Program   NES/MAA Fall 2025 Conference   Sacred Heart University

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1:00 pm - 2:30 pm	Collegiate Math Competition	Martire E-251
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6:00 pm - 7:30 pm	Social Time – Cash bar - Banquet	West Campus Guest House
7:30 pm - 8:30 pm	Christie Lecture: Games and Scams for Mathematicians Art Benjamin, Harvey Mudd College, National Museum of Mathematics	West Campus Guest House

Schedule: Saturday, 22nd November 2025

Time	Event	Location
8:00 am - 12:00 pm	Registration, Coffee, Tea	Loris Martire Forum lobby
8:00 am - 9:00 am	Breakfast snacks	Loris Martire Forum lobby
9:00 am - 10:00 am	Teaching Hour	Loris Martire Forum
10:00 am - 10:30 am	Business/Membership meeting	Loris Martire Forum
10:30 am - 11:00 am	Break	Loris Martire Forum lobby
11:00 am - 12:00 pm	Distinguished Teacher Talk: Ungrading to Support Learning Speaker: Christine von Renesse, Westfield State University	Loris Martire Forum
12:00 pm - 1:00 pm	Lunch	Loris Martire Forum lobby
1:00 pm - 2:00 pm	Contributed Talks	E251, E253, E257
2:00 pm - 3:00 pm	Talk: On Postsecondary Learning and Development in Mathematics Speaker: Brian Darrow, Jr., Central CT State University	Loris Martire Forum

Section NExT Workshop   12:30 PM - 2:00 PM   Location: Martire W-349

Speaker: Rachel Schwell, Central Connecticut State University

Title: Introducing and Cultivating Meta Skills in Math Majors (in the Age of AI)

Abstract: "Good mathematics is not about how many answers you know…it's about how you behave when you don't know." This quotation opens all of my upper-level math course syllabi, to set the stage that the "how we behave when we don't know" will be one of our fundamental course goals. I interpret this as referring to the habits of mind ("meta-skills") of mathematicians, such as persistence, experimentation, creativity, and critical self-analysis, that we aim to develop in students and which are arguably more important than the course topics themselves. As many of us have probably experienced however, these are unfortunately the most vulnerable to the easy access of AI-produced solutions. How can we design our courses and create assessments that will still build these skills? How can we communicate their importance to students in a way that will resonate and stay with them? Is the answer the same for every student? In this session, I will not claim to have resolved these deep and complex issues. I will however offer some perspectives and specific suggestions from my own classroom experiences, and we will take time to brainstorm and discuss as a group to generate insights and share ideas.

Bio: Rachel Schwell is a professor of mathematics at Central Connecticut State University. She completed her B.A. in mathematics and French at SUNY Geneseo, and her M.A. and Ph.D. in mathematics at the University of Connecticut. Her current pedagogical interests center around inquiry-based learning, particularly in proof-based courses. She has written IBL course notes for several math courses, with her text for Transition to Advanced Mathematics being recently published in the Journal of Inquiry-Based Learning for Mathematics. She spends several months in France every year with her French husband and cat and attended her first francophone math education conference in Montreal this past spring. She has been the Managing Editor for the journal PRIMUS since 2019.

Invited Talk: Friday 2:45 PM – 3:15 PM   **Location:** Loris Martire Forum

Speaker: Ockle Johnson, Keene State College

Title: A Run Through the History of the Northeastern Section of the MAA

Abstract: In honor of the 70th anniversary of the founding of the Northeastern Section, which we will celebrate next week, this talk will highlight some of the notable people who contributed to the history of the Section and illuminate some themes in the development of the Section over the decades. I will include some of my own reminiscences and invite others to share their reminiscences as well.

Bio: Ockle Johnson is a Professor Emeritus at Keene State College, from which he retired in his prime at the age of 67 after teaching 29 years. He received his B.S. in Physics from Siena College, M.A. and Ph.D. in Mathematics at the University of Georgia and Brown University, respectively. He has been a Section member since 1992 and has served as Section Chair, Section Governor, and also on the MAA Board of Governors as the Chair of the Council on Communities. He co-authored with Rob Poodiack two decades of Section History for the website. He is part of a distinguished tradition of Section marathoners and half marathoners.

Christie Lecture: Friday 7:30 PM – 8:30 PM   **Location:** West Campus Guest House

Speaker: Art Benjamin, Harvey Mudd College, National Museum of Mathematics

Title: Games and Scams for Mathematicians

Abstract: For entertainment and educational purposes only. Audience members are discouraged from applying these methods to nefariously win money from unsuspecting friends or enemies!

Bio: Art earned his B.S. in Applied Mathematics from Carnegie Mellon and his PhD in Mathematical Sciences from Johns Hopkins. Since 1989, he has taught at Harvey Mudd College, where he is the Smallwood Family Professor of Mathematics. In 2000, he received the Haimo Award for Distinguished Teaching by the Mathematical Association of America, and served as the MAA's Polya Lecturer from 2006 to 2008. For the current academic year, he is the Visiting Professor for Public Outreach at the National Museum of Mathematics in New York City.

NES/MAA Distinguished Teacher: Saturday 11:00 AM – 12 noon   Location: Loris Martire Forum

Speaker: Christine von Renesse, Westfield State University

Title: Ungrading to Support Learning

Abstract: Dr. von Renesse has been using alternative grading and open inquiry techniques for many years and believes that there are always ways to tweak the system to improve student success. In this active talk, participants will have the opportunity to reflect on grading and assessment - which connects to teaching and motivation and AI. Dr. von Renesse will also share what she is currently doing in her classes and why there is not just one right answer to the problem of education.

Bio: Dr. Christine von Renesse uses open inquiry and ungrading techniques in all her mathematics classes, believing that this is the most effective and enjoyable way of learning and teaching. She is part of the Discovering the Art of Mathematics project https://www.artofmathematics.org/ and includes connections to games, music, dance, and arts in her Mathematics for Liberals Arts classes at Westfield State University. Dr. von Renesse is the secondary education coordinator for mathematics and passionate about improving STEM education for all students. To this effort, she is part of the STEM-ACT project https://www.westfield.ma.edu/STEM-ACT. Dr. von Renesse is also on the leadership team of NE-COMMIT https://www.ne-commit.org/ and has been facilitating professional development workshops and coaching for K-12 teachers and higher education faculty for the past 15 years.

Invited Talk: **Saturday 2:00 PM – 3:00 PM** **Location:** Loris Martire Forum

Speaker: Brian Darrow, Jr., Central Connecticut State University

Title: On Postsecondary Learning and Development in Mathematics

Abstract: In building upon nearly sixty years of educational research establishing the inextricable link between schoolchildren's learning and development, our work has focused on investigating this link in college students. Our longitudinal cohort research over the past two decades has extensively investigated the academic trajectories of tens of thousands of college students, leading to the development of a robust explanatory framework for postsecondary academic success. Our most recent work has shifted the focus of this research to the investigation of learning outcomes in mathematics. Through the analysis of student responses to our innovative psychometric instruments, we have identified a unique psychoeducational facet of students' academic profiles specific to mathematics that is not sufficiently explained by other domain-general facets already under measure. The incorporation of direct academic information in subsequent analyses has led to additional insights regarding mathematics learning and development at the college level. In this presentation, the prior seminal work of James P. Comer, Michael Ben-Avie, and our other colleagues will be briefly reviewed to provide context for our current work. The development and refinement of our new psychometric instruments will also be discussed. The results of our analyses conducted on psychometric data and direct academic measures will be given within the larger context of improving collegiate outcomes in mathematics. Updates on current work and directions for future research will also be given.

Bio: Brian Darrow, Jr. is an Assistant Professor of Pure Mathematics at Central Connecticut State University. He completed his B.S. in Mathematics with Secondary Education Certification from Southern Connecticut State University, where he worked after graduation as an adjunct professor of mathematics and researcher within the School of Health and Human Services and the University's Division of Institutional Effectiveness. He then became a high school mathematics teacher and mathematics team coach while earning master's degrees and a Ph.D. from Columbia University. After this, he returned to his undergraduate alma mater to serve as an assistant professor before joining the faculty at Central. In addition to his mathematical work in combinatorics and number theory, he maintains a deep interest in mathematics education research and practice. He proudly continues to mentor undergraduate students in research in each of these areas.

Graduate Student Talks **Friday 3:20 PM – 4:00 PM**

Room	3:20 PM – 3:40 PM	3:40 PM – 4:00 PM
E-259	NO TALK	Working with Continued Fractions
W-238	CAT(0) Cube Complexes	Preliminary Notes for Studying General Topological Neighborhoods on Affine Transformation, Similar Subsets and Others.

Time: 3:20 PM - 3:40 PM

Location: W-238

Title: CAT(0) Cube Complexes
Speaker: Lydia Ahlstrom, Wesleyan University
Abstract: A cube complex is a geometric space constructed by gluing together cubes of various dimensions. We may glue the cubes in such a way that the resulting space exhibits characteristics of non-positive curvature. We call such a space CAT(0) and will outline the necessary conditions a cube complex must meet to be CAT(0). Then we will discuss hyperplanes – a useful tool when working with CAT(0) cube complexes.

Time: 3:40 PM - 4:00 PM

Location: E-259

Title: Working with Continued Fractions
Speaker: Stefan Hesseling, Wesleyan University
Abstract: Any real number x can we written as a simple continued fraction. In this talk, we will discuss exactly how to write a real number as a continued fraction, and how to evaluate which number a given continued fraction represents. Further, we will explore how to compare two continued fractions, all with the goal of building a beginning understanding of how to work with them as mathematical objects.

Location: W-238

Title: Preliminary Notes for Studying General Topological Neighborhoods on Affine Transformation, Similar Subsets and Others.
Speaker: Tony Sün, William Paterson University
Abstract: The absence of distance does not prevent a plausible definition of neighborhoods in a topology, and in this presentation, I continue from after the summer a specific discussion on topological neighborhoods that actually provide the topology via open subsets, from a few common and intuitive examples and other tentative angles such as Fermat's Principle of Least Time. For instance, if another point is affine-transformed from the point of interest perhaps with a restricted and small translator, it can be a candidate of its neighbor. Tentatively I provide a summary of non-metrizable spaces. The attempt is for a further definition or re-definition of topological openness (e.g. $\mathbb{R}^n$ and $\mathbb{C}^n$) which is set-wise whereas neighborhood is element-wise while in the mindful avoidance of circular reasoning.

Undergraduate Student Talks   Friday   4:00 PM - 5:00 PM

Room	4:00 PM – 4:20 PM	4:20 PM – 4:40 PM	4:40 PM – 5:00 PM
E-259	Elliptic Curve and Post-Quantum Cryptography: Data Encryption through Math	A Comparative Analysis of the Black-Scholes Model and Monte Carlo Simulation on European Call Options	A Noise-Resistant k-Nearest Neighbor Classification
W-238	Square Dance Numbers	Ramsey Numbers	Fractals and their Dimension
Loris Martire Forum	Group (Music) Theory	All the Right "Grates"	Predicting Barren Plateaus in Variational Quantum Algorithms Using Empirical Hardness Models

Time: 4:00 PM - 4:20 PM

Location: Room E-259

Title: Elliptic Curve and Post-Quantum Cryptography: Data Encryption through Math
Speaker: William Allen, Wesleyan University
Abstract: Elliptic curves form the foundation of many modern cryptographic systems. In this talk, we will discuss one such cryptosystem, the Elliptic-Curve Diffie—Hellman algorithm. To understand the role of elliptic curves in this algorithm, we will first explore how the set of points on elliptic curves form a group, and then how that group structure lends itself to efficiently encrypting data.

Location: Room W-238

Title: Square Dance Numbers
Speaker: Jeanna Neglia, Sacred Heart University
Abstract: In this talk, we will explore a topic in number theory called square dance numbers. A natural number, n, is considered a square dance number if the numbers from 1 to n can be paired in such a way that the sum of each pair is a perfect square. We will discuss several theorems where different patterns among square dance numbers are established. Our results allow us to determine all possible square dance numbers.

Location: Loris Martire Forum

Title: Group (Music) Theory
Speaker: William Krebs, Hampshire College
Abstract: Music theory can be conceptualized with Group theory. With this we can conceive a new way to analyze music. With a set of notes of one octave (the 12-pitch classes) & the group $(\mathbb{Z}/12\mathbb{Z},+)$ acting on it, we can define intervals & represent triads (a "nice" triple of notes) mathematically. The natural patterns that appear in music can then be explained and interpreted mathematically. Even more excitingly, we can show how a torus can be a useful model in a chordal space!

Time: 4:20 PM - 4:40 PM

Location: Room E-259

Title: A Comparative Analysis of the Black-Scholes Model and Monte Carlo Simulation on European Call Options
Speaker: Ryan Mastropaolo, Sacred Heart University
Abstract: In this talk, we will compare the Black-Scholes model and the Monte Carlo simulation, which are two methods for estimating the fair value of a European call option. Although both methods are based on the same stochastic foundation of geometric Brownian motion, the Black-Scholes method provides a closed-form analytical solution, whereas the Monte Carlo method relies on repeated numerical sampling. We will outline the mathematical framework behind each model and then examine how Monte Carlo estimates converge to the Black-Scholes price under identical assumptions. We will look at quantitative simulations using real market data when a sufficient number of paths is used. This demonstrates the consistency between the two methods when pricing European call options, highlighting the trade-off between analytical precision and computational flexibility.

Location: Room W-238

Title: Ramsey Numbers
Speaker: Thomas Lombardi, Sacred Heart University
Abstract: We aim to determine the smallest order n in which any k-edge coloring of the complete graph K_n will guarantee the existence of a monochromic edge colored graph G_i in the set $\{ G_1, G_2, \cdots, G_n \}$ for some i. When this is not possible, we will instead find an upper and lower bound for n for where this is guaranteed.

Location: Loris Martire Forum

Title: All the Right "Grates".
Speaker: Zachary Lariccia, Central Connecticut State University
Abstract: This research was inspired by a "grate" presentation given by Prof. Brian Darrow last year. An (n,k)-grate is a binary n-tuple containing k ones, such that there are never two adjacent zeroes. In his talk (on joint work with Joe Fields and Heiko Todt), Darrow developed a formula for counting the number of grates in terms of the parameters n and k, and considered the process of flipping the bits (0's turning into 1's) of a sequence of n zeroes until a grate is created. This talk was so "grate" that it inspired us to extend this work to higher dimensions! After first defining several types of two-dimensional grates, we developed computer programs to generate all the m x n grates with k-ones for small values of m and n. This revealed a number of "grate" connections to well-known sequences as well as a wide range of chess

problems. Returning to the original problem of expectation, we began considering the process of randomly flipping the bits in two-dimensional arrays until a grate is created. This lead to an initial result on 2 x n grates.

In this presentation, the results from the original "grate" problem will be reviewed before detailing more recent work on higher dimensions. The computer programs used to generate small examples and the connections this problem has with other well-known work will also be discussed. Finally, a discussion of how meaningful this project was for all involved will be given.

Time: 4:40 PM - 5:00 PM

Location: Room E-259

Title: A Noise-Resistant k-Nearest Neighbor Classification
Speaker: Zhenglin Wang, Boston University
Abstract: The k-nearest neighbors (k-NN) algorithm is a simple and widely used non-parametric classifier, yet its performance is highly sensitive to both the choice of k and the presence of noisy observations. This study first investigates how test accuracy varies with k across multiple train–test splits. When the accuracy curve stabilizes in its right tail, a critical value is identified using an ε-neighborhood criterion. Next, artificial label noise is incrementally introduced to examine how accuracy degrades with increasing noise levels, yielding an empirical estimate of a critical noise threshold beyond which k-NN can no longer be regarded as noise-resistant. Building on these findings, a new variant, the Reliability-Weighted All-Neighbor (RWAN) classifier, is proposed. Unlike standard k-NN, RWAN utilizes all n training observations, assigning each a reliability weight based on its distance to the class centroid within its true category, thereby allowing more representative points to exert greater influence and robustness on classification decisions.

Location: Room W-238

Title: Fractals and their Dimension
Speaker: Quinn Trumbull-Olsen, Worcester State University
Abstract: An introduction to fractals and an overview of calculation their dimension. Special focus on self-similarity dimension, box-counting dimension, and a brief discussion of Hausdorff dimension.

Location: Loris Martire Forum

Title: Predicting Barren Plateaus in Variational Quantum Algorithms Using Empirical Hardness Models
Speaker: Amy Qiao, Brown University, Harrison Copp, Yale University
Abstract: Variational quantum algorithms (VQAs), such as the Quantum Approximate Optimization Algorithm (QAOA), are hybrid quantum-classical machine learning algorithms designed to run on near-term quantum hardware. However, practical implementation of VQAs is impeded by the so-called "barren plateau" phenomenon: exponentially flat cost landscapes which necessitate exponentially more measurements. While an extensive Lie algebraic theory of barren plateaus in the regime of deep quantum circuit depths has been developed, less is known about the behavior of barren plateaus in shallow depths. Using the class of machine learning models known as empirical hardness models (EHMs), we investigate the emergence of barren plateaus for QAOA applied to Maximum Independent Set, an NP-hard optimization problem in graph theory. We find that barren plateaus and VQA training difficulty are independently associated with various graph properties, and that EHMs can accurately predict barren plateaus.

Undergraduate Student Talks   Friday   5:00 PM - 6:00 PM

Room	5:00 PM – 5:20 PM	5:20 PM – 5:40 PM	5:40 PM – 6:00 PM
E251	Mapping the Neural Manifold of Consciousness: Electrophysio-logical Signatures of Varying Levels of Consciousness During Sleep	NO TALK	Optimizing the Height-to-Radius Ratio of a Can for Cost-Effectiveness
E253	The Linear Algebra of the Game: Models for MAAC Women's Basketball Standings	Generalized Inverses and Their Applications	An Introduction to Matrix Lie Groups
E257	Bibliotherapy as an Intervention to Math Anxiety in Developmental Math Students	From Geometric Mean to Multiplicative Calculus	NO TALK
E-259	Deconstructing the Gun: Tracing Technologies through the Linkage Coefficient	Optimal Thresholding for Structural Interpretation of Markov Chains	Hidden Markov Models for Regime-Based Trading: A Robust Alternative to Traditional Time Series Methods
W-238	Relationships Between Sides and Areas of Polygons and Their Generalizations	New Methods for Identifying Important Structures in a Neural Network Model of the Brain	Why Geographers Don't Care About the Four-Color Theorem - An Overview of Empire Coloring

5:00 PM - 5:20 PM

Location: Room E-251

Title: Mapping the Neural Manifold of Consciousness: Electrophysiological Signatures of Varying Levels of Consciousness During Sleep
Speaker: Yao Yue, Boston University
Abstract: Despite decades of research on sleep and dreaming, there is still no widely accepted definition of consciousness or a unified computational framework to describe its dynamics. In this study, we investigate the neural features of various conscious states based on polysomnographic (PSG) recordings and propose a continuous, manifold-based view of consciousness. Rather than categorizing conscious states as discrete labels, we model them as dynamic positions within a topological landscape shaped by brain signal dynamics. Using manifold learning and vector-field estimation, we can recover the topology of this landscape directly from EEG recordings from curated datasets spanning multiple sleep laboratories, identifying basins, ridges, and transitional flows that correspond to varying levels of consciousness. This geometric formulation provides a quantitative language for mapping and predicting brain states, offering a physically interpretable bridge between sleep science, dreaming, and disorders of consciousness.

Location: Room E-253

Title: The Linear Algebra of the Game: Models for MAAC Women's Basketball Standings
Speaker: Lily Gentile, Sacred Heart University
Abstract: This paper investigates how team performance statistics relate to success in MAAC women's basketball. Using both linear and polynomial regression models, the study examines the relationships between point differential, field goal percentage, and fan attendance with win percentage. The analysis shows that point differential has a strong and consistent relationship with winning, while field goal percentage demonstrates a moderate connection. Fan attendance begins with a weak correlation that strengthens as higher-degree models are applied. Overall, the findings illustrate how regression analysis and the coefficient of determination can reveal meaningful patterns and compare the strength of statistical relationships in sports performance data."

Location: Room E-257

Title: Bibliotherapy as an Intervention to Math Anxiety in Developmental Math Students
Speaker: Alivia Glynn, Worester State University
Abstract: Math anxiety is a widespread emotional barrier present in elementary to post-secondary classrooms that hinder a student's emotional well-being, confidence, and long-term relationship with mathematics. This study investigates the potential of bibliotherapy, in the format of a relatable audio-based narrative, as an emotional intervention to reduce math anxiety amongst undergraduate developmental math students at Worcester State University. Twelve students from the MA 099 developmental math course participated in this study, completing a variety of quantitative Likert-scale-style pre- and post-surveys paired with qualitative reflection questions about their math experiences and mindsets. These surveys measured their self-reported anxiety levels and mindset shifts. The intervention method was an audio recording of a narrative called Grace's Story, designed to help students identify with a character who overcomes math anxiety through persistence and reframed thinking. Quantitative results revealed an overall decrease in anxiety levels, with most students showing measurable improvement between the two surveys. Qualitative analysis further demonstrated a shift from language expressing frustration and fear to satisfaction, happiness, and growth. The findings from this study show that bibliotherapy as an intervention for math anxiety can serve as an accessible, easy-to-implement, classroom tool to address the emotional complexity of math anxiety and promote a growth-oriented mindset among students.

Location: Room E-259

Title: Deconstructing the Gun: Tracing Technologies through the Linkage Coefficient
Speaker: Ethan Chu, Wesleyan University
Abstract: This research delves into one of the applications of bipartite network projections in observing the behavior of technological systems across time, particularly in reference to gun technology. In this talk, we explain the methods we use to quantify technological growth in a network of gun patents, using standard statistical methods to formulate the Linkage Coefficient. The frequency-based coefficient accounts for varying co-occurrence rates, repeated classifications representing distinct technologies, and asymmetric relationships, enabling construction of weighted adjacency matrices and network visualizations from late 1800s to 2023 data. We end the talk with a few results from our data and applications towards other fields such as the social sciences. This is joint work with Maryam Gooyabadi.

Location: Room W-238

Title: Relationships Between Sides and Areas of Polygons and Their Generalizations
Speaker: Ethan Miller, Keene State College
Abstract: In the article, "Quadrilaterals with area formula $\sqrt{abcd}$", (Math Gazette, Vol. 96, July 2012) the author shows that the only quadrilaterals with sides a, b, c, d with this property are rectangles and cyclic quadrilaterals with an inscribed circle. In this presentation, we show how the property involving rectangles can be generalized to the (2n-1)th root of an n-dimensional parallelotope and extend the cyclic quadrilateral property to a (2n)-sided nonconvex polygon whose area is the nth root of the product of its sides.

5:20 PM - 5:40 PM

Location: Room E-253

Title: Generalized Inverses and Their Applications
Speaker: Derek Coady, Sacred Heart University
Abstract: Under the traditional principles of Linear Algebra, matrices are only known to be invertible if they are square and non-singular. However, within this paper, we show how many other matrices can have an inverse under the idea of generalized inverses. By using only a subset of the properties that a matrix must uphold to be invertible, we can extend the idea of inverses to singular and even rectangular matrices. We see how special types of inverses that are classified differently based on the properties they hold serve as a means to expand the capabilities of matrices. This is

seen as most useful in the context of least-squares solutions, where these matrices and their generalized inverses can assist us in finding the best-fit solutions to systems of equations that may not have exact solutions.

Location: Room E-257

Title: From Geometric Mean to Multiplicative Calculus
Speaker: Sixu Liu, Cedar Xiao Mt. Holyoke College
Abstract: Differentiation and integration are two fundamental operations in calculus. They are the infinitesimal versions of the subtraction and addition operations on numbers. Motivated by problem #1420 in the PME journal, we explored the study of multiplicative calculus, which was defined by Michael Grossman and Robert Katz in the late 1960s. In this presentation, we want to compare and contrast classical calculus and multiplicative calculus, in which the traditional notion of rate of change is replaced with the rate of growth.

Location: Room E-259

Title: Optimal Thresholding for Structural Interpretation of Markov Chains
Speaker: Yiren Wang, Boston University
Abstract: Many real-world systems appear stable until they suddenly undergo rapid, often catastrophic transitions. This study introduces T-stability, a thresholder Markov chain framework that enables early structural interpretation of such systems before observable collapse. Given a sample transition matrix, an optimal threshold $T^*(t)$ is selected by balancing five criteria: external leakage, internal uniformity, block structure, class stability, and model complexity. Tracking these structural quantities over time reveals a consistent pattern: as systems approach a tipping point, T-stability deteriorates—marked by declining $T^*(t)$ and coherence score $S(t)$, rising leakage $L(t)$, and a narrowing spectral gap. This behavior mirrors known early warning signals from critical transition theory. A motivating example is cognitive state dynamics in mental health, where declining T-stability precedes events like attentional collapse or emotional instability. Similar signatures also emerge in algorithmic drift, AI hallucinations, social contagion, and regime shifts in biological or economic systems. T-stability thus provides a unified and interpretable early warning indicator applicable across domains—from minds to machines and complex adaptive systems alike.

Location: Room W-238

Title: New Methods for Identifying Important Structures in a Neural Network Model of the Brain
Speaker: Olivia Kaminske, Keene State College
Abstract: Combinatorial Threshold-Linear Networks (CTLNs) are a neural network model that is used to simulate the firing rates of neurons. This model is based on a system of differential equations that compute the firing rates of each neuron in the system. In particular, we are interested in a special family of CTLNs called core motifs. Identifying these core motifs is integral to extrapolating CTLN findings to larger networks like the brain, but checking if CTLNs are core is computationally complex and difficult to scale. In an effort to more easily identify core motifs, I formed two conjectures that rule out large numbers of CTLNs as not core using simpler computations. These two conjectures use determinant sign and out-degree uniformity respectively to drastically reduce the computations required to find core motifs, allowing for greater scalability and computability.

5:40 PM - 6:00 PM

Location: Room E-251

Title: Optimizing the Height-to-Radius Ratio of a Can for Cost-Effectiveness
Speaker: Erin Edgar, Sacred Heart University
Abstract: This presentation explores the optimization of production costs for an aluminum can by analyzing surface are and manufacturing factors. We use calculus-based optimization to determine the ideal height/radius ratio that minimizes material cost for a fixed volume by comparing two methods for cutting the circular top and bottom of the lids to minimize waste. The results indicate cutting the discs from a hexagon is more optimal than cutting the discs from

squares. The cost for assembling the can is also evaluated, showing that optimal shape of the can is determined by the height/radius ratio.

Location: Room E-253

Title: An Introduction to Matrix Lie Groups
Speaker: Tomás Pérez, Wesleyan University
Abstract: The aim of this presentation is to introduce the elementary aspects of Lie Theory by presenting the mathematical objects it studies through examples and relevant theorems. We will introduce the general linear group, GL(n, C), in order to define some matrix Lie groups that can be derived from it, such as SL(n, C),SU(n),GL(n, R), and SO(n). We will explore some of the topological properties of matrix Lie groups such as their path connectedness. Ultimately, we will define the Lie algebra of a matrix Lie group which will aid our study by giving us a flat insight into a curved object.

Location: Room E-259

Title: Hidden Markov Models for Regime-Based Trading: A Robust Alternative to Traditional Time Series Methods
Speaker: Kaiyi Liu, Boston University
Abstract: Financial markets exhibit complex, noisy behavior characterized by frequent shifts in underlying structure, rendering traditional time series forecasting models like ARIMA unreliable due to their assumption of stationarity. In this study, we adopt a regime-based trading approach using Hidden Markov Models (HMMs) to identify latent market states rather than directly predict prices. Applied to one year of S&P 500 data sampled every five minutes, the model extracts over 35 market features, including price dynamics, volatility, volume, and intraday timing patterns, then reduces them to approximately 15 principal components via PCA to denoise and stabilize learning. The HMM uncovers four to six interpretable regimes, each with distinct behavioral traits; some support trend-following, while others align with mean-reverting strategies. Trading decisions adapt based on the active regime, and back testing across multiple time periods shows this method achieves a Sharpe ratio near 5, outperforming classical ARIMA-based methods and highlighting the advantage of learning structure over forecasting raw prices.

Location: Room W-238

Title: Why Geographers Don't Care About the Four-Color Theorem - An Overview of Empire Coloring
Speaker: Finnian Nibert, Keene State College
Abstract: The four-color theorem is one of the most famous theorems in graph theory, but it may surprise you to learn this property is not often used in creating maps of countries. This talk will give an introduction to the reasons why many political maps may exceed the four-color threshold and investigate the required number of colors for some interesting maps which have qualities that are not represented in the four-color theorem.

Teaching Hour   **Saturday**   **9:00 AM – 10:00 AM**   **Location:** Loris Martire Forum

Title: "Show Me You Know It": Rethinking Assessment in Calculus with Standards-Based Grading
Speaker: Nick Kapoor, Fairfield University
Abstract: In Spring 2024, I adopted a standards-based grading (SBG) framework in Calculus II as an alternative to traditional high-stakes examinations, providing students with opportunities to demonstrate mastery. Students engaged with short "Show Me You Know It" problems, with chances for reassessment and final recertification. This approach particularly empowered the "middle 70%" of the class to persist with challenging topics and shifted the emphasis from grading to learning. I will share the system's design, student responses, and strategies for adapting SBG to mathematics courses.

2. **Title:** Guided Notes
Speaker: Eric Johnson, Coast Guard Academy
Abstract: What are "Guided Notes?" How covering class for a colleague slowly (over the past decade plus) but profoundly changed how I present material in class.

3. **Title:** Guided Notes + Universal Design for Learning = *Guiding* Notes
Speakers: Elliott Bertrand, Lindsay Keazer, Sacred Heart University
Abstract: We share strategies for improving mathematics faculty's implementation of guided notes using Universal Design for Learning (UDL), a framework of considerations for reducing barriers to learning. We present opportunities for mathematics instructors to improve learner agency by transforming guided notes into an enhanced, UDL-inspired version we call *guiding notes*. Guiding notes maintain the helpful structure of note-taking scaffolds while offering support for diverse learner needs by intentionally integrating multiple means of *engagement*, *representation*, and *action & expression*. We will showcase example segments of guiding notes to highlight actionable strategies and helpful tools.

Contributed Talks

Room	1:00 PM – 1:20 PM	1:20 PM – 1:40 PM	1:40 PM – 2:00 PM
E251	Bringing the Math Behind AI into PK–12 Classrooms	A Resource for Navigating the Universal Design for Learning Guidelines in Postsecondary Mathematics Teaching	Try Something: Leading Students in Vocational Discernment
E253	Search for Upsets, Part I: Seed Differences and Point Spreads	March Madness Part II: Analysis Upsets Using Colley Rating	An Expository Introduction to Convolutions of Bounded Harmonic Close-to-Convex Mappings
E257	Chicken McNuggets, Symmetry, and Cyclotomic Units	c^c–c	Spectral Information Theory
E259	Learning Labs to Support College Students in Foundational Algebra	Strategies for Student Engagement in College Algebra	

1:00 PM – 1:20 PM

Location: Room E-251

Title: Bringing the Math Behind AI into PK–12 Classrooms
Speakers: Jane Lee, Stonehill College
Abstract: Artificial intelligence can feel abstract and distant to PK–12 students, but its underlying mathematics already appears in the curriculum. In this talk, I will share two classroom lesson ideas from recent Growing Problem Solvers articles in Mathematics Teacher: Learning and Teaching PK–12 on AI image processing and decision making. I will highlight the core mathematical ideas and illustrate how they can be developed through age-appropriate tasks across grade bands.

Location: Room E-253

Title: Search for Upsets, Part I: Seed Differences and Point Spreads
Speakers: Rick Cleary, Babson College
Abstract: In the annual NCAA Division I Basketball Championships for men and women (aka March Madness), teams are seeded based on their perceived strength. Upsets occur when a team considered weaker (a higher seed number) defeats a team that would have been expected to win based on the seeding. In this talk we examine how the probability of an upset is related to readily available public information like the difference in seeding between two teams, and the

point spread associated with the game by sports betting sites. We also explore how these predictors of seed difference and point spread are related to one another. We consider this preliminary work with a long-term 'big picture' goal of helping fans be competitive in betting pools of various types.

Location: Room E-257

Title: Chicken McNuggets, Symmetry, and Cyclotomic Units
Speakers: Caleb Shor, Western New England University
Abstract: The ""Chicken McNuggets Problem"" has to do with determining the largest number of nuggets that cannot be purchased if nuggets are sold only in packs of 6, 9, or 20. In this talk, we will consider the case where the pack numbers form a geometric sequence, and we will look for certain symmetries that exist among the non-nugget numbers in general. This will lead us first to questions about polynomial factorizations and ultimately to the world of cyclotomic units and finding dependence relations among them.

Location: Room E-259

Title: Learning Labs to Support College Students in Foundational Algebra
Speaker: Tina Romansky, Sacred Heart University
Abstract: This talk will discuss the implementation of College Algebra Learning Labs at SHU to support the students in our entry level course in the Algebra – Precalculus – Calculus sequence. The program was designed to supplement the traditional assistance formats of instructor office hours and tutoring sessions. The presentation will address the impetus for the labs, their format and effectiveness.

1:20 PM – 1:40 PM

Location: Room E-251

Title: A Resource for Navigating the Universal Design for Learning Guidelines in Postsecondary Mathematics Teaching
Speaker(s): Elliott Bertrand, Lindsay Keazer, Sacred Heart University
Abstract: The Universal Design for Learning (UDL) Guidelines offer an array of considerations for improving students' access and minimizing learning barriers. However, the sheer number of options could be overwhelming to faculty looking to improve their teaching. We share development work from an NSF-funded research project (Award #2142315) that mapped research and best practices from mathematics education onto the UDL Guidelines to develop a UDL-Mathematics Education Framework (UDL-MEF). This framework curates math-specific resources and considerations that may be used to provide students with multiple means of engagement, representation, and action & expression. We will highlight a sampling of high-impact strategies and tools for mathematics faculty to consider integrating in their classrooms.

Location: Room E-253

Title: March Madness Part II: Analysis Upsets Using Colley Rating
Speaker: Peter Staab, Fitchburg State University
Abstract: The NCAA basketball tournaments are colloquially known as "March Madness" and the madness part is often that there are unexpected outcomes when a lower-ranked team upsets a higher-ranked team. The ranking of a team is embedded in the tournament bracket as the seed, which does not always accurately reflect the true strength of a team. I use the Colley method and ranking system to determine an alternative ranking of tournament teams and explore upsets in a more objective manner. I will show examples of tournaments on both the Men's and Women's sides, highlighting tournaments with both high and low upset measures, as well as develop a model to predict upsets.

Location: Room E-257

Title: $\mathcal{C}^{\mathcal{C}}$–$\mathcal{C}$
Speaker: Cheng-Han Pan, Mount Holyoke College

Abstract: Given two subsets A, B ⊆ R, their algebraic difference is defined by A − B{a − b : a ∈ A, b ∈ B}. For the classical ternary Cantor set C ⊆ [0, 1], a well-known result states that $\mathcal{C} - \mathcal{C}$ = [−1, 1]. What, then, can be said about the set $\mathcal{C}^{\mathcal{C}}$–$\mathcal{C}$? How about $\mathcal{C}^{\mathcal{C}}$–$\mathcal{C}$ for a generalized Cantor set?

Location: Room E-259

Title: Strategies for Student Engagement in College Algebra
Speakers: Julianne Howard, Lindsay Keazer, Sacred Heart University
Abstract: This session will explore ways to improve student engagement in college algebra, both through content-based motivation and facilitation strategies. We will demonstrate an activity that engages students in exploring an application of quadratics, while also modeling for participants the use of research-based facilitation strategies such as hosting group work at vertical whiteboards and using random name generators for group assignment and to determine which groups to call on for reporting findings.

1:40 PM – 2:00 PM

Location: Room E-251

Title: Try Something: Leading Students in Vocational Discernment
Speaker: Michael Veatch, Gordon College
Abstract: For 12 years we have been refining a course on vocation. I will relate several things that have made the course popular: 1) readings that recognize their anxiety and encourage them to try things, dream, make changes, and continue discerning; 2) alumni with a wide variety of jobs; 3) descriptions of newer careers, such as business analytics and data science; 4) a larger vision of vocation that includes service to society.

Location: Room E-253

Speaker: Melike Aydogan, Istanbul Technical University
Title: An Expository Introduction to Convolutions of Bounded Harmonic Close-to-Convex Mappings
Abstract: This extended expository article introduces harmonic mappings and explores their convolution properties with a special focus on the radii of starlikeness and convexity. In particular, we investigate the radius of starlikeness and the radius of convexity of harmonic convolutions for a subclass of bounded harmonic close-to-convex mappings, obtained by convolving two univalent harmonic convex mappings. The aim is to provide a teaching-oriented resource that balances mathematical rigor with accessibility for students and instructors. Historical context, fully worked examples, exercises, and visual illustrations are included to enhance understanding and to make the subject approachable in a classroom environment. The work presented here is supported by Istanbul Technical University.

Location: Room E-257

Title: Spectral Information Theory
Speaker: Jared Deighton, Simmons University
Abstract: How do populations of neurons collectively encode information? We present a theoretical and computational framework that unifies efficient coding principles with the emergence of place and head direction cells. Building on information theory, we introduce two measures—the joint stimulus information rate and the spectral stimulus information—that quantify how groups of neurons encode stimuli. The latter measure, derived from the leading eigenvalue of the "stimulus information matrix", is maximized when neurons have localized, minimally overlapping firing fields—strikingly similar to place and head direction cells in mammals. In this talk, I present various mathematical properties of these novel information-theoretic measures and, briefly, discuss how they can be used for machine learning.

Undergraduate Math Competition Teams

	Team Name	Student #1	Student #2	Student #3
1	Nikolas and Tatiana	Nikolas Nemergut	Tatiana Rivera	
2	Bourbaki	Zain Salim	Caleb Whitehead	Alex Grosman
3	PPPOTTT	Sixu Liu	Cedar (Yuntong) Xiao	
4	corni	Corinne Owens	Daniela Ramos	
5	Worcester State	Quinn Trumbull-Olsen	Alivia Glynn	Anna Riley
6	The Differential Annihilators	Timothy Nelson	Caleb Peterson	
7	JK	Kayli Hung	Jack Chow	
8	Pi-oneers	Lily Gentile	Erin Edgar	Karleigh Lemond
9	MathaHolics	Connor MacDonald	Derek Coady	
10	Non Mathis Scire	Noah Godwin	Wolfie Krebs	
11	The Golden Bears	Dylan Laramee	Yousif Elamin	
12	Team Harary	Olivia Kaminske	Ethan Miller	Finnian Nibert
13	Team Bourbaki	Blessing Sithole	Jasmine Warner-Demond	Ava Twiss
14	Overfitted but Confident	Yiren Wang	Zhenglin Wang	
15	Statistically Insignificant but its OK	Yao Yue	Kaiyi Liu	

Technology Notes

1. Speakers do not have access to the internet.
2. WiFi is available through the guest access or Eduroam.
3. Speakers have access to poduim projection (HDMI cord)

Buildings and Parking

1. To get to the Martire Center, use the address 5401 Park Avenue, Fairfield in the GPS.
2. The entire conference, except for the Friday banquet and the Christie Lecture, will take place in the Martire Center for the Liberal Arts. You may park in the Martire parking lot.
3.   The Friday banquet and Christie Lecture will take place at the West Campus Guest House, located on West Campus (about 1 mile from the main campus). Address for West Campus is 3135 Easton Turnpike, Fairfield. To get there from the Martire building on the main campus, travel west on Jefferson Street for about 1.1 miles. This will bring you right to the entrance.

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