Saturday Afternoon
Contributed Talks

1. **Christopher Baltus**, SUNY Oswego

Central Collineations: Straightedge Constructions and Matrix Algebra

A classroom topic that ties synthetic geometry with matrix algebra. A collineation is a 1-to-1 mapping of the projective plane onto itself that respects collinearity. If there is a line of fixed points, it's a Central Collineation. Interesting constructions are by straightedge and a device for drawing parallels. Multiplication by nonsingular 3-by-3 matrices produce the collineations in homogeneous coordinates.

Question: Which matrices produce central collineations?

2. **Hossein Behforooz**, Utica College

Linear Algebra Properties of Magic Squares

First of all, this talk is especially suitable and understandable for undergraduate students. We know that every magic square is a very especial square matrix and in this talk, we will present some interesting linear algebra properties of these magic square matrices. There are some published materials and short articles or notes related to this subject but they are not very complete papers with all details in one place. Since the time of the lecture is short, I will state the theorems without proofs or I will make the proofs as simple as possible. Some entertainment properties of magic square will be followed if time permits. Yes, MATH is FUN. Remember that we have Magic Squares for thousands of years, way before new born entertainment with Sudoku Squares.

3. **Gordon Craig,** Université Laval and Mérici College

The Unsteady Invisible Hand

The concept of general equilibrium (namely, that supply equals demand for all goods) is fundamental to economic theory. In the 1950s Arrow and Debreu used fixed-point theory to show that, under certain hypotheses, such an equilibrium exists. Unfortunately, their theorem did not address the issue of the stability of the equilibrium. In this talk, I will present several simple examples due to Scarf showing that in general, the Arrow-Debreu equilibrium is unstable. The talk will assume no prior knowledge of economics, and will be accessible to anyone who has completed an ordinary differential equations course.

4. **Joseph Kolacinski,** Elmira College

A Mathematical Comparison of Open and Closed Primaries through Fairness Criteria

This talk will explores the differences between open, closed, and semi-closed primary elections, both from theoretical standpoint. We define five of the most fundamental "fairness criteria," a set of desirable characteristics "fair" election systems should satisfy. Using these definitions, we determine that by allowing voters to choose which primary election in which to vote, open primaries satisfy four out of the five fairness criteria while closed primaries do not: anonymity, neutrality, majority, and Pareto. We also determined that closed primaries satisfy monotonicity while open primaries do not. We use these results to argue that open primaries are superior to closed primaries in selecting candidates that represent the interests of the greatest number of citizens.

Saturday Afternoon
Contributed Talks

5. **Amanda Mangum**, Niagara University (Work done in collaboration with **Dr. Mansoor Haider**, North Carolina State University)

Comparing Clustering Algorithms on Porcine Atherosclerotic Data

Atherosclerosis is a cardiovascular disease in which plaque accumulates along the wall of an artery, altering blood flow and increasing the risk for heart attack or stroke. Acoustic Radiation Force Impulse (ARFI) is an ultrasound imaging technique in which acoustic waves are focused at a point, causing displacement of the tissue that is then tracked over time to measure elastic and viscoelastic material properties from the imaging data. We investigate the application of data clustering algorithms, K-Means, Self-Organizing Maps (SOMs), and Relational SOMS to ARFI imaging for early detection and characterization of atherosclerotic plaques.

In this context, we hope to cluster images based on similar patterns in the data set. Based on the dimension, size and scope of image patterns considered in this work, the clustering configuration used for each clustering algorithm considered was a 3x3 lattice of nine neurons. We will discuss metrics, including the topographic product, used to compare the performance of the three algorithms as well as comparing different clusterings using the same algorithm.

6. **Chad Mangum**, Niagara University

New Realization of Twisted Toroidal Lie Algebras

The representation theory of Lie algebras is a vibrant field of research and has been significant in various areas of mathematics and physics for several decades. In this talk, we will discuss a recent advance in part of this theory, namely twisted (2-)toroidal (Lie) algebras, which we view as universal central extensions of twisted multi-loop algebras. The usual loop algebra realization generalizes the familiar realization of affine Kac-Moody algebras. We will discuss a new realization of these algebras given by generators and relations, based on a similar realization by Moody, Rao, and Yokonuma in the untwisted case. This has the advantage of being more amenable than the loop algebra realization to studying the representation theory. This is joint work with Dr. Kailash Misra and Dr. Naihuan Jing.

7. **James Marengo**, RIT

A Geometric Deviation of the Irwin-Hall Probability Distribution

In this talk an n-dimensional geometric derivation will be presented for the probability distribution of the sum of n independent random variables, each of which is uniformly distributed on the interval (0,1). The derivation makes use of the inclusion-exclusion principle and should be accessible to anyone who has had a first course in probability.

Saturday Afternoon
Contributed Talks

8. **Yozo Mikata,** Bechtel Corporation

1D Phononic Metamaterials: Infinitely Periodic and Finitely Periodic Materials

Metamaterials have been studied extensively since Pendry and Holden (1999), and Smith et al. (2000) have succeeded in creating an electromagnetic composite material (photonic metamaterial) with negative permeability and negative permittivity in certain frequency range (double negative materials). But the original concept goes back to a theoretical paper by Veselago in 1967. In this talk, binary and ternary 1D phononic metamaterials will be discussed in relation to local resonance. Particular attention will be focused on the effect of the geometrical parameters of the material periodicity on the dispersion characteristics of SH waves. Both infinitely layered material and finitely layered material will be considered. For infinitely periodic materials, dispersion relations will be obtained, and for finitely periodic materials, transmission coefficients will be discussed.

9. **Darren Narayan,** RIT

Research with Undergraduates: Towards a Characterization of Graphs with Distinct Betweenness Centralities

The betweenness centrality of a vertex v is the ratio of the number of shortest paths between two other vertices u and w which contain v to the total number of shortest paths between u and w. We consider the problem of characterizing all graphs with distinct betweenness centralities. We begin by solving the problem for all graphs with less than or equal to seven vertices. Next, we investigate graph properties such as density and minimality. Finally, we determine sufficient conditions for graphs with distinct betweenness centralities to be extended to infinite families of graphs of the same type. This is joint work with Ruth Lopez, California State University at Long Beach, and Jacob Worrell, Indiana University.

10. **Olympia Nicodemia,** SUNY Geneseo

Calculus: Closing the Equity Gap

I have spent the last year serving students from mathematically disadvantaged backgrounds in pre-calculus and calculus 1. I will briefly summarize some of the observations and questions prompted by this experience with the objective of establishing a continuing discussion of such matters within the Seaway Section.

Saturday Afternoon
Contributed Talks

11. **Sam Northshield**, SUNY Plattsburgh

Small Denominators and Their Corresponding Numerators

For two random numbers from the unit interval, there is a unique rational number of lowest denominator between them We study several aspects of the distribution of this random rational number R. Baney, Beslin, and DeAngelis first discovered the distribution of D, the denominator of R; a contribution I make is to prove that the expected value of D is 4. In this talk, I will also discuss the distribution the numerator of R, and make some connections with open problems in number theory.

12. **James Parkus**, RIT

Trajectories around Lagrange Points in the Restricted Three-Body Problem

In this paper we will present trajectories of a spacecraft moving in the gravitational field, considering the restricted three-body problem. We will study closed orbits around Lagrange points using Matlab.

Saturday Afternoon
Contributed Talks

Teachers' Masters Capstone Projects in Secondary and College Mathematics
Session Organizer, Keary Howard, SUNY Fredonia

These sessions are highlighted by the presentation of research results from secondary school mathematics teachers Masters theses. Topics and presenters include:

Session 1 Danielle Czerwinski: *Feared Fractions and Dreaded Decimals: A Study of College Students' Preferences Between Fractions and Decimals*. This research explores student understanding when solving routine fraction and decimal arithmetic problems. Specifically, it searches to unveil the misconceptions students have with both fractions and decimals, and if there lies a preference between the two when computing a solution both mentally, and on paper. It is hypothesized that non-major college mathematics students are likely to prefer fractions over decimals when given a routine problem involving fraction arithmetic. Additionally, students will prefer using decimals when given a problem involving decimal arithmetic. On the contrary, students will tend towards decimals when given an arithmetic problem involving both fractions and decimals, whether it is administered verbally or on a written assessment.

Session 2 Jacob Brostrom: *The Effectiveness of Teaching Constructions Using Straightedge and Compass Versus Using Technology.* This research investigates two different approaches to the teaching and learning of basic geometric constructions, namely straightedge and compass, and by use of technology. It is hypothesized that students will perform better when performing constructions using technology than when performing them by hand. Specifically, students who are able to use technology will have significantly higher scores than those who simply use a straightedge and compass.

Session 3 Nicole Sottilaro: *Sig Figs and Scientific Notation Confusion: Misunderstandings in Significant Figures and Scientific Notation*. This research focuses on student understanding of significant figures and scientific notation in mathematics and science. It is hypothesized that college students fail to recall the rules for significant figures. Furthermore, it is hypothesized that students will also have difficulties writing numbers in scientific notation when asked to write their answer to a certain amount of significant figures. More specifically, when students perform one of the four basic operations on numbers in scientific notation, they will forget that the rules of significant figures still apply.

Session 4 Elyssa Adams: *The Efficacy of Video-Based Learning in the Common Core Algebra Classroom.* This research examines the effects of video-based learning in comparison to traditional classroom instruction. Specifically, it explores the use of the online application Edpuzzle to implement a "flipped classroom" and compares student growth and engagement in comparison to those receiving traditional instruction. It is hypothesized that Common Core Algebra 1 students receiving instruction through a flipped classroom using Edpuzzle will demonstrate more growth in content knowledge than their peers receiving traditional instruction. Furthermore, it is also hypothesized that students will prefer to receive instruction via Edpuzzle opposed to traditional instruction.