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

Program and Abstracts

Pitzer College October 5, 2024

Acknowledgements

The Southern California-Nevada Section of the MAA welcomes participants to our 2024 Fall Meeting at Pitzer College. We are excited that you have joined us!

We would like to thank our invited speakers and our contributed paper session presenters for their participation in the meeting.

Our student volunteers pay a vital role in putting on the meeting. Many thanks to our volunteers from Pitzer College for this meeting.

Finally, the Section thanks Pitzer College, and especially Dr. Bahar Acu and Sr. Administrative Coordinator for Academic Affairs Carlos Alvarez, for their hospitality in hosting the meeting. We would like to especially thank our program committee who handled the arrangements for the meeting program.

Section Officers, 2024-2025

MAA Representative: Edray Goins
Section Chair: Kim Ayers
Section Vice-Chair: Konrad Aguilar
Past Section Chair: Shanna Dobson
Program Chair: Bahar Acu
Vice Program Chair: on leave
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Meetings Co-Coordinators: Konrad Aguilar and Karrolyne Fogel
Newsletter Editor: position open
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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 January) 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 (Shanna Dobson).

Schedule

All events take place in Benson Auditorium, with the exception of the Contributed Paper Sessions. The rooms for the Contributed Paper Sessions are listed with the individual session schedules on page 3-5 of this program.

9:00-9:05	Welcome Remarks
	Shanna Dobson, CSU Los Angeles, Past Section Chair, and
	David Bachman, Pitzer College Mathematics Department
9:05-10:05	Invited Address
	Christina Edholm, Scripps College
	Utilizing Mathematical Modeling and Computation to Gain Insight into Epidemics
10:05-10:35	Section Business Meeting
10:35-10:45	Break
10:45-12:30	Faculty and Student Contributed Paper Session
	Organized by **Bahar Acu**, Pitzer College
12:30-1:45	Lunch
1:45-2:45	Invited Address
	Naneh Apkarian, Arizona State University
	Updating the Research on the Uptake of Research-Based Instructional Practices Post-COVID
2:45-2:50	Conference Photo
2:50-3:00	Break
3:00-4:00	Invited Address
	Anastasia Chavez, St. Mary's College of California
	Matroids, Positroids, and Beyond!
4:00-4:15	Closing Remarks by Past Section Chair **Shanna Dobson**, CSU Los Angeles,

Contributed Paper Sessions

There are five concurrent sessions in rooms Fletcher 104, Fletcher 106, Fletcher 110, Fletcher 112, and Benson Auditorium (Main Room). Abstracts are listed at the end of the program.

10:45-12:30	**Contributed Paper Session** Keywords–Functional Analysis, Number Theory, Fractal Dynamics Fletcher 104 Moderator: Dr. Jane Panangaden
10:45-11:00	Jane Panangaden, Pitzer College *Exploring real quadratic fields with quantum statistical mechanics*
11:05-11:20	Mark Wang, Pitzer College *Extensions of the j-function to the real boundary of the upper half plane*
11:25-11:40	Shanna Dobson, UC Riverside *Condensed Enhancement of Fractal Cohomology*
11:45-12:00	Jaden Segovia, CSU Fullerton *A Natural Characterization of Uniform Continuity*
12:05-12:20	—

10:45-12:30	**Contributed Paper Session** Keywords–Analysis Fletcher 106 Moderator: Dr. Konrad Aguilar
10:45-11:00	John Rock, Cal Poly Pomona *Arbitrarily close in topology and analysis*
11:05-11:20	Tai Fowler, Jade Jiao, and Levko Stepchuk, Pomona College *Quantum metrics on vector-valued functions on intervals*
11:25-11:40	Karina Behera and Katrine von Bornemann Hjelmborg, Pomona College and University of Southern Denmark *A family of orthonormal bases on the quantized interval*
11:45-12:00	Alexandro Luna, UC Irvine *On the spectrum of Sturmian Hamiltonians of bounded type in a small coupling regime*
12:05-12:20	—

10:45-12:30	**Contributed Paper Session** Keywords–Number Theory, Combinatorics, Theoretical Computer Science Fletcher 110 Moderator: Dr. Shriya Nagpal
10:45-11:00	Adrian Zhang, Sage Hill School *Partial Fraction Decompositions on Euclidean Domains*
11:05-11:20	Peter Kagey, Cal Poly Pomona *On Ron Graham's Sequence and a Longstanding Conjecture*
11:25-11:40	John Villalpando, California Lutheran University *Updates on Icaps of $C_n \times C_m$ for $n = 3$ and $n = 5$*
11:45-12:00	Ian Farish and Erik Imathiu-Jones, California State Polytechnic University, Pomona and California Institute of Technology *Numerical Semigroups and Pflueger's Conjecture: A Look At Properties Of Algebraic Curves Through Number Theory*
12:05-12:20	Mithra Karamchedu, Harvey Mudd College *Phase Transitions in Biased Random k-SAT*

10:45-12:30	**Contributed Paper Session** Keywords–Topology, Spherical Geometry, Geometric Group Theory, Algebraic Geometry Fletcher 112 Moderator: Dr. David Bachman
10:45-11:00	Ari Benveniste, Jorge Yahel Montes Guzman, Pomona College and California State Polytechnic University, Pomona *Counting Zariski dense representations of hyperbolic 3-manifold groups*
11:05-11:20	Marshall Whittlesey, CSU San Marcos *A quaternion proof of a theorem in spherical geometry*
11:25-11:40	Marwan Bit, Jenna Luo, Harvey Mudd College *The Toric Compactification of $P_{d,n}$ and P-Nestohedra*
11:45-12:00	Arta Modarres Kamaly, Troy High School/Fullerton College *The 4-dimensional Smooth Poincaré Conjecture*
12:05-12:20	Yang Zhang, Justin Son, Claremont McKenna College *Exceptional Collections for Toric Fano Fourfolds*

10:45-12:30	**Contributed Paper Session** Keywords–Mathematics Education, Graph Theory, Algebra Benson Auditorium (Main Room) Moderator: Dr. Amelia Stone-Johnstone
10:45-11:00	Aaron Christopherson, Pomona College *Properties of Algebraically Defined Edge-Colored Graphs*
11:05-11:20	Ruilin Zhu, Troy High School *Investigating Equations with the Theory of Inequalities*
11:25-11:40	Brianna Huynh and Luc Frost-Neto, Cal Poly Pomona *From Challenges to Triumphs: Students' Journeys in Mathematics*
11:45-12:00	Brian P Katz (BK), CSU Long Beach *Groups en Action*
12:05-12:20	—

Invited Addresses

Invited Address: ***"Updating the Research on the Uptake of Research-Based Instructional Practices Post-COVID"***
Naneh Apkarian, Arizona State University

This seminar will include a discussion of prior work on the uptake of research-based instructional practices (RBIS) in introductory undergraduate chemistry, mathematics, and physics courses as well as a discussion of upcoming research. A prior NSF-funded project mapped the instructional landscape and factors influencing instructors' pedagogical choices, but that data was collected in 2019. Although COVID-19 has not left, postsecondary institutions are no longer operating under the public health emergency policies they implemented in 2020. However, little is known about the longer-term impacts of emergency remote teaching on instructional practice or the uptake of RBIS. Dr. Estrella Johnson and Dr. Naneh Apkarian have recently been awarded NSF funding to investigate this question, re-running the 2019 survey to gather information on how the landscape has changed, and amending the survey to explore how instructors' pandemic experiences influenced that change (if at all). We will present conjectures, proposed methods of testing those conjectures, and engage in a discussion with attendees about additional conjectures or considerations to improve this research study.

Invited Address: ***"Matroids, Positroids, and Beyond!"***
Anastasia Chavez, St. Mary's College of California

Matroids are a fundamental combinatorial object with connections to many areas of mathematics: algebraic geometry, cluster algebra, coding theory, polytopes, physics ... just to name a few. Introduced in the 1930's, Whitney defined matroids with the desire to abstract linear and graphical dependence. In fact, every graph is associated with a matroid (called graphical) and from every vector configuration arises a representable matroid (over some field F). It has been shown that most matroids are neither graphical or representable, making these two matroid properties rare and highly desired.

A particularly well-behaved family of representable matroids, called positroids, was introduced by Postnikov and shown to have deep connections to the totally nonnegative Grassmannian and particle physics. Moreover, he described several combinatorial objects in bijection with positroids that compactly encodes matroidal data and have been shown to characterize many matroidal properties. With just a few definitions and examples revealing their connections to a variety of fields, you too can begin searching for the matroids living among us.

Invited Address: ***"Utilizing Mathematical Modeling and Computation to Gain Insight into Epidemics"***
Christina Edholm, Scripps College

Studying epidemics with mathematics gives insight to various questions such as vaccination analysis with COVID-19 and behavioral considerations for Ebola. We will discuss the use of mathematical models to capture different dynamics during an epidemiological outbreak and the associated questions these models address. Further, we will explore the computational tools used to analyze the models such as incorporating data through parameter estimation, management from control theory, and sensitivity analysis.

Invited Address Biographies

Naneh Apkarian, Arizona State University

Dr. Naneh Apkarian is an Assistant Professor of Mathematics Education in the School of Mathematical and Statistical Sciences at Arizona State University. She is originally from Southern California, where she attended Pomona College (BA Mathematics), UC San Diego (MA Mathematics), and the joint doctorate program of UC San Diego and San Diego State University (PhD, Mathematics and Science Education). Pursuing an interest in departmental change as a strategy for transforming undergraduate mathematics education, she was for two years a postdoctoral researcher at Western Michigan University's Center for Research on Instructional Change in Postsecondary Education. Her research continues to span many facets of STEM education, including the knowledge, beliefs, practices, and experiences of students and instructors, departmental climate and culture, and how interactions within and across levels drive culture - all in the service of developing inclusive excellence in undergraduate STEM education. Outside of academia, Dr. Apkarian continues to play competitive water polo as a vehicle for stress relief and to travel the US and the world.

Anastasia Chavez, St. Mary's College of California

Anastasia Chavez is an Assistant Professor of Mathematics at Saint Mary's College of California. Born and raised in California, she transferred from the Santa Rosa Junior College and earned a bachelors in applied mathematics and masters in mathematics from San Francisco State University. After earning her Ph.D. in enumerative and algebraic combinatorics with an emphasis in matroid theory from the University of California, Berkeley, Anastasia was a Huneke Fellow at the Mathematical Sciences Research Institute and Presidents' Postdoctoral Fellow, NSF Mathematical Sciences Research Postdoctoral Fellow, and Krener Assistant professor at the University of California, Davis. As a math educator and researcher, Anastasia aims to nurture the math ability that exists in every person. In and out of the classroom, she hopes to inspire the confidence to be curious, explore the unknown, and search for solutions that lead to even more meaningful questions. When Anastasia puts the math books down, you'll most likely find her hiking, camping, and exploring nature with her partner, two kids, and two rambuncious pups.

Christina Edholm, Scripps College

Christina Edholm is an applied mathematician who focuses on mathematical biological questions and analysis. Dr. Edholm earned her B.A. in Mathematics from Willamette University in Salem Oregon, and M.S. and Ph.D in Mathematics from the University of Nebraska-Lincoln. The two main areas of her research are invasive species control and epidemiological modeling. The models are formulated using difference equations, ordinary differential equations, continuous time Markov chains, or stochastic differential equations to characterize interactions between populations. Dr. Edholm uses a variety of different mathematical and computational tools to perform analysis on the models. In most problems she strives to understand the dynamics and gain insight to manage the populations. Dr. Edholm's teaching is influenced by her research. She works to incorporate applications into her courses and discuss connections to current research problems.

Contributed Paper Session Abstracts

Abstracts are listed by session

Fletcher 104
(Functional Analysis, Number Theory, Fractal Dynamics)

10:45-11:00 in Fletcher 104
Presenter(s): Jane Panangaden, Pitzer College
Other Author(s): Matilde Marcolli (Caltech)
Title: *Exploring real quadratic fields with quantum statistical mechanics*
Abstract: Describing the field extensions of number fields is an important problem in number theory. This has been done explicitly only in two cases: for the rationals and for the imaginary quadratic extensions. In the latter case, the geometric theory of elliptic curves, their moduli space, and complex multiplication is used. Manin's program of real multiplication aims to extend this geometric picture to a setting that can be used to study the real quadratic field extensions by replacing elliptic curves with non-commutative two-tori and replacing the moduli space with a non-commutative geometric object. Meanwhile, there has been a body of work started by Bost and Connes in the '90s and later extended by others in which quantum statistical mechanical systems are constructed using C^*-algebras, which have interesting connections to the properties of number fields. In this work we combined Manin's real multiplication program with the Bost-Connes strategy to construct a quantum system whose thermal properties, such as the partition function and ground states, are related to the real quadratic fields.

11:05-11:20 in Fletcher 104
Presenter(s): Mark Wang, Pitzer College
Other Author(s): Research Advisor: Dr. Michel Lapidus (UCR)
Title: *Extensions of the j-function to the real boundary of the upper half plane*
Abstract: A large area of interest within number theory is extending the j-function onto the real boundary of the upper half-plane to investigate the class field theory of real quadratic field extensions. Kaneko provided a method for extending the j-function, however it is limited to real quadratic irrationalities [Kaneko, 2009]. In joint work-in-progress with Jane Panangaden, we investigate two ways of extending the j-function to the whole real boundary and compare them numerically to Kaneko's method. In our approach, instead of integrating over geodesics connecting conjugate roots, we integrate over a sequence of geodesics determined by the continued fraction expansion. In the hyperbolic plane, their arc lengths are infinite, requiring regularization of the integrals. Bruinier, Funke, and Imamoglu introduce a method of regularizing these divergent integrals using the cycle integrals of modular functions [Bruinier, Funke, Imamoglu, 2011]. Anderson instead modifies the j-function by removing the part that would cause it to diverge [Anderson, 2014]. Using these different approaches, we compute proposed extensions of the j-function numerically and compare them to Kaneko's numerics for consistency and effectiveness.

11:25-11:40 in Fletcher 104
Presenter(s): Shanna Dobson, UC Riverside
Other Author(s): Research Advisor: Adam Glesser
Title: *Condensed Enhancement of Fractal Cohomology*
Abstract: In this talk, we present our current work on extending fractal cohomology, in the sense of Lapidus and David, to the condensed formalism of Scholze and Clausen. We will first review the prefractal approximation of the Weierstrass Curve and key elements of the condensed formalism. We conclude with an overview of our extended construction.

11:45-12:00 in Fletcher 104
Presenter(s): Jaden Segovia, CSU Fullerton
Title: *A Natural Characterization of Uniform Continuity*
Abstract: We introduce a novel characterization of uniform continuity of a real-valued function. The characterization relies on the domain of the function having an internal, nested cover by spaces which satisfy the conclusion of the classical Heine–Cantor theorem. To investigate such covers, we generalize the Heine–Cantor theorem over $\mathbb{R}$. We conclude with describing exactly when this characterization of uniform continuity can be applied.

Fletcher 106 (Analysis)

10:45-11:00 in Fletcher 106
Presenter(s): John Rock, Cal Poly Pomona
Title: *Arbitrarily close in topology and analysis*
Abstract: A point is arbitrarily close to a set if every neighborhood of the point contains an element of the set. This formal definition for an informal but ubiquitous phrase in analysis and topology provides a kernel for many concepts. In particular, the transition to the formal definition for the convergence of a sequence is made as follows: A point is the limit of a sequence if every neighborhood contains a tail defined by a threshold. The talk focuses on connections between this formal notion for arbitrarily close and its negation (away from) to classic concepts of Euclidean spaces such as convergence, closure, boundary, interior, exterior, accumulation points, and convergence, highlighted by the following fundamental result: In Euclidean spaces, a point is arbitrarily close to a set if and only if the point is the limit of a sequence in the set. Time permitting, a quick round of JEOPARDY! will be featured at the end of the talk.

11:05-11:20 in Fletcher 106
Presenter(s): Tai Fowler, Jade Jiao, and Levko Stepchuk, Pomona College
Other Author(s): Filiana Kostpoulou (Pomona College); Research Advisor: Konrad Aguilar
Title: *Quantum metrics on vector-valued functions on intervals*
Abstract: Quantum metric spaces, which are induced by certain seminorms called L-seminorms, were developed by M. A. Rieffel to address some structures from the particle physics literature. However, this quantum metric theory can be applied in many different contexts to discover new

structures there that aren't necessarily related to the physics picture. For instance, we developed and examined seminorms to measure the behavior of real-valued and vector-valued functions on intervals that have emerged thanks to recent developments in quantum metric theory and found constants allowing us to draw comparisons between two metrics. These seminorms are built using quantities such as the Lipschitz constant and standard deviation.

11:25-11:40 in Fletcher 106
Presenter(s): Karina Behera and Katrine von Bornemann Hjelmborg, Pomona College and University of Southern Denmark
Title: *A family of orthonormal bases on the quantized interval*
Abstract: Recent developments in quantum metric theory have brought attention to certain projections on the space of complex-valued functions on the quantized interval, $C(\overline{\mathbb{N}})$. However, to generalize these results, we need to better understand these projections. Now, these projections are orthogonal projections and thus can be described by orthonormal bases. Thus, in this project, we have found natural orthonormal bases for this space using a standard basis on a certain subalgebra of $C(\overline{\mathbb{N}})$. (This is joint work with Konrad Aguilar.)

11:45-12:00 in Fletcher 106
Presenter(s): Alexandro Luna, UC Irvine
Other Author(s): Research Advisor: Anton Gorodetski
Title: *On the spectrum of Sturmian Hamiltonians of bounded type in a small coupling regime*
Abstract: We prove that the Hausdorff dimension of the spectrum of a discrete Schrödinger operator with Sturmian potential of bounded type tends to one as coupling tends to zero.

Fletcher 110 (Number Theory, Combinatorics, Theoretical Computer Science)

10:45-11:00 in Fletcher 110
Presenter(s): Adrian Zhang, Sage Hill School
Other Author(s): Research Advisor: Dr. Taiji Chen
Title: *Partial Fraction Decompositions on Euclidean Domains*
Abstract: We formally define partial fraction decompositions of a number across the integer and Gaussian integer domains. Ideas from the method of finding partial fraction decompositions over a polynomial fraction can be combined with number theory concepts of parity and combinatorics to define the existence of decompositions of an integer. We can also count the number of decompositions for each fraction. These results can be translated to the Gaussian integer field by using the complex plane to find the existence of partial fraction decompositions as well. A similar idea can be generalized in any other integer domains.

11:05-11:20 in Fletcher 110
Presenter(s): Peter Kagey, Cal Poly Pomona
Title: *On Ron Graham's Sequence and a Longstanding Conjecture*
Abstract: Ron Graham's Sequence is a suprising bijection between the non-negative integers and the non-negative non-prime numbers, which is related to sequences of numbers whose product is square. This function first appeared as a question from Ron Graham in the June 1986 Problems section of *Mathematics Magazine* and appeared later in 2013 as Problem A2 on the Putnam Exam. We discuss a history of this problem, a computationally efficient method for computing the terms, some generalizations, and the resolution of a 20 year-old conjecture.

11:25-11:40 in Fletcher 110
Presenter(s): John Villalpando, California Lutheran University
Other Author(s): Karrolyne Fogel and Chris Brown, California Lutheran University
Title: *Updates on Icaps of $C_n \times C_m$ for $n = 3$ and $n = 5$*
Abstract: An L(2,1)-labeling of a graph is a labeling of the vertices using non-negative integers such that adjacent vertices differ in label by at least two while distance two vertices differ in label by at least one. An L(2, 1)-labeling of a graph is reducible if reducing the label on some vertex results in an L(2,1)-labeling. If no such vertex label exists, then the labeling in irreducible. The invariant Icap of a graph is the least number of labels required to create an irreducible L(2,1)-labeling on the graph. We determine Icap of the Cartesian product or two cycles, $C_n \times C_m$ for $n = 3$ and $n = 5$.

11:45-12:00 in Fletcher 110
Presenter(s): Ian Farish and Erik Imathiu-Jones, California State Polytechnic University, Pomona and California Institute of Technology
Other Author(s): Research advisor: Dr. Nathan Kaplan, University of California, Irvine
Title: *Numerical Semigroups and Pflueger's Conjecture: A Look At Properties Of Algebraic Curves Through Number Theory*
Abstract: Numerical semigroups are subsets of the natural numbers that are closed under addition and have a finite complement. The size of this complement is known as the genus of the semigroup. These structures arise in algebraic geometry through the study of Weierstrass semigroups associated with points on algebraic curves. Each numerical semigroup is generated by a finite set of natural numbers, where every element of the semigroup can be expressed as a linear combination of the generators with non-negative integer coefficients. Nathan Pflueger introduced the concept of effective weight as a numerical invariant that measures the complexity of a semigroup by counting pairs of generators and gaps, where gaps are the elements not included in the semigroup. Pflueger conjectured that, for any numerical semigroup of genus g, the effective weight is bounded above by $\left\lfloor \frac{(g+1)^2}{8} \right\rfloor$. We present our progress toward a proof of Pflueger's conjecture. We organize numerical semigroups by associating an integer called the depth, which reflects the structure of their gaps, and have proven the conjecture for semigroups of depth 2.

12:05-12:20 in Fletcher 110
Presenter(s): Mithra Karamchedu, Harvey Mudd College
Other Author(s): Research advisor: Cristopher Moore, Santa Fe Institute, and Gülce Kardeş, University of Colorado, Boulder and Santa Fe Institute
Title: *Phase Transitions in Biased Random k-SAT*
Abstract: In computational complexity theory, the Boolean satisfiability problem (SAT) is often regarded as the canonical "hard" problem of the field. In understanding the SAT problem, the field has tended to emphasize its worst-case complexity; when we instead explore *randomized* SAT instances, the problem exhibits striking *phase transitions*—moments where the problem's complexity abruptly changes from "easy" to "hard" with respect to some parameter. Several researchers have explored the satisfiability phase transition (from satisfiable to unsatisfiable) of k-SAT, where the SAT instances have been sampled uniformly from all possible k-CNF formulas. Here, we explore *biased* random k-SAT, a model of random k-SAT with an additional parameter p characterizing the likelihood that a given literal is positive or negative. To analyze the satisfiability phase transition in this model, we apply tools from the field of randomized algorithms that allow us to make conclusions about the likelihood that a SAT instance is satisfiable (the first- and second-moment methods and weighted assignments). We hope this research will allow us to explore how the phase transitions in one NP-complete problem correlate with those in others.

Fletcher 112 (Topology, Spherical Geometry, Geometric Group Theory, Algebraic Geometry)

10:45-11:00 in Fletcher 112
Presenter(s): Ari Benveniste, Jorge Yahel Montes Guzman, Pomona College and California State Polytechnic University, Pomona
Other Author(s): Additional authors: June Lee, Adam Wesley, and Diana Yang; Research advisors: Tamunonye Cheetham-West, Franco Vargas Pallete, and Andrew Yarmola
Title: *Counting Zariski dense representations of hyperbolic 3-manifold groups*
Abstract: We study hyperbolic Dehn fillings of the figure 8 knot to find examples for which the discrete faithful representation is the only infinite, irreducible representation up to conjugation in $\mathrm{PSL}(2,\mathbb{C})$ and up to Galois conjugation of the trace field $k_{\rho_i}/\mathbb{Q}$. This property of Galois rigidity was used by Bridson, McReynolds, Reid, and Spitler to give examples of full-sized arithmetic lattices in $\mathrm{PSL}(2,\mathbb{C})$, arising from hyperbolic geometry, that are *profinitely rigid in the absolute sense*, i.e. distinguished by their set of finite quotients from all other finitely generated, residually finite groups. We prove that for a hyperbolic p/q Dehn filling of the figure-8 knot $\Gamma_{p/q}$, if p and q are coprime with $4 \mid p$, then $\Gamma_{p/q}$ is not Galois rigid.

11:05-11:20 in Fletcher 112
Presenter(s): Marshall Whittlesey, CSU San Marcos
Title: *A quaternion proof of a theorem in spherical geometry*
Abstract: Quaternions can be used to prove theorems in spherical geometry. Here we use quaternions to provide an interesting new proof of a theorem from the 'Sphaerica' of Menelaus about midlines in spherical triangles. (A midline is an arc connecting the midpoint of two sides of a triangle.) The technique of proof is featured in the speaker's book "Spherical Geometry and its Applications," with CRC Press. The speaker teaches a class in spherical geometry to mathematics majors at Cal State San Marcos. This an example of possible topics that might be covered in such a class.

11:25-11:40 in Fletcher 112
Presenter(s): Marwan Bit, Jenna Luo, Harvey Mudd College
Other Author(s): Research Advisor: Javier Gonzalez Anaya and Dagan Karp
Title: *The Toric Compactification of $P_{d,n}$ and P-Nestohedra*
Abstract: A moduli space is a parameter space where each point corresponds to some geometric object up to equivalence. Ferreira da Rosa, et al. (2015) **[3]** characterize which weighted compactifications of the space $M_{0,n}$, ($M^A_{0,n}$) can be constructed from polytopes called graph associahedra. In our work, we generalize this classification result, finding the generalization of graph associahedra for weighted compactifications of the moduli space $P_{d,n}$.

11:45-12:00 in Fletcher 112
Presenter(s): Arta Modarres Kamaly, Troy High School/Fullerton College
Other Author(s): Research Advisor: Dana Clahane
Title: *The 4-dimensional Smooth Poincaré Conjecture*
Abstract: In 2003, Grigori Perelman proved the Poincaré Conjecture, one of the 7 Millennium prize problems, making a significant breakthrough in the field of geometric topology. But his proof was for only one instance of the more generalized problem which states that an n-manifold with the homotopy type of S^n is diffeomorphic or homeomorphic to S^n. Now, more than a century after this problem was stated by Poincaré, only one version of it remains unsolved, the 4-dimensional smooth Poincaré Conjecture. In this talk, we will explore the smooth case of the problem, and how the existence of **exotic smooth structures** in four dimensions, which do not appear in lower dimensions, make this problem more complicated to solve in the fourth dimension. Additionally, the differences between **homeomorphism** (topological equivalence) and **diffeomorphism** (smooth equivalence) play a key role in understanding the conjecture. The uniqueness of dimension four and its exotic structure continue to puzzle mathematicians.

12:05-12:20 in Fletcher 112
Presenter(s): Yang Zhang, Justin Son, Claremont McKenna College
Other Author(s): Jumari Querimit Ramirez, Claremont McKenna College; Research Advisor: Reginald Anderson
Title: *Exceptional Collections for Toric Fano Fourfolds*
Abstract: In 1978, Beilinson resolved the diagonal for $\mathbb{P}^n$. By 2000, Bayer-Popescu-Sturmfels generalized Beilinson's resolution to unimodular toric varieties, a more restrictive class than smooth varieties. This also extends to a virtual, generally non-minimal, resolution of the diagonal for smooth projective toric varieties. In recent developments, Hanlon-Hicks-Lazarev (H-H-L) provided a minimal resolution of any toric subvariety of any smooth projective toric variety. We investigate implications of the H-H-L resolution of the diagonal for smooth projective toric Fano varieties in dimension 4. Our analysis reveals that for 73 out of 124 such varieties, the H-H-L resolution yields a full strong exceptional collection of line bundles.

Benson Auditorium (Main Room)
(Mathematics Education, Graph Theory, Algebra)

10:45-11:00 in Benson Auditorium (Main Room)
Presenter(s): Aaron Christopherson, Pomona College
Other Author(s): Research advisors: Dr. Brian Kronenthal, Kutztown University of Pennsylvania; Dr. Karen McCready, King's College
Title: *Properties of Algebraically Defined Edge-Colored Graphs*
Abstract: An algebraically defined edge-colored graph $(K, \Gamma^c_{\mathbb{F}}(f(X,Y)))$ is constructed using a field $\mathbb{F}$, a complete bipartite graph K where each partite set is a copy of $\mathbb{F}^2$, and a function $f(X,Y)$. We denote the vertices of the first partite set by (a_1, a_2) and of the second by $[x_1, x_2]$. We color the edge (a_1, a_2) $[x_1, x_2]$ blue if their coordinates satisfy the equation $a_2 + x_2 = f(a_1, x_1)$, otherwise we color the edge red. These graphs are properly connected, meaning that there exists a path with alternating edge colors between any two vertices. We will discuss properties of algebraically defined edge-colored graphs including: proper diameter, the length of the longest minimal proper path length between any pair of vertices; proper girth, the length of the shortest properly colored cycle; and proper vertex cuts, the minimum number of vertices that can be cut to make the graph not properly connected. We motivate our work by a link to incidence geometry.

11:05-11:20 in Benson Auditorium (Main Room)
Presenter(s): Ruilin Zhu, Troy High School
Other Author(s): Research Advisor: Dr. Bogdan Suceavă
Title: *Investigating Equations with the Theory of Inequalities*
Abstract: Some equations are difficult to solve even using calculus. Yet they can be approached by investigating the equality case in some inequalities. In the present work, I will present my solutions to three problems from the Gazeta Matematică. The solutions involve converting equations to inequality problems and investigate when the equality case holds.

11:25-11:40 in Benson Auditorium (Main Room)
Presenter(s): Brianna Huynh and Luc Frost-Neto, Cal Poly Pomona
Other Author(s): Anne Cawley, Cal Poly Pomona and Sara Elakesh, Michigan State University
Title: *From Challenges to Triumphs: Students' Journeys in Mathematics*
Abstract: This mixed-methods study examines students' mathematical autobiographies (MAB) to evaluate their relationship with mathematics and influential actors in their math life stories. One hundred thirty-five MABs were collected from students enrolled in Calculus 1, Abstract Algebra, or Topology, all taught by the same instructor. Analysis revealed that most students reported consistently positive experiences with mathematics. Hypothesis testing indicated that students enrolled in upper-division courses, Latine students, White students, and math majors had a higher likelihood of having a positive math experience. Instructors were the most frequently named influential actors, with K-12 instructors appearing more often than college instructors. Additionally, family members were almost exclusively mentioned by students with positive math experiences. These findings suggest that MABs can be a way for students to process their math stories, reflecting on their positive or negative experiences.

11:45-12:00 in Benson Auditorium (Main Room)
Presenter(s): Brian P Katz (BK), CSU Long Beach
Title: *Groups en Action*
Abstract: Inspired by prior research of Jessi Lajos and team, I wanted to incorporate some embodied cognition in my abstract algebra course to help my students make meaning of the most challenging ideas (and to have some fun). In this session, we will discuss an activity that spanned three class days in which my students acted out algebraic structures, including the properties of groups, generation, cosets, homomorphisms, and quotients. I hope to share the tasks, some student thinking, and my experience ramping up an embodied task in my classroom.