

2017 Meeting of the Missouri Section of MAA  
Abstracts of Contributed Talks

Note: All contributed talks are in Plaster Hall.

Room

**FRIDAY: 2:30 - 3:00**

207 **Lori McCune - Choosing Another Voting Method**

In November 2016, the voters of Maine elected to use Ranked-Choice Voting (or Plurality with Elimination) in their elections for U.S. Senate, Congress, Governor, State Senate, and State Representative. In this talk, we will take a mathematical look at the voting methods of Plurality (Maine's original voting method) versus Plurality with Elimination and discuss how one might mathematically determine one voting method is better" than the other."

208 **Wayne Johnson - Stirling Numbers and the Dimension of a Highest-Weight Representation**

Combinatorial methods in representation theory have a rich history. We present some recent results on the interplay between the study of generating functions and the representation theory of a semisimple complex Lie algebra. We show how a simple combinatorial idea leads to a description of the dimension of any finite-dimensional irreducible representation of the Lie algebra. Along the way, we encounter some surprising combinatorial identities involving the Stirling numbers of the second kind, which give the number of ways to partition a set of  $n$  objects into  $k$  non-empty subsets.

212 **Charlie Smith - Beautiful Integer Patterns: Version 3.0**

This talk continues the investigation established in previous renditions, focusing on finite sums involving polynomials, exponentials, binomial coefficients, and their alternating counterparts. Formulas will be revealed which have been discovered independently by the presenter.

**FRIDAY: 3:00 - 3:30**

207 **Eric Briscoe - Using Computer Simulation to Investigate Differences in Voting Methods**

We examine four different methods of ranked voting: Borda, Copeland, Instant Runoff, and Iterated Borda, and determine the frequency with which these methods produce different winners or opposite rankings from the same sampling of votes. We simulate elections involving three candidates and randomly assign voters to one of the 6 possible rankings and use these votes to compare the different methods. Each method is compared to each other method 100,000 times using a group of voters consisting of 100 to 1000001 individuals.

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208 **David Lindow & Samuel Chamberlain - Straightening Identities in Twisted Multiloop Lie Algebras**

Twisted multiloop Lie algebras are generalizations of affine Kac-Moody Lie algebras, which have numerous applications in mathematics and physics. In some of these twisted multiloop algebras we have formulated and proved various straightening identities, which allow one to understand how certain products can be reordered. Such identities can be used to better understand the structure of these non-commutative algebras and their representations.

212 **Mark Rogers & Cameron Wickham - Polynomials Inducing the Zero Function**

The set of polynomials that induce the zero function on the coefficient ring is an ideal; this talk is about generators of that ideal.

215 **Andrew Crutcher - Playfair Cipher**

In this talk, we will discuss the Playfair cipher, a digraph substitution cipher created in the 1800s. We will go over a bit of the history, the encryption/decryption process, and then some cryptanalysis of this cryptosystem.

**FRIDAY 3:30 - 4:00**

208 **Hang Chen & Curtis Cooper - Sudoku: Alternating Cycles - Part i**

We relate some structures in Sudoku puzzles to graph objects - alternating cycles. It allows us to solve some hard puzzles. Adjacency matrices help us in generating some interesting Sudoku puzzles.

212 **Rebecca Miller - Sage: An Introduction**

SAGE is an open source mathematical software started in 2005. It is much like Mathematica and Maple, except with the bonus fact that it is free and open-source. It also has a higher level of functionality than Mathematica or Maple. It is ever growing and changing with a new, non-beta version being released every few months. In this talk we will discuss the history of SAGE, give an introduction on how to use it, and talk briefly about how you can add functionality and get your students involved. My work for the sage-dynamics project whose goal is to improve the Sage for computer exploration in dynamical systems and foster code sharing between researchers in this area.

215 **Kevin Anderson - Proving That e is Irrational**

A proof of the irrationality of "e" will be presented that should be accessible to everyone. If you haven't seen a proof that "e" is irrational now is your chance!

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**FRIDAY 4:00 - 4:30**

207 **Phoebe McLaughlin & Jean Tao - An Optimal Pension Funding Under Stochastic Investment Returns**

In this talk we will present a dynamic funding model for defined benefit pension plans. A stochastic control technique is applied to find the optimal funding by minimizing the risks associated with pension plans. The investment rates of return are considered to be stochastic following moving average models.

208 **Curtis Cooper & Hang Chen - Sudoku: Alternating Cycles - Part ii**

We relate some structures in Sudoku puzzles to graph objects - alternating cycles. It allows us to solve some hard puzzles. Adjacency matrices help us in generating some interesting Sudoku puzzles.

212 **Zdenka Buadarrama - Use Your Art to Experience the Math**

This talk will illustrate different ways in which art can be used to enhance the learning of mathematics, and will showcase examples of art projects and objects which my students and I have used for the exploration, analysis and synthesis of mathematical concepts. I will argue that the interactions between art and math provide a great platform for reflection and creation of new mathematical ideas. I will demonstrate my arguments with a little in-talk activity. Come prepared to put your hands to work and use your creativity!

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**SATURDAY 8:30 - 9:00**

207 **Daniel Daly & Laurie Wern Overmann - Is Combining College Algebra and Intermediate Algebra Possible?**

In Spring 2016, Southeast Missouri State University began to devote serious thought to the possibility of creating a co-requisite course combining College Algebra and Intermediate Algebra. We built a five-credit hour course centered on the idea of developing student proficiency with broad families of functions. Students can enter this course with the prerequisites required for a Developmental or Intermediate Algebra course, but, if successful, leave with a course satisfying their College Algebra requirement. Highly-motivated students with a strong work ethic were encouraged to enroll in a pilot version of this course for Spring 2017 which is a mixture of lecture and group activities. The environment is designed to encourage questions and develop mathematical reasoning. Thus far, the results have been promising.

208 **Jonathan Rehmert & Brandt Kronholm - Integer Partition Theory**

The partition function counts how many ways a natural number can be written as the sum of natural numbers. The restricted partition function counts how many ways a number can be written as the sum of a fixed number of natural numbers. This paper examines divisibility properties of these functions including original results proven by the author.

**Saturday 9:00 - 9:30**

207 **Aladar Horvath - The Development of Function Composition Across the Curriculum**

Composition of functions can be understood with functions as processes or as objects. It is important for students to grasp both perspectives in order to establish a deep understanding of composite functions. This session will discuss the development of function composition in the algebra to calculus curriculum. I will also share problems to promote a broader knowledge of function composition.

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208 **Nicholas Baeth - Spectacularly Non-unique Factorizations**

The Fundamental Theorem of Arithmetic states that every integer larger than 1 factors uniquely as a product of primes. The human brain enjoys this structure and erroneously presumes this is the usual way of things. It is often in a first (or second) course in abstract algebra that students are introduced to the idea that unique factorization is not a property shared by algebraic structures. More often than not, however, the examples explored in such courses are rather benign and do not give students a sense of how wild factorization can be. In this expository talk I will discuss the ubiquity of non-unique factorizations and give many examples of rings and semigroups where factorization fails spectacularly.

**SATURDAY 9:30 - 10:00**

207 **Gavin Waters - Improvements via Placement Exam at MWSU**

A data talk about who and how we targeted students to place them into courses that they would be more successful.

Lots of data, and descriptions on how to set up your own open source Mathematics Placement Exam.

208 **Rebecca Miller - TFAE**

At the beginning of the 20<sup>th</sup> century the Axiom of Choice changed the face of mathematics. Its uses have allowed mathematicians to prove what was once deemed unprovable, and have even allowed us to find the paradoxical. This led to major controversies surrounding the Axiom of Choice. In this talk we will discuss the development of the AC, the controversy around it, major theorems we have proved with it, as well as the mathematicians involved. A perfect talk to let you spice up the next time you prove AC's equivalency with controversy and historical fact!

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SATURDAY 10:00 - 10:30

207 **Ahmad Talafha & Emmanuel Thompson - European Option Valuation: An Econometric Approach**

The world of finance has changed significantly in recent years. As many countries struggle to recover from the shock of recent financial crisis, it is obvious that we do not want to stand another crisis like the global financial crisis. Nevertheless, it is imperative to study the past behavior in order to prevent future financial crisis. Valuation of stock price proved to be difficult to determine, and to this day there is no agreement among financial economists about what the price of a given stock should be. An option is a derivative contract that has a value determined by the price of some underlying risky asset such as a stock. The value of an option is easily obtained from the Black-Scholes (BS) equation in terms of many quantities which are assumed to be known and fixed. It is important to add that the assumptions underlying the BS formula are unrealistic and too restrictive. This paper relaxes some of the assumptions by empirically motivating the equity price process within the framework of a vector autoregressive (VAR) process using stock indexes and the constant risk-free rate replaced by a process emanating from a cointegrated VAR model based on treasury securities. However, we estimate the value of the European call options and then compare them to the corresponding values from the standard BS model using Monte Carlo (MC) simulation. Also, the applicability of the antithetic variate as a variance reduction technique to improve the accuracy of our MC estimates will be explored.

208 **Pam Ryan - The Intercollegiate Biomathematics Alliance and How It Can Benefit Your Students**

At Truman State, we had funding for undergraduate research projects in mathematical biology through an NSF UBM grant until 2016. However, that grant no longer exists. Olcay Akman, a professor at Illinois State University, realized that all smaller schools were dealing with these same issues. He started the Intercollegiate Biomathematics Alliance (IBA). This group of nine schools (to date) share resources (computer, faculty, students) to give students the opportunity to work on exciting undergraduate research projects in mathematical biology. I will give an overview of the IBA and some of the research projects that are available.