2024 Annual Meeting of the Kentucky Section
of the Mathematical Association of America
at Eastern Kentucky University
Friday, April 5, 2024

2:00pm – 2:50pm	**Registration** (Science Atrium)			
2:50pm – 3:00pm	**KYMAA Announcements and Opening Remarks** (Science 3104)			
3:00pm – 4:00pm	**Invited Address** (Science 3104) **Pattern Avoidance in Restricted Permutations** *Opel Jones* – Johns Hopkins University Applied Physics Laboratory			
4:10pm – 5:20pm	**Registration** (Science Atrium)			
	Science 3101	Science 4101	Science 4105	Science 5101
4:10pm – 4:30pm	**Domino tilings viewed algebraically as ideals** *Shelly Bouchat (F) – Berea College*	**Squarely: A New Puzzle of Arithmetic, Sets, and Logic** *John Wilson (F) – Centre College*	**ODE Modeling of Cancer with Drug Administration** *Madison Genslinger (U) – Thomas More University*	**Expanding the Reach of Teaching Math for Social Justice** *Ashlee Matney (F) – Campbellsville University*
4:35pm – 4:55pm	**Graceful Argyle Graphs** *Kaimera Greear (U) – Berea College*	**An inside perspective to Math Olympiad thinking** *Jaime Araujo (U) – Campbellsville University*	**Modeling of Lamprey Population Dynamics and Ecological Effects** *Willem Hanssen (U) – Asbury University and Matthew Shiheng (U) – West Jessamine High School*	**Measuring the Effect of the Implementation of a Mathematical Modeling Unit on Growth Mindset and Comfort Levels** *Courtney Bowling (U) – Morehead State University*

	Science 3101	Science 4101	Science 4105	Science 5101
5:00pm – 5:20pm	**Maximal Elements of the Depolarization Poset of Monomial Ideals** *Ryan Gipson (F) – Campbellsville University*	**The Efficiency of Quantum Computers vs. Classical Computers** *Maria Hernandez (U) – Thomas More University*	**Balancing Act: A Model for Managing Water Levels in the Great Lakes Region** *Caleb Bill (U) and Aaron Hamby (U) – Asbury University*	**Using Mathematical Modeling to Impact Students' Ability to Distinguish Misinformation** *Will Tidwell (F) -- Morehead State University*
5:25pm – 5:45pm	**On quotients of parity numerical semigroups** *Ash Coleman (U) – Thomas More University*	**A Chern-Simons Approach to Lie Algebra Characters** *Michael Baker (F) – University of Kentucky*	**Sustainable Insurance Modeling for Extreme Weather Events** *Talaya Jones (U), Aaron Raver (U), and Hayden Smeal (U) – Asbury University*	**Counting Your Chickens Before They've Hatched: Inquiry and Modeling in Combinatorics** *Kristen Barnard (F) – Berea College*
5:50pm – 6:10pm	**Algorithm for determining if a double coset digraph is a generalized wreath product** *Benjamin Meyer (U) – Morehead State University*	**The Shape of Wavelet Space** *David Roach (F) – Murray State University*	**Modeling Competitions: Reflections and Lessons Learned** *Benjamin McLaughlin (F) – Asbury University*	
6:15pm – 7:00pm	**Banquet** (Science Atrium)			
7:00pm – 7:45pm	**Invited Address** (Science Atrium) **A Teaching Focus on Commonalities across Representations** *Daniel McGee* - Northern Kentucky University			

Contributed Talks (F: faculty; RF: retired faculty; U: undergraduate; G: graduate)

All times are Eastern Daylight Time, and all activities are in the Science Building (Square C2 of EKU parking map).

2024 Annual Meeting of the Kentucky Section
of the Mathematical Association of America
at Eastern Kentucky University
Saturday, April 6, 2024

8:00am – 10:00am	**Registration** (Science Atrium)			
	Science 3101	Science 4101	Science 4105	Science 5101
8:30am – 8:50am	**Three Dimensional Ferrers Boards, Rook Numbers, and Hit Numbers** *Kenny Barrese (F) – Brescia University*	**Loop nesting in stitched hitomezashi work** *Jake Wildstrom (F) – University of Louisville*	**Identifying the Factors Affecting the Survival of the Trauma Patients Using Logistic Regression Analysis** *Maggie Smith (U) – Murray State University*	
8:55am – 9:15am	**Cultivating Strong Neighbors: A Prime Labeling for Graphs** *Micheal Arnal-Brown (U) – Murray State University*	**Math and Art in the Classroom** *Steven Wilkinson (RF), Lisa Holden (F), and Blake Settle (U) – Northern Kentucky University*	**Blocked and Reported** *Trinity Maxwell (U) –Eastern Kentucky University*	
9:20am – 10:05am	**Coffee Chats (Science Atrium)**		**Undergraduate Student Puzzle Competition (Science 3208)** *Moderator: erica Whitaker*	
10:10am – 11:05am	**Invited Address** (Science 3104) **Narrow Margins: Winning the Presidency with Minimal Popular Vote** *Russ Goodman* – Central College			
11:05am - 11:15am	**Section Election** (Science 3104)			

	Science 3101	Science 4101	Science 4105	Science 5101
11:20am – 11:40am	**Zero Divisor Graphs of 3x3 Tridiagonal Matrices over the Integers Mod 6** *Emily Blevins (U) – Morehead State University*	**Assessments in an Inquiry-Based Introduction to Proof Course** *Praneel Samanta (F) -- University of Kentucky*	**Submersible Location Model: Don't Lose the Sub** *Katherine Stanley (U). Rebekah Bogle (U), and Josef Morstatt (U) – Asbury University*	**Sums of Square Roots of Integers** *Tom Richmond (F) – Western Kentucky University*
11:45am – 12:05pm	**A Polynomial Algorithm to Compute Geodetic Ratio of a Tree** *Mustafa Atici (F) – Western Kentucky University*	**How and Why to Introduce Exponential Random Graph Models to Students** *Vicki Modisette (F) – Eastern Kentucky University*	**Geometries Gon Wild** *Naat Ambrosino (U) – Bellarmine University*	**A. A. Albert's Influence on the Development of Cryptology in Post-WWII America** *Roland Long (U) – Northern Kentucky University*
12:10pm – 12:30pm	**The capacities of rectangular chessboards** *Doug Chatham (F), Morehead State University*	**Infinity: A little fun managing Hilbert's Hotel with our students** *Towanna Roller (F) – Asbury University and Kristyn Roller (G) – University of Kentucky*	**Recent Advances in Fractional h-Discrete Calculus** *Ferhan Atici (F) – Western Kentucky University*	**Binary rules that satisfy neutrality and monotonicity** *Bob Powers (F) – University of Louisville*
12:35pm – 1:15pm	**Business Meeting & Luncheon** Science Atrium			
1:15pm – 1:30pm	**KYMAA Executive Committee Meeting** Science Atrium			

Contributed Talks (F: faculty; RF: retired faculty; U: undergraduate; G: graduate)

All times are Eastern Daylight Time, and all activities are in the Science Building (Square C2 of EKU parking map).

2024 KYMAA Abstracts for Invited Talks

Narrow Margins: Winning the Presidency with Minimal Popular Vote
Russ Goodman, Central College

Abstract: Polya (1961) and Wessel (2012) investigated the hypothetical question of "What is the smallest fraction of the popular vote a candidate can receive and still be elected President of the United States?" What's your best guess of the answer to this question? This talk will give a thorough account of the dynamics behind the question, pursue a sub-optimal approach, identify a more effective approach, and leave the audience with an invitation to explore some unresolved issues within this topic. A resource with historical data will also be offered to the audience for their continued exploration.

Bio: Russ Goodman is Professor of Mathematics at Central College (Pella, Iowa) and is Officer At-Large on the MAA Board of Directors. He also serves/served the MAA on the Council for Teaching of Undergraduate Mathematics and the Classroom Resource Materials Editorial Board. Russ has been at Central College since 2002 and is also an assistant coach for the Dutch women's soccer team. In his free time, he enjoys spending time with his beautiful wife and two daughters, running, doing origami, watching sports, and enjoying all kinds of music.

Pattern Avoidance in Restricted Permutations
Opel Jones, Johns Hopkins University Applied Physics Laboratory

Abstract: In 1974 Dumont found two types of permutations are counted by the same sequence. The first type is a permutation in which each even entry is followed by a smaller entry, and each odd entry is followed by a larger entry or ends the permutation. The second type is a permutation wherein if an entry is a deficiency, it must be even, and if an entry is an exceedance or a fixed point, it must be odd. These are now known as Dumont permutations of the first and second kinds. In this talk we will discuss several enumerations of restricted Dumont permutations, that is Dumont permutations avoiding certain patterns. We will also briefly discuss their proofs which involve methods using induction, block decomposition, Dyck paths, and generating functions. We will conclude with a conjecture that the patterns 2143 and 3421are indeed Wilf-equivalent on Dumont permutations of the first kind.

Bio: Opel is a loving husband, dedicated father, and servant to the community. He mentors, tutors, and volunteers in his free time through his fraternity, and coaches youth football and youth baseball. Throughout the years, Opel has worked as an engineer, mathematics and statistics lecturer, development officer, and computer scientist, at several institutions and the federal government. He also served as Director of the Leadership Institute for several years at Hampton University, teaching leadership studies and developing leaders in addition to teaching mathematics and honors seminars. Currently, he is a mathematician and analyst at The Johns Hopkins University Applied Physics Laboratory. Additionally, he is currently serving on the County Council in Howard County, Maryland. He was first elected to office in 2018, and just re-elected in 2022.

Opel earned the B.S. in mathematics from Hampton University, the M.S. in mathematics from Howard University, and the Ph.D. in mathematics also from Howard University. He is a Life Member of Alpha Phi Alpha Fraternity, Inc., initiated at Hampton University, and past president of the local Howard County chapter. His professional associations include the American Mathematical Society, the Mathematical Association of America, and the National Association of Mathematicians. Opel loves music, football, baseball, reading, and Sudoku puzzles, and is a lifelong practitioner of martial arts. He and his wife, Shaundra, are extremely proud parents of three: Opel II, Ivan, and Whitley!

A Teaching Focus on Commonalities across Representations

Daniel McGee, Northern Kentucky University

Abstract: A guiding principle throughout my career as an educator is that concepts are best understood by seeing the commonality across situations, formulas, tables, and graphs. Pursuing this goal has led me in various directions. A slope between 2 points in 3D was not included in Multivariable Calculus curriculum but it is a fundamental representation that is needed to understanding partial and directional derivatives. So, I found that I needed to create curriculum supplements that include a 3D slope in various representations. Finding that students struggle to visualize 3D concepts on a page or screen, I created a 3D "kit" that allows students to experience 3D points, curves, surfaces, and volumes in their natural dimension. To facilitate multirepresentational understanding, I shifted from a lecture format to an activity-based classroom. And created numerous activities designed to be completed as part of our classroom discussion. In this presentation, I'll discuss this journey, the materials I've created, what I've learned and how it has impacted my mathematics instruction from Precalculus to Multivariable Calculus.

Bio: Dr. Daniel McGee graduated from Georgia Tech and began his career in engineering. However, after working several years teaching middle and high school math in Botswana as a Peace Corps volunteer, he knew math education was destined to be a part of his life. He enrolled in the Doctoral Program in Applied Mathematics at the University of Arizona, and upon receiving his degree, spent almost two decades in Puerto Rico where he studied the impact of metarepresentational approaches to teaching undergraduate mathematics. In 2013, he came to Kentucky to serve as the Executive Director of the Kentucky Center for Mathematics. He spent 6 years in this role where he focused on continuity across grades in the p–16 mathematics learning experience. In 2019, he returned to the classroom as a mathematics professor at NKU where he continues his exploration of student understanding of postsecondary mathematics across multiple contexts.

2024 KYMAA Abstracts for Contributed Talks

Geometries Gon Wild

Naat Ambrosino, Bellarmine University

A circle is mathematically defined as the collection of points a given distance away from a set point. Thus, the appearance of a circle varies dramatically across different metrics—for example, the taxicab metric (as popularized by Krause and Reynolds) has a circle that is a Euclidean square. As such, metrics can be partially defined by the appearance of their unit circles. This thesis focuses on creating and analyzing an infinite set of metrics defined by their circles being regular polygons.

An inside perspective to Math Olympiad thinking

Jaime Araujo, Campbellsville University

The presentation pretends to bring an insider perspective to Math Olympiad thinking while solving Problem 1 of the International Math Olympiad of 2020. The exploration encompasses a blend of insightful angle chasing, geometric reasoning, and deductive inference.

Cultivating Strong Neighbors: A Prime Labeling for Graphs

Micheal Arnal-Brown, Murray State University

A neighborhood-prime labeling is a bijective function f from V(G) to the set of positive integers up to |V(G)| such that for every vertex v with degree greater than 1, the greatest common divisor of labels of adjacent vertices of v is 1. We strengthen this definition by introducing a strong neighborhood-prime labeling where for every vertex v in V(G), there exists a neighborhood-prime labeling such that f(v)=1. We will investigate what families of graphs are strongly neighborhood-prime as well as discuss the impact of graph operations on this type of labeling.

Recent Advances in Fractional h-Discrete Calculus

Ferhan Atici, Western Kentucky University

In this talk, we introduce basic definitions and some recent results in fractional h-discrete calculus. We use backward difference operator and define Riemann-Liouville fractional operators in discrete time. Some of the recent developments in the theory include linear fractional h-difference equations, boundary value problems, and controllability. After giving a brief survey on these developments, we close the talk with one application in cancer research.

A Polynomial Algorithm to Compute Geodetic Ratio of a Tree

Mustafa Atici, Western Kentucky University

Computing the geodetic ratio of a given graph is NP-complete. A polynomial algorithm is given to compute an upper bound for the geodetic ratio of any simple connected graph G. In this study, we give a polynomial algorithm to compute the geodetic ratio of a tree T.

A Chern-Simons Approach to Lie Algebra Characters

Michael Baker, University of Kentucky

Characters are one of the most important parts of representation theory, giving numbers that tell one a lot about many representations in both group theory and algebras. Relations amongst characters have a lot of value in understanding and calculating these characters, so anything that gives us new insight into these has value. Inspiration strikes in the most unlikely of places, as CS/WZW models have conjectured an identity that we call the Porrati-Yu identity, which says that the sum of characters of weights in a weight space is equal to the character of the highest weight. We prove this identity by using CS/WZW models ourselves, giving us a much more hands-on approach to a problem which would be computationally difficult combinatorically.

Counting Your Chickens Before They've Hatched: Inquiry and Modeling in Combinatorics

Kristen Barnard, Berea College

Unfortunately, many undergraduate mathematics programs are unable to offer courses completely dedicated to mathematical modeling. This is the story of how a conversation with a friend led to a mindset change in my teaching to incorporate concepts of mathematical modeling in nontraditional places.

Three Dimensional Ferrers Boards, Rook Numbers, and Hit Numbers

Kenny Barrese, Brescia University

This talk will present an extension from traditional rook placements into three dimensions and what changes this causes when discussing the rook and hit numbers. To do this, we will suggest a definition of three-dimensional Ferrers Board. We will also highlight a significant relation between the rook and hit numbers. From this, we can calculate the rook number from the hit number for any board.

Balancing Act: A Model for Managing Water Levels in the Great Lakes Region

Caleb Bill and Aaron Hamby, Asbury University

Rising water levels in the Great Lakes region prompt concerns for residents and wildlife. Blamed largely on Plan 2014, devised by the International Joint Commission (IJC), our model aims to address safety and environmental needs. Focused on controlling two main dams, it divides the system into two control areas, with Lake Ontario as a focal point. While offering a framework, our model acknowledges the complexities of the system, calling for future refinements.

Zero Divisor Graphs of 3x3 Tridiagonal Matrices over the Integers Mod 6

Emily Blevins, Morehead State University

Zero-divisors in modular rings have been widely explored and documented in mathematics literature, yet less is known concerning the existence of zero-divisors in the ring of restricted tridiagonal matrices over the integers modulo n, where n is some composite integer. We explore all zero-divisors in the ring formed by a restricted subset of 3x3 tridiagonal matrices whose entries are elements of the integers modulo 6. Particularly, we prove the number of zero-divisors which exist in this ring and how they can be found, later constructing the zero-divisor graph of this ring using a quotient graph.

Domino tilings viewed algebraically as ideals

Shelly Bouchat, Berea College

Domino tilings have been studied in combinatorics. It is well known that the number of domino tilings of a 2 x n tableau is given by a Fibonacci number. This talk will focus on results that can be obtained for algebraic objects, by viewing these domino tilings as monomial ideals. Furthermore, the relationship between the Fibonacci numbers and the graded Betti numbers of the corresponding domino ideal will be explored.

Measuring the Effect of the Implementation of a Mathematical Modeling Unit on Growth Mindset and Comfort Levels

Courtney Bowling, Morehead State University

Research shows that when students have a growth mindset and feel comfortable with their instructor, the classroom environment, and the course, they perform at a much higher level. This is true for students despite their background, but especially relevant when looking through the lens of a student's first-generation college student status, their geographical background, and their social class. Having the proper background and resources available to students is incredibly important to their performance in their classes. Many disadvantaged students may struggle feeling comfortable in the class and believe that intelligence is innate rather than something that can be cultivated, especially in mathematics classrooms. Mathematical modeling is an application of math students should already be familiar with that allows them to approach real-world problems in a meaningful way. The purpose of this research is to investigate how engaging in mathematical modeling affects a student's growth mindset and their comfort levels with regards to the instructor, the classroom environment, and the course materials. To do this, students responded to a questionnaire at the beginning and end of the module to determine if student's mindsets towards mathematics and their comfort levels changed, if at all. This talk will discuss how student's mindsets and comfort levels towards mathematics changed after engaging in a mathematical modeling unit.

The capacities of rectangular chessboards

Doug Chatham, Morehead State University

How many black and white chess pieces (queens, kings, knights, rooks, bishops, and pawns) can we place on the squares of an m × n chess board so that none of those pieces attack any other piece? We call this number the "capacity" of the board and determine the capacity for infinitely many values of m and n, including $m = 3a + 2$ where $a \geq 1$ and $n = 1,2,3,4b$ and $4b+3$, where $b \geq 1$. For example, if $n=4b$ or $m=3a+2$, $a \geq 1$, and $n \geq 3$, the capacity is $2m/3$, rounded up to the next integer, times n.

On quotients of parity numerical semigroups

Ash Coleman, Thomas More University

If S is a numerical semigroup, then for a given positive integer n, it may not be true that $S = T/n$ where T is a parity numerical semigroup. We prove this by example. We also show that it is true when S is parity and $n = 3$.

ODE Modeling of Cancer with Drug Administration

Madison Genslinger, Thomas More University

Cancer, renowned within the medical community as a terrifying disease with hundreds of variations, is at its core most commonly a mutation in cells that promote unregulated cell growth. Several recognized pathways exist for the development of cancer growth and treatment creating a complex system of cellular growth and decay. Using mathematical modeling and differential equations, an investigation into the drug delivery timing and dosage allows for the determination of a drug administration optimal control for the system (dePillis et al., n.d.). With this, a scheme for drug treatment can possibly be created for advancement in drug administration. Thus, using simplified ODEs to mathematically model patient response, we will graph the solution under different conditions to illustrate progression to survival or death.

Maximal Elements of the Depolarization Poset of Monomial Ideals

Ryan Gipson, Campbellsville University

Following the work of Mohammade et al., we advance the investigations of depolarization posets. While polarization of monomial ideals has been studied extensively in the literature, depolarization's utility in multiple applications has been recently exhibited, arising from its ability to reduce the number of variables of the ambient ring. To this end, the depolarization poset is particularly useful since its maximal elements correspond to those ideals with minimal variables. In this talk, for a given ideal I, we will provide a lower bound on the number of maximal elements of a given depolarization poset of I by considering the associated $\leq$-support poset of the same.

Graceful Argyle Graphs

Kaimera Greear, Berea College

This presentation builds upon the Graceful Tree conjecture proposed by Kotzig, Ringel, and Rosa in 1967, which claims all trees can be gracefully labeled. We define argyle graphs, and extend this conjecture to them, by proposing a novel method that guarantees a graceful labeling for argyle graphs of height one.

Modeling of Lamprey Population Dynamics and Ecological Effects

Willem Hanssen, Asbury University and Matthew Shiheng, West Jessamine High School

This talk presents a comprehensive two-part model elucidating the relationships between relative abundance, sex ratio, and ecological impacts of Lamprey. Utilizing logistic regression and matrix equations, we unveil the intricate dynamics of Lamprey growth and its ecosystem repercussions. Our model underscores the species' pivotal role and offers insights for future ecological research.

The Efficiency of Quantum Computers vs. Classical Computers

Maria Hernandez, Thomas More University

We studied two quantum algorithms from N. David Mermin's book, "Quantum Computer Science: An Introduction", to understand in what ways quantum mechanics is applied to computer science. The Deutsch algorithm and the Bernstein-Vazirani algorithm were chosen to illustrate the efficiency of quantum computing. To explore these topics, quantum computers will be modeled, and the results will be compared to the classical computer algorithms. We will use computational efficiency to demonstrate the advantages of quantum computers over classical computers.

Sustainable Insurance Modeling for Extreme Weather Events

Talaya Jones, Aaron Raver, and Hayden Smeal, Asbury University

In response to escalating extreme weather events exacerbated by climate change, our model aids insurance companies in sustainable decision-making. Focused on areas prone to hurricanes, floods, and wildfires, it assesses risk to enable broader coverage, bolstering consumer confidence and regional economic resilience. Case studies include Fort Myers, Florida, and the Philippines.

A. A. Albert's Influence on the Development of Cryptology in Post-WWII America

Roland Long, Northern Kentucky University

Abraham Adrian Albert "A cubed" (1905-1972) was an algebraist best known academically for his study of associative and non-associative algebras. By the 1940's he had also developed an interest in cryptology and its relationship to mathematics, stating in a 1941 address to the American Mathematical Society that "abstract cryptography is identical with abstract mathematics." Throughout the following two decades, Albert would serve in several federally funded operational mathematics programs to study and advise on cryptanalysis. In particular, Albert's work with the National Security Agency (NSA) and NSA-adjacent projects set a framework for the development of cryptology as a mathematical discipline. This research aims to present a timeline for and the breadth of Albert's promotion of cryptology in the post-WWII American mathematical community.

Modeling Competitions: Reflections and Lessons Learned

Benjamin McLaughlin, Asbury University

Mathematics competitions provide unique opportunities for students to bridge the gap between success in the undergraduate classroom and success in graduate research and the workplace. This talk will present reflections from past competitors and advisors to share lessons learned from participation in the COMAP modeling competition, including the ways in which participants benefit during their academic pursuits and beyond, and ways in which faculty advisors can help students get the most out of their modeling competition experience.

Expanding the Reach of Teaching Math for Social Justice

Ashlee Matney, Campbellsville University

While teaching math for social justice has become a heavily researched and highly published topic in recent decades, nearly all the research has been conducted in the traditional classroom setting, and predominantly in K-12 school systems. My research sought to broaden this knowledge base by examining the impact of discussion forums on students' social justice beliefs in fully online undergraduate math courses. Analysis of merged quantitative and qualitative data resulted in optimistic outcomes and laid groundwork for future research in teaching math for social justice beyond the classroom.

Blocked and Reported

Trinity Maxwell, Eastern Kentucky University

An experimental design study focusing on applying statistics to hobbies. A randomized block design was used to determine if there is a difference in the mean size of crocheted squares when using the crochet blocking methods (steam, dry, mist, wet). Statistical analysis was performed with the SAS statistical software.

Algorithm for determining if a double coset digraph is a generalized wreath product

Benjamin Meyer, Morehead State University

My goal is to write an algorithm in the algebraic coding language Magma, in which one inputs a double coset digraph and the program returns all the pairs of graphs of which the double coset digraph is a generalized wreath product. This builds off the work of my advisor Dr. Barber's dissertation. Her dissertation is concerned with showing the sufficient and necessary conditions that a double coset digraph is isomorphic to a wreath product. It is hoped that this will give mathematicians more tools to determine the automorphism group of a graph.

How and Why to Introduce Exponential Random Graph Models to Students

Vicki Modisette, Eastern Kentucky University

Exponential Random Graph Models are an increasingly popular way to provide an understandable and effective way to analyze networks. This talk demonstrates example activities scaled to introduce these models and their prerequisites to students of different skill levels. From quick fun activities for students with minimal background to example R code and simulations for building a network for more advanced students, we present research questions and examples to interest a wide range of students including ideas for undergraduate research.

Binary rules that satisfy neutrality and monotonicity

Bob Powers, University of Louisville

A binary rule is a function of the form $f : \{-1,0,1\}^n \to \{-1,0,1\}$ where $n \geq 3$ is the number of voters and $\{-1,1\}$ is a set of two competing alternatives. The value 0 in the domain of f represents voter indifference and 0 in the range represents a tie voting outcome. Simple and absolute majority rules are well-known examples of binary rules that satisfy the reasonable conditions of neutrality and monotonicity. In this talk, I will present a new result that characterizes the class of binary rules that satisfy neutrality and monotonicity.

Sums of Square Roots of Integers

Tom Richmond, Western Kentucky University

The square root of 193605 is 440.00568178… and the square root of 278790 is 528.00568178…, so these square roots differ by 88.00000000…. Is it possible to find two natural numbers a and b which are not perfect squares such that the difference of their square roots is an integer? Is it possible to find two natural numbers a and b which are not perfect cubes, but the sum of their cube roots is an integer? We use elementary techniques to investigate these questions and similar ones.

The Shape of Wavelet Space

David Roach, Murray State University

Wavelets are compactly supported functions that form an orthogonal basis for $L^2(R)$. In particular, they are self-referentially defined functions whose dilations by any power of two and integer shift are orthogonal to one another for any pair of dilations and shifts. Wavelets can be classified into parametrized families based on their finite length which is defined as the number of non-zero coefficients in their associated dilation equation. These dilation coefficients can be considered a parameterized set of unit vectors that live on a hypersphere in R^n where n is the length of the wavelet. In this talk, we will look at ways to visualize the parameterized families of wavelets as points in R^n for various wavelet lengths with the hope to better understand the shape of wavelet space

Infinity: A little fun managing Hilbert's Hotel with our students

Towanna Roller, Asbury University and Kristyn Roller, University of Kentucky

Sometimes we just need to play. Maybe our students need to see us enjoying the beauty, challenge, and comradery of doing a wide variety of math together. This journey into Hilbert's Hotel was designed for one of this semester's weekly social times with our faculty and math majors along with a few general education students, depending on the topic.

Assessments in an Inquiry-Based Introduction to Proof Course

Praneel Samanta, University of Kentucky

In this brief presentation, I will discuss my experience in developing an inquiry-based elementary number theory course at the University of Kentucky. This introduction to proof course aims to actively involve students in the learning process. Students are encouraged to work in groups and learn by formulating questions and exploring answers on their own. The teacher serves as a facilitator, leveraging students' strengths and learning needs to guide the course and enhance the effectiveness and efficiency of the process. Providing students with multiple ways to demonstrate their content understanding enriches their learning experience and offers the instructor more insights into the students' thinking and learning needs. During this presentation, we will examine evidence-based concepts for alternative assessments of students' success and how to align them with the curriculum expectations.

Identifying the Factors Affecting the Survival of the Trauma Patients Using Logistic Regression Analysis

Maggie Smith, Murray State University

Numerous factors affect the clinical outcomes such as survival status of patients with physical trauma. Logistic regression is one of the widely used methods to analyze relationships between a set of factors with a binary outcome variable. In this study, we built a logistic regression model for a binary outcome variable, Hospital Discharge Status (HDS). Factors included in this analysis are injury severity score, admission to trauma, heart rate, length of hospital stay, patient transfer or direct admittance, and the lapsed time between an injury and arrival at the hospital. The goal of this retrospective observational study is to assess the association between the factors and HDS and evaluate the odds of survival corresponding to the factor.

Submersible Location Model: Don't Lose the Sub

Katherine Stanley, Rebecca Bogle, and Josef Morstatt, Asbury University

This model presents a method of locating a submersible which has lost communication with the host ship while diving with tourists to explore shipwrecks.

Data utilized in order to locate the submersible include readings from magnetic anomaly detectors (MAD), last known location of the submersible, readings from the passive towed sonar array, and depth, temperature, and salinity readings from an expendable bathythermograph.

The submersible will be equipped with a Submersible Communication Recurring Emergency Actuator Module (SCREAM) of 128 Hz. This device will be activated automatically when communications with the host ship are disrupted and generate the SCREAM signal once every 15 seconds. If SCREAM must instead be activated manually due to mechanical failure, it will be activated every 30 seconds, notifying the rescue team that there could be human error causing further uncertainty to the calculations.

The SCREAM signal will allow for two primary methods of locating the submersible with a passive sonar array. The first method is the Doppler processing model, which when combined with the last known location will allow for a velocity vector to be constructed. Each vector can be interpreted as a cone of probability, describing the predicted area in which the submersible may be located. A helicopter equipped with sonobuoys can then assist with locating the submersible rapidly.

The second method, the triangulation model, will utilize the individual reported distance of the submersible from each hydrophone in the sonar array, which can be employed to triangulate the exact coordinates of the submersible every 15 or 30 seconds. As the ship drifts, subsequent coordinates can be utilized to construct a velocity vector which describes the location and direction of the submersible.

Through this model's intentional redundancies, the submersible's location can be found with great accuracy in case of communication loss, with a predicted probability of finding the submersible at 100%.

Using Mathematical Modeling to Impact Students' Ability to Distinguish Misinformation

Will Tidwell, Morehead State University

With the prevalence of social media and information being at our fingertips, the world has access to many resources that could potentially misinform the public. Making the power to distinguish misinformation vital, we engaged students in modeling tasks to grow this ability. In this session, we will explore how students' ability to identify misinformation changes in a course on modeling.

Loop nesting in stitched hitomezashi work

Jake Wildstrom, University of Louisville

Hitomezashi is a form of embroidery in which two extremely simple stitch patterns are worked on the same piece of fabric, to interact in ways which produce surprisingly sophisticated systems of paths and loops. The loops produced by hitomezashi can nest within each other; this talk will briefly discuss the bounds on how deeply such nesting can occur, and the depth of nesting which occurs in fixed patterns both traditional and modern, as well as the expected depth of a random hitomezashi pattern.

Math and Art in the Classroom

Steven Wilkinson, Lisa Holden, and Blake Settle, Northern Kentucky University

In the fall 2023 semester NKU ran a course for new math/stats majors that focused on math and art. We presented the students with a number of variations on mathematical ideas and let them create their own artwork from their chosen variations. This talk will discuss the class and focus on variations of well-known fractals like the Koch and Sierpinski fractals.

Squarely: A New Puzzle of Arithmetic, Sets, and Logic

John Wilson, Centre College

For most people, the primary appeal of Sudoku is the simplicity of its rules and the challenge of its logic. Fill a 9x9 grid consisting of nine 3x3 cages so that each row, column, and cage contains all the digits 1 through 9. Squarely is a new type of number puzzle that blends these aspects of Sudoku with the basic addition and multiplication aspects of Kakuro puzzles. In its most basic form, solving a Squarely puzzle consists of filling the 25 cells in a 5x5 grid with three occurrences of the digits 2 through 9 and a single occurrence of the digit 1 in such a way that each row, column, and the two long diagonals contain no repeated digits. As with Sudoku, the Squarely puzzles range in difficulty based on how much information is provided. In this talk, I will present several mathematical questions that arise in creating and solving these puzzles.