

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

Poster Session Abstracts



CSU Fullerton
October 18, 2025

Contributed Paper 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 α -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 α -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 parks in it, otherwise, it keeps driving down the street and finds the next available spot to park. We say a sequence $(a_1, a_2, \dots, a_n)$ 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 weakly 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 ϕ -Pebbling Number of Graphs*

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 ϕ -pebbling in which each pebble may move once without another being removed. We compute the ϕ -pebbling number of trees, cycles, and thorn graphs and establish bounds on the ϕ -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 ϕ -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), Narayanan 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, Giovanni 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 $S = X_1 + X_2 + \cdots + X_N$, where each X_i 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