our Faculty, and its' members over the past year. All welcome, refreshments provided.

YP17HCSSiM Reunion Breakfast, Friday, 7:17–9:00 am.

Travel/Transportation

The 2019 Joint Mathematics Meetings will be held at the Baltimore Convention Center, located at 1 W. Pratt Street, Baltimore, MD 21201. Some committee meetings and social events will be held at the Hilton Baltimore and the Marriott Inner Harbor. Baltimore is on Eastern Standard Time.

The Baltimore/Washington International Thurgood Marshall Airport (**BWI**) (`https://www.bwiairport.com/`) is served by all major airlines and is approximately 12 miles from the Inner Harbor area where the Baltimore Convention Center and the conference hotels are located. The street address of the airport is 7062 Friendship Rd, Baltimore, MD 21240.

Airline

The official airline for this meeting is **Southwest Airlines**. Beginning on August 15, Joint Mathematics Meetings participants will receive a discount and bonus Rapid Reward points from Southwest Airlines through Southwest's SWABIZ® account. Southwest Airlines is offering an 8% discount off Anytime & Business Select® fares and a 2% discount off select 'Wanna Get Away®' fares for travel to

and from the conference. Southwest is also offering no baggage fees for the first two bags, no change or cancellation fees, and no peak travel or fuel surcharges. Book your travel between **August 15, 2018** and **December 29, 2018** to take advantage of the discounted rates. Discounts are available for travel **January 12, 2019** through January 22, 2019. To take advantage of this offer, follow these steps: (1) Go to `www.swabiz.com` (2) Click on 'Flight,' and (3) Enter Corporate ID: **99884540**.

If you are a member of the Southwest Rapid Rewards program, you will receive 50% bonus Rapid Reward points for your travel to and from the meeting if you add your Rapid Rewards number to your reservation. To enroll in the Rapid Rewards program, visit `www.southwest.com /corporaterapidrewards`.

Train

Amtrak Baltimore Penn Station is located at 1515 North Charles Street, Baltimore, MD, 21201, approximately two miles from the Inner Harbor area. For information about rail service to Baltimore, please call 1-800-USA-RAIL, or visit `www.amtrak.com`.

Ground Transportation

Car Rental: The car rental facility at BWI is located at 7432 New Ridge Road, Hanover, MD, 21076. All of the major car rental agencies are available. Their free shuttle service carries customers to and from the airport approximately every 10 minutes. The shuttle leaves the lower level terminal near the baggage claim area. The trip takes around 10 minutes.

Hertz is the official car rental company for the meeting. To access the JMM special meeting rates at `www.hertz .com`, please click on the words "Discount Code" and enter **CV#04N30009** as the convention number. Reservations can also be made by calling Hertz directly at 800-654-2240 (U.S. and Canada) or 405-749-4434. Meeting rates include unlimited mileage and are subject to availability. Advance reservations are recommended and blackout dates may apply. Government surcharges, taxes, tax reimbursement, airport-related fees, vehicle licensing fees and optional items are extra. Standard rental conditions and qualifications apply. Minimum rental age is 20 (age differential charge for 20–24 applies). At the time of your reservation, the meeting rates will be automatically compared to other Hertz rates and you will be quoted the best comparable rate available.

Shuttles: The authorized list of shuttle and limousine companies at BWI can be found at `https://www.bwiairport .com/to-from-bwi/transportation/authorized-pre -arranged-commercial-transportation-operators`.

Taxi: The taxi stand at BWI is located just outside of the baggage claim area of the lower level of the terminal near doors 5 and 13. There are always taxis available. For more information, call 410-859-1100 or visit `www.bwiairport` `taxi.com`. The average taxi fare to the Baltimore Inner Harbor area is US$30.

App-Based Ride Services: App-Based Ride Services such as Uber and Lyft pick up and drop off passengers at the terminal curbs at the Departures/Ticketing Level between doors 9 and 11.

Public Transportation: The Maryland Transit Administration (MTA) in Baltimore has a regular bus, subway, and light rail system. For details, maps, and schedules see `mta.maryland.gov/` or call 410-539-5000. For particular inquiries, call 410-767-3999. One-way fares are currently US$1.80. The Light Rail is recommended for travel from the airport to the Convention Center area via public transportation.

Light Rail from the Airport: Take the Light Rail from the BWI Marshall Light Rail Station, located outside the lower level of the terminal building near Concourse E. The route is called "Hunt Valley and BWI Marshall Airport." Take the train towards Hunt Valley. There is a stop at the Convention Center (Howard and Pratt Street), after Camden Yards, and the Hilton and Marriott Inner Harbor hotels are one block west of the stop. For more details, see `mta.maryland .gov/light-rail`. The train runs from 5:00 am to 11:00 pm weekdays, 6:00 am to 11:00 pm on Saturday, and 11:00 am to 7:00 pm on Sunday, approximately every 30 minutes (varies with time of day) and takes about 30–35 minutes. The cost is currently US$1.80 one way.

Charm City Circulator: Baltimore has a **free shuttle service** with four routes around Baltimore, called the **Charm City Circulator (CCC)**, see `www.charmcitycirculator .com/` for information on routes and schedules. The Green Route runs from City Hall to Fells Point to Johns Hopkins, the Purple Route runs from 33rd Street to Federal Hill,the Orange Route runs from Hollins Market to Harbor East, and the Banner Route runs from the Inner Harbor to Fort McHenry. All the routes have stops in the Inner Harbor area.

The Orange route has a Convention Center stop, and the Banner Route has stops at Pratt Street and at Otterbein, both near the Convention Center. The Purple route has a stop at Light Street and E. Pratt Street, called Pratt Street-Inner Harbor. The Green Route can be picked up at. E. Baltimore Street and N. Gay Street. Many local attractions are accessible on the CCC. The National Aquarium and the Jewish Museum of Maryland are on the Orange Line. The Banner Line goes to the Maryland Science Center, Fort McHenry, the Baltimore Museum of Industry, and the American Visionary Art Museum. The Green Line travels near the Frederick Douglass–Isaac Myers Maritime Park Museum. **The Charm City Circulator does not go to the airport.**

Parking: There is a link to an interactive map of parking garages at the "Visit Baltimore" parking informa-

tion page at `https://baltimore.org/info/parking-information`. This parking information page also offers a service called "Parking Panda," which allows you to book your parking space at a nearby garage in advance; see `https://www.parkingpanda.com/baltimore-parking`.

Driving Directions from the airport to the Convention Center: Start out going southeast on Friendship Road toward Oak Road. Keep left to continue on Service Road, Lower Level, and then continue onto Friendship Road. Take I-195 W (follow signs for MD-170/Interstate 95/Annapolis/Baltimore/Washington). Merge onto I-95 N via exit 4A toward I-695/Baltimore. Take the I-395 N exit (Exit 53) toward Downtown/Inner Harbor. Merge onto I-395 N. Stay straight to go onto S. Howard Street, and take the first right onto W. Pratt Street. The Convention Center will be on your right (12.3 miles).

2019 JOINT MATHEMATICS MEETINGS

January 16-19, 2019 • Baltimore, Maryland

Visit**Baltimore**

HOTELS

1. Hilton Baltimore (co-HQ)
   401 W Pratt St. • Baltimore, MD 21201

2. Baltimore Marriott Inner Harbor at Camden Yards (co-HQ)
   110 S Eutaw St. • Baltimore, MD 21202

3. Days Inn Inner Harbor
   100 Hopkins Plaza • Baltimore, MD 21201

4. Holiday Inn Inner Harbor
   301 W Lombard St. • Baltimore, MD 21202

5. Hotel Monaco
   2 N Charles St. • Baltimore, MD 21201

6. Hyatt Regency Baltimore
   300 Light St. • Baltimore, MD 21202

7. Lord Baltimore Hotel
   20 W Baltimore St. • Baltimore, MD 21201

8. Renaissance Baltimore Harborplace
   202 E Pratt St. • Baltimore, MD 21202

9. Royal Sonesta Harbor Court
   550 Light St. • Baltimore, MD 21202

10. Sheraton Inner Harbor Hotel
    300 S Charles St. • Baltimore, MD 21201

TRANSPORTATION

- Ⓜ Metro Line
- Ⓛ Light Rail
- ┼┼┼┼┼ MARC Train
- Water Taxies
- ⓘ Visitors Center
- Charm City Circulator - Green Route
- Charm City Circulator - Orange Route
- Charm City Circulator - Purple Route
- Charm City Circulator - Banner Route
- Parks and green spaces

MAP IS APPROXIMATELY 1.5 MILES ACROSS
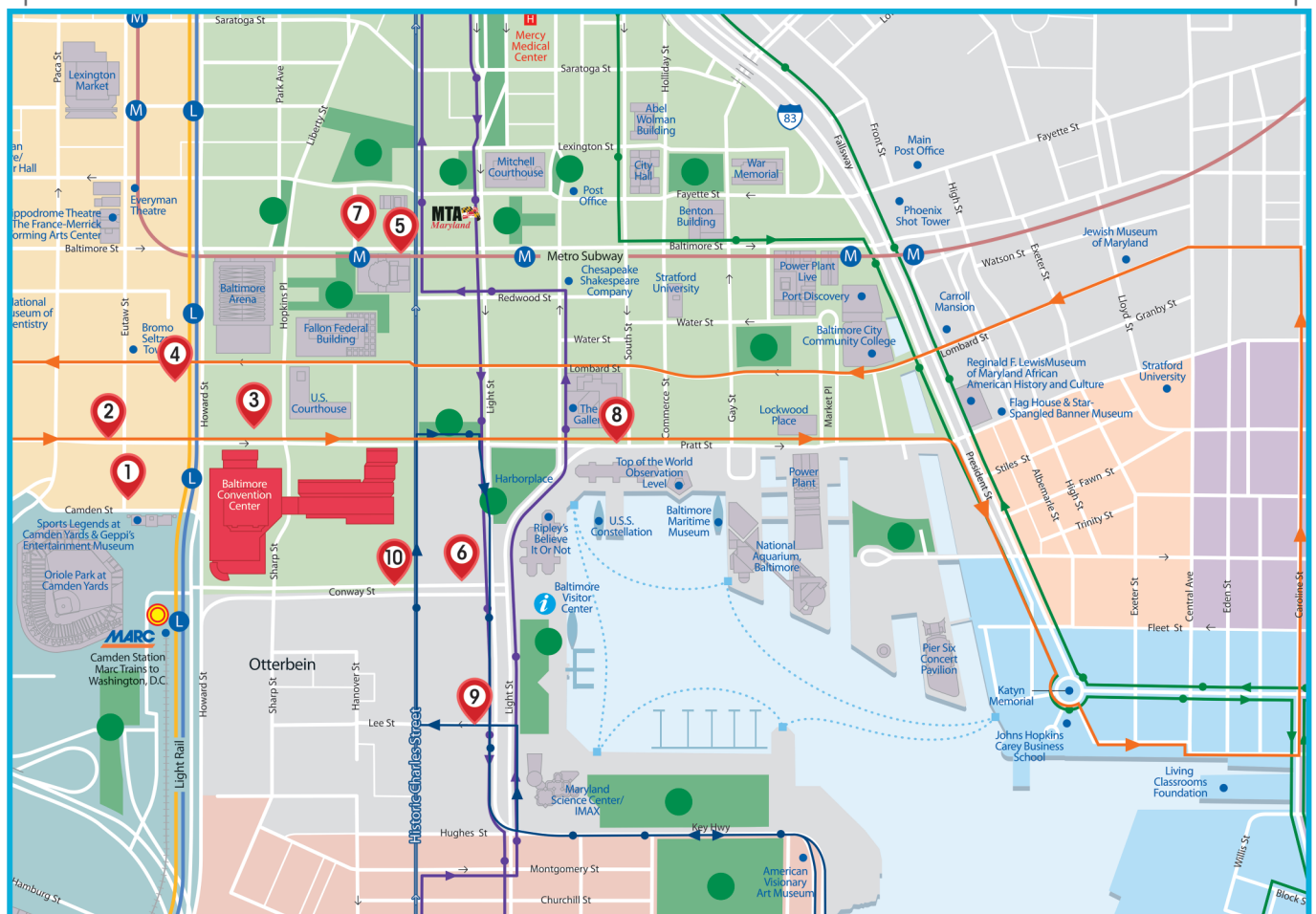
Program Timetable

This document provides an at-a-glance timetable of all scientific and social events scheduled for the JMM, so you can easily see which events may overlap and better plan your time.

AMS AMERICAN MATHEMATICAL SOCIETY

MAA MATHEMATICAL ASSOCIATION OF AMERICA

JMM JOINT MATHEMATICS MEETINGS
BALTIMORE • JAN 16–19, 2019
AMS • MAA

Monday, January 14

| 8:00 am– 5:00 pm | **AMS SHORT COURSE ON SUM OF SQUARES: THEORY AND APPLICATIONS, PART I** |
| 5:00 pm– 6:00 pm | **AMS SHORT COURSE RECEPTION** |

Tuesday, January 15

8:00 am– 5:00 pm	**AMS SHORT COURSE ON SUM OF SQUARES: THEORY AND APPLICATIONS, PART II**
8:00 am– 6:30 pm	**AMS DEPARTMENT CHAIRS WORKSHOP**
1:30 pm–10:00 pm	**AMS COUNCIL**
3:00 pm– 7:00 pm	**JOINT MEETINGS REGISTRATION**, Pratt Street Lobby, 300 Level, BCC

Wednesday, January 16

7:00 am– 6:00 pm	**JOINT MEETINGS REGISTRATION**, Pratt Street Lobby, 300 Level, BCC
7:00 am– 5:30 pm	**EMAIL CENTER**
7:00 am– 8:45 am	**MAA MINORITY CHAIRS MEETING**

AMS SPECIAL SESSIONS

8:00 am–11:00 am	*Algorithmic Dimensions and Fractal Geometry, I (AMS-ASL)*
8:00 am–11:00 am	*How to Guard an Art Gallery and Other Discrete Mathematical Adventures (In Memory of T. S. Michael, 1960 to 2016), I*
8:00 am–11:00 am	*Analysis of Fractional, Stochastic, and Hybrid Dynamic Systems with Applications, I*
8:00 am–11:00 am	*New Directions in the Theory of Complex Multiplication, I*
8:00 am–11:00 am	*Nonlinear Evolution Equations and Their Applications, I*
8:00 am–11:00 am	*Quaternions, I*
8:00 am–11:00 am	*Numerical Methods for PDEs and Applications, I*
8:00 am–11:00 am	*Recent Advancements in Mathematical Modeling of Cancer, I*
8:00 am–11:00 am	*Natural Resources Modeling, I*
8:00 am–11:00 am	*Geometry Labs United: Research, Visualization, and Outreach, I*
8:00 am–11:00 am	*Commutative Ring Theory: Research for Undergraduate and Early Graduate Students, I*
8:00 am–11:00 am	*Hopf Algebras and Tensor Categories, I*
8:00 am–11:00 am	*Mappings on Metric and Banach Spaces with Applications to Fixed Point Theory, I*
8:00 am–11:00 am	*Recent Advances and Trends in Computable Structure Theory (in honor of J. Remmel), I*
8:00 am–11:00 am	*Financial Mathematics, I*
8:00 am–11:00 am	*Recent Advances in Regularity Lemmas, I*

8:00 am–11:00 am	*Bifurcations of Difference Equations and Discrete Dynamical Systems with Applications, I*
8:00 am–11:00 am	*A Showcase of Number Theory at Undergraduate Institutions, I*
8:00 am–11:00 am	*Optimal Methods in Applicable Analysis: Variational Inequalities, Low Rank Matrix Approximations, Systems Engineering, Cyber Security, I*
8:00 am–11:00 am	*25 years of Conferences for African-American Researchers in the Mathematical Sciences (CAARMS times 25), I*
8:00 am–11:00 am	*Symbolic Dynamics, I*

MAA INVITED PAPER SESSIONS

8:00 am–10:50 am	*Trends in Mathematical and Computational Biology*
8:00 am–11:00 am	*Building Successful Communities in Mathematics*

MAA CONTRIBUTED PAPER SESSIONS

8:00 am–11:00 am	*The Scholarship of Teaching and Learning in Collegiate Mathematics, I*
8:00 am–11:00 am	*Inquiry-Based Learning and Teaching, I*
8:00 am–11:00 am	*Discrete Mathematics in the Undergraduate Curriculum—Ideas and Innovations in Teaching, I*
8:00 am–11:00 am	*Innovative Curricular Strategies for Increasing Mathematics Majors*
8:00 am–11:00 am	*Mathematics and the Arts, I*
8:00 am–10:55 am	**SIAM MINISYMPOSIUM ON ADVANCES IN MATHEMATICAL MODELING OF COMPLEX MATERIALS SYSTEMS**
8:00 am–6:00 pm	**PROJECT NEXT WORKSHOP**
8:00 am–10:55 am	**AMS CONTRIBUTED PAPER SESSIONS**
8:00 am–10:55 am	**MAA GENERAL CONTRIBUTED PAPER SESSIONS**
8:00 am–5:30 pm	**EMPLOYMENT CENTER**
9:00 am–11:00 am	**MAA MINICOURSE #1: PART A** *Mathematical Inquiry and Writing through Sports*
9:00 am–11:00 am	**MAA MINICOURSE #2: PART A** *Start Teaching Statistics using R and RStudio*
9:00 am–11:00 am	**MAA MINICOURSE #7: PART A** *Using Data Applications to Inspire Linear Algebra Topics in the Classroom*
9:00 am–9:50 am	**MAA-SIAM-AMS HRABOWSKI–GATES–TAPIA–MCBAY SESSION: LECTURE**
9:00 am–10:20 am	**MAA PANEL** *What Every Student Should Know about the JMM*
9:35 am–10:55 am	**MAA PANEL** *Mathematics Placement Trends and Innovations that Increase Equitable Access & Success*
9:35 am–10:55 am	**MAA WORKSHOP** *NSF Funding Opportunities in the Education and Human Resources Directorate and the Division of Mathematical Sciences*
9:50 am–10:30 am	**MAA-SIAM-AMS HRABOWSKI–GATES–TAPIA–MCBAY PANEL** *Actions to increase the participation of underrepresented minority groups in mathematics.*
10:05 am–10:55 am	**AMS INVITED ADDRESS** *Algebraic, Geometric, and Topological Methods in Optimization.* **Jesus A. De Loera**
10:20 am–10:50 am	**RADICAL DASH KICKOFF MEETING**
11:10 am–12:00 pm	**AMS-MAA INVITED ADDRESS** *What is the shape of a rational map?* **Sarah Koch**
12:15 pm–5:30 pm	**EXHIBITS AND BOOK SALES**
1:00 pm–1:50 pm	**AMS COLLOQUIUM LECTURES: LECTURE I** *Complex multiplication: past, present, future.* **Benedict H. Gross**
2:15 pm–3:05 pm	**MAA INVITED ADDRESS** *Symmetry, almost.* **Amanda Folsom**

AMS SPECIAL SESSIONS

2:15 pm–6:15 pm	*Algorithmic Dimensions and Fractal Geometry, II (AMS-ASL)*
2:15 pm–6:15 pm	*How to Guard an Art Gallery and Other Discrete Mathematical Adventures (In Memory of T. S. Michael, 1960 to 2016), II*
2:15 pm–6:15 pm	*Analysis of Fractional, Stochastic, and Hybrid Dynamic Systems with Applications, II*
2:15 pm–6:15 pm	*New Directions in the Theory of Complex Multiplication, II*

2:15 pm– 6:15 pm	*Nonlinear Evolution Equations and Their Applications, II*
2:15 pm– 6:15 pm	*Quaternions, II*
2:15 pm– 6:15 pm	*Algebraic and Geometric Methods in Discrete Optimization, I*
2:15 pm– 6:16 pm	*Numerical Methods for PDEs and Applications, II*
2:15 pm– 6:15 pm	*Recent Advancements in Mathematical Modeling of Cancer, II*
2:15 pm– 6:15 pm	*Natural Resources Modeling, II*
2:15 pm– 6:15 pm	*Geometry Labs United: Research, Visualization, and Outreach, II*
2:15 pm– 6:15 pm	*Commutative Ring Theory: Research for Undergraduate and Early Graduate Students, II*
2:15 pm– 6:15 pm	*Hopf Algebras and Tensor Categories, II*
2:15 pm– 6:15 pm	*Mappings on Metric and Banach Spaces with Applications to Fixed Point Theory, II*
2:15 pm– 6:15 pm	*Financial Mathematics, II*
2:15 pm– 6:15 pm	*Recent Advances in Regularity Lemmas, II*
2:15 pm– 6:15 pm	*Bifurcations of Difference Equations and Discrete Dynamical Systems with Applications, II*
2:15 pm– 6:15 pm	*A Showcase of Number Theory at Undergraduate Institutions, II*
2:15 pm– 6:15 pm	*Optimal Methods in Applicable Analysis: Variational Inequalities, Low Rank Matrix Approximations, Systems Engineering, Cyber Security, II*
2:15 pm– 6:15 pm	*25 years of Conferences for African-American Researchers in the Mathematical Sciences (CAARMS times 25), II*
2:15 pm– 6:15 pm	*Symbolic Dynamics, II*

MAA INVITED PAPER SESSIONS

2:15 pm– 5:35 pm	*Using Research about Teaching and Learning to Inform the Preparation of Graduate Students to Teach*
2:15 pm– 4:15 pm	**MAA MINICOURSE #3: PART A** *Advanced Authoring in WeBWorK: Turn good math problems into great ones & submit them to the OpenProblemLibrary*
2:15 pm– 4:15 pm	**MAA MINICOURSE #4: PART A** *Teaching an Undergraduate Computational Science Course*
2:15 pm– 4:15 pm	**MAA MINICOURSE #9: PART A** *Mathematical Art from Complex Analysis*

MAA CONTRIBUTED PAPER SESSIONS

2:15 pm– 6:00 pm	*The Scholarship of Teaching and Learning in Collegiate Mathematics, II*
2:15 pm– 6:00 pm	*Infusing Data Science and Big Data into the Statistics Classroom*
2:15 pm– 6:00 pm	*Inquiry-Based Learning and Teaching, II*
2:15 pm– 6:00 pm	*Integrating Research into the Undergraduate Classroom*
2:15 pm– 6:00 pm	*Discrete Mathematics in the Undergraduate Curriculum—Ideas and Innovations in Teaching, II*
2:15 pm– 6:00 pm	*Mathematics and the Arts, II*
2:15 pm– 6:00 pm	*Mathematics and Sports, I*
2:15 pm– 6:00 pm	*Undergraduate Student TAs in Mathematics*
2:15 pm– 6:00 pm	**SIAM MINISYMPOSIUM ON MATHEMATICAL MODELS IN CANCER**
2:15 pm– 3:35 pm	**MAA PANEL** *Pursuing New Directions in Your Academic Career*
2:15 pm– 3:35 pm	**MAA PANEL** *Mental Health in the Mathematics Profession*
2:15 pm– 3:25 pm	**MAA WORKSHOP** *Discussing Project Ideas with NSF/EHR Program Officers, Part I*
2:15 pm– 3:40 pm	**ASSOCIATION FOR WOMEN IN MATHEMATICS PANEL DISCUSSION** *Promoting Inclusion in STEM.*
2:15 pm– 6:00 pm	**AMS CONTRIBUTED PAPER SESSIONS**
2:15 pm– 6:00 pm	**MAA GENERAL CONTRIBUTED PAPER SESSIONS**
2:15 pm– 4:30 pm	**AMS SPECIAL EVENT** *Activities in NSF's Division of Mathematical Sciences*
3:20 pm– 4:10 pm	**MAA INVITED ADDRESS** *Title to be announced.* **Emmanuel Candes**
3:35 pm– 4:15 pm	**MAA PANEL** *Impacting Mathematics Instruction Through Meaningful Collaboration with Partner Discipline Faculty*
3:45 pm– 4:15 pm	**AWM BUSINESS MEETING**
4:00 pm– 5:00 pm	**MAA SECTION OFFICERS**

4:30 pm–6:00 pm	**AMS COMMITTEE ON THE PROFESSION PANEL DISCUSSION** *Permanent teaching faculty in research oriented departments*
4:30 pm–5:50 pm	**TOWN HALL MEETING** *Spectra: Identifying Workplace Best Practices for LGBTQ Mathematicians*
4:30 pm–5:30 pm	**RECEPTION FOR UNDERGRADUATE STUDENTS**
5:30 pm–6:30 pm	**RECEPTION FOR GRADUATE STUDENTS AND FIRST-TIME PARTICIPANTS**
5:30 pm–8:00 pm	**MATHEMATICAL INSTITUTES OPEN HOUSE**
6:15 pm–7:15 pm	**SIGMAA ON THE HISTORY OF MATHEMATICS (HOM SIGMAA) BUSINESS MEETING AND RECEPTION**
7:00 pm–8:30 pm	***MATHILY, MATHILY-ER* YEARLY GATHER**
7:15 pm–8:15 pm	**SIGMAA ON THE HISTORY OF MATHEMATICS (HOM SIGMAA) GUEST LECTURE**
8:30 pm–9:20 pm	**AMS JOSIAH WILLARD GIBBS LECTURE** *Title to be announced.* **Alan Perelson**
9:30 pm–11:00 pm	**ASSOCIATION FOR WOMEN IN MATHEMATICS RECEPTION AND AWARDS PRESENTATION**

Thursday, January 17

7:30 am–4:00 pm	**JOINT MEETINGS REGISTRATION**, Pratt Street Lobby, 300 Level, BCC
7:30 am–5:30 pm	**EMAIL CENTER**
	AMS SPECIAL SESSIONS
8:00 am–12:00 pm	*Definability and Decidability Problems in Number Theory, I (AMS-ASL)*
8:00 am–12:00 pm	*The Mathematics of Gravity and Light (a Mathematics Research Communities Session), I*
8:00 am–12:00 pm	*Harmonic Analysis: Recent Developments on Oscillatory Integrals (a Mathematics Research Communities Session), I*
8:00 am–12:00 pm	*Quantum Symmetries: Subfactors and Fusion Categories (a Mathematics Research Communities Session), I*
8:00 am–12:00 pm	*Number Theoretic Methods in Hyperbolic Geometry (a Mathematics Research Communities Session), I*
8:00 am–12:00 pm	*Agent-based Modeling in Biological and Social Systems (a Mathematics Research Communities Session), I*
8:00 am–12:00 pm	*New Directions in the Theory of Complex Multiplication, III*
8:00 am–12:00 pm	*Algebraic and Geometric Methods in Discrete Optimization, II*
8:00 am–12:00 pm	*Continued Fractions, I*
8:00 am–12:00 pm	*Problems in Partial Differential Equations, I*
8:00 am–12:00 pm	*Riordan Arrays, I*
8:00 am–12:00 pm	*Stochastic Differential Equations and Applications, I*
8:00 am–12:00 pm	*Recent Advances and Trends in Computable Structure Theory (in honor of J. Remmel), II*
8:00 am–12:00 pm	*Analysis and Geometry of Nonlinear Evolution Equations, I*
8:00 am–12:00 pm	*Women in Topology, I*
8:00 am–12:00 pm	*Lattice Path Combinatorics and Applications, I*
8:00 am–12:00 pm	*Recent Advances in Homological and Commutative Algebra, I*
8:00 am–12:00 pm	*Research in Mathematics by Early Career Graduate Students, I*
8:00 am–12:00 pm	*Mathematical Models in Ecology, Epidemiology, and Medicine, I*
8:00 am–12:00 pm	*Recent Progress in Multivariable Operator Theory, I*
8:00 am–12:00 pm	*Differential Equations on Fractals, I*
8:00 am–12:00 pm	*The Mathematics of Historically Black Colleges and Universities (HBCUs) in the Mid-Atlantic, I*
	MAA INVITED PAPER SESSIONS
8:00 am–11:00 am	*Inspiring Diversity in Mathematics: Culture, Community, and Collaboration*
8:00 am–11:00 am	*Research in Improving Undergraduate Mathematical Sciences Education: Examples Supported by the National Science Foundation's IUSE: EHR Program*

MAA CONTRIBUTED PAPER SESSIONS

8:00 am–12:00 pm	*Introducing Mathematical Modeling through Competitions*
8:00 am–12:00 pm	*Mathematics and the Life Sciences: Initiatives, Programs, Curricula*
8:00 am–12:00 pm	*Humanistic Mathematics*
8:00 am–12:00 pm	*Inequalities and Their Applications*
8:00 am–12:00 pm	*Innovative and Effective Ways to Teach Linear Algebra*
8:00 am–12:00 pm	*Research in Undergraduate Mathematics Education (RUME), I*
8:00 am–11:00 am	**SIAM MINISYMPOSIUM ON DATA ASSIMILATION: THEORY AND PRACTICE**
8:00 am–6:00 pm	**PROJECT NEXT WORKSHOP**
8:00 am–11:55 am	**AMS CONTRIBUTED PAPER SESSIONS**
8:00 am–12:00 pm	**MAA GENERAL CONTRIBUTED PAPER SESSIONS**
8:00 am–11:00 am	**PME COUNCIL MEETING**
8:00 am–5:30 pm	**EMPLOYMENT CENTER**
9:00 am–9:50 am	**MAA INVITED ADDRESS** *The past 50 years of African Americans in the mathematical sciences.* **Edray Goins**
9:00 am–11:00 am	**MAA MINICOURSE #2: PART B** *Start Teaching Statistics using R and RStudio*
9:00 am–11:00 am	**MAA MINICOURSE #5: PART A** *IBL SIGMAA Minicourse: Introduction to Inquiry-Based Learning*
9:00 am–11:00 am	**MAA MINICOURSE #8: PART A** *Dance and Mathematics*
9:00 am–10:00 am	**SIGMAA ON BUSINESS, INDUSTRY, AND GOVERNMENT (BIG SIGMAA) BUSINESS MEETING**
9:00 am–10:20 am	**MAA PANEL** *Connecting High School and Post High School Mathematics*
9:00 am–10:20 am	**MAA PANEL** *Preparing Math and Stats Students for Industry Careers*
9:00 am–10:20 am	**MAA WORKSHOP** *Making it Happen: Modeling in Your Differential Equations Course*
9:30 am–5:30 pm	**EXHIBITS AND BOOK SALES**
10:00 am–12:00 pm	**ESTIMATHON!** *A mindbending mixture of math and trivia.*
10:00 am–12:00 pm	**MAA POSTER SESSION** *Mathematical Outreach Programs*
10:05 am–10:55 am	**AWM-AMS NOETHER LECTURE** *Dynamics of systems with low complexity.* **Bryna Kra**
10:30 am–12:00 pm	**SIGMAA OFFICERS MEETING**
10:35 am–11:55 am	**MAA WORKSHOP** *For Faculty on Fostering Student Engagement: Experience Classroom Practices from the MAA IP Guide*
11:10 am–12:00 pm	**MAA PROJECT NEXT LECTURE ON TEACHING AND LEARNING**
11:10 am–12:00 pm	**SIAM INVITED ADDRESS** *Recent advances in mathematical theory and scientific computation for biological fluids.* **Suncica Canic**
1:00 pm–1:50 pm	**AMS COLLOQUIUM LECTURES: LECTURE II** *Complex multiplication: past, present, future.* **Benedict H. Gross**

AMS SPECIAL SESSIONS

1:00 pm–4:00 pm	*Definability and Decidability Problems in Number Theory, II (AMS-ASL)*
1:00 pm–4:00 pm	*The Mathematics of Gravity and Light (a Mathematics Research Communities Session), II*
1:00 pm–4:00 pm	*Harmonic Analysis: Recent Developments on Oscillatory Integrals (a Mathematics Research Communities Session), II*
1:00 pm–4:00 pm	*Quantum Symmetries: Subfactors and Fusion Categories (a Mathematics Research Communities Session), II*
1:00 pm–4:00 pm	*Number Theoretic Methods in Hyperbolic Geometry (a Mathematics Research Communities Session), II*
1:00 pm–4:00 pm	*Agent-based Modeling in Biological and Social Systems (a Mathematics Research Communities Session), II*
1:00 pm–4:00 pm	*Algebraic and Geometric Methods in Discrete Optimization, III*
1:00 pm–4:00 pm	*Continued Fractions, II*
1:00 pm–4:00 pm	*Problems in Partial Differential Equations, II*

1:00 pm–4:00 pm	*Riordan Arrays, II*
1:00 pm–4:00 pm	*Stochastic Differential Equations and Applications, II*
1:00 pm–4:00 pm	*Recent Advances and Trends in Computable Structure Theory (in honor of J. Remmel), III*
1:00 pm–4:00 pm	*Analysis and Geometry of Nonlinear Evolution Equations, II*
1:00 pm–4:00 pm	*Women in Topology, II*
1:00 pm–4:00 pm	*Lattice Path Combinatorics and Applications, II*
1:00 pm–4:00 pm	*Recent Advances in Homological and Commutative Algebra, II*
1:00 pm–4:00 pm	*Recent Advances in Regularity Lemmas, III*
1:00 pm–4:00 pm	*Research in Mathematics by Early Career Graduate Students, II*
1:00 pm–4:00 pm	*Mathematical Models in Ecology, Epidemiology, and Medicine, II*
1:00 pm–4:00 pm	*Recent Progress in Multivariable Operator Theory, II*
1:00 pm–4:00 pm	*The Mathematics of Historically Black Colleges and Universities (HBCUs) in the Mid-Atlantic, II*
1:00 pm–4:00 pm	*Symbolic Dynamics, III*

MAA INVITED PAPER SESSIONS

1:00 pm–4:00 pm	*Modular Forms: Aesthetics and Applications*
1:00 pm–3:00 pm	**MAA MINICOURSE #10: PART A** *Object Based Learning and the Smithsonian Learning Lab*
1:00 pm–3:00 pm	**MAA MINICOURSE #11: PART A** *Object Based Learning and the Smithsonian Learning Lab*
1:00 pm–3:00 pm	**MAA MINICOURSE #9: PART B** *Mathematical Art from Complex Analysis*

MAA CONTRIBUTED PAPER SESSIONS

1:00 pm–4:15 pm	*Integrated STEM Instruction in Undergraduate Mathematics*
1:00 pm–4:15 pm	*Revitalizing Complex Analysis*
1:00 pm–4:15 pm	*The EDGE (Enhancing Diversity in Graduate Education) program: Pure and Applied talks by Women Math Warriors*
1:00 pm–4:15 pm	*Formative and Summative Assessment of Mathematical Communication and Conceptual Understanding*
1:00 pm–4:15 pm	*Mathematics and Sports, II*
1:00 pm–4:15 pm	*Touch it, Feel it, Learn it: Tactile Learning Activities in the Undergraduate Mathematics Classroom*
1:00 pm–4:15 pm	*Research in Undergraduate Mathematics Education (RUME), II*
1:00 pm–4:10 pm	**SIAM MINISYMPOSIUM ON HUMAN FACTORS IN MATHEMATICS EDUCATION**
1:00 pm–2:30 pm	**AMS COMMITTEE ON EDUCATION PANEL DISCUSSION**
1:00 pm–2:20 pm	**MAA PANEL** *Advising and Mentorship: Fostering Successful Students*
1:00 pm–2:20 pm	**MAA PANEL** *Coping Professionally with Unprofessional Behavior*
1:00 pm–4:00 pm	**AMS CONTRIBUTED PAPER SESSIONS**
1:00 pm–2:00 pm	**THE DOLCIANI AWARD LECTURES**
1:00 pm–4:00 pm	**MAA GENERAL CONTRIBUTED PAPER SESSIONS**
1:00 pm–3:00 pm	**SUMMER PROGRAM FOR WOMEN IN MATHEMATICS (SPWM) REUNION**
2:00 pm–4:00 pm	**MAA POSTER SESSION: PROJECTS SUPPORTED BY THE NSF DIVISION OF UNDERGRADUATE EDUCATION**
2:15 pm–3:05 pm	**AMS INVITED ADDRESS** *Title to be announced.* **Peter Oszvath**
2:35 pm–3:55 pm	**MAA PANEL** *Pathways to Leadership*
2:35 pm–3:55 pm	**MAA WORKSHOP** *How to Talk About Math So People Want to Listen*
2:45 pm–4:15 pm	**AMS EDUCATION AND DIVERSITY DEPARTMENT PANEL** *Bridge-to-PhD and Postbac Programs Working to Open Doors for Students from Underrepresented Groups*
3:20 pm–4:10 pm	**AMS INVITED ADDRESS** *Title to be announced.* **Lior Pachter**
4:25 pm–5:25 pm	**JOINT PRIZE SESSION**
5:30 pm–6:00 pm	**SIGMAA ON THE PHILOSOPHY OF MATHEMATICS (POM SIGMAA) RECEPTION**

5:30 pm–6:30 pm	**JOINT PRIZE SESSION RECEPTION**
5:30 pm–7:30 pm	**ASSOCIATION OF CHRISTIANS IN THE MATHEMATICAL SCIENCES RECEPTION AND LECTURE**
5:30 pm–6:30 pm	**BUDAPEST SEMESTERS IN MATHEMATICS ANNUAL ALUMNI REUNION**
5:30 pm–7:00 pm	**MAA TWO-YEAR COLLEGE RECEPTION**
5:30 pm–7:00 pm	**UNIVERSITY OF MICHIGAN MATHEMATICS ALUMNI AND FRIENDS RECEPTION**
5:30 pm–7:30 pm	**UNIVERSITY OF TENNESSEE MATHEMATICS DEPARTMENT ALUMNI AND FRIENDS RECEPTION**
6:00 pm–6:15 pm	**SIGMAA ON THE PHILOSOPHY OF MATHEMATICS (POM SIGMAA) BUSINESS MEETING**
6:00 pm–7:30 pm	**SIGMAA ON QUANTITATIVE LITERACY (SIGMAA QL) JOINT GUEST LECTURE AND RECEPTION**
6:00 pm–8:00 pm	**SPECTRA RECEPTION FOR LGBT MATHEMATICIANS AND ALLIES**
6:00 pm–8:00 pm	**NSA'S WOMEN IN MATHEMATICS SOCIETY NETWORKING SESSION**
6:00 pm–8:00 pm	**UNIVERSITY OF WATERLOO FACULTY OF MATHEMATICIANS ALUMNI & FRIENDS RECEPTION**
6:15 pm–7:05 pm	**SIGMAA ON THE PHILOSOPHY OF MATHEMATICS (POM SIGMAA) GUEST LECTURE**
6:30 pm–8:00 pm	**MSRI RECEPTION FOR CURRENT AND FUTURE DONORS**
6:30 pm–8:30 pm	**PROMYS AND ROSS RECEPTION FOR ALUMNI AND FRIENDS**
8:15 pm–9:45 pm	**KNITTING CIRCLE** *Knitting Circle: Bring a project (knitting/crochet/tatting/beading/etc.) and chat with other mathematical crafters*

Friday, January 18

7:17 am–9:00 am	**YP17 HCSSIM REUNION BREAKFAST**
7:30 am–4:00 pm	**JOINT MEETINGS REGISTRATION**, Pratt Street Lobby, 300 Level, BCC
7:30 am–5:30 pm	**EMAIL CENTER**
	AMS SPECIAL SESSIONS
8:00 am–11:00 am	*Research in Mathematics by Undergraduates and Students in Post-Baccalaureate Programs, I (AMS-MAA-SIAM)*
8:00 am–11:00 am	*Stochastic Analysis and Applications in Finance, Actuarial Science and Related Fields, I*
8:00 am–11:00 am	*Mathematics in the Realm of Cyber Research, I*
8:00 am–11:00 am	*Recent Advances in Inverse Problems and Imaging, I*
8:00 am–11:00 am	*Advances in Operator Theory, Operator Algebras, and Operator Semigroups, I*
8:00 am–11:00 am	*Mathematical Analysis in Fluid Dynamics, I*
8:00 am–11:00 am	*Analytic Number Theory, I*
8:00 am–11:00 am	*Geometric and Topological Combinatorics, I*
8:00 am–11:00 am	*Harmonic Analysis, Partial Differential Equations, and Applications, I*
8:00 am–11:00 am	*Multiscale Problems in the Calculus of Variations, I*
8:00 am–11:00 am	*Geometry and Dynamics of Continued Fractions, I*
8:00 am–11:00 am	*Topology, Structure and Symmetry in Graph Theory, I*
8:00 am–11:00 am	*Algebraic Structures Motivated by Knot Theory, I*
8:00 am–11:00 am	*Arithmetic Statistics, I*
8:00 am–11:00 am	*If You Build It They Will Come: Presentations by Scholars in the National Alliance for Doctoral Studies in the Mathematical Sciences, I*
8:00 am–11:00 am	*Low Complexity Models in Data Analysis and Machine Learning, I*
8:00 am–11:00 am	*Recent Advances in Biological Modeling and Related Dynamical Analysis, I*
8:00 am–11:00 am	*Counting Methods in Number Theory, I*
8:00 am–11:00 am	*Geometric and Topological Generalization of Groups, I*

8:00 am–11:00 am	*Mathematical Investigations of Spatial Ecology and Epidemiology, I*
8:00 am–11:00 am	*Differential Equations on Fractals, II*

MAA INVITED PAPER SESSIONS

8:00 am–11:00 am	*The Past 50 Years of African Americans in the Mathematical Sciences*

MAA CONTRIBUTED PAPER SESSIONS

8:00 am–11:00 am	*Open Educational Resources: Combining Technological Tools and Innovative Practices to Improve Student Learning*
8:00 am–11:00 am	*Mathematical Experiences and Projects in Business, Industry, and Government (BIG)*
8:00 am–11:00 am	*Ethnomathematics: Ideas and Innovations in the Classroom*
8:00 am–11:00 am	*Philosophy of Mathematics*
8:00 am–11:00 am	*Inquiry-Based Learning and Teaching, III*
8:00 am–11:00 am	*Technology and Resources in Statistics Education, I*
8:00 am–11:00 am	*Research in Undergraduate Mathematics Education (RUME), III*
8:00 am–10:55 am	**SIAM MINISYMPOSIUM ON RECENT ADVANCES IN MATHEMATICAL THEORY AND SCIENTIFIC COMPUTATION FOR BIOLOGICAL FLUIDS.**
8:00 am– 9:20 am	**MAA PANEL** *Advanced Placement Calculus and Student Understanding*
8:00 am– 6:00 pm	**PROJECT NEXT WORKSHOP**
8:00 am–10:55 am	**AMS CONTRIBUTED PAPER SESSIONS**
8:00 am–11:00 am	**MAA GENERAL CONTRIBUTED PAPER SESSIONS**
8:00 am–5:30 pm	**EMPLOYMENT CENTER**
8:30 am–10:30 am	**AMS-MAA GRAD SCHOOL FAIR** *Undergrads! Take this opportunity to meet representatives from mathematical science graduate programs.*
9:00 am– 9:50 am	**MAA INVITED ADDRESS** *A mathematical journey of culture, community, and collaboration.* **Pamela Harris**
9:00 am– 9:50 am	**ASL INVITED ADDRESS** *Colorings of finite subgraphs of the Henson graphs.* **Natasha Dobrinen**
9:00 am–11:00 am	**MAA MINICOURSE #1: PART B** *Mathematical Inquiry and Writing through Sports*
9:00 am–11:00 am	**MAA MINICOURSE #6: PART A** *Visualizing Multivariable Calculus & Differential Equations using CalcPlot3D*
9:00 am–11:00 am	**MAA MINICOURSE #7: PART B** *Using Data Applications to Inspire Linear Algebra Topics in the Classroom*
9:00 am–11:00 am	**MAA POSTER SESSION** *Recreational Mathematics: Puzzles, Card Tricks. Games, and Gambling*
9:30 am–5:30 pm	**EXHIBITS AND BOOK SALES**
9:35 am–10:55 am	**MAA PANEL** *Increasing Diversity and Retention in STEM Through Math-Focused First-Year Seminars*
9:45 am–10:55 am	**MAA WORKSHOP** *Discussing Project Ideas with NSF/EHR Program Officers, Part II*
10:00 am–10:50 am	**ASL INVITED ADDRESS** *35 years later: A fresh perspective on classifiable theories.* **Michael C Laskowski**
10:05 am–10:55 am	**AMS INVITED ADDRESS** *The Roaring Twenties in American Mathematics.* **Karen Hunger Parshall**
10:30 am–11:00 am	**RADICAL DASH PRIZE SESSION**
11:10 am–12:00 pm	**AMS-MAA INVITED ADDRESS** *Miracles of Algebraic Graph Theory* **Daniel Spielman**
12:00 pm–1:00 pm	**BUDAPEST SEMESTERS IN MATHEMATICS EDUCATION (BSME) INFORMATIONAL SESSION**
1:00 pm–1:50 pm	**AMS COLLOQUIUM LECTURES: LECTURE III** *Complex multiplication: past, present, future.* **Benedict H. Gross**

1:00 pm–1:50 pm	**MAA LECTURE FOR STUDENTS** *Drawing conclusions from drawing a square.* **Annalisa Crannell**
1:00 pm–4:45 pm	**CURRENT EVENTS BULLETIN**

AMS SPECIAL SESSIONS

1:00 pm–6:00 pm	*Research in Mathematics by Undergraduates and Students in Post-Baccalaureate Programs, II (AMS-MAA-SIAM)*
1:00 pm–6:00 pm	*Stochastic Analysis and Applications in Finance, Actuarial Science and Related Fields, II*
1:00 pm–6:00 pm	*Mathematics in the Realm of Cyber Research, II*
1:00 pm–6:00 pm	*Recent Advances in Inverse Problems and Imaging, II*
1:00 pm–6:00 pm	*Orthogonal Polynomials, Quantum Probability, Harmonic and Stochastic Analysis, I*
1:00 pm–6:00 pm	*Advances in Operator Theory, Operator Algebras, and Operator Semigroups, II*
1:00 pm–6:00 pm	*Mathematical Analysis in Fluid Dynamics, II*
1:00 pm–6:00 pm	*Analytic Number Theory, II*
1:00 pm–6:00 pm	*Geometric and Topological Combinatorics, II*
1:00 pm–6:00 pm	*Harmonic Analysis, Partial Differential Equations, and Applications, II*
1:00 pm–6:00 pm	*Multiscale Problems in the Calculus of Variations, II*
1:00 pm–6:00 pm	*Geometry and Dynamics of Continued Fractions, II*
1:00 pm–6:00 pm	*Topology, Structure and Symmetry in Graph Theory, II*
1:00 pm–6:00 pm	*Algebraic Structures Motivated by Knot Theory, II*
1:00 pm–6:00 pm	*Arithmetic Statistics, II*
1:00 pm–6:00 pm	*If You Build It They Will Come: Presentations by Scholars in the National Alliance for Doctoral Studies in the Mathematical Sciences, II*
1:00 pm–6:00 pm	*Low Complexity Models in Data Analysis and Machine Learning, II*
1:00 pm–6:00 pm	*Recent Advances in Biological Modeling and Related Dynamical Analysis, II*
1:00 pm–6:00 pm	*Geometric and Topological Generalization of Groups, II*
1:00 pm–6:00 pm	*Mathematical Investigations of Spatial Ecology and Epidemiology, II*

MAA INVITED PAPER SESSIONS

1:00 pm–3:30 pm	*Mathematical Thinking for Modern Data Science Problems*

AMS SPECIAL SESSIONS

1:00 pm–6:00 pm	*History of Mathematics, I (AMS-MAA-ICHM)*
1:00 pm–3:00 pm	**MAA MINICOURSE #12: PART A** *Keep Teaching Statistics using R and RStudio*
1:00 pm–3:00 pm	**MAA MINICOURSE #3: PART B** *Advanced Authoring in WeBWorK: Turn good math problems into great ones & submit them to the OpenProblemLibrary*
1:00 pm–3:00 pm	**MAA MINICOURSE #4: PART B** *Teaching an Undergraduate Computational Science Course*

MAA CONTRIBUTED PAPER SESSIONS

1:00 pm–5:00 pm	*Mathematical Themes in a First-Year Seminar*
1:00 pm–5:00 pm	*Good Math from Bad: Crackpots, Cranks, and Progress*
1:00 pm–5:00 pm	*It's Circular: Conjecture, Compute, Iterate*
1:00 pm–5:00 pm	*The Teaching and Learning of Undergraduate Ordinary Differential Equations*
1:00 pm–6:00 pm	*Inquiry-Based Learning and Teaching, IV*
1:00 pm–6:00 pm	*Research in Undergraduate Mathematics Education (RUME), IV*
1:00 pm–6:00 pm	**SIAM MINISYMPOSIUM ON RECENT DEVELOPMENTS IN NUMERICAL METHODS FOR FLUIDS.**
1:00 pm–5:00 pm	**NAM HAYNES-GRANVILLE-BROWNE SESSION OF PRESENTATIONS BY RECENT DOCTORAL RECIPIENTS**
1:00 pm–2:20 pm	**MAA PANEL** *MAA Instructional Practices Guide's Value for Your Department*
1:00 pm–6:00 pm	**AMS CONTRIBUTED PAPER SESSIONS**
1:00 pm–6:00 pm	**MAA GENERAL CONTRIBUTED PAPER SESSIONS**

1:30 pm–3:30 pm	**MAA POSTER SESSION** *Activities for Teaching Multivariable Thinking through Data Visualization in introductory Statistics*
2:00 pm–2:50 pm	**ASL INVITED ADDRESS** *Some questions and results for classical algebraic structures.* **Sergey Goncharov**
2:15 pm–4:00 pm	**ROCKY MOUNTAIN MATHEMATICS CONSORTIUM BOARD OF DIRECTORS MEETING**
2:30 pm–3:45 pm	**PRESENTATIONS BY MAA TEACHING AWARD RECIPIENTS**
2:30 pm–4:00 pm	**AMS COMMITTEE ON SCIENCE POLICY PANEL DISCUSSION**
3:00 pm–3:50 pm	**ASL INVITED ADDRESS** *Valuations and o-minimality.* **Jana Marikova**
	MAA CONTRIBUTED PAPER SESSIONS
3:30 pm–6:00 pm	*Technology and Resources in Statistics Education, II*
4:00 pm–5:50 pm	**ASL CONTRIBUTED PAPER SESSION**
4:30 pm–5:15 pm	**SIGMAA ON BUSINESS, INDUSTRY, AND GOVERNMENT (BIG SIGMAA) GUEST LECTURE**
4:30 pm–6:00 pm	**MAA STUDENT POSTER SESSION**
4:30 pm–6:30 pm	**AMS CONGRESSIONAL FELLOWSHIP SESSION**
5:00 pm–6:15 pm	**AWM WORKSHOP: POSTER PRESENTATIONS BY WOMEN GRADUATE STUDENTS AND RECEPTION**
5:00 pm–7:00 pm	**MAA PANEL** *Advising Actuarial Science Students*
5:15 pm–6:00 pm	**SIGMAA ON BUSINESS, INDUSTRY, AND GOVERNMENT (BIG SIGMAA) RECEPTION**
5:30 pm–7:30 pm	**TEXAS A & M UNIVERSITY MATHEMATICS DEPARTMENT ALUMNI, STUDENT, AND FACULTY RECEPTION**
6:00 pm–7:00 pm	**SIGMAA ON MATHEMATICAL AND COMPUTATIONAL BIOLOGY(BIO SIGMAA) RECEPTION AND BUSINESS MEETING**
6:00 pm–7:30 pm	**SIGMAA ON MATHEMATICS INSTRUCTION USING THE WEB (WEB SIGMAA) BUSINESS MEETING, RECEPTION, AND GUEST LECTURE**
6:00 pm–7:00 pm	**MATHEMATICALLY BENT THEATER** *Performed by Colin Adams and the Mobiusbandaid Players.*
6:00 pm–7:00 pm	**AMS *MATHEMATICAL REVIEWS* RECEPTION**
6:00 pm–8:40 pm	**NAM RECEPTION AND BANQUET**
6:00 pm–8:00 pm	**UNIVERSITY OF CALIFORNIA, SAN DIEGO RECEPTION FOR MATHEMATICS**
6:00 pm–7:30 pm	**UNIVERSITY OF ILLINOIS AT URBANA–CHAMPAIGN DEPARTMENT OF MATHEMATICS ALUMNI RECEPTION**
6:30 pm–7:30 pm	**SIGMAA ON INQUIRY BASED LEARNING BUSINESS MEETING**
6:30 pm–7:30 pm	**SIGMAA ON MATH CIRCLES FOR STUDENTS AND TEACHERS BUSINESS MEETING**
6:30 pm–7:30 pm	**SIGMAA ON STATISTICS EDUCATION BUSINESS MEETING**
7:00 pm–8:00 pm	**SIGMAA ON MATHEMATICAL AND COMPUTATIONAL BIOLOGY GUEST LECTURE**
7:00 pm–8:30 pm	**MAA SPECIAL PRESENTATION:** *Poetry Reading*
7:00 pm–8:30 pm	**SCUDEM GATHERING AND REUNION**
7:30 pm–8:30 pm	**SIGMAA ON STATISTICS EDUCATION GUEST LECTURE**
7:45 pm–8:35 pm	**NAM COX–TALBOT ADDRESS** *A Seat at the Table: Equity and Social Justice in Mathematics Education.* **Talitha Williams**
8:00 pm–10:00 pm	**PROJECT NEXT RECEPTION** *All Project NExT Fellows, consultants, and other friends of Project NExT are invited.*
8:00 pm–10:00 pm	**BACKGAMMON!** *Learn to play backgammon from expert players.*

Saturday, January 19

7:30 am–1:00 pm	**JOINT MEETINGS REGISTRATION**, Pratt Street Lobby, 300 Level, BCC
7:30 am–1:00 pm	**EMAIL CENTER**

AMS SPECIAL SESSIONS

8:00 am–10:00 am	*Research in Mathematics by Undergraduates and Students in Post-Baccalaureate Programs, III (AMS-MAA-SIAM)*
8:00 am–12:00 pm	*Advances in Quantum Walks, Quantum Simulations, and Related Quantum Theory, I*
8:00 am–12:00 pm	*Mathematicians at Sea (in the Sky, or on Land): Defense Applications of Mathematics, I*
8:00 am–12:00 pm	*Enumerative Combinatorics, I*
8:00 am–12:00 pm	*Orthogonal Polynomials, Quantum Probability, Harmonic and Stochastic Analysis, II*
8:00 am–12:00 pm	*Using Modeling to Motivate the Study of Differential Equations, I*
8:00 am–12:00 pm	*Latinx in Math, I*
8:00 am–12:00 pm	*Group Representation Theory and Character Theory, I*
8:00 am–12:00 pm	*Advances and Applications in Integral and Differential Equations, I*
8:00 am–12:00 pm	*Algebraic, Discrete, Topological and Stochastic Approaches to Modeling in Mathematical Biology, I*
8:00 am–12:00 pm	*Statistical, Variational, and Learning Techniques in Image Analysis and their Applications to Biomedical, Hyperspectral, and Other Imaging, I*
8:00 am–12:00 pm	*Network Science, I*
8:00 am–12:00 pm	*Geometry of Representation Spaces, I*
8:00 am–12:00 pm	*Number Theory, Arithmetic Geometry, and Computation, I*
8:00 am–12:00 pm	*Topological Data Analysis: Theory and Applications, I*
8:00 am–12:00 pm	*Advances by Early Career Women in Discrete Mathematics, I*
8:00 am–12:00 pm	*Not KNerds: A Community for Knot Theory, I*
8:00 am–12:00 pm	*Mathematics of Coding Theory and Applications, I*
8:00 am–12:00 pm	*Partition Theory and Related Topics, I*
8:00 am–12:00 pm	*Localization and Delocalization for Disordered Quantum Systems, I*

MAA INVITED PAPER SESSIONS

8:00 am–11:00 am	*Beauty and Art from Research Mathematics*

AMS SPECIAL SESSIONS

8:00 am–12:00 pm	*History of Mathematics, II (AMS-MAA-ICHM)*
8:00 am–10:00 am	**MAA MINICOURSE #11: PART B** *Object Based Learning and the Smithsonian Learning Lab*

MAA CONTRIBUTED PAPER SESSIONS

8:00 am–12:00 pm	*Approaches to Mathematics Remediation in Baccalaureate-Granting Institutions*
8:00 am–12:00 pm	*Fostering Creativity in Undergraduate Mathematics Courses*
8:00 am–12:00 pm	*Incorporating Programming and Computing in the Math Major Curriculum*
8:00 am–12:00 pm	*Innovative Pathways to Quantitative Literacy*
8:00 am–12:00 pm	*Inclusive Excellence—Attracting, Involving, and Retaining Women and Underrepresented Groups in Mathematics*
8:00 am–12:00 pm	**SIAM MINISYMPOSIUM ON ANALYTICAL TECHNIQUES IN IMAGING ELECTRICAL PROPERTIES OF TISSUE IN COUPLED PHYSICS MODELS.**
8:00 am–5:00 pm	**AWM WORKSHOP:WINCOMPTOP: APPLIED AND COMPUTATIONAL TOPOLOGY**
8:00 am–6:00 pm	**PROJECT NEXT WORKSHOP**
8:00 am–12:00 pm	**AMS CONTRIBUTED PAPER SESSIONS**
8:00 am–12:00 pm	**MAA GENERAL CONTRIBUTED PAPER SESSIONS**

MAA INVITED PAPER SESSIONS

8:30 am–10:50 am	*Research in Undergraduate Mathematics Education: Highlights from the Annual SIGMAA on RUME Conference*
9:00 am– 9:50 am	**AMS INVITED ADDRESS** *Title to be announced.* **Lillian Pierce**
9:00 am– 9:50 am	**ASL INVITED ADDRESS** *Computable aspects of homogeneous structures.* **Douglas Cenzer**
9:00 am–11:00 am	**MAA MINICOURSE #5: PART B** *IBL SIGMAA Minicourse: Introduction to Inquiry-Based Learning*
9:00 am–11:00 am	**MAA MINICOURSE #8: PART B** *Dance and Mathematics*
9:00 am–10:20 am	**MAA PANEL** *Calculus before the Senior Year of High School: Issues and Options*
9:00 am– 9:50 am	**NAM PANEL DISCUSSION** *NAM 2019–2069: Where Do We Go from Here?*
9:00 am–12:00 pm	**EXHIBITS AND BOOK SALES**
9:45 am–10:55 am	**MAA WORKSHOP** *Calculus: Near-Numbers*
10:00 am–10:50 am	**MAA INTERACTIVE LECTURE FOR STUDENTS AND TEACHERS**
10:00 am–10:50 am	**ASL INVITED ADDRESS** *A forcing axiom for a non-special Aronszajn tree.* **John Krueger**

AMS SPECIAL SESSIONS

10:00 am–12:00 pm	*Counting Methods in Number Theory, II*
10:00 am–10:50 am	**NAM BUSINESS MEETING**
10:00 am–10:50 am	**MAA INVITED ADDRESS** *The Inclusion Principle: the importance of community in mathematics.* **Deanna Haunsperger**
10:30 am–11:50 am	**MAA PANEL** *Listening and Responding to Students' Thinking, from Elementary to Undergraduate Mathematics*
11:00 am–12:00 pm	**MATHEMATI-CON PRESENTS: SHOWTIME!**
11:10 am–11:40 am	**MAA BUSINESS MEETING**
11:45 am–12:15 pm	**AMS BUSINESS MEETING**
1:00 pm– 1:50 pm	**NAM CLAYTOR–WOODARD LECTURE** *On Mathematical Problems in Geometric Optics* **Henok Mawi**
1:00 pm– 1:50 pm	**ASL INVITED ADDRESS** *Fifty years in the model theory of differential fields.* **David Marker**

AMS SPECIAL SESSIONS

1:00 pm– 6:00 pm	*Research in Mathematics by Undergraduates and Students in Post-Baccalaureate Programs, IV (AMS-MAA-SIAM)*
1:00 pm– 6:00 pm	*Advances in Quantum Walks, Quantum Simulations, and Related Quantum Theory, II*
1:00 pm– 6:00 pm	*Mathematicians at Sea (in the Sky, or on Land): Defense Applications of Mathematics, II*
1:00 pm– 6:00 pm	*Enumerative Combinatorics, II*
1:00 pm– 6:00 pm	*Using Modeling to Motivate the Study of Differential Equations, II*
1:00 pm– 6:00 pm	*Latinx in Math, II*
1:00 pm– 6:00 pm	*Group Representation Theory and Character Theory, II*
1:00 pm– 6:00 pm	*Advances and Applications in Integral and Differential Equations, II*
1:00 pm– 6:00 pm	*Algebraic, Discrete, Topological and Stochastic Approaches to Modeling in Mathematical Biology, II*
1:00 pm– 6:00 pm	*Statistical, Variational, and Learning Techniques in Image Analysis and their Applications to Biomedical, Hyperspectral, and Other Imaging, II*
1:00 pm– 6:00 pm	*Network Science, II*
1:00 pm– 6:00 pm	*Geometry of Representation Spaces, II*
1:00 pm– 6:00 pm	*Number Theory, Arithmetic Geometry, and Computation, II*
1:00 pm– 6:00 pm	*Counting Methods in Number Theory, III*
1:00 pm– 6:00 pm	*Topological Data Analysis: Theory and Applications, II*
1:00 pm– 6:00 pm	*Advances by Early Career Women in Discrete Mathematics, II*
1:00 pm– 6:00 pm	*Not KNerds: A Community for Knot Theory, II*
1:00 pm– 6:00 pm	*Mathematics of Coding Theory and Applications, II*

1:00 pm–6:00 pm	*Partition Theory and Related Topics, II*
1:00 pm–6:00 pm	*Localization and Delocalization for Disordered Quantum Systems, II*

MAA INVITED PAPER SESSIONS
1:00 pm–4:40 pm   *Mathematics and Policy*

AMS SPECIAL SESSIONS
1:00 pm–6:00 pm   *History of Mathematics, III (AMS-MAA-ICHM)*

1:00 pm–3:00 pm   **MAA MINICOURSE #10: PART B** *Object Based Learning and the Smithsonian Learning Lab*

1:00 pm–3:00 pm   **MAA MINICOURSE #12: PART B** *Keep Teaching Statistics using R and RStudio*

1:00 pm–3:00 pm   **MAA MINICOURSE #6: PART B** *Visualizing Multivariable Calculus & Differential Equations using CalcPlot3D*

MAA CONTRIBUTED PAPER SESSIONS
1:00 pm–5:00 pm   *Meaningful Modeling in the First Two Years of College*

1:00 pm–5:30 pm   **SIAM MINISYMPOSIUM ON FLOW-INDUCED (IN)STABILITY OF ELASTIC STRUCTURES**

1:00 pm–2:45 pm   **AMS SPECIAL PRESENTATION** *Who Wants to Be a Mathematician—Championship Contest.*

1:00 pm–6:00 pm   **AMS CONTRIBUTED PAPER SESSIONS**

1:00 pm–6:00 pm   **MAA GENERAL CONTRIBUTED PAPER SESSIONS**

3:00 pm–4:00 pm   **MAA-AMS-SIAM GERALD AND JUDITH PORTER PUBLIC LECTURE** *Big data, inequality, and democracy.* **Cathy O'Neil**

7:00 pm–9:30 pm   **2019 AMS "UNTIL NEXT TIME" SOCIAL**, Maryland Science Center

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The times noted above and in the full JMM Program listing were current as of press time.

For the most up to date scheduling information, please see:

`http://jointmathematicsmeetings.org/meetings/national/jmm2019/2217_timetable.html`

2019 Joint Mathematics Meetings Advance Registration/Housing Form

JM JOINT MATHEMATICS MEETINGS
BALTIMORE • JAN 16–19, 2019
AMERICAN MATHEMATICAL SOCIETY
MATHEMATICAL ASSOCIATION OF AMERICA

Name _____
(please print your name as you would like it to appear on your badge)

Mailing Address _____

_____

Telephone _____ Fax: _____

In case you have an emergency at the meeting: Day #: _____   Evening #: _____

Email Address _____   Additional email address for receipt _____

Acknowledgment of this registration and any hotel reservations will be sent to the email address(es) given here.   **Check this box to receive a copy in U.S. Mail:** ☐

Affiliation for badge _____   Nonmathematician guest badge name: _____
(company/university)   (Note fee of US$ 22)

PLEASE NOTE THAT BADGES WILL NOT BE MAILED IN ADVANCE FOR THIS MEETING. YOU MAY OPT TO HAVE YOUR PROGRAM MAILED ON DEC. 12 (SEE BELOW)

Registration Fees

Membership please ✓ all that apply. First row is eligible to register as a member.
For undergraduate students, membership in PME and KME also applies.
☐ AMS & MAA ☐ AMS but not MAA ☐ MAA but not AMS ☐ ASL ☐ CMS ☐ SIAM
Undergraduate Students Only: ☐ PME   ☐ KME
Other Societies: ☐ AWM   ☐ NAM   ☐ YMN   ☐ AMATYC

Joint Meetings	by Dec 27	at mtg	Subtotal
☐ Member AMS, MAA, ASL, CMS, or SIAM	US$ 345	US$ 455	
☐ Nonmember	US$ 548	US$ 699	
☐ Graduate Student Member (AMS, MAA ASL, CMS, or SIAM)	US$ 78	US$ 90	
☐ Graduate Student (Nonmember)	US$ 124	US$ 137	
☐ Undergraduate Student (Member AMS, ASL, CMS, MAA, PME, KME, or SIAM)	US$ 78	US$ 90	
☐ Undergraduate Student (Nonmember)	US$ 124	US$ 137	
☐ High School Student	US$ 7	US$ 15	
☐ Unemployed	US$ 78	US$ 90	
☐ Temporarily Employed	US$ 281	US$ 322	
☐ Developing Countries Special Rate	US$ 78	US$ 90	
☐ Emeritus Member of AMS or MAA	US$ 78	US$ 90	
☐ High School Teacher	US$ 78	US$ 90	
☐ Librarian	US$ 78	US$ 90	
☐ Press	US$ 0	US$ 0	
☐ Exhibitor (Commercial)	US$ 0	US$ 0	
☐ Artist Exhibitor (work in JMM Art Exhibit)	US$ 0	US$ 0	
☐ Nonmathematician Guest of registered mathematician	US$ 22	US$ 22	
		$ _____	

AMS Short Course: *Sum of Squares (1/16-1/19)*

☐ Member of AMS	US$ 124	US$ 158	
☐ Nonmember	US$ 190	US$ 225	
☐ Student, Unemployed, Emeritus	US$ 72	US$ 93	
		$ _____	

MAA Minicourses (see listing in text)
I would like to attend: ☐ One Minicourse ☐ Two Minicourses
Please enroll me in MAA Minicourse(s) #_____ and #_____
Price: US$ 100 for each minicourse.
(For more than 2 minicourses, call or email the MMSB.) $ _____

Graduate School Fair Table
☐ Graduate Program Table   US$ 125   US$ 125
   (includes table, posterboard & electricity)
Dept. or Program to be represented (write below or email)
_____ $ _____

Receptions & Banquets
☐ Graduate Student/First-Time Attendee Reception (1/16) (no charge)
☐ NAM Banquet (1/17)
#____Chicken   #____Salmon   #____Vegetarian   US$ 65
#____Kosher *(Additional fees apply for Kosher Meals.)* US$ 204
                    Total for NAM Banquet $ _____
☐ AMS Social (1/19)   Regular Price   #____US$ 75
                     Student Price   #____US$ 35
                    Total for AMS Social $ _____

Printed Meeting Program (PLEASE CHOOSE)
☐ Meeting Program (pick up at mtg only)   US$ 5
☐ Meeting Program mailed (U.S. residents only)   US$ 10
   Registration must be received by Nov. 20 to be eligible for shipping.
☐ I do not want a printed program.
          Total for Meeting Program/Shipping $ _____

Total for Registrations and Events $ _____

Payment

Registration & Event Total (total from column on left) $ _____

Hotel Deposit (only if paying by check) $ _____
If you send a hotel deposit check, the deadline for this form is December 1.

Total Amount To Be Paid $ _____

Method of Payment
☐ **Check**. Make checks payable to the AMS. For all check payments, please keep a copy of this form for your records.
☐ **Credit Card**. All major credit cards accepted. For your security, we do not accept credit card numbers by email, fax, or postal mail. If the MMSB receives your registration form by any of these methods, it will contact you at the phone number provided on this form.

Signature: _____

☐ **Purchase Order** # _____   (please enclose copy)

Other Information

Mathematical Reviews primary field of interest # _____

☐ I am willing to serve as a judge for the MAA Undergraduate Student Poster Session.

☐ If you are an undergraduate, are you interested in participating in the Radical Dash, a multi-day scavenger hunt sponsored by the MAA?

☐ For planning purposes for the MAA Two-year College Reception, please check if you are a faculty member at a two-year college.

☐ Please ✓ this box if you have a disability requiring special services. ♿

To respect your privacy and to better serve you, please indicate your preferences for the following:

☐ Please include my name and affiliation on the JMM Participant List.

☐ Please include my name and postal address on promotional mailing lists.

Registration for the Joint Meetings is not required for the short course but it is required for the minicourses and the Employment Center. To register for the Employment Center, go to www.ams.org/profession/employment-services. For questions, email emp-info@ams.org.

Registration Deadlines

To be eligible for the complimentary hotel room lottery:	**Oct. 30, 2018**
In time to receive programs in the mail:	**Nov. 20, 2018**
Hotel reservations with check deposit:	**Dec. 1, 2018**
Hotel reservations, changes/cancellations through the JMM website:	**Dec. 13, 2018**
Advance registration for the Joint Meetings, short course, minicourses, and dinner tickets:	**Dec. 27, 2018**
Cancel in time to receive 50% refund on advance registration, banquets, minicourses, and short course	**Jan. 8, 2019***

*no refunds issued after this date.

Mailing Address/Contact:

Mathematics Meetings Service Bureau (MMSB)
P. O. Box 6887
Providence, RI 02940-6887   Fax: 401-455-4004; **Email**: mmsb@ams.org
Telephone: 401-455-4144 or 1-800-321-4267 x4144 or x4137

2019 Joint Mathematics Meetings Hotel Reservations – Baltimore, MD

Please see the hotel information in the announcement or on the web for detailed information on each hotel. To ensure accurate assignments, please rank hotels in order of preference by writing 1, 2, 3, etc. in the column on the left and by circling the requested bed configuration. If your requested hotel and room type is no longer available, you will be assigned a room at the next available comparable rate. Please call the MMSB for details on suite configurations, sizes, availability, etc. All reservations, including suite reservations, must be made through the MMSB to receive the JMM rates. Reservations made directly with the hotels before **December 14, 2018** may be changed to a higher rate. All rates are subject to applicable local and state taxes in effect at the time of check-in; currently 15.5% state tax. **Guarantee requirements: First night deposit by check (add to payment on reverse of form) or a credit card guarantee. Please note that reservations with check deposits must be received by the MMSB by December 1, 2018.** People interested in suites should contact the MMSB directly at mmsb@ams.org or by calling 800-321-4267, ext. 4137; (401-455-4137).

☐ **Deposit enclosed (see front of form)**

☐ **Hold with my credit card. For your security, we do not accept credit card numbers by email, postal mail or fax.** If the MMSB receives your registration form by any of these methods, it will contact you at the phone number provided on the reverse of this form.

Date and Time of Arrival _____ Date and Time of Departure _____ Number of adult guests in room _____ Number of children _____

Name of Other Adult Room Occupant (s) _____ Arrival: _____ Departure: _____

Housing Requests: (example: rollaway cot, crib, nonsmoking room, low floor) _____

☐ I have disabilities as defined by the ADA that require a sleeping room that is accessible to the physically challenged. My needs are: _____

☐ I am a member of a hotel frequent-travel club and would like to receive appropriate credit. The hotel chain and card number are: _____

☐ I am not reserving a room. I am sharing with _____ , who is making the reservation.

Order of choice	Hotel	Single	Double 1 bed-2 people	Double 2 beds- 2 people	Triple 3 adults-2 beds	Quad 4 adults-2 beds	Rollaway/Cot Information (add to special requests if reserving online)
	Hilton Baltimore (co-headquarters)	US$ 179	US$ 179	US$ 179	US$ 199	US$ 219	No charge for rollaway cots, available in king-bedded rooms only
	Student Rate	US$ 149	US$ 149	US$ 149	US$ 169	US$ 189	
	Baltimore Marriott Inner Harbor (co-headquarters)	US$ 169	US$ 169	US$ 169	US$ 189	US$ 209	No charge for rollaway cots, available in king-bedded rooms only
	Student Rate	US$ 138	US$ 138	US$ 138	US$ 158	US$ 178	
	Sheraton Inner Harbor	US$ 159	US$ 159	US$ 159	US$ 179	US$ 199	No charge for rollaway cots, available in king-bedded rooms only
	Student Rate	US$ 145	US$ 145	US$ 145	US$ 165	US$ 185	
	Renaissance Harborplace Hotel	US$ 155	US$ 155	US$ 155	US$ 175	US$ 195	Rollaway cots available for US$ 25 per stay, in king-bedded rooms only
	Student Rate	US$ 138	US$ 138	US$ 138	US$ 158	US$ 178	
	Hyatt Regency Baltimore	US$ 150	US$ 150	US$ 150	US$ 175	US$ 200	Rollaway cots available for US$ 25 per stay in king-bedded rooms only
	Student Rate	US$ 140	US$ 140	US$ 140	US$ 165	US$ 190	
	Royal Sonesta	US$ 149	US$ 149	US$ 149	US$ 169	US$ 189	Rollaway cots available for US$ 30 per night in king-bedded rooms only.
	Student Rate	US$ 134	US$ 134	US$ 134	US$ 154	US$ 174	
	Lord Baltimore Hotel	US$ 139	US$ 139	US$ 139	US$ 159	US$ 179	Rollaway cots available for US$ 20 per night in king-bedded rooms only
	Student Rate	US$ 129	US$ 129	US$ 129	US$ 149	US$ 169	
	Hotel Monaco	US$ 135	US$ 135	US$ 135	US$ 155	US$ 175	Rollaway cots available for US$ 25 per stay in king-bedded rooms only.
	Student Rate	US$ 125	US$ 125	US$ 125	US$ 145	US$ 165	
	Days Inn Baltimore Inner Harbor	US$ 139	US$ 139	US$ 139	N/A	N/A	Rollaway cots available for US$ 10 per night based on availability
	Student Rate	US$ 129	US$ 129	US$ 129	N/A	N/A	
	Holiday Inn Inner Harbor	US$ 139	US$ 139	US$ 139	US$ 159	US$ 179	No charge for rollaway cots, available in king-bedded rooms only
	Student Rate	US$ 129	US$ 129	US$ 129	US$ 149	US$ 169	