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

Program and Abstracts

April 29th, 2023

Acknowledgements

The Southern California-Nevada Section of the MAA welcomes participants to our 2023 Spring Meeting.

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

Finally, the Section thanks the Mathematics Department at the University of La Verne for their hospitality in hosting the meeting. We would like to especially thank Gail Tang, who handled the local arrangements for the meeting.

To help reduce the costs of future MAA Meetings, please recycle your name tags at the end of the conference using the boxes provided.

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Schedule

La Fetra Lecture Hall and Foyer are located in Mainiero Hall

8:30-12:30pm	Registration	La Fetra Foyer
8:30-10:30	Poster Presentation Check-In	La Fetra Foyer
9:00-9:15	Welcome Remarks	La Fetra Lecture Hall
9:15-10:15	Invited Address **Gail Tang**, University of La Verne *Inside Out and Outside In: The Cycle of Theory and Thought to Implementation and Evaluation*	La Fetra Lecture Hall
10:15-10:45	Section Business Meeting	La Fetra Lecture Hall
11:00-12:00	Student Poster Session	Fasnacht Court behind Mainiero Hall
12:00-2:00	Lunch Break	
2:00-3:00	Invited Address **Felice Manganiello**, Clemson University *Code-based Cryptography: The Future of Security Against Quantum Threats*	La Fetra Lecture Hall
3:00-3:30	Break	
3:30-4:30	Invited Address **Amanda Ruiz**, University of San Diego *Teaching Mathematics About, With, and For Social Justice*	La Fetra Lecture Hall
4:30-4:45	Closing Remarks	La Fetra Lecture Hall

Invited Addresses

Felice Manganiello Clemson University
"Code-based Cryptography: The Future of Security Against Quantum Threats"

In today's digital age, where our personal data and information are predominantly stored online, security has become a crucial concern. The cryptographic standards currently in use are vulnerable to attacks from quantum computers, which may pose a significant threat in the coming years. Post-quantum cryptography is an area of research focusing on developing cryptosystems that can withstand quantum attacks while working on classical computers. Code-based cryptosystems have proven to be the most resilient over time among the various post-quantum cryptosystems. In this seminar, as a coding theorist, I will present the fundamentals of code-based cryptography, discuss how to build secure mechanisms like authenticated key exchanges, and provide guidelines to prevent weak instances that may create vulnerabilities. This presentation aims to enhance awareness of the importance of security and demonstrate the potential of code-based cryptography in safeguarding our online information against the quantum threat.

Amanda Ruiz, University of San Diego
"Teaching Mathematics About, With, and For Social Justice"

In this talk we will consider the foundations of teaching mathematics for social justice and the potential outcomes for students. We will explore what we mean by teaching mathematics about, with, and for social justice. We draw on the recently released book series Teaching Mathematics to Explore, Understand, and Respond to Social Injustice. We will share some content from the middle school book and talk about how to adapt the lesson to one's own context and empower students to use mathematics as a tool for creating change.

Gail Tang, University of La Verne
"Inside Out and Outside In: The Cycle of Theory and Thought to Implementation and Evaluation"

In this talk, I will share some of the theoretical underpinnings that guide my teaching practices. In particular, Laura Rendón's revised agreements from Sentipensante will be presented. Rendón's framework will be connected to empirical research on the affective outcomes from teaching actions aimed at fostering mathematical creativity. Finally, I will share some experiences and results from participating in the EQUIP project that have had lasting impacts on both my teaching philosophy and teaching strategies.

Speaker Biographies

Felice Manganiello, Clemson University

Felice Manganiello is an Associate Professor at Clemson University's School of Mathematical and Statistical Sciences (SMSS). He has a PhD in Mathematics from the University of Zurich and an MSc in Mathematics from the University of Pisa. His research centers on algebraic methods in communication, including coding theory, network coding, and cryptography. He has received recognition for his work, including an NSF RTG grant and a Swiss National Science Foundation Postdoctoral Fellowship spent at the University of Toronto. In 2019, he was awarded a Simons Visiting Professorship and spent the academic year 2019-20 as a visiting scholar at the Toronto Metropolitan University's Cybersecurity Research Lab.

Aside from his research, Manganiello is dedicated to promoting undergraduate student learning and research. He has been the director and a mentor for the Clemson REU program for several years. Also, he holds the administrative position of Associate Director for Mathematics and Statistics Education in the SMSS.

Amanda Ruiz, University of San Diego

Amanda Ruiz is an Associate Professor in the Department of Mathematics at the University of San Diego. Born in Long Beach and raised in Huntington Beach, CA, she left Southern California for the Bay Area to attend UC Berkeley, where she created her own major focused on Social Movements. After some experience working in secondary education, and a realization that mathematics is a social justice issue, Amanda went back to school to pursue a degree in mathematics. She received a Master's degree in Mathematics from San Francisco State University, her PhD in mathematics from Binghamton University in 2013. Eager to return to California, she accepted a teaching and research postdoctoral fellowship in the Mathematics Department at Harvey Mudd College.

Amanda Ruiz's Ph.D. thesis was on Realization Spaces of Phased Matroids. While her prior research is predominantly in combinatorics and matroid theory, her current interest returns to her social justice roots including working with a team of Mathematics Education experts to edit the recently released book "Middle School Mathematics Lessons to Explore, Understand and Respond to Social Injustice."

Gail Tang, University of La Verne

Gail Tang is Associate Professor and Chair of Mathematics at University of La Verne. While she is involved in several research projects, the foundation of the projects aim to provide more humanistic teaching and researching experiences for students, instructors, and scholars. Her primary research interests investigate how to support students' mathematical creativity development through faculty development. Mentorship is really important to Gail. As a Fulbright Scholar, Gail served as a mentor and professor at Mandalay University in 2019. In Summer 2023, she will be sailing with NOAA as a part of the Teacher at Sea Program. Gail will join the Hawaiian Islands Cetacean and Ecosystem Assessment Survey project to conduct oceanography sampling of whales, dolphins, seabirds in the Hawaiian archipelago. When not engaged in teaching, research, mentorship, or shared governance, Gail enjoys gardening, feeding her chickens, being surrounded by nature and animals, and learning about cultural connections through investigations into global food history.

Gail Tang is the recipient of the 2022 MAA Southern California-Nevada Section Award for Distinguished College or University Teaching of Mathematics.

Poster Session Abstracts

Title: *Analyzing the Relationship Between the Commuting Time and the Public Transportation Ridership*
Presenter(s): Qichuan Xia, Narrabundah College
Abstract: This paper has collected the data of commuting time by car and public transportation (PT) at 25 major US cities and 3 major Australian cities, hence investigated the connection between the percentage differences of commuting time and the percentage of population commuting by PT every day using the observed value of the product moment correlation coefficient. This returns the result of the moderate negative correlation between these two variables, followed by the conclusion that traveling time is an important factor that affects the choice of commuting mode – if taking PT to work could save time then people will be more willing to do it.
Advisor: Xiaoyan Liu
Poster Area(s): Applied Mathematics

Title: *Modified Jackknife Empirical Likelihood Test for Mean Residual Life Functions*
Presenter(s): Jordan Davis, California State University San Bernardino
Abstract: The Jackknife empirical likelihood (JEL) method helps address computational problems that arise when using empirical likelihood (EL) with non-linear statistics. How- ever, there are other weakness in EL that JEL does not address. These include problems with coverage error and computing numerical solutions to the empirical log-likelihood function. In this paper, we propose two modifications to JEL that allow it to address both of these problems, separately. After introducing these methods, we demonstrate their effectiveness with numerical simulations and application to real-world data.
Advisor: Dr. Suthakaran Ratnasingam
Poster Area(s): Probability/Statistics

Title: *Exploration Activity Prior to Precise Definitions*
Presenter(s): Maribel Aguilar, California State University Channel Islands
Abstract: Understanding the properties of exponents is challenging for many algebra students at the high school level. In this project we investigate the quantitative outcome in ninth-grade students' performance related to learning and working with positive integer exponents. We collected detailed scores of 53 students divided into two groups on paper-pencil pre and post tests and their answers to several qualitative questions relevant to the topic administered through the survey conducted outside of the classroom. The objective of the study was to use two different methods to teach three properties of exponents. Participants in our study group had an exploration opportunity prior to learning precise definitions and related formulas, while the control group was provided formal definitions at the beginning and proceeded to problem solving next. We analyzed data using statistical methods and our main result shows that students who did exploration first scored significantly higher than the traditional lecture structure.
Advisor: Ivona Grzegorczyk
Poster Area(s): Education/Pedagogy, Probability/Statistics

Title: *Individual vs Group Work in Mathematics*
Presenter(s): Miguel Solis, California State University Channel Islands
Abstract: My research project is to study two 6th grade mathematics classes taught using two different methods – one focused on small group work, the other on individual problem solving. Both sections are quizzed on mastery of the mathematical background knowledge appropriate for school curriculum. We collected data on learners' preferences, engagement and performances on tests and analyzed them statistically to assess each group and decide on correlations between student preferences for individual or group work and effectiveness of each methodology. Their performance on specific mathematical concepts is graded in the context of the methodology of teaching and learning they were exposed to. We try to identify various subgroups with different characteristics that benefit for each setting and compare them with test scores and preferences.
Advisor: Ivona Grzegorczyk
Poster Area(s): Education/Pedagogy

Title: *Logs Through Technology*
Presenter(s): Alex Guerrero, CSU Channel Islands
Abstract: Mathematics education researchers studied technology use in a vast majority of high school mathematics courses. One of the main questions considered is related to the integration of calculators for graphing functions: are graphic tools beneficial or not for understanding the underlying concepts? Generally, we expect that students would have positive attitudes towards graphs after visualizing them on calculators and then following with more conceptual algebraic or computational operations. In our study we consider the following research question in high school mathematics curriculum: Are there any benefits of learning logarithmic functions by first properly using graphing calculators as an initial tool introducing the concept as compare with traditional method that provides algebraic definitions and practice of arithmetic calculations for sketching the graphs? During this research project we worked with students in two Algebra 2 courses learning about graphs of logarithms using these two different approaches. Collected data was analyzed using statistical methods and we present our results.
Advisor: Ivona Grzegorczyk
Poster Area(s): Education/Pedagogy, Graph Theory/Combinatorics, Algebra

Title: *The Polya Method for Pre-Service Teachers*
Presenter(s): Derek Wahl, CSU Channel Islands
Abstract: As we are currently observing decline in mathematical skills among pre-college students, it is up to the next generation of mathematics and science teachers to bring a better scope of teaching methods to improve students' problem solving skills as well as their attitudes towards mathematics including its own applications of mathematics such as physics, computer science, mechatronics, engineering and more. We worked with pre-service elementary and secondary teachers on implementation of Polya's method of introducing systematic strategies in the context of problem solving. We discuss the results from the assessment of improvement of teachers' skills and their attitudes towards solving word problems in their future lessons to improve the math literacy in schools. Will the future of stem education bring the Polya method as a adequate concept of student learning? Will students be able to bring a better understanding of the mathematical concepts with this method, to improve their performance?
Advisor: Dr. Ivona Grzegorczyk
Poster Area(s): Education/Pedagogy

Title: *Antimagic forest labeling*
Presenter(s): Hanyin Liang, East Los Angeles College
Abstract: Let $G = (V, E)$ be a graph. Let $f : E \to \{1, 2, \ldots, |E|\}$ be a bijection. The sum of a vertex is given by $\sum_{e \in E(v)} f(e)$, where $E(v)$ is the set of all edges incident to the vertex. That is, the vertex-sum is found by adding all the edge labels of the edges incident to the vertex. We say f is an antimagic labeling of the graph G if for any two vertices $u \neq v$, $\sum_{e \in E(u)} f(e) \neq \sum_{e \in E(v)} f(e)$, meaning each vertex has a unique vertex-sum. A graph is antimagic if it has an antimagic labeling. It was conjectured that every connected graph except for K_2 (the graph with one edge and two vertices) is antimagic. It was shown trees with at most one degree-2 vertex are antimagic. This was proven by using the zero-sum partition. I will demonstrate how to use the zero-sum partition to label forests with at most one degree-2 vertex.
Poster Area(s): Graph Theory/Combinatorics

Title: *Improving the Logistic Growth Model*
Presenter(s): Timothy Harris, CSU Los Angeles
Abstract: The logistic growth model is one of the more widely used population models in ecology. The model is described by a first order ordinary differential equation with growth rate and carrying capacity as the two constant parameters and measures a population over time. Unlike the exponential growth model that allows boundless population growth, the carrying capacity parameter determines the limiting population size. Despite this improvement, the logistic model still has several limitations—it does not take into consideration dispersion of population and density, and consequently, crowding is not considered. We extend the logistic model into a second order partial differential equation model that overcomes these limitations, and hence making the model more realistic and applicable.
Advisor: Dr. Melisa Hendrata
Poster Area(s): Analysis, Applied Mathematics

Title: *Interactive Proof Assistant for Group Theory*
Presenter(s): Isaac Hershenson, Maxine Liu, Harvey Mudd
Abstract: Abstract Algebra students working on problem sets have little recourse when they are stuck than to email their professors to ask for hints. To provide another avenue of assistance, our team built an automated proof assistant that could help students when they are stuck on a proof. We implemented our system in Python using a global environment approach for Set Theory. Our system implements a simple to understand programming language and GUI for users to write proofs in. It will automatically catch proof logic errors and can also check the validity of a completed proof. In addition, our tool automatically converts proofs into an easy-to-read Latex or PDF format, which eliminates the requirement for students to type up their proofs by hand. Our tool provides the proof of concept for more in-depth automated proof assistants that could one day augment the learning process of students in proof based technical courses.
Advisor: Lucas Bang
Poster Area(s): Education/Pedagogy, Algebra

Title: *Impact of COVID-19 on Student Performance*
Presenter(s): Joseph Martin, Cal State University Channel Islands
Abstract: The last three years of university education were strongly affected by the pandemic and its consequences, including online courses, lack of adequate preparation of entering freshmen, and frequent absences due to the disease or related personal issues. This study investigates the impact of COVID-19 on student performance in a university logic class using one-way ANOVA and Tukey HSD post-hoc tests. Final course grades from five semesters between 2020 and 2022 were analyzed to assess differences in online and in-person instruction. We find that there was a significant difference between semesters overall as determined by one-way ANOVA. A Tukey post-hoc test revealed that final course grades were significantly lower after the transition to online instruction and did not significantly increase following the return to in-person instruction. There was no significant difference between each semester during online instruction. We present our results that demonstrate a lasting effect of COVID-19 on student performance.
Advisor: Dr. Ivona Grzegorczyk
Poster Area(s): Education/Pedagogy, Probability/Statistics

Title: *All Links Are Sublinks of Cuboctahedral Links*
Presenter(s): Luisa Boateng, California State University, Los Angeles
Abstract: In a paper by Mark D. Baker, he proves that all links are sublinks of arithmetic links, and uses an octahedral parent link, also proving that all links are sublinks of octahedral links. We now start with an arithmetic cuboctahedral nested link and find a similar method, using covering spaces and Dehn twists, to find any closed braid, thus proving that all links are sublinks of cuboctahedral links. We then study the cusps of the crossing circles used, and determine which of the resulting links will remain hyperbolic after Dehn fillings on a specific case of cusp shapes.
Advisor: Dr. Rolland Trapp
Poster Area(s): Topology, Knot Theory

Title: *Non-Parametric Confidence Intervals for Generalized Lorenz Curve using Modified Empirical Likelihood*
Presenter(s): Jade Romero, California State University, San Bernardino
Abstract: The Lorenz curve portrays the inequality of income distribution. In this article, we develop three modified empirical likelihood (EL) approaches including adjusted empirical likelihood, transformed empirical likelihood, and transformed adjusted empirical likelihood to construct confidence intervals for the generalized Lorenz ordinate. We have shown that the limiting distribution of the modified EL ratio statistics for the generalized Lorenz ordinate follows the scaled Chi-Squared distributions with one degree of freedom. The coverage probabilities and mean lengths of confidence intervals are compared of the proposed methods with the traditional EL method through simulations under various scenarios. Finally, the proposed methods are illustrated using a real data application to construct confidence intervals.
Advisor: Suthakaran Ratnasingam
Poster Area(s): Probability/Statistics

Title: *The p-adics, Continued Fractions, and Their Construction*
Presenter(s): Jacob Rosales, California Lutheran University
Abstract: This project investigates changes to division when counting by primes instead of base ten. With a prime base, we use a new measure of size (a valuation) to compare numbers. The p-adic valuation uses the power of the prime base that divides a number to determine its size. We use this p-adic valuation to compute division with a "small" remainder relative to the prime base. We adapt the Euclidean Algorithm to the p-adics, using the theory of Linear Diophantine equations to find pairs of solutions for the quotient and remainder. This division enables us to construct a type of nested fraction called a continued fraction. We explore conditions that allow the construction of continued fractions across a types of algebraic structures called Integral Domains. The p-adics meet these conditions. Continued fractions only occur when the Euclidean Algorithm can be applied. These types of Integral Domains are known as Euclidean Domains.
Advisor: Dr. Karrolyne Fogel
Poster Area(s): Number Theory, Algebra

Title: *Equivalence constants between deviations and maximum slope*
Presenter(s): Ari Benveniste, Louis Burns, Brianna Huynh, Pomona College
Abstract: Given a real-valued function, its (maximum or absolute) deviation and maximum slope both calculate how far the function is from not being constant. One can find many examples of functions for which the deviation and maximum slope disagree. However, if we consider a fixed finite subset of the reals and the family of real-valued functions on that set, its deviation and maximum slope must be equivalent as seminorms by finite-dimensionality. In this project, we found equivalence constants (with respect to both maximum and absolute deviation) for any fixed finite subset of the reals. Furthermore, we found various settings where we determined the best/sharpest equivalence constants with respect to maximum deviation. We also studied some functions on infinite sets and how their equivalence constants behaved when restricted to finite sets of growing size. Regarding absolute deviation, we have computational speculations for sharp equivalence constants that differ from the aforementioned ones.
Advisor: Konrad Aguilar
Poster Area(s): Analysis

Title: *Having Academic Friends Helps to Keep You at School*
Presenter(s): Alexandra dePillis-Lindheim, Emily Gottry, Azusa Pacific University
Abstract: High attrition among first and second-year undergraduates is an ongoing subject of concern and research in higher education institutions. Using seven years of student enrollment and class performance data from Azusa Pacific University, this research specifically examines the effect of academic communities and classmates on student retention, comparing it with other factors such as grades, performance in introductory courses, and student support in classes. Students who share more classes with the same classmates during the first two semesters are more likely to be retained. Additionally, participation in a living-learning community is a strong predictor of higher retention. The modeling and data dissemination methods used in this work could provide unique insight into how smaller colleges and universities could make data-driven choices to increase retention of students from all backgrounds.
Advisor: Kaitlyn Fitzgerald
Poster Area(s): Education/Pedagogy, Analysis

Title: *Students the Struggle with Math Quantifiers*
Presenter(s): Erik Bravo, CSU Channel Islands
Abstract: This research project studies student understanding of mathematical quantifiers. We began with a pilot study, analyzing answers involving quantifiers given to university sophomores in a logic course. Each question provided a statement with symbolic quantifiers, and the students were asked to rewrite it in English (or vice-versa). The analysis of data showed that their performance depended strongly on the number of quantifiers included in the statement and most students had problems with the proper order of two or more quantifiers. Next, we prepared an in-depth survey that was administered to 3-groups of students at different college levels. Each group was taught using different methods of introducing quantifiers. We analyzed collected data using statistics. Our results suggest ways to improve the methodology for teaching and the retention of this knowledge.
Advisor: Ivona Grzegorczyk
Poster Area(s): Education/Pedagogy

Title: *Explicit measurements in quantum metrics*
Presenter(s): fangqian zhang, Pomona College
Abstract: Quantum metrics on quantum states were developed by Marc Rieffel to measure distances between quantum spaces arising from the high-energy physics literature. However, it is usually the case that approximations between quantum states using a quantum metric are all that is used to produce these measurements between quantum spaces. But, as the theory develops further, it is important to see if we can actually make exact calculations in the quantum metrics. In this project, we looked at the quantum space of 2x2 complex-valued matrices equipped with a certain seminorm. For this space, we were able to find exact calculations in the quantum metric for various types of quantum states including ones induced by certain Hermitian matrices of trace 2.
Advisor: Konrad Aguilar
Poster Area(s): Analysis

Title: *Finite-Dimensional Approximations on a Discretized Interval*
Presenter(s): Evelyne Knight, Pomona College
Abstract: The discretization of an interval allows one to analyze continuous functions with more ease. In this project, we study real-valued continuous function on the discretized interval given by 0 and nonnegative integer powers of 1/2. On this discretized interval, we show that we can analyze any continuous function whose maximum slope is less than or equal to 1 with even more ease. We accomplish this by proving that any such continuous function can be uniformly approximated by a finite-dimensional approximation of dimension n for every natural number n. This approximation is given by "leveling-off" of the given continuous function at the nth power of 1/2 all the way to 0. We establish formally that these approximate the given continuous function by showing that these n-dimensional approximations converge uniformly to the continuous function.
Advisor: Konrad Aguilar
Poster Area(s): Analysis

Title: *Optimal Bubble Clusters in the Plane with Density*
Presenter(s): Marcus Collins, Harvard-Westlake School
Abstract: A circle is the least-perimeter way to enclose a given area in the plane. Similarly, familiar "bubble clusters" seek the least-perimeter way to enclose and separate several given areas. Especially since Perelman's proof of the Poincaré Conjecture, there has been much interest in such problems in the presence of a density such as r^2 that weights both perimeter and area. Using Brakke's Evolver, we numerically verify conjectured optimal planar double bubbles for density r^p and provide conjectures for triple and quadruple bubbles.
Advisor: Frank Morgan
Poster Area(s): Geometry

Title: *Frobenius-Rieffel norms and subspace distortion*
Presenter(s): Karina Behera, Pomona College
Abstract: Frobenius-Rieffel norms were developed by Marc Rieffel in 2014 and are built from a given norm and projections onto subspaces. If a vector lies in the subspace, then the Frobenius-Rieffel norm is the same as the given norm, but if the vector does not lie in the subspace, then the Frobenius-Rieffel norm and the given norm may disagree. Therefore, in some sense, the Frobenius-Rieffel norm might provide a way to detect a vector's relationship with the subspace that induced the Frobenius-Rieffel norm. In this project, we built a quantity, called the subspace distortion, to see how the Frobenius-Rieffel norm might detect this relationship. In particular, we studied the normed vector space of real-valued continuous functions on a discretized interval and subspaces of eventually constant functions and calculated the distortion of certain basis elements.
Advisor: Konrad Aguilar
Poster Area(s): Analysis

Title: *Trisection of Areas with Parallel Lines*
Presenter(s): Darren Okura, Fullerton Mathematical Circle and Los Alisos Intermediate School
Abstract: We investigate the conditions when two parallel lines trisect the area of a planar figure in the Euclidean plane.
Advisor: Bogdan Suceava and Shoo Seto
Poster Area(s): Geometry

Title: *Mathematical Modeling of COVID-19*
Presenter(s): Matthew Perez, Cal State LA
Abstract: Mathematical modeling is an important tool in epidemiology that enables us to project how infectious disease progresses, predict the likely outcome of the epidemic, and to better develop intervention strategies to mitigate disease spread. The SIR-model is a widely-used model in mathematical epidemiology that divides the population into three compartments—Susceptible, Infected and Recovered populations. As intervention strategies often focus on isolation of infected individuals, we study the extended SIR-type models involving more compartments to accommodate different states of infection and intervention strategies. By applying the least square technique to COVID-19 dataset, we estimated its transmission parameters, and by using the next generation matrix, we computed its basic reproduction number, a quantity that determines the growth rate of the infection. By solving the model numerically, we analyzed the effect of lockdown strategy that was implemented during the early pandemic and agreement with data was obtained with high level of accuracy.
Advisor: Dr. Melisa Hendrata
Poster Area(s): Applied Mathematics

Title: *CART: Decision Making*
Presenter(s): Douglas Escobar, Spencer Mack, California State University Channel Islands
Abstract: The objective of this poster is to explore Classification and Regression Tree models for making decisions, predictions, and classifications. The poster will also guide readers through the main components of CART and explore their many applications. We will also present the construction of a decision tree. This will include both the mathematics and coding required to make one. We will also define some key elements such as Gini impurity, information gain, root nodes, decision nodes, and leaf nodes. We will look at the advantages and limitations of decision trees and how they can be used to accurately predict both continuous and categorical variables. Additionally, this research project will provide an overview of the Classification and Regression Tree methodology, focusing on its core principles, algorithms, and application in various domains. Finally, we want to present the practical applications of CART and demonstrate its versatility and effectiveness in the workforce.
Advisor: Ivona Grzegorczyk
Poster Area(s): Probability/Statistics

Title: *Reverse Mathematics of Ramsey Theorem for Pairs*
Presenter(s): Nikolay Maslov, California State University - San Bernardino
Abstract: Reverse mathematics aim to determine which set theoretic axioms are necessary to prove the theorems outside of the set theory. Since the 1970's, there has been an interest in applying reverse mathematics to study combinatorial principles like Ramsey's theorem to analyze its strength and relation to other theorems. Ramsey's theorem for pairs states that for any infinite complete graph with a finite coloring on edges, there is an infinite subset of nodes all of whose edges share one color. In this poster, we will introduce the basics of reverse mathematics, highlight the equivalence of Kőnig's lemma to ACA_0 over RCA_0, and survey the foundational reverse mathematics results concerning Ramsey's theorem.
Advisor: Dr. Lynn Scow
Poster Area(s): Graph Theory/Combinatorics, Logic

Title: *Modeling the Pharmacokinetics of Paracetamol*
Presenter(s): Daniel Ramirez, California State University Los Angeles
Abstract: Paracetamol is an over-the-counter pain reliever that is primarily used to treat acute pain but has also been used in opioid sparing regimens for postoperative patients. Paracetamol has been observed to offer similar pain-relieving effects when taken orally as when it's administered intravenously. Understanding how the body processes this highly accessible drug allows individuals to make informed decisions on how to appropriately administer oral dosages when treating non-severe level pain. Using a two-compartment pharmacokinetic model expressed by a system of first-order ordinary differential equations, the concentration of paracetamol after it has been taken orally can be calculated in different bodily compartments over time. Observing the body's response to a single dose, we can determine the optimal dosing strength and frequency to ensure that the drug's concentration is at least 12 μg/ml to treat moderate-level pain while not exceeding 3000 mg in a 24-hour period.
Advisor: Melisa Hendrata
Poster Area(s): Applied Mathematics

Title: *Sheaf-Based Opinion Dynamics*
Presenter(s): Robert Bowden, Harvey Mudd College
Abstract: We construct a novel hypergraph laplacian matrix to generalize graph-based opinion dynamics models to higher-order social networks. Using the lens of topology, opinion dynamics occurs on a sheaf of opinions over a graph, giving room to extend the dynamics to hypergraphs. Sheaf cohomology tools allow us to write down Hodge k-Laplacians, which we modify to eventually construct the hypergraph laplacian. As an application, we begin to examine the Bounded Confidence hypergraph laplacian, which generalizes the Hegselmann-Krause opinion dynamics model to hypergraphs. We prove that Ricci curvature dictates fragmentation of the social network. Graph laplacian-based dynamics play a central role in many network models, and so the hypergraph laplacian, combined with the generality of sheaves, provides a direct path to incorporating higher-order network structure into a wide variety of network dynamics models.
Advisor: Heather Zinn-Brooks
Poster Area(s): Geometry, Graph Theory/Combinatorics, Applied Mathematics, Topology

Title: *An Exploration of the Cantor-Zassenhaus Algorithm*
Presenter(s): Anna Balana, California Lutheran University
Abstract: Cryptography is a field that is constantly growing and needs more secure mathematical methods to ensure an effective encryption system. Public key cryptography is one type of encryption used to secure information, communicate, and avoid stolen information. Public key cryptography is used in time stamping, money transfers, and disk encryption. Thus, the exploration of the "Cantor-Zassenhaus" algorithm, used in public key encryption, is significant for securing information. We focused on the component of the Cantor-Zassenhaus algorithm known as the distinct degree factorization. The algorithm will be explored by working through previous examples from other literature and there will be an exploration of how the algorithm works for small primes. It is expected to fully understand the algorithm to make conjectures and build on what is already known about the algorithm.
Advisor: Karrolyne Fogel and John Villalpando
Poster Area(s): Number Theory, Algebra

Title: *Lecture on Dilation*
Presenter(s): Ninibeth Palencia, CSUCI
Abstract: The research project studies knowledge of the geometry of future elementary school teachers. Includes problem-solving strategies and addresses learning issues. Students follow the state-approved educational mathematics standards. For this project, our primary focus is on Geometric Dilation. We implemented a survey before and after the special lecture on dilation. We taught dilation using two different methods to two groups of students. The first lecture was presented traditionally following the textbook, and the second class included handwritten handouts, visual cues, and kinesthetic learning. The same PowerPoint on the dilation lesson and the same activity on dilating the students' names were given. We used Vygotsky's Schema, Zone of Proximal Development, and Scaffolding of tasks throughout both lectures. We collected data on student performance and compared the results from both groups using statistical methods.
Advisor: Ivona Grzegorczyk
Poster Area(s): Education/Pedagogy

Title: *Group vs Individual environment and their outcomes for Algebra 2 students*
Presenter(s): Nancy Villegas Sanchez, CSU Channel Islands
Abstract: Modern classrooms are organizing instructions using variety of teaching methodologies, in in various settings, often grouping students for collaborative problem-solving assignments or exploratory activities. The purpose of this experiment is to evaluate the effectiveness of individual class work versus group class work in a college Algebra 2 classroom. Students attending the course typically complete several complex Rich Task assignments that consist of 3 to 4 questions per task considering the situation form various angles and at different difficulty levels. We start by analyzing data and observations collected during a class session from a single Rich Task that students have completed working in small groups. Then, students were given the same Rich task and worked on it individually, providing their own solutions. We administered a survey asking questions related to preferences on problem solving settings and work ethics while working with others. We analyzed the data statistically to evaluate students' performance in both environments and to better understand students' preferences and related work ethics issues.
Advisor: Ivona Grzegorczyk
Poster Area(s): Education/Pedagogy, Interdisciplinary Topics

Title: *The Benefits of Collaboration in High School Math*
Presenter(s): Citlalli Villegas, CSU Channel Islands
Abstract: This comparative study examines student performance in two different settings in high school math classes: individual and collaborative. Our quantitative analysis of student scores was based on two Integrated Math 2 courses receiving the same instruction by the same teacher over the course of two quarters. The data was collected from 60 teenagers ages 15 – 17 and we evaluated differences in their overall performance. Additionally, we analyze the influence collaborative learning has on their success in the next level of mathematics. We obtained interesting results that highlight the significance of collaborative learning in mathematics classrooms.
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Poster Area(s): Education/Pedagogy