Student Talk Abstracts

Louis Boguchwal, Hamilton College
Optimal Vaccination Strategies

Abstract: This research provides a novel framework for modeling infectious disease propagation throughout a population, and ultimately for determining socially optimal vaccine allocation. Given a fixed stockpile of vaccines, I determine the best geographic distribution that minimizes the number of infections in the population. This approach integrates network modeling, statistical analysis, and ordinary differential equations. The analysis reveals both the network attributes as well as the social characteristics that are critical in determining whether one city is more important than another in terms of vaccination, leading to the derivation of the "salience function." Finally, I evaluate the socially optimal vaccination policy in a governmental context. Through game-theoretic analysis and optimization methods, I propose a framework for finding the nearest-to-optimal policy that would likely be ratified by congress.

Taylor Borcyk, Ithaca College
Weighing in on Weighted Voting

Abstract: Weighted voting systems are used for games in which the players of the game are not equal. They are often used for votes between shareholders of a corporation, or in representation of the municipalities of a county, as a substitute for redistricting. But how should these weights be assigned in order to be true to the power of each player? How many votes should be required for a win? If weights are assigned based on the fraction of shares or population that a player holds, will this yield the desired distribution of power? The Banzhaf Index of Power indicates that weighted voting systems are not so obvious. And so the question becomes, how can a system be created which will give the desired power distribution?

Eileen Bruns and Caitlin VerSchneider, Nazareth College
Got PCK?

Abstract: If you do not know what PCK is, come join us to find out! In this talk we will describe pre-service teachers understanding of division of fractions as well as how they analyzed pupils understanding of it within un-contextualized and contextualized problems. We will briefly discuss some of our findings and their implications for future pre-service programs.

Scott Constable, Ithaca College
Elliptic Curves and Modular Forms: Application to Cryptology

Abstract: Andrew Wiles infamous proof of the Taniyama-Shimura Conjecture established a remarkable correspondence between elliptic curves defined over $\mathbb{Q}$ and modular forms of weight 2. Elliptic curves defined over $\mathbb{Z}/n\mathbb{Z}$ have numerous implications in cryptology, particularly in attacks on RSA security. Unfortunately, a correspondence between these elliptic curves modulo n and modular forms has yet to be ob- served. This lecture gives an overview of the marriage of modular forms and elliptic curves, and investigates possibility of extending this marriage to include elliptic curves over $\mathbb{Z}/n\mathbb{Z}$.

Yinghan Ding, Hamilton College
A Dynamical Systems Approach to Prove Fermat's Little Theorem

Abstract: In this talk we use a dynamical systems approach to prove Fermat's Little Theorem by proving and applying propositions about fixed and periodic points. The result demonstrates that the study of dynamical systems can go beyond its own scope and it can be applied to solve problems in many other disciplines of mathematics.

Zane Glauber, Hamilton College
Substitutions and the Tower of Hanoi Puzzle

Abstract: In this talk I will explore the various properties of the Tower of Hanoi puzzle described in the paper titled Morphisms, Squarefree Strings, and the Tower of Hanoi Puzzle by Jean-Paul Allouche, Dan Astoorian, Jim Randall, and Jeffrey Shallit. We can code the puzzle's behavior and piece together an infinite string to describe the optimal solution to the puzzle. In the process of doing so, we introduce the topic of substitutions, and define a distinct substitution to help us prove more about this optimal solution.

Michael Griffith, Ithaca College
Figurate Numbers in Arbitrarily Many Dimensions

Abstract: Figurate Numbers can be used to describe geometrical objects such as polygons and polyhedra. Using the basic definitions of Figurate Numbers, we have derived a general formula for "polygonal numbers describing polygons with arbitrarily many sides and presented what we hope is an intuitive proof. We then used this finding to construct equivalent formulae for "pyramidal numbers, and the analogous Figurate Numbers in greater than three dimensions.

Spencer Gulbronson, Hamilton College
Solving Solitaire

Abstract: Peg solitaire is a single player board game that has intrigued players for over 300 years. Although computers today can find solutions through brute force attacks, a clever use of mathematics provides a greater understanding of the intricacies and patterns within the game. In this talk, we will discuss some of the mathematics behind peg solitaire, including its relationship to abstract algebra and group theory.

Sara Harding, Hamilton College
The Relationship between Pascal's Triangle and Fractal Geometry

Abstract: What is the probability that "n choose r" is odd? Divisible by 3? I will be looking at an infinitely large Pascals triangle, which includes all possible numbers for "n choose r", and relating it to fractal geometry to answer some of these questions.

Robert Huben, Hamilton College
Can $A^{-1} + B^{-1} = (A + B)^{-1}$?

Abstract: We will explore when there exist $N \times N$ matrices such that $A^{-1} + B^{-1} = (A + B)^{-1}$. Using the minimal polynomial and eigenvalues we will show that such matrices exist if and only if N is even.

Kelly Husted and Kerrie Sirianni, Nazareth College
How Poor Mathematical Attitude Impacts Learning

Abstract: In this talk, we will present findings on how poor mathematical attitudes in below-average high school students impacts learning in the classroom. Based on past literature, we customized and administered a Mathematics Attitude Inventory, interviewed, and observed students in the classroom. We will talk about future teaching implications from our preliminary findings.

Mark Ibrahim, Hamilton College
Cryptography: Secret Sharing

Abstract: Beginning with a specific example to introduce the set of secret sharing problems, I will then generalize the example to include w participants with t needed to recover the message. Then I will present the Shamir threshold scheme with a system of equations as a foundational approach to secret sharing problems; the number of participants t required to recover the message parallels the number of points required to defined a line, plain, etc. depending on the original message.

Sheraz Iqbal, Ithaca College
Where are Limits Used in Calculus?

Abstract: Developing ideas presented in "Where are Limits Needed in Calculus," presented by R. Michael Range; we are able to find a new method to calculating the slope of tangent lines of polynomials algebraically without the use of limits. Additionally, we find ways to calculate critical points of polynomials through a similar approach.

Mark Kleehammer, SUNY Fredonia
Star Studded Mathematics

Abstract: In this talk we will explore the interior angle sum of stars. We will look at complete stars and apply the results to prove Barbier's Theorem for Reuleaux Polygons.

Amelia Mattern, Hamilton College
Matrix Magnitude and Eigenvalues: Relationship Status?

Abstract: In linear algebra, we learn that the set of square matrices constitutes a vector space. In this talk, we go one step further and define the notion of matrix norms. We then address the relationship between the magnitude of a matrix and its eigenvalues.

Elisa Napierala, Nazareth College
Mathematics Anxiety Anonymous

Abstract: In this talk, I will present both past and current literature concerning mathematical anxiety. Based on this literature, I constructed and administered testing instruments to current college students in order to analyze mathematical anxiety. While past quantitative studies often tested participants for mathematical accuracy, I tested participants for mathematical fluency. Testing instruments, as well as teaching implications, will be discussed.

Dan Rossi, SUNY Geneseo
Numerical Ranges: When is a Matrix like an Ellipse?

Abstract: Let A be an $n \times n$ matrix. The numerical range of A, denoted $W(A)$, is defined as $\{v * Av : v \in \mathbb{C}^n, ||v|| = 1\}$ (where v^* is the conjugate transpose of v). We consider the set of 4×4 doubly stochastic matrices (i.e. matrices whose rows and columns each sum to 1) and their numerical range. We categorize the shapes that the numerical range of a 4×4 doubly stochastic matrix A may have. We then provide our new necessary and sufficient conditions on A for $W(A)$ to have some of these shapes, including ellipses and quadrilaterals.

Alex Snow, Hamilton College
Geometry of the Mandelbrot Set

Abstract: This talk will be a brief introduction to the geometry and certain properties of the Mandelbrot fractal set and their related Julia Sets. The Mandelbrot set is the parameter space for an iterative quadratic polynomial and has become one of the most famous mathematical pictures in the recent century. Its construction gives the Mandelbrot set many interesting features, several of which will be covered in this talk.

Kristin Stenerson, Hamilton College
Lagrange and Newton Interpolation

Abstract: This talk will build on the ideas about Secret Sharing Schemes discussed by Mark Ibrahim. Next, it will delve into a different approach to construct a Secret Sharing Scheme, the Lagrange Interpolation Polynomial. An example will be used to illustrate the scheme and a few smaller variations will be explained. Finally, the Newton form of the interpolant will be explored as an extension of the Lagrange approach.

Kathryn Walker, Elmira College
Rounding Bias of Geometric and Poisson Distributions

Abstract: We predict bounds for the bias of data from geometric or Poisson distributions when rounded in various ways: including to the nearest 10; rounded up to the next 10; and rounded down to the previous 10. We then apply these estimates to discrepancies found in the National Health and Nutrition Examination Survey (NHANES) data collected from 1999 to 2010 concerning the reported number of sex partners. We find that the rounding bias does not account for the differences.

Keon Wilson, SUNY Oneonta
Circumference and Diameter in Various Geometries

Abstract: It is well known that, in Euclidean geometry, the ratio between the circumference of a circle and its diameter is π. In this presentation, we look at the possible values of this ratio in some non-Euclidean geometries, such as spherical, hyperbolic, and taxicab geometry.

Roy Wood and David Zanghi, D'Youville College
Dynamics of Iterated Maps

Abstract: Consider the quadratic function $f(z) = z^2 + a$, where z is a complex variable and a is a complex constant. For any initial value z_0, the "orbit of z_0 under the iterates of f" is defined to be the infinite sequence: $\{z_0, f(z_0), f(f(z_0), f(f(f(z_0))), ...\}$. These orbits can be very interesting: there are fixed points, finite orbits, bounded orbits, unbounded orbits, etc. Our presentation will give an introduction to this fascinating subject.

Zijun Zhang and Yating Guan, Hamilton College
Differences In Housing Choices Among Student Groups

Abstract: Our presentation on Hamilton College Housing Lottery mainly focuses on how students individual characteristics affect their choices in entering Hamilton College Substance-Free housing lottery. We found that students current living environment, race, and class year are the most important factors that influencing their decision for entering the lottery. This study would be helpful for Hamilton College Resident Life improving student-housing options in the future.