# Fall Meeting
# of
# The Southern California-Nevada Section of
# The Mathematical Association of America

# Program and Abstracts


CSU Fullerton
October 18, 2025

## Acknowledgements

The Southern California-Nevada Section of the MAA welcomes participants to our 2025 Fall Meeting at CSU Fullerton honoring our section's centennial anniversary. There has been 100 years of MAA in Southern California, and we are excited that you have joined us to celebrate! We thank our program committee and the Ad Hoc Committee on MAA SoCal/Nev Section Centennial Celebration Planning for their work in planning this meeting.

The Section thanks the Mathematics Department and Dean Marie Johnson of the College of Natural Sciences and Mathematics for their hospitality in hosting the meeting. We would especially like to thank Dr. Amelia Stone-Johnstone who handled the local arrangements for the meeting. Our volunteers play a vital role in the organization of the meeting. We thank the section members who agreed to serve as a moderator for our contributed paper session. We also are indebted to our student and faculty volunteers from CSU Fullerton for contributing to the success of this meeting. Thank you to Dr. Scott Annin and Dr. Shoo Seto for facilitating the student volunteers.

Finally, we thank our invited speakers, contributed paper session presenters, and poster presenters for their participation in the meeting. A special thanks to Glen Whitney of Studio Infinity for providing the supplies and instructions for building our icosahedron.

## Section Officers, 2025-2026

MAA Representative: Edray Goins
Section Chair: Konrad Aguilar
Section Vice-Chair: Shanna Dobson
Past Section Chair: Kim Ayers
Program Chair: Bahar Acu
Vice Program Chair: Amelia Stone-Johnstone
2nd Program Vice-Chair: Christina Edholm
Secretary: Mary Legner
Treasurer: Natalia Postrigan
Meetings Co-Coordinators: Konrad Aguilar and Karrolyne Fogel
Newsletter Editor: position open
Student Chapters Coordinator: position open
Section NExT Liaison: Matthew Gherman
Las Vegas Liasion: Zhijian Wu
Web Page Editor: Karrolyne Fogel

Looking for a way to engage with and support our math community? Our officer positions rotate frequently. Current openings are the MAA Representative (elected this spring) and the Student Chapters Coordinator who runs our Student Poster Session at the spring meeting (appointed). Also, each spring we elect a new Section Vice-Chair and 2nd Program Vice-Chair, who serve on the board for three years. If you are interested in serving in any of the Section Officer positions, but especially one of these that will be open soon, please contact the Past Section Chair (Kim Ayers).

# Schedule

| | | |
|---|---|---|
| 9:00-9:05 | Welcome Remarks<br>**Konrad Aguilar**, Pomona College, Section Chair | SGMH 1502 |
| 9:05-9:45 | Invited Address: *Miraculous Cancellations for Quantum Matrices*<br>**Francis Bonahon**, University of Southern California and Michigan State University | SGMH 1502 |
| 9:50-10:20 | Section Business Meeting | SGMH 1502 |
| 10:20-10:30 | Break | — |
| 10:30-11:10 | Invited Address:<br>*The POWER of Data Science: Passion, Obstacles, Willingness, Endurance, and Respect in Building Pathways for the Next Generation*<br>**Jessica Jaynes**, California State University, Fullerton | SGMH 1502 |
| 11:10-11:20 | Break | — |
| 11:25-12:25 | Faculty and Student Contributed Paper Session | See p 3-6 |
| 12:25-2:05 | Lunch and Activities<br>12:25-2:05 *Icosahedron Build* with **Glen Whitney**<br>1:30-2:00 *Section NExT Workshop* with **Anna Aboud**, Westmont College | Registration Area<br>Outer Courtyard<br>SGMH 1112 |
| 2:05-2:45 | Invited Address: *Teaching Proofs as a Way of Knowing*<br>**Brian P Katz (BK)**, California State University, Long Beach | SGMH 1502 |
| 2:45-2:50 | Conference Photo | SGMH 1502 |
| 2:50-3:00 | Break | — |
| 3:00-3:50 | Invited Address: *Math and the Mind*<br>**Ami Radunskaya**, Pomona College | SGMH 1502 |
| 3:50-4:50 | Student Poster Session with 100th Anniversary Celebration Cake | Central Courtyard |
| 4:50-5:00 | Closing Remarks | SGMH 1502 |

# Contributed Paper Sessions Schedule

There are ten concurrent sessions with the following themes. Abstracts, with times and room numbers, are listed on pages 9-18 of the program.

- Algebra: SGMH 1308
- Analysis: SGMH 1307
- Number Theory: SGMH 1303
- Graph Theory/Combinatorics: SGMH 1112 and SGMH 1113
- Geometry/Topology: SGMH 1109 and SGMH 1406
- Math Education/Pedagogy: SGMH 2201 and SGMH 2205
- Applied Math: SGMH 1506

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|---|---|
| 10:45-12:30 | **Contributed Paper Session**; Keyword–Algebra<br>SGMH 1308 |
| 11:25-11:40 | Bobby Orozco, CSU Fullerton<br>*Reconstructing Functions on Finite Abelian Groups with Autocorrelations* |
| 11:45-12:00 | Darren Okura, Fullerton Mathematical Circle & Laguna Hills High School<br>*Three Interesting Algebra Problems* |
| 12:05-12:20 | Ruilin Zhu, Troy High School and Fullerton Math Circle<br>*Applications of Function–Inverse Graphical Relationships in Solving Challenging Algebraic Problems* |

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|---|---|
| 10:45-12:30 | **Contributed Paper Session**; Keywords–Analysis<br>SGMH 1307 |
| 11:25-11:40 | John Rock, Cal Poly Pomona<br>*Desmos and GeoGebra activities for analysis* |
| 11:45-12:00 | Julia Aceron, Pomona College<br>*Quantum metrics on standard and non-standard matrix products* |
| 12:05-12:20 | Anna Aboud, Westmont College<br>*A New Graph-Directed Construction of Nonlocal Energies on the Unit Interval* |

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|---|---|
| 10:45-12:30 | **Contributed Paper Session**; Keyword—Number Theory<br>SGMH 1303 |
| 11:25-11:40 | W. Riley Casper, CSU Fullerton<br>*Pascal's Matrix, Point Counting on Elliptic Curves and Prolate Spheroidal Functions* |
| 11:45-12:00 | Maddox Lister, CSU Fullerton<br>*Solution to AMM Problem 12419 — On the infinite signed sum of digits of the consecutive positive base 10 integers* |

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|---|---|
| 10:45-12:30 | **Contributed Paper Session**; Keywords—Graph Theory/Combinatorics<br>SGMH 1112 |
| 11:25-11:40 | Max Hlavacek, Pomona College<br>*Maximal tubings of the cycle graph* |
| 11:45-12:00 | Joshua Bowman, Pepperdine University<br>*Collapsing states in digraphs* |
| 12:05-12:20 | Ayşegül Kula, Pomona College, Nitipon Moonwichit, Claremont Graduate University, and Deniz Tanaci, Pomona College<br>*On Uniform Chain Partitions of Normalized Matching Posets* |

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|---|---|
| 10:45-12:30 | **Contributed Paper Session**; Keywords—Graph Theory/Combinatorics<br>SGMH 1113 |
| 11:25-11:40 | Briana Foster-Greenwood, Cal Poly Pomona<br>*Metric Dimension of Direct Products of Complete Graphs* |
| 11:45-12:00 | Leila Anicia Corrales, Cal Poly Pomona<br>*Restricted Bounds on Parking Functions* |

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|---|---|
| 10:45-12:30 | **Contributed Paper Session**; Keywords—Geometry/Topology<br>SGMH 1109 |
| 11:25-11:40 | Puttipong Pongtanapaisan, Pitzer College<br>*Knots, Systems of Linear Equations, and Categorification* |
| 11:45-12:00 | Levi Puga, CSU Channel Island<br>*Field Extensions and Multiplication on their Induced Tori* |
| 12:05-12:20 | louis ye, Harvey Mudd College<br>*Unitary Actions and Equivariant Volumes of Symmetric Edge Polytope* |

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|---|---|
| 10:45-12:30 | **Contributed Paper Session**; Keywords—Geometry/Topology<br>SGMH 1406 |
| 11:25-11:40 | Marshall Whittlesey, CSU San Marcos<br>*A quaternion construction of the 'miraculous pentagram' on the sphere* |
| 11:45-12:00 | Yorick Herrmann, Jimmy Nguyen, Murong Ning, UC Irvine<br>*Sums of Cantor Sets Arising from Non-Autonomous Tent Map Systems* |
| 12:05-12:20 | Mark Maldonado, California Polytechnic State University Pomona<br>*An Investigation of the Čech Homology Groups of the Sierpinski Gasket* |

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|---|---|
| 10:45-12:30 | **Contributed Paper Session**; Keywords–Math Education/Pedagogy<br>SGMH 2201 |
| 11:25-11:40 | Jeffrey Pair and David Chi, California State University, Long Beach<br>*Graph Theory Research in a Transition-to-Proof Course* |
| 11:45-12:00 | Rasha Issa, Dr. Sara Lapan, UC Riverside<br>*From Noticing to Reflection: Graduate Teaching Assistants' Experiences with Written Classroom Accounts* |

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|---|---|
| 10:45-12:30 | **Contributed Paper Session**; Keywords–Math Education/Pedagogy<br>SGMH 2205 |
| 11:25-11:40 | Mariela Rivas, Caylor Davis<br>*Transfer is the Goal: Helping Students Apply Statistical Knowledge Across Disciplines* |
| 11:45-12:00 | Joan Horvath, Nonscriptum LLC<br>*Teaching Calculus with LEGOs and 3D Prints* |

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|---|---|
| 10:45-12:30 | **Contributed Paper Session**; Keywords–Applied Math<br>SGMH 1506 |
| 11:25-11:40 | Lara Kassab, CSU Fullerton<br>*How to Build Rankings from Noisy Pairwise Comparisons* |
| 11:45-12:00 | Yolanda Ba, Cole Plepel, Harvey Mudd College<br>*Efficient Tensor Decomposition: Column Space Convergence and Randomized Least Squares Solvers* |
| 12:05-12:20 | Sylvia Wagner, California State Polytechnic University, Pomona<br>*Multi-Visit Drone and Truck Delivery Scheduling* |

# Invited Addresses

Invited Address: ***"Miraculous Cancellations for Quantum Matrices"***
Francis Bonahon, University of Southern California and Michigan State University

Quantum matrices are matrices whose entries do not commute with each other, but "almost" commute in a sense controlled by a complex number $q$. They occur in many mathematical contexts, for instance in the construction of invariants used to prove that two knotted curves in space cannot be deformed to each other. Motivated by these applications, Bonahon will describe unexpected simplifications that occur in powers of quantum matrices when the quantum parameter $q$ is a root of unity. This is analogous to the famous Frobenius relation that $(x+y)^n = x^n + y^n$, frowned upon in a (pre)calculus class but valid in a ring of prime characteristic $n$. The talk will only require basic notions of linear algebra.

Invited Address: ***"The POWER of Data Science: Passion, Obstacles, Willingness, Endurance, and Respect in Building Pathways for the Next Generation"***
Jessica Jaynes, California State University, Fullerton

The story of developing data science education is one of POWER—Passion, Obstacles, Willingness, Endurance, and Respect. This theme captures both the challenges and opportunities of building accessible pathways for students to thrive in an increasingly data-driven world.

This talk explores the POWER of building sustainable pathways into data science through Passion for innovative teaching, confronting Obstacles in curriculum design, showing Willingness to collaborate across institutions and disciplines, demonstrating Endurance in sustaining large-scale initiatives, and maintaining Respect for learners at every level.

Highlights include the development of introductory data science courses, cross-campus and industry-partnered programs, statewide efforts to create data science pathways, and outreach that extends into K–12 education. Together, these initiatives reflect how embracing POWER can transform statistics and data science education, fostering collaboration "one dataset at a time," and prepare a generation of students to thrive in a data-driven future.

Invited Address: ***"Teaching Proofs as a Way of Knowing"***
Brian P Katz (BK), California State University, Long Beach

A central thread in my professional work is the need to teach mathematical proof as a way of knowing: a human endeavor, done by humans, with human tools, in human sociocultural/political contexts, for the human purpose of understanding our experiences. In this session, we will discuss some of the ways Katz tries to meet this need as a practitioner and researcher and why he thinks it is so important for society and our students.

Invited Address: ***"Math and the Mind"*** Ami Radunskaya, Pomona College

There has been a lot of noise about algorithms that can think and be creative, but we are still a long way from understanding how to model the human brain, much less the human spirit. In this talk I will describe three current projects that consider mathematical models of the human brain from different perspectives. In one project, we develop mathematical models and optimal strategies to deliver dopamine agonists, the "happy hormone," to the brain at just the right time and in just the right place. In another project, we develop a model to understand the well-known but poorly understood "gut-brain connection." For example, did you know that the gut has its own set of neurons that comprise the "enteric nervous system," sometimes called the "brain in your gut"? We study the links between this brain and the one in our heads, and how the two work together to affect everything from our mood to our sleep. And then, on a more light-hearted note, I will describe a project that uses real-time brain waves to understand how we respond to music.

# Invited Address Biographies

**Francis Bonahon**, University of Southern California and Michigan State University

Francis Bonahon taught for 35 years at the University of Southern California, during which time he was a proud and active member of the SoCal-Nevada Section of the MAA. He is very pleased and honored to be invited to this celebration of the centennial of the Section. He retired from USC, but not from mathematics, in 2021 and now lives in Michigan, where he holds a courtesy appointment at Michigan State University. He misses hiking in the San Gabriel Mountains, but now has the opportunity to cross-country ski from his backyard in winter.

**Jessica Jaynes**, California State University, Fullerton

Dr. Jessica Jaynes is a Professor of Mathematics and Statistics at California State University, Fullerton, and Director of the Titan Supercomputing Center. A first-generation college graduate, she earned her Ph.D. in Statistics from UCLA and has devoted her career to advancing both the practice and teaching of statistics and data science.

Her leadership spans several transformative initiatives. She co-directed the NSF SoCal Data Science Program, engaging over 90 students in industry-partnered research projects, and is Principal Investigator of Project PIPE-LINE, a California Learning Lab Grand Challenge initiative creating equitable pathways and new degree programs in data science. She also serves as Program Coordinator for the NIH EAGER Program, which immerses undergraduates in genomics, computational biology, and bioinformatics alongside world-class researchers at UC Berkeley. Beyond higher education, Dr. Jaynes helped launch Project IDEEM, empowering K–5 teachers to bring data literacy into their classrooms.

Her work reflects a deep commitment to opening doors for students and faculty, inspiring them to pursue innovation, and building diverse communities in data science.

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

Brian P Katz (BK) is faculty in Mathematics Education and coordinator of the single subject mathematics credential at CSULB. BK is passionate about interactions between inquiry, epistemology, identity, authority, and justice as both a scholar and teacher, especially in the context of preparing teachers to lead student-centered and rehumanizing classrooms of their own. BK is Associate and Communications Editor with PRIMUS, a former Chair of IBL SIGMAA and the SoCal-NV Section of the MAA, a current member of the executive board of SIGMAA RUME, an MAA textbook author, an Editor of the inclusion/exclusion blog, and an Associate Director of Project NExT. BK supports two of the best cats in the world and loves to sing.

**Ami Radunskaya**, Pomona College

A California native, Professor Ami Radunskaya received her Ph.D. in Mathematics from Stanford University. She has been a faculty member in the Math Department at Pomona College since 1994. In her research, she specializes in ergodic theory, dynamical systems, and applications to various "real-world" problems. Some current research projects involve mathematical models of cancer immunotherapy, developing strategies for targeted drug delivery to the brain, and studying stochastic perturbations of dynamical systems. Professor Radunskaya believes strongly in the power of collaboration and that everyone can learn to enjoy mathematics; as President of the Association of Women in Mathematics, she encouraged collaborative research, international outreach and cooperation between all the mathematical societies. She is the President of the EDGE (Enhancing Diversity in Graduate Education) Foundation, whose summer program won a "Mathematics Program that Makes a Difference" award from the American Mathematics Society in 2007, and a Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring (PAESMEM) in 2017.

Professor Radunskaya is a 2021 Fellow of the Association for Women in Mathematics, a Fellow of the American Math Society, and she is the recipient of several awards, including a WIG teaching award in 2012, the 2017 AAAS Mentor award, and the 2020 Intercollegiate Biomathematics Alliance Distinguished Senior Fellowship. She was featured in the documentary, "The Empowerment Project: ordinary women doing extraordinary things," as well as in the 2020 book: "Power in Numbers: the Rebel Women of Mathematics."

# Lunch Activities

**Section NExT Workshop**, Anna Aboud, Westmont College
SGMH 1112

Anna Aboud will facilitate an interactive discussion about diverse assessment types that effectively measure student learning while simultaneously providing incentive and opportunity for students to hone their mathematical communication skills. Among other assessment types, we will discuss oral exams, metacognitive reflections, and community engagement activities.

*Workshop Leader Biography* Dr. Anna Aboud (Project NExT Brown '20) is an associate professor of mathematics at Westmont College in Santa Barbara, CA. With degrees in mathematics and mathematics education, Dr. Aboud has experience teaching math in the K-12 classroom, as well as at community college, research institutions, and primarily undergraduate institutions. These varied experiences have given Dr. Aboud a deep and nuanced perspective on mathematics education. Dr. Aboud enjoys investigating and implementing learning structures which promote strong conceptual understandings of mathematics, and she prioritizes strategies which foster a sense of connection and belonging within the mathematics classroom.

**Icosahedron Build**, Glen Whitney, Studio Infinity
Outer Courtyard

Add your contribution to the building of a celebratory 8-10 foot icosahedron, decorated to resemble the MAA Logo (as much as possible). Organized and led by Glen Whitney and Studio Infinity, you have the opportunity to help construct this participatory mathematical art installation!

*Build Leader Biography* Glen Whitney's loathing of math transformed into love at the Ross Program, a love which has played a central role in every chapter of his career: assistant professor, quantitative analyst, founder of the National Museum of Mathematics, and principal of Studio Infinity. He's also proud to serve as the Problem Warden of the Prison Mathematics Project.

# Contributed Paper Session Abstracts

*Abstracts are listed by session*

## SGMH 1308(Algebra)

**11:25-11:40** in SGMH 1308
**Presenter(s):** Bobby Orozco, CSU Fullerton
**Title:** *Reconstructing Functions on Finite Abelian Groups with Autocorrelations*
**Abstract:** The higher-order autocorrelations of integer-valued or rational-valued gridded data sets appear naturally in X-ray crystallography, and have applications in computer vision systems, correlation tomography, correlation spectroscopy, and pattern recognition. In this talk, we consider the problem of reconstructing a gridded data set from its higher-order autocorrelations. We describe an explicit reconstruction algorithm, and mention that the autocorrelations up to order $3r + 3$ are always sufficient to determine the data up to translation, where $r$ is the dimension of the grid. We also provide an explicit example of our algorithm in action.
**Area(s):** Algebra, Applied Math

**11:45-12:00** in SGMH 1308
**Presenter(s):** Darren Okura, Fullerton Mathematical Circle & Laguna Hills High School
**Title:** *Three Interesting Algebra Problems*
**Abstract:** In 1821, Cauchy published his Cours d'analyse, which contained the first rigorous proof of the AM-GM inequality. In the first problem we present, the AM-GM inequality is used to prove the specified inequality, which is an example of its widespread utility. Another inequality that he used extensively is the triangle inequality, and we will also discuss a second problem based on the same inequality over the set of complex numbers. He also thoroughly investigated properties of certain sequences and their behavior at infinity. One sequence which behaves especially nicely at infinity is the sequence of iterations of Newton's method, which can be used to estimate square roots. However, when evaluating this sequence numerically, two of the terms that are added have a difference that equals $c^n$, where $c$ is a constant determined by the initial guess and $n$ is the number of iterations. In the special case $c = 1$, this difference remains constant and only one of the terms needs to be calculated. This property is used in the third problem we present, which concerns a sequential limiting process.
**Area(s):** Algebra

**12:05-12:20** in SGMH 1308
**Presenter(s):** Ruilin Zhu, Troy High School and Fullerton Math Circle
**Other Author(s):** Research advisors: Drs. Bogdan Suceavă and Shoo Seto, California State University, Fullerton
**Title:** *Applications of Function–Inverse Graphical Relationships in Solving Challenging Algebraic Problems*
**Abstract:** The graphs of a function and its inverse are reflections of each other across the line $y = x$. This fundamental property provides powerful tools for addressing challenging algebraic problems. In this presentation, I will review these tools and illustrate their application through examples involving both equations and inequalities. By working through these problems, we can develop a deeper understanding of the relationship between a function and its inverse and become more proficient in employing these creative techniques to construct and solve challenging problems.
**Audience:** Algebra
**Area(s):** Algebra, Math Education/Pedagogy

# SGMH 1307(Analysis)

**11:25-11:40** in SGMH 1307
**Presenter(s):** John Rock, Cal Poly Pomona
**Title:** *Desmos and GeoGebra activities for analysis*
**Abstract:** Desmos and GeoGebra are free mathematical tools that allow us to visualize a wealth of mathematical concepts. This talk showcases a variety of Desmos and GeoGebra activities designed to illustrate and animate difficult definitions in analysis such as limit of a sequence, continuity, Riemann and Lebesgue integrals, pointwise and uniform convergence, and the Weierstrass Approximation Theorem via Bernstein polynomials. Bring a phone or tablet so you can take advantage of QR codes and play around with the activities yourself!
**Audience:** Calculus, Intro to Proofs, Real Analysis
**Area(s):** Real Analysis

**11:45-12:00** in SGMH 1307
**Presenter(s):** Julia Aceron, Pomona College
**Title:** *Quantum metrics on standard and non-standard matrix products*
**Abstract:** Quantum metrics, which were originally introduced by Rieffel and motivated by Physics, provide new ways of extracting information from the data listed in a matrix. The standard matrix multiplication gives an important way to combine the information from two matrices, and there are known ways of how quantum metrics behave with respect to this product. However, there many other important matrix products besides standard matrix multiplication, such as the Cracovian product or Schur product, that also combine the information of two matrices in interesting ways, but there is much less information about how quantum metrics behave with respect to these products. In this project, we studied the way quantum metrics on matrices behave with these other matrix products as well as the standard product, while introducing a new matrix product (called the CraSH product) and also studying the effect the quantum metric has on this product. (This work is partially supported by NSF grant DMS-2316892).
**Area(s):** Analysis

**12:05-12:20** in SGMH 1307
**Presenter(s):** Anna Aboud, Westmont College
**Other Author(s):** Mary Vaughan, Texas State University; Patricia Alonso Ruiz, University of Jena, Friedrich-Schiller-Universität Jena
**Title:** *A New Graph-Directed Construction of Nonlocal Energies on the Unit Interval*
**Abstract:** Generalizations of iterated function systems, graph-directed fractals enable constructions well suited for modeling nonlocal processes. In this talk we use a graph-directed fractal structure to approximate the unit interval with a sequence of discrete, complete graphs with vertices at the dyadic rationals. We then construct graph-directed self-similar energies on the interval, ultimately showing the Mosco convergence of these energies to a nonlocal energy form.
**Audience:** Undergraduate Discrete Math
**Area(s):** Analysis

# SGMH 1303(Number Theory)

**11:25-11:40** in SGMH 1303
**Presenter(s):** W. Riley Casper, CSU Fullerton
**Title:** *Pascal's Matrix, Point Counting on Elliptic Curves and Prolate Spheroidal Functions*
**Abstract:** The eigenvectors of the $(N+1) \times (N+1)$ symmetric Pascal matrix $T_N$ are analogs of prolate spheroidal wave functions in the discrete setting. The generating functions of the eigenvectors of $T_N$ are prolate spheroidal functions in the sense that they are simultaneously eigenfunctions of a third-order differential operator and an integral operator over the critical line $\{z \in \mathbb{C} : \mathrm{Re}(z) = 1/2\}$. For even, positive integers $N$, we obtain an explicit formula for the generating function of an eigenvector of the symmetric pascal matrix with eigenvalue 1. When $N = p-1$ for an odd prime $p$, we show that the generating function is equivalent modulo $p$ to $(\#E_z(\mathbb{F}_p) - 1)^2$, where $\#E_z(\mathbb{F}_p)$ is the number of points on the Legendre elliptic curve $y^2 = x(x-1)(x-z)$ over the finite field $\mathbb{F}_p$. Furthermore when $N = p^n - 1$, our generating function is the square of a period of $E_z$ modulo $p^n$ in the open $p$-adic unit disk.
**Area(s):** Algebra, Analysis, Number Theory

**11:45-12:00** in SGMH 1303
**Presenter(s):** Maddox Lister, CSU Fullerton
**Title:** *Solution to AMM Problem 12419 — On the infinite signed sum of digits of the consecutive positive base 10 integers*
**Abstract:** The infinite signed sum of the digits of the consecutive positive base 10 integers has first few terms

$$1 - 2 + 3 - 4 + 5 - 6 + 7 - 8 + 9 - 1 + 0 - 1 + 1 \ldots$$

We are asked to prove that given an integer $n$, there are infinitely many partial sums of the sequence that equal $n$. We solve the problem using a clever trick or two and a lot of "shifty" algebra.
**Audience:** Anyone! No prior math knowledge required.
**Area(s):** Number Theory

# SGMH 1112(Graph Theory/Combinatorics)

**11:25-11:40** in SGMH 1112
**Presenter(s):** Max Hlavacek, Pomona College
**Title:** *Maximal tubings of the cycle graph*
**Abstract:** Fix a graph $G$ with vertex set $V = [n] := \{1, 2, \ldots, n\}$. A *maximal tubing* $\mathcal{T}$ of a graph $G$ is a maximal collection of compatible subsets of vertices called tubes of $G$. It is possible to construct a poset $\mathrm{MTub}(C)$ on the set of maximal tubes of $G$. Both the weak order and the Tamari lattices can be realized as $\mathrm{MTub}(G)$ and have several interesting properties: They are lattices, and furthermore, they are semidistributive and congruence-uniform. However, for some $G$, $\mathrm{MTub}(G)$ is not even a lattice. A fundamental open question in the field is to classify for which $G$ is $\mathrm{MTub}(G)$ a lattice. In 2021, Barnard and McConville show that $\mathrm{MTub}(G)$ is a lattice if $G$ is *filled*. In this talk, we consider the cycle graph, $C_n$, which is not a filled graph, and show that $\mathrm{MTub}(C_n)$ is a semidistributive and congruence-uniform lattice. In the process, we introduce and explore a specific map between tubings of the path graph and the cycle graph.
**Area(s):** Graph Theory/Combinatorics

**11:45-12:00** in SGMH 1112
**Presenter(s):** Joshua Bowman, Pepperdine University
**Title:** *Collapsing states in digraphs*
**Abstract:** Directed graphs, or digraphs, can be used to model a finite collection of "states" and the allowed "transitions" between them. They are therefore useful in combinatorial problems involving objects that can be built up from smaller pieces in controlled ways. This observation is at the heart of the transfer matrix method, which involves the determinant of a matrix whose rows and columns are labeled by the states of the digraph. We will show how the matrix is changed when states are removed by a "collapsing" process, and what effect this change has on the determinant. Because collapsing states results in a smaller matrix, this process can make calculation of the determinant easier. We will also explain how the collapsing process relates to a geometric interpretation of the determinant in terms of cycles in the digraph.
**Area(s):** Graph Theory/Combinatorics

**12:05-12:20** in SGMH 1112
**Presenter(s):** Ayşegül Kula, Pomona College, Nitipon Moonwichit, Claremont Graduate University, and Deniz Tanaci, Pomona College
**Other Author(s):** Qiyue Feng, Pomona College, Shahriar Shahriari, Pomona College
**Title:** *On Uniform Chain Partitions of Normalized Matching Posets*
**Abstract:** Dilworth's theorem guarantees that every poset can be partitioned into as few chains as its width, but it gives no information about the structure of such partitions. A natural next question is: Can there be a Dilworth chain partition in which the chain sizes are as uniform as possible, differing by at most one? A still open conjecture of Füredi from 1985 says that the answer is yes for the poset of subsets of a finite set ordered by inclusion (i.e., finite boolean lattice). It has been proven that the answer is yes for the poset of subspaces of a finite-dimensional vector space over a finite field. A generalization of both of these families of posets is normalized matching posets (i.e., LYM posets). Since 2006, several authors have proposed strengthening F$\ddot{(}$u)redi's conjecture to normalized matching posets (possibly with unimodal and symmetric rank numbers). In our talk, we present infinite families of simple counterexamples, "whisker posets," to multiple versions of the stronger conjectures. We then discuss why the set of counterexamples may be limited and make a new conjecture. *Combinatorics of partially ordered sets*
**Audience:** Some Combinatorics experience is helpful but not necessary
**Area(s):** Graph Theory/Combinatorics

# SGMH 1113(Graph Theory/Combinatorics)

**11:25-11:40** in SGMH 1113
**Presenter(s):** Briana Foster-Greenwood, Cal Poly Pomona
**Other Author(s):** Christine Uhl, St. Bonaventure University
**Title:** *Metric Dimension of Direct Products of Complete Graphs*
**Abstract:** Imagine you are lost but can measure your distance to several landmarks. How many landmarks do you need to guarantee you can determine your location? This scenario is analogous to finding the metric dimension of a graph. We construct the optimal number of landmarks for a family of direct products of three complete graphs. Our strategy involves analyzing edge-colored hypergraphs and avoiding forbidden subgraphs. Watch out for shark teeth!
**Audience:** Graph Theory
**Area(s):** Graph Theory/Combinatorics

**11:45-12:00** in SGMH 1113
**Presenter(s):** Leila Anicia Corrales, Cal Poly Pomona
**Other Author(s):** Dr. Steve Butler, Kimberly Hadaway, Iowa State University; Maya Mubayi, Northwestern University; Jennifer Rotter, University of Illinois Urbana-Champagne
**Title:** *Restricted Bounds on Parking Functions*
**Abstract:** Parking functions represent possible preferences of $n$ cars that enter a one-way street where every car is able to park according to the following parking rules: each car (1) parks in their preferred spot if it is empty, or (2) parks at the next available spot if their preferred spot is filled. This paper discusses parking functions where the number of times a spot can be preferred is at most $k$. We provide multiple closed formulas, making use of both previously defined and newly introduced objects. We construct a bijection between ordered, unlabeled trees and our restricted parking functions, where the number of children each node has corresponds to the number of times a spot appears in the parking function. We also construct a bijection between $k$-paths (a modified Motzkin path that we define in the paper) and our restricted parking functions. Finally, we introduce lucky spots, which are spots that are parked in by a car that prefers it, and we construct the number of lucky spots in our restricted parking functions through an alteration of our main formula. As a further direction of research, we propose looking more closely at lucky spots and our restricted parking functions.
**Audience:** Permutations/Combinations
**Area(s):** Graph Theory/Combinatorics

# SGMH 1109(Geometry/Topology)

**11:25-11:40** in SGMH 1109
**Presenter(s):** Puttipong Pongtanapaisan, Pitzer College
**Title:** *Knots, Systems of Linear Equations, and Categorification*
**Abstract:** By examining solutions of systems of linear equations, we can use linear algebra to distinguish knotted shapes. Building on an idea of Cho and Nelson, one can construct a directed graph whose vertices correspond to solutions of these systems, with edges connecting solutions that are related by certain rules. In this talk, we use these directed graphs to distinguish knotted objects that have the same number of solutions. This approach also provides undergraduate students with an accessible introduction to categorification, the process of promoting an algebraic object to one with additional structure. This talk is based on joint work with Tirasan Khandhawit, Korn Kruaykitanon, and Brandon Wang.
**Area(s):** Algebra, Topology

**11:45-12:00** in SGMH 1109
**Presenter(s):** Levi Puga, CSU Channel Island
**Title:** *Field Extensions and Multiplication on their Induced Tori*
**Abstract:** We explore the relationships between quadratic fields and their respective rings of algebraic integers, focusing on two-dimensional rational vector spaces and two dimensional integer lattices. We investigate how these structures interact and examine their underlying algebraic and geometric properties. We delve into the ways in which the properties of quadratic fields influence the structure of two dimensional rational vector spaces and how their rings of algebraic integers influence two dimensional integer lattices. We also introduce a concept we call induced multiplication, which arises from vector space and Z-module isomorphisms. These isomorphisms link these distinct mathematical structures together. We leverage these relationships to construct lattices and tori which allows for geometric interpretations of quadratic fields and their integer rings. This provides valuable insight into their topological and algebraic properties, enhancing our understanding of the connection between algebra and geometry. We provide an investigation of the rational circle group, rational lattices and rational tori. Additionally, we study the endomorphisms of rational tori along with matrix representations for algebraic integers.
**Area(s):** Algebra, Geometry, Topology

**12:05-12:20** in SGMH 1109
**Presenter(s):** louis ye, Harvey Mudd College
**Title:** *Unitary Actions and Equivariant Volumes of Symmetric Edge Polytope*
**Abstract:** The symmetric edge polytope (SEP) of a finite simple graph $G$ is a centrally symmetric lattice polytope whose vertices are defined by the edges of the graph. Among the information encoded by these polytopes are the symmetries of the graph, which appear as symmetries of the polytope. We describe the rigid symmetries of these polytopes, and show that SEPs are unitarily equivalent exactly when their associated graphs are isomorphic. We then find an explicit relationship between the relative volumes of the subsets of the symmetric edge polytope SEP fixed by the natural action of symmetric group elements and the symmetric edge polytopes of smaller graphs to which the subsets are linearly equivalent. We also provide a vertex description of the fixed polytopes and find a description of the symmetric edge polytopes to which they are equivalent, in terms of contractions of the graph $G$ induced by the cycle decompositions of the permutations under which the subsets are fixed. Specializations of our results provide equivalence and volume relationships for fixed polytopes of symmetric edge polytopes of complete graphs (equivalently, for fixed polytopes of root polytopes of type $A_n$), and describe the symmetry group of this family of polytopes.
**Area(s):** Geometry, Graph Theory/Combinatorics

# SGMH 1406(Geometry/Topology)

**11:25-11:40** in SGMH 1406
**Presenter(s):** Marshall Whittlesey, CSU San Marcos
**Title:** *A quaternion construction of the 'miraculous pentagram' on the sphere*
**Abstract:** The *pentagramma mirificum* ('miraculous pentagram') is a spherical star shaped polygon that arises naturally and unexpectedly in the study of spherical geometry. It can be used as a device to construct and understand the trigonometric relationships among the sides and angles of a spherical right triangle. We show how to construct the pentagram and show that its existence can be seen as a consequence of algebraic identities among quaternions.
**Audience:** precalculus
**Area(s):** Geometry

**11:45-12:00** in SGMH 1406
**Presenter(s):** Yorick Herrmann, Jimmy Nguyen, Murong Ning, UC Irvine
**Title:** *Sums of Cantor Sets Arising from Non-Autonomous Tent Map Systems*
**Abstract:** The standard tent map is a classical model in dynamical systems that exhibits chaotic behavior. The set of orbits that remain bounded is the middle third Cantor set, one of the best known and studied fractals. Studying fractal geometry involve studying different notions of dimension such as the box-counting dimension and Hausdorff dimension where dimension can be a non-integer. It is known that no interval is contained in the Minowski sum of two Cantor sets whose sum of upper box-counting dimension is less than one. In our setting, we study Cantor sets arising from non-autonomous tent map systems and their properties. One goal of this project includes determining sufficient conditions for when the sum of these Cantor sets contains intervals when the sum of their Hausdorff dimension is less than one. Through examining known results and considering geometric approaches, we were able to accomplish this goal.
**Area(s):** Geometry

**12:05-12:20** in SGMH 1406
**Presenter(s):** Mark Maldonado, California Polytechnic State University Pomona
**Other Author(s):** Thesis Advisor: Dr. Arlo Caine, California Polytechnic State University Pomona
**Title:** *An Investigation of the Čech Homology Groups of the Sierpinski Gasket*
**Abstract:** We present what we believe to be a unique approach to the computation of the Betti numbers of the Čech homology groups of the Sierpinski Gasket inspired by Vanessa Robins's (Ph.D. Mathematics) work on computational topology. We introduce the fundamental concepts of fractal geometry needed to construct the Sierpinski Gasket, for which we formally construct a model of Sierpinski's Gasket, based on its iterates constructed from an iterated function system of dilations, using 0, 1, and 2 simplices where vertices are indexed using a base-3 system. We then compute the Betti numbers of all simplicial homology groups of the iterates, for which we transition into inverse limit systems from both a topological and group perspective. Using the approach of inverse limit systems to define Čech homology groups, we construct a sequence of open covers of the Sierpinski Gasket and construct their Nerves in order to rigorously verify that the 1st Čech homology group of the Sierpinski Gasket has an infinite Betti number and the 0th Čech homology group of the Sierpinski Gasket has Betti number equal to 1.
**Audience:** Fractal Geometry, Algebraic Topology (a basic understanding of simplicial homology will be helpful)
**Area(s):** Fractal Geometry, Algebraic Topology, Real Analysis

# SGMH 2201(Math Education/Pedagogy)

**11:25-11:40** in SGMH 2201
**Presenter(s):** Jeffrey Pair and David Chi, California State University, Long Beach
**Title:** *Graph Theory Research in a Transition-to-Proof Course*
**Abstract:** In this study, we report on a pure mathematics Course-Based Undergraduate Research Experience (CURE) implemented within a transition-to-proof course where students learned about graph theory research. Through the CURE, students worked independently and collaboratively as they learned about fundamental concepts of graph theory, watched videos of graph theorists discussing their work, and made sense of a theorem from published research papers. As a result of the CURE, students reported learning about the practices of mathematicians—they were impressed with the time and effort mathematicians put into proving the conjectures; students also believed they developed skills and confidence to pursue advanced mathematics.
**Audience:** Mathematics Instructors, Mathematics Education Researchers
**Area(s):** Math Education/Pedagogy

**11:45-12:00** in SGMH 2201
**Presenter(s):** Rasha Issa, Dr. Sara Lapan, UC Riverside
**Title:** *From Noticing to Reflection: Graduate Teaching Assistants' Experiences with Written Classroom Accounts*
**Abstract:** Noticing is the first step to reflective teaching. Mathematics graduate teachers (MGTs) used 'brief-but-vivid' classroom accounts to reflect on teaching, documenting weekly moments and discussing them in facilitated groups. Two major themes emerged: (1) Collaborative Learning and Shared Reflection, where peer interaction fostered camaraderie, accountability, and co-construction of professional knowledge; and (2) Capturing Fleeting Moments, emphasizing subtle classroom dynamics, student behavior, and practical strategies. Participants focused more on pedagogy than content, highlighting early instructors' priorities. Findings demonstrate that socially mediated reflection shapes teaching identity, informs instructional decisions, and links individual noticing to collective learning, with implications for designing more effective teaching professional development.
**Area(s):** Math Education/Pedagogy

# SGMH 2205(Math Education/Pedagogy)

**11:25-11:40** in SGMH 2205
**Presenter(s):** Mariela Rivas, Caylor Davis
**Title:** *Transfer is the Goal: Helping Students Apply Statistical Knowledge Across Disciplines*
**Abstract:** Statistics is a foundational discipline, but students often struggle with knowledge transfer—the ability to apply concepts across different contexts and build upon them for advanced learning. This talk introduces a curriculum developed at CourseKata.org that addresses this challenge by integrating principles from the learning sciences (Fries et al., 2020), specifically targeting two forms of transfer. First, generalization, which refers to applying statistical methods, such as regression, to diverse domains like biology and business. Second, preparation for future learning by building foundational concepts to master more complex topics. We've designed an interactive statistics curriculum that includes a set of core interactive textbooks and Jupyter notebooks. This curriculum is currently being used in introductory courses across various fields, including mathematics, psychology, sociology, and business. Our materials continuously improve (the "Kata") based on student data and feedback from instructors and researchers, allowing us to refine the learning experience. This presentation will explore the design principles of a transfer-focused curriculum and discuss how this approach can equip students with flexible and highly transferable statistical skills.
**Area(s):** Math Education/Pedagogy

**11:45-12:00** in SGMH 2205
**Presenter(s):** Joan Horvath, Nonscriptum LLC
**Title:** *Teaching Calculus with LEGOs and 3D Prints*
**Abstract:** Calculus is usually presented as the culmination of years of algebra and geometry. However, suppose instead one could describe the core concepts purely in terms of physical models like LEGO bricks, 3D prints, and household items? Then, after the student has a firm grasp of these ideas, there is more motivation to learn the algebra needed to compute specific cases and build for the future. We asked the question, "What would have happened if Newton had been able to use a 3D printer to explain calculus?" and developed a set of models that became our book "Make: Calculus" (2022, Make: Community LLC, https://www.makershed.com/products/make-calculus-print) and its associated open-source Github repository of 3D printable files written in the OpenSCAD constructive-geometry language. I will demonstrate how we have used our models to teach elementary-age students. This approach is also inherently accessible to populations like the visually impaired who are not served well with equations on a blackboard, and is a boon to others who are "underprepared" for calculus.
**Area(s):** Math Education/Pedagogy

# SGMH 1506(Applied Math)

**11:25-11:40** in SGMH 1506
**Presenter(s):** Lara Kassab, CSU Fullerton
**Title:** *How to Build Rankings from Noisy Pairwise Comparisons*
**Abstract:** Suppose you want to rank teams in a sports league, movies on a streaming site, or search results on the web. Often, what we have are not full rankings but only pairwise comparisons—who beat who, or which movie someone liked more. From this incomplete and sometimes noisy data, can we still recover a good overall ranking? In this talk, we show how stochastic gradient descent approaches, particularly the Kaczmarz method, can be used to uncover the underlying ranking efficiently. We'll present theoretical convergence guarantees and share insights into how much data is enough, how noise affects the results, and why these methods are both mathematically interesting and practically useful.
**Area(s):** Applied Math

**11:45-12:00** in SGMH 1506
**Presenter(s):** Yolanda Ba, Cole Plepel, Harvey Mudd College
**Title:** *Efficient Tensor Decomposition: Column Space Convergence and Randomized Least Squares Solvers*
**Abstract:** Tensors are high-dimensional generalizations of vectors and matrices that can be thought of as n-dimensional arrays of numbers. Many applications, from chemometrics to medical imaging, benefit from tensor decompositions, such as the CP decomposition, in which an arbitrary tensor is expressed as a sum of rank-one tensors, allowing for easier analysis and interpretation. CP decompositions are typically computed via the Alternating Least Squares (ALS) algorithm, which reduces tensor decomposition to solving repeated overdetermined linear least squares problems with Khatri-Rao structure. We investigate variants of the ALS algorithms based around efficient approximate least squares subroutines, identifying key aspects of these subroutines affecting ALS convergence, such as the ability to quickly learn the correct column spaces of the CP factors. In particular, we show under mild conditions that the ALS algorithm identifies the correct column space of each factor matrix after one iteration, and preserves this information through future iterations. We also propose and evaluate an efficient family of least squares solvers, taking advantage of the Katri-Rao structure.
**Area(s):** Applied Math

**12:05-12:20** in SGMH 1506
**Presenter(s):** Sylvia Wagner, California State Polytechnic University, Pomona
**Title:** *Multi-Visit Drone and Truck Delivery Scheduling*
**Abstract:** In this project we investigate the problem of package delivery scheduling. More specifically, to increase the efficiency of last mile delivery, we consider a joint truck and drone setting. Each truck carries a fleet of heterogeneous drones possessing varying capabilities. Drones can be launched and retrieved at each customer delivery location along their truck's route. We consider the multi-visit scenario where each drone can deliver to one or more customers before returning to its truck. Following and expanding upon work by Y. Jiang, M. Liu, X. Jia, and Q. Xue, we formulate a mixed integer programming problem whose solution yields an optimal delivery schedule which minimizes the route completion time. Finally, we present numerical results demonstrating optimal schedules and the impact of various truck and drone characteristics.
**Area(s):** Applied Math, Operations Research, Linear Programming

# Student Poster Session Abstracts

3:50-4:50pm, SGMH Central Courtyard

**Poster Presenter(s):** Junshu Feng, Theo Chinn, Peiting Jiang, Pomona College
**Title:** *Numerical Semigroups from Rational Matrices*
**Authors(s):** Theo Chinn (Pomona College), Junshu Feng (Pomona College), Peiting Jiang (Pomona College)
**Abstract:** We introduce a module-theoretic approach and an linear-programming method to compute the matricial dimension of numerical semigroups. We use these to determine the matricial dimension of every numerical semigroup with Frobenius number at most 8 or genus at most 5.
**Advisor:** Stephan Ramon Garcia
**Area(s):** Algebra

**Poster Presenter(s):** Jacob Mendenhall, CSU San Marcos
**Title:** *Tic Tac Toe Draws*
**Authors(s):** Jacob Mendenhall, Shahed Sharif
**Abstract:** Much is known about the conventional game of Tic Tac Toe. However, when increasing the dimension or board size, many new questions arise. These are called $n^d$ games, where $n$ is the board size and $d$ is the board dimension. This poster examines some natural questions that may arise when studying $n^d$ games, specifically finding results about the amount and type of draws possible on these larger boards. This poster will discuss the number of draws on certain $n^d$ games, and the minimum required O's to create a draw on a board of size $n^2$.
**Advisor:** Shahed Sharif
**Area(s):** Graph Theory/Combinatorics, Game Theory

**Poster Presenter(s):** Jimena Sanchez, Scripps College
**Title:** *Optimal Control Approach to Developing Sex-Structured Release Strategies For Dengue Prevention*
**Authors(s):** Evan Gibbs (York College of Pennsylvania), Khaled E Hassan (Ohio State University), Unnati Gil (Arizona State University), Heliana Arias Castro (Universidad del Valle), Jordy Cevallos Chavez (Arizona State University)
**Abstract:** Dengue Fever is widespread in warm, tropical regions, putting nearly half the world's population at risk. It spreads primarily through bites of infected female Aedes Aegypti and Aedes Albopictus mosquitoes, which acquire the virus from infected humans and continue the cycle through further bites. Each year, over 100 million people are infected with dengue, with symptoms varying in intensity. This makes disease control essential to eliminate deadly cases. Wolbachia are maternally transmitted bacteria present in about 60 percent of arthropods. When introduced into mosquito vectors like Aedes Aegypti, they reduce disease transmission by lowering mosquito fitness, fertility, and causing cytoplasmic incompatibility. These effects make Wolbachia a valuable biological control, though different strains vary in how successfully they spread in wild mosquito populations. We propose a two sex-structured dynamical models for mosquito populations: (1) a mosquito- only system modeling interactions between wild and Wolbachia-infected males and females, and (2) an extended system coupling these dynamics with a human compartment (infected) to capture dengue transmission. An optimal control problem was formulated to identify time- dependent release strategies for Wolbachia-infected female and male mosquitoes. The goal is to minimize a cost functional that reflects both biological and operational objectives: reducing the number of dengue-infected humans, limiting the intensity of mosquito releases, and accounting for baseline introduction costs. The dynamics of different Wolbachia strains were explored to assess their potential for long-term population replacement and vector control.
**Advisor:** Heliana Arias Castro
**Area(s):** Applied Mathematics, Optimal Control

**Poster Presenter(s):** Eric Parrott, CSU San Marcos
**Title:** *3-D Reflecting Brownian Motion in $\alpha$-fair Workload Cones with Applications to Bandwidth Sharing Networks*
**Authors(s):** Renton McGregor, Eric Parrott, Dr. Amber Puha
**Abstract:** We investigate the existence of three-dimensional reflecting Brownian motion in $\alpha$-fair workload cones, a diffusion model motivated by bandwidth sharing networks. An existing conjecture states that existence of such processes depends on a condition for the convex combination of normal vectors at boundaries where cone faces intersect. We show that this condition holds along intersections of any two workload cone faces for all $\alpha > 0$.
**Advisor:** Dr. Amber Puha
**Area(s):** Probability/Statistics

**Poster Presenter(s):** Davis Liu, Chaparral Middle School
**Title:** *Solutions to Selected Problems from Gazeta matematica*
**Authors(s):** Codrut Sorin Zmicala, Maramures
**Abstract:** In this poster, we solve several problems from the Mathematical Gazette, a monthly publication established in 1895 and published continuously ever since by the Romanian Society for Mathematical Sciences. These problems are proposed to the students working with the Fullerton Mathematical Circle, an outreach program of the Department of Mathematics at Cal State Fullerton. The problems solved here are from a recent 2025 issue.
**Advisor:** Dr. Bogdan Suceavă
**Area(s):** Algebra, Number Theory

**Poster Presenter(s):** Joseph Salamante, University of Southern California
**Title:** *Asthma Co-Benefits and Educational Disparities in The Transition to Electric Vehicles in California*
**Authors(s):** Joseph Salamante, Justin Coles, Jessy Garcia
**Abstract:** Low-income communities are often disproportionately exposed to traffic-related air pollution, which makes them especially vulnerable to health impacts. Light duty vehicle emissions contribute to various respiratory diseases, such as asthma. This study examines the larger California region to determine the correlation between higher numbers of light duty zero emission vehicles (ZEVs) and asthma-related emergency department (ED) visits. We focus on California zip code level data tracing ED visits from 2013 to 2022. Using multilevel linear regression models to study socioeconomic indicators and education attainment, we relate ZEV adoption to age-adjusted asthma ED visit rates through non linear temporal trends. Our findings suggest a correlation between higher ZEV adoption and lower asthma ED visit rates over time. This highlights the importance of ZEV expansion efforts, such as California's 2020 executive order increasing zero-emission vehicle targets, as widespread adoption can yield significant public health benefits for communities.
**Advisor:** Dr. Sandrah Proctor Eckel and Dr. Erika Garcia
**Area(s):** Probability/Statistics, Biostatistics/Epidemiology

**Poster Presenter(s):** Vincent Razo, California State University, Fullerton
**Title:** *Optimal Retirement Withdrawal Strategies*
**Authors(s):** Jason Luo, Vincent Razo
**Abstract:** What retirement withdrawal strategy would be best for you? Given three people in three different financial situations, we will utilize known withdrawal rules and Monte Carlo Simulations to determine which strategy would best suit our clients. We translate three different rules into mathematical models with iterative formulas. Given information about our clients such as age, sex, portfolio value in USD, and asset allocation, we can simulate our withdrawal strategies while accounting for economic uncertainty and analyze the statistics of our results. Finally, we select the model that best suits our client which maximizes their withdrawn amount while ensuring our client does not go broke before their life expectancy.
**Advisor:** Dr. Christopher Lee
**Area(s):** Applied Mathematics

**Poster Presenter(s):** Jenson Molebash, Chris Porter, Loyola Marymount University
**Title:** *Parking Lot Functions*
**Authors(s):** Jenson Molebash, Chris Porter, Joshua Hallam
**Abstract:** Imagine you have $n$ cars that want to park along a one way street with $n$ parking spots. Each car has its own preferred spot (cars can share the same preference) and will drive to that spot and attempt to park there. If that spot is empty, the car the parks in it, otherwise, it keeps driving down the street and finds the next available spot to park. We say a sequence $(a_1, a_2, \ldots, a_n)$ denoting each car's preference is a *parking function* of length $n$ if all cars are able to park under this rule. Now let's consider a slight modification of this rule, instead of parking in the next available spot, each car parks in the last available empty spot. We call these sequences *parking lot functions*. While every parking lot function is a parking function, the converse is not true. We are able to count certain subsets of parking lot functions of length $n$, such as the number of weakling increasing ($2^{n-1}$), weakly decreasing (the $n^{th}$ Catalan number), and parking lot functions where only the first $k$ cars are lucky ($k!S(n,k)$ where $S(n,k)$ is the Stirling number of the second kind). While we are not able to yet count the total number of parking lot functions of length $n$, we conjecture that it is $(2n-1)!!$.
**Advisor:** Joshua Hallam
**Area(s):** Graph Theory/Combinatorics

**Poster Presenter(s):** Omar Bello, California State University, Fullerton
**Title:** *"I'm trying to grow, trying to be better": Successes, Challenges, and Supports for Part-Time Faculty Engaged in Instructional Improvement*
**Authors(s):** Dr. Alison Marzocchi, Omar Bello
**Abstract:** Part-time lecturers (PTLs) often teach foundational-level mathematics courses crucial to the university and department. Yet, contractual, cultural, and logistical limitations can result in challenges to attend professional development (PD) and participate in departmental activities. This study examines the experiences of thirteen PTLs who actively participated in the META PD program at California State University, Fullerton, from Fall 2022 to Spring 2025. Analyzing surveys, interviews, and reflection cycle data, we identified their successes, challenges, and supports. Reported successes included increased student engagement, and increased mindfulness around student participation. Reported challenges included time constraints, encouraging student participation, and experiencing limited involvement in departmental activities. Reported supports included learning from different-ranked colleagues and increased openness to try new teaching strategies. These findings demonstrate the potential of PD to empower PTLs, foster a sense of community, and improve teaching effectiveness. Institutions interested in faculty PD should consider the unique challenges and goals of PTLs.
**Advisor:** Dr. Alison Marzocchi
**Area(s):** Math Education/Pedagogy

**Poster Presenter(s):** Marvin Pena, CSU San Marcos
**Title:** *Stationary Distribution of a Diffusion Model for a Shortest Remaining Processing Time Queue*
**Authors(s):** Sixian Jin (CSUSM); Marvin Pena (CSUSM); Amber Puha (CSUSM)
**Abstract:** We study a diffusion model introduced in Banerjee, Budhiraja, and Puha (2022). In that work, this diffusion model was shown to be a heavy traffic approximation for a shortest remaining processing time queue with a heavy tailed service time distribution. Here we are interested in characterizing the stationary distribution of this diffusion model. Of particular interest is to show its existence and uniqueness and describe its distributional properties.
**Advisor:** Prof. Amber Puha
**Area(s):** Probability/Statistics

**Poster Presenter(s):** Jin Park, Veda Chennupati, Christopher Meza, Erik Ledvina, Caltech
**Title:** *Optimal Pebbling Number of Lobster Trees*
**Authors(s):** Veda Chennupati, Caltech, Erik Ledvina, Caltech, Christopher Meza, Caltech, Jin Park, Caltech
**Abstract:** A pebbling distribution assigns to each vertex non-negative integer. A pebbling move removes two pebbles from a vertex and adds one to an adjacent vertex. The optimal pebbling number of a graph, $\pi^*(G)$, is defined as the minimum number of pebbles $k$ such that it is possible to reach each vertex in the graph with a configuration of $k$ pebbles. In this poster, we prove the optimal pebbling number of certain classes of lobster trees.
**Advisor:** Matthew Gherman
**Area(s):** Graph Theory/Combinatorics

**Poster Presenter(s):** Aidan Rodriguez, CSU San Marcos
**Title:** *Testing the Distribution of Weak Erdős–Rényi Ideal Class Groups*
**Authors(s):** Aidan Rodriguez, Shahed Sharif, CSU San Marcos
**Abstract:** A subset $S$ of a finite Abelian group $G$ is called Weakly Erdős–Rényi if every element $g$ can be expressed as a product of a subset of elements $S$. It is conjectured for ideal class groups of imaginary quadratic fields, the subset of its small generating prime ideals is almost always Weakly Erdős–Rényi. With large discriminants, the probability of finding one that isn't Weakly Erdős–Rényi becomes negligible. The goal of this research is to experimentally test this assumption for odd discriminants up to $2^{30}$.
**Advisor:** Dr. Shahed Sharif
**Area(s):** Cryptography

**Poster Presenter(s):** Soren Ghorai, Ryan Rodrigue, Tutlalee Wines, Caltech
**Title:** *Improving Bounds on the $\phi$-Pebbling Number of Graphs*
**Authors(s):**
**Abstract:** Graph pebbling was first introduced as a tool for solving a combinatorial number theory conjecture of Erdős and Lemke. Pebbles are moved throughout a graph by removing two from one vertex to place one on an adjacent vertex. We study a pebbling variant called $\phi$-pebbling in which each pebble may move once without another being removed. We compute the $\phi$-pebbling number of trees, cycles, and thorn graphs and establish bounds on the $\phi$-pebbling number for graphs of diameter two, Cartesian products of graphs, complete $k$-partite graphs, paths, hypercubes, grids, and crowns. The results aid our understanding of Graham's Conjecture as $\phi$-pebbling represents moving a pebble through both graphs in a Cartesian product simultaneously.
**Advisor:** Matthew Gherman
**Area(s):** Graph Theory/Combinatorics

**Poster Presenter(s):** Veronica De Leon, Pomona College
**Title:** *Modeling the Opioid Epidemic in the Inland Empire*
**Authors(s):** Devi Canseco Lopez, Veronica De Leon, Ameya Teli, Pomona College
**Abstract:** The Inland Empire Crisis Coalition is an organization dedicated to reducing vulnerability towards the opioid epidemic in San Bernardino and Riverside through various ways, like increasing access to treatment and analyzing data. This research used data pulled from multiple sources, like national, state and local dashboards, to work towards making inferences about the opioid epidemic in California counties, with an emphasis on the IE counties using statistical models. Different phases of the epidemic–emergency department visits and deaths due to overdose–were modeled using generalized linear models. Visualization tools, like Plotly, were also used to display existing patterns. As a result, various statistical inferences were made, comparing Inland Empire counties with each other and nearby counties. From this, we gained a better understanding of differences of the epidemic's impact between counties. Further exploration using more county-specific data will be considered in the future to understand how to help more local communities.
**Advisor:** Alejandra Castillo
**Area(s):** Probability/Statistics

**Poster Presenter(s):** Anne Bannon, Scripps College
**Title:** *Spectral Analysis of the Laplacian on Graph Approximations of the Basilica Group*
**Authors(s):** Anne Bannon, Scripps College; Jeanette Patel, Haverford College; Shivani Regan, George Washington University
**Abstract:** We study the Basilica group, a self-similar group generated by a 3-state automaton. Grigorchuk and Zuk established the group as the first example of an amenable but not subexponentially amenable group, and Nekrashevych uses it as the simplest nontrivial example in his theory of iterated monodromy groups. We investigate spectral properties of Schreier graphs of the Basilica group. These were first considered by Grigorchuk and Zuk, who revealed a family of weighted Laplacians on these graphs whose spectra are invariant under a two-dimensional dynamical system. Our interest is in describing the structure of the eigenfunctions for this sequence of graphs. We develop an alternative description of the dynamical system introduced by Grigorchuk and Zuk and study the corresponding dynamics for the eigenfunctions. Using a recursive algorithm to construct Laplacian eigenfunctions on approximations of the Basilica fractal, we identify similarities between these eigenfunctions and those of the continuous Laplacian on $\mathbb{R}$.
**Advisor:** Luke Rogers
**Area(s):** Analysis, Graph Theory/Combinatorics

**Poster Presenter(s):** Jacob Bergsma, CSU San Marcos
**Title:** *Wasserstein Projections in the Distribution-Based Optimal Selling Problem*
**Authors(s):** Jacob Bergsma (CSU San Marcos), Sixian Jin (CSU San Marcos)
**Abstract:** We consider the distribution-based optimal selling problem, where a client specifies a target probability distribution to represent their preferences instead of using a utility function. Two related tasks arise: if the distribution is unattainable, we minimally alter to reach attainability; if it is attainable but suboptimal, we seek an attainable, stochastically dominant distribution that improves upon the original. In both cases, the problem reduces to finding the closest distribution under the Wasserstein metric, subject to a scaled mean constraint set to zero. For the 1-Wasserstein distance, we show that the curvature of the diffusion scale function determines the structure of optimal transfers: with zero drift, multiple solutions are equally optimal, while positive or negative drift yield unique greedy strategies shifting mass minimally left or right. We also present initial insights into the 2-Wasserstein case and potential extensions to continuous distributions.
**Advisor:** Sixian Jin
**Area(s):** Applied Mathematics, Probability/Statistics

**Poster Presenter(s):** Jade Jiao, Pomona College
**Title:** *Statistical Ensemble of Subgraph Fingerprints for de novo Aptamer Design*
**Authors(s):** Jade Jiao (Pomona College), Alexander Kimm (University of California, Irvine), Narayannan Kannan (University of California, Los Angeles), Starlika Bauskar (Texas Tech University)
**Abstract:** Machine-learning methods in biochemistry commonly represent molecules as graphs of pairwise intermolecular interactions for property and structure predictions. Most methods operate on a single graph, typically the minimal free energy (MFE) structure, for low-energy ensembles (conformations) representative of structures at thermodynamic equilibrium. We introduce a thermodynamically parameterized exponential-family random graph (ERGM) embedding that models molecules as Boltzmann-weighted ensembles of interaction graphs. We evaluate this embedding on SELEX datasets, where experimental biases (e.g., PCR amplification or sequencing noise) can obscure true aptamer–ligand affinity, producing anomalous candidates whose observed abundance diverges from their actual binding strength. We show that the proposed embedding enables robust community detection and subgraph-level explanations for aptamer-ligand affinity, even in the presence of biased observations. This approach may be used to identify low-abundance aptamer candidates for further experimental evaluation.
**Advisor:** Andrea Bertozzi
**Area(s):** Applied Mathematics, Graph Theory/Combinatorics, Probability/Statistics

**Poster Presenter(s):** Nazgol Hadaegh, California State University, Fullerton
**Title:** *Human vs. Robot: Exploring the Potentials and Pitfalls of AI-Led Mathematics Instructor Professional Development*
**Authors(s):** Nazgol Hadaegh, California State University, Fullerton
**Abstract:** The META project at California State University, Fullerton, aims to support instructors in improving their instruction. Research shows that professional development benefits instructors; however, many struggle to participate because of limited time. Because of this challenge, META created an AI tool on the School AI platform to help faculty engage in the professional development programs that META provides. META provides Reflection Cycles, which guide instructors through three phases: planning, implementation, and debrief. From 2022 to 2024, META completed 31 reflection cycles, and 18 were analyzed for this study. Nine mathematics instructors (six women and three men) participated, with different rankings. Instructor feedback from the reflection cycles was entered into the chatbot and compared with feedback from student researchers. Student researchers gave advice based on what other mathematics instructors had done; however, the chatbot gave advice based on the structured guidance it was programmed to provide. This research suggests that AI can support professional development, but human involvement remains essential.
**Advisor:** Alison Marzocchi
**Area(s):** Math Education/Pedagogy

**Poster Presenter(s):** Yiming Xiong, Pitzer College
**Title:** *Redistricting Reform for the Los Angeles City Council: Statistical Models and Simulations*
**Authors(s):** Yiming Xiong, Pitzer College
**Abstract:** Following a 2022 scandal, Los Angeles is considering reforms to City Council elections, including expanding the number of districts. We utilize voter file-based statistical modeling and computational simulation to examine the impact of proposed reforms. In this project, we study: The impact on racial representation. Aggregating survey-based predictions of voter support with precinct-level results from the 2022 LA elections. Simulating ranked-choice elections under alternative districting plans to evaluate balance of progressive vs. moderate representation in LA City Council.
**Advisor:** Evan Rosenman
**Area(s):** Applied Mathematics, Probability/Statistics

**Poster Presenter(s):** Enzo Mediana, CSU Fullerton
**Title:** *Investigating resource allocation for wildfire prevention using topological data analysis*

**Authors(s):** Enzo Mediana, Giovani Gutierrez
**Abstract:** We use topological data analysis to study the distribution of wildfire prevention resources across Los Angeles County. Using fire stations as witnesses and census tract centroids as landmarks, we use persistent homology to identify areas that may not have enough fire stations nearby. Our results highlight regions with less coverage, including sparsely populated areas like the Angeles National Forest and more populated areas like the San Fernando Valley and West regions. We explore how this information might help make wildfire prevention more equitable and suggest future research directions.
**Advisor:** Dr. Kristin Kurianski
**Area(s):** Applied Mathematics

**Poster Presenter(s):** Kiana Jones, California State University - Fullerton
**Title:** *Understanding the Rindler Group*
**Authors(s):** Kiana Jones, CSU Fullerton
**Abstract:** An observer undergoing constant acceleration will observe a thermal distribution of particles (the Unruh effect) if the quantum field is in the vacuum state associated with an inertial observer. In a recent paper by Lochan and Padmanabhan, they show that an accelerating observer who is spatially shifted relative to another will observe thermal particles in the others' vacuum state. The analysis involves constructing a nested sequence of Rindler wedges and viewing each wedge as an independent spacetime. In our research, we study the transformation groups associated with these Rindler wedge spacetimes. Since the Rindler wedges are subspaces of Minkowski space, we begin with a review of the Lorentz and Poincare groups and their action on Minkowski space.
**Advisor:** Alfonso Agnew
**Area(s):** Algebra, Quantum Field Theory in Curved Spacetime, General Relativity

**Poster Presenter(s):** Niko Calabro, MiraCosta College
**Title:** *Randomly Generating Symmetric Circulant Unitaries*
**Authors(s):** Niko Calabro, MiraCosta College
**Abstract:** We study the matrices $e^{iC}$, where $C$ is a symmetric circulant whose entries are drawn independently from a uniform distribution. Further exploration is performed on these matrices to yield partial results on the distribution of its eigenvalues. This is motivated by the problem of generating random unitary matrices by taking the complex exponentiation of a real symmetric matrix.
**Advisor:** Dr. Shahed Sharif
**Area(s):** Algebra, Probability/Statistics

**Poster Presenter(s):** Jingfan Zheng, Arjun Sisodia, Pomona College
**Title:** *Order in Chaos: Investigating the Fermi-Pasta-Ulam-Tsingou Problem*
**Authors(s):** Jingfan Zheng & Arjun Sisodia, Pomona College
**Abstract:** The Fermi-Pasta-Ulam Tsingou (FPUT) problem explores the dynamical process of a one-dimensional lattice of particles connected by nonlinear springs. The initial assumption was that due to the nonlinear components of the system, the energy introduced at the lowest frequency mode should drift to the other modes of energy. However, that assumption turned out to not be true as the system exhibited non-ergodic behavior. As a result, this led to what is known as the FPUT paradox. We investigate the nonlinear dynamics of certain one-dimensional lattice systems using both analytical and numerical approaches to understand energy transfer mechanisms and recurrence phenomena.
**Advisor:** Adam Yassine
**Area(s):** Applied Mathematics, Dynamical Systems and Ergodic Theory

**Poster Presenter(s):** Kavini Vinayagamoorthy, California State University Fullerton
**Title:** *Explorations in High School Algebra*
**Authors(s):** Kavini Vinayagamoorthy California State Fullerton Math Circle
**Abstract:** In this project, I investigate some problems from the Gazeta Matematică that illustrate the richness of high school algebra. The first is an inequality comparing exponential forms, the second a trigonometric identity derived from the geometry of the regular heptagon, and finally an equation involving rational powers of two. These examples show how algebraic reasoning unifies diverse areas of mathematics.
**Advisor:** Bogdan Suceavă
**Area(s):** Algebra

**Poster Presenter(s):** Abel Sekone, UC San Diego & San Diego State University
**Title:** *Modeling Left Center Right game as a Discrete Time Markov Chain*
**Authors(s):** Abel Sekone, UC San Diego & San Diego State University
**Abstract:** Research in mathematics education documented that meaningful learning contexts such as the ones provided through games can enhance students' probabilistic thinking. Probability can therefore emerge from games of chance. One example of a luck game dependent solely on the roll of a dice is the Left Right Center (LCR) game. LCR follows a probabilistic rhythm until only one player has any coins in their possession and is thus the winner. It is a perfect case of applying probability and specifically Discrete Time Markov Chain (DTMC) to real world situations e.g., a game. On this poster we provide a general DTMC model of LCR specifying the state space, feasible states, a transition matrix describing the probabilities of transitions, and an initial state across the state space. We also discuss an example of modeling an LCR game with 3 players using one die.
**Area(s):** Math Education/Pedagogy, Probability/Statistics

**Poster Presenter(s):** Jaron Johnstone and Manting Yu, California State University Fullerton
**Title:** *Insurance Premiums: Net Stop Loss*
**Authors(s):** Loc Nguyen, Jaron Johnstone, Manting Yu
**Abstract:** This research investigates calculating the net stop loss when severity is a continuous random variable. First of all, for a given frequency random variable $N$, define the total cost of a loss to an insurance company as $S = X1 + X2 + \cdots + XN$, where each $Xi$ represents severity. Given a deductible $d$, the net stop loss is $E[(S-d)+] = E(S \wedge d) - E(S)$. When $X$ follows a discrete distribution, it is easy to calculate the net Stop Loss. On the other hand, when $X$ follows a continuous distribution, this approach is no longer applicable. For this research project, we want to know if there is any special continuous distribution for the severity random variable for which the calculation of the net stop-loss is feasible. Then want to investigate basic methods to discretize a continuous distribution and then approximate the net stop loss.
**Advisor:** Loc Nguyen
**Area(s):** Probability/Statistics

**Poster Presenter(s):** Miriam Zhou, Pomona College
**Title:** *Modeling Supply Chain Equilibrium Using Variational Inequalities*
**Authors(s):** Miriam Zhou, Pomona College
**Abstract:** This project studies how uncertainty, such as COVID-19 PPE disruptions, influences equilibrium performance in supply chain networks. Using symbolic computation and the variational inequality (VI) framework from Nagurney (2006), it models decentralized optimization among manufacturers, retailers, and markets. A deterministic 2–1–1 benchmark is solved symbolically in SymPy to obtain equilibrium flows, prices, and profits. The model is then extended to a stochastic PPE network with random supply and demand to simulate pandemic shocks. Key metrics $(E^{\circ}, Ew, R, \hat{E})$ quantify efficiency, robustness, and risk-adjusted performance. The framework illustrates how uncertainty propagates through production and pricing, offering a flexible tool for evaluating supply chain resilience.
**Area(s):** Operations Research

**Poster Presenter(s):** Samuel DuBois, Chris Feltman, and Weston Andrew Hernandez Waggoner, CSUF
**Title:** *Arbitrarily Hard Unknot Diagrams and Bubble Tangles*
**Authors(s):**
**Abstract:** We are investigating example diagrams of the following conjecture.
**Conjecture:** *For all $m \in \mathbb{N}$, there exists a diagram of the unknot with $n$ crossings such that any sequence of Reidemeister moves from that diagram to the trivial unknot diagram that passes through a diagram with at least $n + m$ crossings.*
**Advisor:** Dr. Rathbun
**Area(s):** Topology

## Contribute A Story About the Section!

During 2025, the MAA SoCal-Nev Section is celebrating its 100 year anniversary! We are asking long-time members of the Section to submit fond memories of section events and meetings. Follow the QR code submit your story. We intend to post some of these stories on the MAA SoCal-Nevada Website for others to read.