2014 ISMAA Annual Meeting
Plenary Speakers

Friday, 12:50pm – 2:00pm, Peck Hall 1402

Tony Giaquinto, Loyola University

Prime Fascinations

This talk will be survey on the rich history of prime numbers, from Euclid to Riemann, and to the breakthroughs this past year on gaps between primes. The latter topic has undergone intense study since Yitang Zhang unleashed his "Bounded Gaps Between Primes" to the mathematical world in the spring of 2013. As of this writing, the Polymath project reports that there are infinitely many pairs of primes separated by at most 270.

Friday, 7:30 - 8:30pm, Morris University Center Conference Center

Rick Gillman, Valparaiso University

Why do Left-handed People Survive?

This talk explores the question of why people are predominately right-handed, a trait shared by no other species. It answers the title question by considering the cultural, biological, and genetic explanations for our left-handedness. Two evolutionary game theoretic models are offered to explain why it may have been advantageous (from an evolutionary perspective) to have a fraction of the population be left-handed.

Saturday, 8:30 - 9:30am, Peck Hall 2304

Sharon Robbert, Trinity Christian College

Leading by example? Mathematics in 21st Century Academia

In May of 2013, the National Academy of Sciences published a Research Council report of more than 200 pages called The Mathematical Sciences in 2025. While the conclusions of this report may not fit with every academic setting, this fact remains: the academic world is changing yet again and mathematics faculty have an opportunity to lead the way. In this talk, I will summarize conclusions from this report, discuss how the mathematics academic community has benefited from disruptive innovation in the past, and pose conjectures on the future.

Saturday, 12:10 - 1:10pm, Peck Hall 2304

Steven Krantz, Washington University St. Louis

A Matter of Gravity

We study the concept of center of gravity from a new point of view. The question of when the center of gravity is contained in the region is considered. New results are obtained both in two dimensions and in higher dimensions. Especially interesting are asymptotic results as the dimension goes to infinity.

2014 ISMAA Annual Meeting
General Session Speakers

Fatjona Aliaj, Benedictine University (undergraduate)

with Andriana Saric

Advisor: Manmohan Kaur

Decryption of "Omaha" through formal concept analysis

During an interview with Entertainment and Sports Programming Network (ESPN), Peyton Manning, the quarterback of the American football team the Denver Broncos, explained that the meaning of the play call Omaha, "varies on which way we [the Broncos] are going, the wind, the quarter, and the jersey which we [the Broncos] are wearing". According to Manning, this play call can have three possible outcomes: pass play, run play, or pass-action play. Interpretation of American football has been analyzed through development of algorithms which use artificial intelligence to understand and predict plays (Lazarescu et al. 1999). In addition, formal concept analysis establishes a relationship between human interactions and lets one predict future human interactions (Blohlávek 2008). In this project, we attempt to create a concept lattice comparing the independent and dependent variables used by Manning and to devise an algorithm to decrypt the meaning of Omaha.

Jeremy Alm, Illinois College

Easy to State, Hard to Solve: Covering points in the plane with unit disks

Given a set of k points in the plane, can you cover them with unit disks that don't overlap, except at their boundaries? It is easy to show that any set of 3 points can be covered, no matter their positions. For 4 or more points, naïve "disk-shifting" arguments get bogged down in case-analysis. Fortunately, a non-constructive proof can be given that any set of 10 points in the plane can be covered; the proof uses *linearity of expectation*, a simple but powerful technique from probability theory. There is also a constructive proof, suggested by Peter Winkler, that is straight from The Book. We will conclude with some interesting questions, as well as a new result that "most" of the points of any countable point set without accumulation points can be covered.

Fedor Andreev, Western Illinois University

Quaternion Iterations in Locally Invariant Planes

The derivative of Newton's iteration function at a fixed point is generally zero. For iterations over quaternions, the null-space of the derivative has dimension two, leaving the other two dimensions as a locally invariant plane through a fixed point. In order to visualize the convergence of methods such as Newton's method, an analogue of Newton's fractal is constructed. It is argued that the locally invariant plane presents a natural choice for the visualization plane. Conditions, under which the locally invariant plane becomes a globally invariant, are studied.

Andrew Bartlett, Southern Illinois University Edwardsville

Extreme Value Estimators for Various Non-Negative Time Series with Heavy-tail Innovations

Extreme value theory is a new exciting branch of statistics that is devoted to studying the phenomena governed by extremely rare events. The modeling and statistics of such phenomena are tail dependent and vary from classical modeling and statistical analysis, which give primacy to central moments, averages, and the normal density, which has a light tail and are often labeled as outliers and even ignored.

In this talk, we propose extreme value estimators for various non-negative time series, where the innovations are positive random variables with regular variation at both the right endpoint infinity and the positive left endpoint θ. For certain estimation problems like this one, the presence of heavy tails can provide the setting for exceedingly accurate estimates.

Within each model, we provide estimates for the model parameters with respect to an extreme value criteria. Through the use of regular variation and point processes the limit distribution for the proposed estimators are obtained. An extensive simulation study will be presented to first, asses the small sample size behavior and reliability of our proposed estimates and secondly to compare the performance of our extreme value estimation procedure and that of traditional and alternative estimation procedures.

The main goal of our proposed methods is to capitalize on the behavior of extreme value estimators over traditional estimators when the regular varying exponent β is $0 < \beta < 2$. In this heavy-tail regime, extreme value estimators converge at a rate faster than square root n. If a practitioner can entertain an infinite variance time series model, then methods such as the one proposed in this talk should receive consideration and even more so if an infinite mean time series model.

Dana Cairns, Benedictine University (undergraduate)

Advisor: Timothy Comar

Integrated Pest Management with a Mixed Birth Rate for Prey Species

X. Song and Z. Xiang (2006) developed an impulsive differential equations model for a two-prey one-predator model with stage structure for the predator. They demonstrate the conditions on the impulsive period for which a globally asymptotically stable pest eradication periodic solution exists, as well as conditions on the impulsive period for which the prey species is permanently maintained under an economically acceptable threshold. We extend their model by including stage structure for both predator and prey as well as by adding stochastic elements in the birth rate of the prey. As in the paper by Song and Xiang (2006), we find the conditions under which a globally asymptotically stable pest eradication periodic solution exists for our system and find conditions under which our system is permanent.

Xinwei Chen, Benedictine University (undergraduate)

Advisor: Ellen Ziliak

Geometry of Quasigroups and Its Applications

A quasigroup is a binary operation whose multiplication table is a Latin square. In this talk, we will see how one can use a Cayley graph to visually study properties of a quasigroup. A Cayley graph is a directed graph that encodes the multiplication table for an algebraic structure. In this talk, the structure we will focus on is a quasigroup. We will illustrate how these graphs can be used to study the security of cryptographic schemes based on quasigroups. In addition, we will show how this work can be related to classification problems related to quasigroups.

Anthony DeLegge, Benedictine University

with Taliha Nadeem, Rachel Nicinski

An Epidemic Model with Different Susceptibility Classes

Consider the common cold, or even the flu. Chances are, when someone in your house gets one of these illnesses, it will spread to others in your house. But, not everyone is affected equally. For example, you may end up with fairly mild symptoms that don't affect your daily activities, but your spouse may end up bedridden for days, while your daughter might not get sick at all! Now, imagine this on a larger scale: Some people in a population will have higher susceptibility to a disease than others, and this will affect the spread of the disease throughout the population.

This project concerned setting up and analyzing a model to account for this in hopes of answering the question: If we only could vaccinate/quarantine those highly susceptible individuals, will that be enough to cause the disease to die out? In this talk, we will discuss the model and what it tells us in response to this question.

Alexa Dokter, Trinity Christian College (undergraduate)

with Dave Klanderman, Bill Boerman-Cornell

Advisor: Dave Klanderman

Dimensional movement, Expanding Dimensions, and Propelling through Space: A look at Higher Dimensionality as seen through Harry Potter

Mathematics is one of the hardest subjects to understand and relate to for students, so why not try to explain mathematical ideas by connecting to a popular work of literature such as the Harry Potter series by J. K. Rowling? Higher Dimensionality can be explained through examples from the literature. In this research, the focus was on a typology with five categories: three dimensions within two dimensions, movement that goes from two dimensions to three and back again, higher dimensionality within three dimensions, higher dimensional movement, and higher dimensional traces. Each idea has an abstract concept that is grounded in mathematics that can then be illustrated through examples from the Harry Potter text. Through this typology you will be able to connect two different disciplines to better reach those who are not interested in these abstract concepts. In this talk we will look in detail at the different mathematical concepts and provide specific examples from the Harry Potter series to illustrate how each idea can be viewed. This will help to shed light on how to explain a more complicated idea in a setting that students are more comfortable.

Meagan Donahue, Illinois College (undergraduate)

Advisor: Patricia Kiihne

Continued Fractions

Leonhard Euler's paper *De fractionibus continuis dissertatio* (An Essay on Continued Fractions) provided a foundation for mathematical work in continued fractions. In this talk, I examine contributions from this paper, including definitions and examples of continued fractions. Moreover, I will look at some ways continued fractions affect contemporary mathematics.

Heather Dye, McKendree University

Virtual (and More) Knots

This talk is an introduction to virtual knot theory and the multiverse of combinatorial knot theories. I will introduce the basic concepts, provide references and talk about generating research problems in combinatorial knot theory.

Tarek Elashmawi, Benedictine University (undergraduate)

with Bassma Harajli

Advisor: Manmohan Kaur

A Summary of Current Research in Quantum Cryptography

In this presentation, we describe the use of the principles of quantum mechanics for cryptographic purposes. In particular, we will describe quantum key distribution, explain how it is used in cryptography and discuss its security. We will also assess the limitations of the security of quantum key distribution and explain how it can theoretically be hacked. We will then discuss some of the practical uses of QKD, including when and where we can expect to see it implemented in the future.

Jacob Gaier, Augustana College (undergraduate)

Advisor: Brian Katz

Red vs. Blue

We will discuss a generalization of Conway's Game of Life, where the cells have two colors: red and blue. We will show examples of different interaction types.

Gregory Galperin, Eastern Illinois University

Geometry of Quaternions

Complex numbers describe motions of Euclidean plane; in particular, rotations around the origin are described by unit complex numbers. To describe rotations of the Euclidean 3D-space, one needs to use 4 numbers. These 4 numbers come from vectors of the Euclidean 4D-space $\mathbf{R}^4$ and are called *quaternions*. Like complex numbers, quaternions can be added, multiplied, and divided by each other. Moreover, the quaternions can describe rotations of the 3D-space: the standard scalar and vector products of two vectors are just two shards of the quaternion product. Using quaternions, I will explain how to represent the product of two axes rotations in the 3D-space as one rotation around a third axis. If time will allow, I will explain the quaternion construction of the Hopf Fibration – a natural map $S^3 \to S^2$.

Marihan Hegazy, Benedictine University (undergraduate)

Advisor: Tim Comar

The Structure of the State Transition Graph for Boolean Models of Gene Regulatory Networks with Two Feedback Circuits

Relationships between network structure and dynamics have been under investigation for a long time. Thomas (Thomas, 1995) conjectured conditions for multistability and the existence of attractive cycles in networks with one feedback circuit, which are the existence of a positive circuit and negative circuit, respectively. This presentation looks to extend the results of Thomas to networks with two feedback circuits. As general results are not yet possible, we restrict our investigation to networks with a Hamiltonian circuit being one of the two circuits and one gene X_i acted upon by two genes using the synchronous Boolean updating model. We find using the XOR logical gate results in a state transition graph that differs from using the AND and OR logical gates. In addition, we find that the sign of the feedback circuits influence the existence of cycles and fixed points in the AND and OR logical gates.

Miranda Henderson, Benedictine University (undergraduate)

with Marihan Hegazy

Advisor: Timothy Comar; Daniel Hrozencik

A Comparison of the Boolean and Continuous Dynamics of Three-Gene Regulatory Networks

We investigate the dynamics of three-gene regulatory networks with one feedback circuit using the Boolean and continuous models put forth by Gehrmann Drossel (2010). We specifically comment on the influence of the sign of feedback circuits on the dynamics of both models for three-gene networks. We establish the existence of Hopf bifurcations in the continuous models and use these bifurcations to compare the models more closely and determine when these models are in agreement.

Nicholas Hommowun, Illinois College (undergraduate)

with Aaron Schneider

Advisor: Jeremy Alm

Mixed Ramsey numbers involving trees of small diameter

For graphs G and H, let $R(G, H)$ denote the least N such that any edge-coloring of K_N in two colors contains either a copy of G in the first color or a copy of H in the second color. We study $R(G, H)$ where G is a tree of small diameter, and H is either a tree of diameter 2 or a complete graph.

Ki Yeun Kim, University of Illinois at Urbana-Champaign (graduate)

with Y. Baryshnikov, V. Blumen, and V. Zharnitsky

Advisor: Vadim Zharnitsky

Billiard dynamics of bouncing dumbbell

A system of two masses connected with a weightless rod, called dumbbell, interacting with a flat boundary is considered. The sharp bound on the number of collisions with the boundary is found using billiard techniques. In case the ratio of masses is large and the dumbbell rotates fast, we prove that there exists an adiabatic invariant of the dumbbell system, given by $I = |\dot{\phi}|(\pi - \arccos y)$, where $\dot{\phi}$ is the angular velocity of the dumbbell and y is the vertical distance from the center of mass of the dumbbell to the boundary. This is a joint work with Baryshnikov, Blumen, and Zharnitsky.

Yasanthi Kottegoda, Southern Illinois University Carbondale (graduate)

Advisor: Dr. Robert Fitzgerald

The number of zeros of linear recurring sequences over finite fields

I discuss the possible number of zeros of a homogeneous linear recurring sequence over a finite field $\mathbb{F}_q$, based on an irreducible polynomial of degree d and order m as the characteristic polynomial. I give upper and lower bounds on the cardinality of the set of number of zeros. The set is determined when $t = (q^d - 1)/m$ has the form $q^a + 1$ or $q^{2a} - q^a + 1$ where $a \in \mathbb{N}$. The connection with coding theory is a key ingredient.

Elizabeth Manary, Illinois College (undergraduate)

Advisor: Jeremy Alm

Embedding the lattice M_ℓ as a 0-1 sublattice in subgroup lattices of direct powers of $\mathbb{Z}_n$

Let M_ℓ denote the lattice with top element, bottom element, and ℓ pairwise-incomparable atoms. If M_ℓ appears as a 0-1 sublattice in $\mathrm{Sub}(G)$ for a finite abelian group G, then the top element of M_ℓ is G, the bottom element is $\{e\}$, and the atoms $H_1, \ldots, H_\ell$ are subgroups satisfying $H_i \cap H_j = \{e\}$ and $H_i H_j = G$ for all $i \neq j$. For $G = \mathbb{Z}_n^N$, we have the following:

(1) If N is odd, then the maximum ℓ is 2;
(2) if $N = 2$, the maximum ℓ is $p + 1$, where p is the smallest prime dividing n; and
(3) we conjecture that for $N = 2k$, the maximum ℓ is $p^k + 1$, where p is the smallest prime dividing n.

Mojtaba Moniri, Western Illinois University

with Iraj Kalantari

On "Guess the Next Number" Type of Questions

Have you not seen questions when a finite sequence (often quite short) of positive integers is presented and the task is to pick the next term? And isn't it true that usually the longer the given initial segment, the more confident the solver feels about the intended next term they find. However, there are concrete examples with equally natural distinct possibilities even when the first several hundred trillions or more terms are given. The competing defining formulas need not involve anything beyond just a few very basic functions and constants as we illustrate.

Aleesha Moran, Southern Illinois University Edwardsville (graduate)

with Jason Haarmann

Advisor: Roberto Pelayo (Hawaii)

Factorization Properties of Leamer Monoids

The Huneke-Wiegand conjecture has prompted much recent research in Commutative Algebra. In studying this conjecture for certain classes of rings, García-Sánchez and Leamer construct a monoid S_Γ^s whose elements correspond to arithmetic sequences in a numerical monoid Γ of step size s. These monoids, which we call Leamer monoids, possess a very interesting factorization theory that is significantly different from the numerical monoids from which they are derived. We offer much of the foundational theory of Leamer monoids, including an analysis of their atomic structure, and investigate certain factorization invariants. Furthermore, when S_Γ^s is an arithmetical Leamer monoid, we give an exact description of its atoms and use this to provide explicit formulae for its Delta set and catenary degree.

Tung Nguyen, Illinois Wesleyan University (undergraduate)

with Tian-Xiao He

Advisor: Tian-Xiao He

Construction of Spline Type Orthogonal Scaling Functions and Wavelets

In this talk, we present a method to construct orthogonal spline-type wavelet. B-spline functions have several useful properties such as compactly support and refinement relationship. However, except for the case of the first order, B-splines of order greater than one are not orthogonal. To induce the orthogonality while keeping the properties of B-splines, we use a class of polynomial function factors to transform the original B-splines to a spline-type orthogonal compactly-supported and refinable scaling functions in L^2. In this paper we establish the existence of this class of polynomial factors and their construction. In addition, the corresponding spline-type wavelets and the decomposition and reconstruction formulas for their Multi-Resolution Analysis (MRA) are given.

Todd Oberg, Illinois College

Elementary and Middle Grades Program Redesigns Updates

This talk will serve two purposes. The first will be to update institutions of higher education on the ISBE rules for Elementary and Middle Grades Endorsements (Parts 20 and 21), and what needs to be done for programs to be re-approved by ISBE under these rules. The second will be an opportunity for institutions to discuss and share ideas and models for redesigning programs.

Jim Olsen, Western Illinois University

Teacher Education Session: Update on CCSSM, PARCC, and the Model Curriculum

In this session we will look at new materials that have come out regarding the Common Core State Standards for Mathematics (CCSSM) and recent information and newly released items from the Partnership for Assessment of Readiness for College and Careers (PARCC). The PARCC assessments will be given in grades 3-11 in spring 2015. In addition we will look at the Illinois Model Curriculum, which has grown significantly in the past year. Ideas for using the Illinois Model Curriculum in teacher education courses will be shared.

Melanie Pivarski, Roosevelt University

with Lee Gibson

Isoperimetry and the Sierpinski Carpet: Describing regions in space

Suppose you want to enclose the largest area that you can using the smallest amount of fence (perimeter). In the plane, we can do that with a circle. But what happens if we have lakes in the plane, and don't need to fence in that portion? What if we have a fractal pattern of lakes? In this talk we'll look at the case of the fractal blow-up of the Sierpinski carpet, which is created by iteratively removing the middle square from a 3 by 3 grid and enlarging the size. We'll use series to describe how the maximum area enclosed by a length varies as we change the length.

Mubashir Razvi, Benedictine University (undergraduate)

Advisor: Manu Kaur

The Road to Securing Security

Proofs in cryptography are not quite the same as proofs in other fields of mathematics, relying heavily on assumptions and constrictions of approaches in order to assure "security" of a particular algorithm or system. However, is this really "secure", or is it merely a semblance of security? This paper will discuss the limitations of the modern approach to proving the security of a cryptosystem, touching upon the differences between proofs in other fields of mathematics and cryptography. Examples, such as RSA and elliptic curve, will be used to illustrate the idea, and some changes to the approach will also be suggested, not as outright solutions, but as means to reaching a more ideal paradigm.

Benjamin Reiniger, University of Illinois at Urbana-Champaign

with Nicholas Kosar, Sarka Petrickova, Elyse Yeager

List-coloring powers of graphs

Recently, Kim and Park have found an infinite family of graphs whose squares are not chromatic-choosable. Xuding Zhu asked whether there is some k such that all kth power graphs are chromatic-choosable. We answer this question in the negative: there is a positive constant c such that for any k there is a family of graphs G with $\chi(G^k)$ unbounded and $\chi_\ell(G^k) \geq c\chi(G^k)\log\chi(G^k)$. We also give an easy upper bound on the choosability of kth powers. The talk will start with an introduction to list coloring.

Jonathan Schram, Benedictine University (undergraduate)

Advisor: Manu Kaur

Security of Public Key Cryptosystems based on the Discrete Logarithm Problem

Cryptography is the science and mathematics behind secret messages. It is required for secure communication all over the Internet or local networks, such as in email, online shopping, and smart cards. Our studies concern the security of cryptosystems built from the Discrete Logarithm Problem. While theoretical cryptographers are primarily concerned with security, practitioners that implement cryptosystems are more interested in efficiency. This research attempts to bridge this gap through implementations of various cryptosystems in Maple.

Vali Siadat, Richard J. Daley College

with Euguenia Peterson, Cyrill Oseledets, Ming-Jer Wang

Component Study of Cooperative-Learning and Frequent-Quizzing Effects in Keystone Methodology

In this presentation we will discuss the experimental design of the component study of cooperative-learning and frequent-quizzing effects in the Keystone methodology. In the previous presentations, the synergistic effects of the Keystone methodology had been presented. However, there was no study about the influence of individual components and their interactions. This experiment will address these questions in more details and will enhance our understanding of the overall Keystone methodology effect.

ABDALLAH TALAFHA, SOUTHERN ILLINOIS UNIVERSITY CARBONDALE (GRADUATE)

with Henri Schurz

Advisor: Henri Schurz

Modified Stochastic Sine-Gordon Equation

Consider the SPDE with multiplicative noise (Modified Stochastic Sine-Gordon Equation):

$$u_{tt} = \sigma^2 u_{xx} - \alpha u_t - \delta \sin(\|u\|^\gamma) + b(u, u_t)\frac{dW}{dt}$$

where $\gamma > 0$ is the parameter of the power of non-linearity, $\delta \geq 0$ is the magnitude of non-linearity, $\alpha > 0$ is the damping parameter, and $\sigma \in \mathbb{R}$ the diffusion intensity, on one- dimensional domain. We analyze the properties of the solution of the SPDE by the eigenfunction approach allowing us to truncate the infinite-dimensional stochastic system (i.e. the SDEs of Fourier coefficients related to the SPDE), to controal its energy, existence, uniqueness, continuity and stability. The expectation of the Lyapunov functional in terms of system-parameters.

CYRUS TURNER, MONMOUTH COLLEGE (UNDERGRADUATE)

with Michael Sostarecz

Advisor: Michael Sostarecz

Experiential and Computational Flow Visualization

This talk examines steady fluid flow experimentally using particle tracking velocimetry. The rate of steady flow past a certain length scale is directly related to a dimensionless quantity known as the Reynolds number. Using computational software and a flow tank, this talk unites the experimental and the theoretical through this dimensionless physical quality.

WILFREDO URBINA-ROMERO, ROOSEVELT UNIVERSITY

with Robert Di Martino

Staking Cantor sets

We explore the geometric and measure-theoretic properties of set built by staking different types of Cantor-like sets.

BAILEY WEBER, BENEDICTINE UNIVERSITY (UNDERGRADUATE)

Advisor: Manmohan Kaur

Cryptography During World War II

The Nazi military used Enigma to send encrypted messages throughout occupied Europe during World War II. The breakthrough cracking of the Enigma code by the Polish and then the Allied troops greatly affected the outcome of the War. In this presentation, we will describe the working of the Enigma machine and how it was finally broken. We will also discuss the contribution of women and technology and how it led to permanent changes to the society.

Ming-Jer Wang, Richard J. Daley College

with M. Vali Siadat, Euguenia Peterson, Cyrill Oseledets

Initial Observational Study of Cooperative Learning in Intermediate Algebra Classes

In this presentation we will discuss the results of an initial observational study of cooperative learning techniques which is one of the crucial components of the Keystone methodology and learning community approach. The preliminary result of this project provides a piece of positive evidence for applying the cooperative learning techniques which could possibly resolve some of the problems we face in classroom. The findings could also be used to tackle the challenge of national mathematics education once it is verified to be effective in general educational settings.

Kimberly Wenger, Illinois Wesleyan University (undergraduate)

with Dan Roberts

Advisor: Dan Roberts

In Pursuit of the Ringel-Kotzig Conjecture: Uniform k-distant Trees are Graceful

Graph labeling has been an active area of research since 1967, when Rosa introduced the concept. Arguably, the biggest open conjecture in the field is referred to as the Ringel-Kotzig conjecture, which states that all trees admit a graceful labeling. In this talk, we will give a bit of background on the problem, as well as present our own results. Namely, that a certain infinite class of trees (called uniform k-distant trees) admits a graceful labeling.

Mason Williams, Benedictine University (undergraduate)

Advisor: Ellen Ziliak

Making Blankits to Cover Cold Integers

In this talk I will discuss some of the history and applications of covering systems. The purpose of this research was to explore Erdos style blankits which form successful covering systems of the set of integers. A *blankit* is a collection of congruence classes a_i mod m_i with $1 \leq i \leq k$. A blankit is called a *covering system* or *cover* if every integer n satisfies at least one of the congruences n $\equiv a_i$ mod m_i. An Erdos style covering system is one in which there is a smallest m_1 and these covers are created using all divisors of some number as the moduli. Using GAP and previously established theory, I have attempted to find all the covering systems that exist for a lowest moduli of 2 and 3 using divisors of 12 and 120 as moduli respectively. I will explain why using divisors of a fixed number is required to create a covering system. My ultimate goal is to use these findings to come up with a count and a set of rules that describe all possible covers for a given lowest moduli.

Ellen Ziliak, Benedictine University

An investigation of generalized symmetric spaces of $SL_2(\mathbb{F}_q)$ and $GL_2(\mathbb{F}_q)$

In this talk I will illustrate the computer algebra system GAP can be used to study a classification problem. The inclusion of software can be a useful way to make progress on a problem without the requirement of developing a deep foundation in a particular field. This is extremely important when working with undergraduates. I will illustrate this process by showing how we discovered and classified the generalized symmetric spaces of $SL_2(\mathbb{F}_q)$ and $GL_2(\mathbb{F}_q)$. Additionally these techniques have lead to preliminary similar results for $SL_3(\mathbb{F}_q)$.