Mathematical Association of America
MD-DC-VA Section, April 28 & 29, 2017
Frostburg State University
Abstracts

Abstracts for the workshop and invited addresses are listed first, in chronological order, followed by faculty and graduate student abstracts, alphabetized by submitting presenter's last name. Student presentation abstracts follow, with student poster abstracts at the end (also alphabetized by submitting presenter's last name).

Invited Addresses

FRIDAY WORKSHOP

Cassie Williams, James Madison University
Amy Ksir, United States Naval Academy
Mitch Keller, Washington and Lee University
How to Use as Much Inquiry as You're Comfortable with in Your Calculus Class
4:00 PM, Room 156, Gira Center

Using inquiry in the mathematics classroom has gained popularity in recent years, and has been persistently supported by education research. Across the United States, the amount of inquiry being used in calculus courses varies widely, from occasional activities to fully IBL courses. Wherever you currently are on this spectrum, this workshop is designed to help you successfully move up a notch, and incorporate an amount of inquiry that you are comfortable with. In this workshop, we will discuss a variety of ways to effectively include inquiry in any calculus class. Whether you're looking to include occasional activities, regular tasks, or change your entire course structure, we have ideas (and materials) for you!

BANQUET ADDRESS

Laura Taalman, James Madison University
FAIL: A Mathematician's Apology
8:00 PM, Room 397, Gira Center

The job of being a math professor primarily consists of long periods of failure punctuated by short bursts of success which later seem to be somewhat obvious. But that's what we love about it. In this banquet talk we'll take a journey through many failures and try to laugh about it the best we can.

SATURDAY INVITED ADDRESSES

Paul Humke, St. Olaf College and Washington & Lee University
A Voyager from the Fourth Dimension
9:55 AM, Room 218, Dunkle Hall

When speaking about The Fourth Dimension I'm invariably asked "How do you know this is what the 4^{th} dimension really looks like?" My answer is "I know because my students and I used the computer to make a four dimensional world and then used the monitor as a window to view it." There is nothing magical or new in what we did (it is only elementary linear algebra), but there **is** a bit of magic in what you'll see.

Alissa Crans, Loyola Marymount University
Frosting Fairness, Finally!
3:45PM, Room 218, Dunkle Hall

Many of us are familiar with how to slice a cake ensuring equal sized slices for all. But what about those of us who want an equal amount of frosting as well?! This question is a classic with the problem solvers amongst us. In 1975, Martin Gardner considered a square cake cut into 7 pieces in his Scientific American column. More than a decade earlier, H.S.M. Coxeter posed the problem for a square cake sliced into 9 pieces as an exercise in his book, Introduction to Geometry. Together, we will solve this problem for a square cake cut into 5 pieces, and investigate the other cake shapes for which the same procedure will produce slices with equal cake and frosting.

Contributed Faculty Papers by Author

Abdinur Ali, Norfolk State University
Chung-Chu (George) Hsieh, Norfolk State University
Mushtaq Khan, Norfolk State University
Application of Cycle-Free Graphs for Data Security in Large Distributed Systems
9:25 AM, Room 264, Gira Center
The security issues of distributed systems are truly astounding. Analysis of these large systems can be done by investigating the characteristics of the parts and the connections of the vast web of nodes. The major problem of analyzing the distributed networks is that the key players are anonymous. The classical concepts of central nodes and key players for connected graphs cannot be easily quantified. Therefore, the focus of this research is to explore the invisible topographies of these complex networks and the in-depth identifying of the graph evolution. The graph evolution is used to discover the changes of the internal logical structures over time for these complex graphs. In this paper, we will cover graph algorithms for cycle free graphs. This material is based on research sponsored by the Office of the Assistant Secretary of Defense for Research and Engineering (OASD(R&E)) under agreement number FAB750-15-2-0120.
Content Area: Applied Mathematics
Recommended for Students: Yes

Frank Barnet, Frostburg State University
A Brief Geometrical Tour of Artificial Gravity in a Rotating Space Station
8:35 AM, Room 221, Gira Center
All free trajectories in the artificial gravity inside a rotating space station can be understood in terms of classical curves such as the involute of circles, Archimedean spirals, and the pedal curve of the involute of a circle. This presentation will be illustrated with several short 3D animations.
Content Area: Physics, Geometry, Trigonometry, Space Science
Recommended for Students: Yes

Jim Blowers, Retired Independent Mathematician
Polynomial Equations and Tangents
9:25 AM, Room 333, Gira Center
Recently a problem from brilliant.org appeared on Facebook asking for the sum of three angles in a 3x3 grid. This is equivalent to evaluating tan(arctan(1)+arctan(2)+arctan(3)). We will show the relationship between roots and coefficients of polynomial equations and the tangent of the sum of angles and show how this can be used to solve the Facebook problem.
Content Area: Theory of Equations, Trigonometry
Recommended for Students: Yes

Mark Branson, Stevenson University
Fighting Alternative Facts: Teaching Quantitative Reasoning with Social Issues
8:10 AM, Room 223, Gira Center
Mathematics has a unique and powerful role to play in the teaching of social justice issues. There is substantial quantitative evidence for social injustice, but many citizens lack the quantitative skills to understand that evidence. A course in quantitative literacy is a unique opportunity to provide this quantitative understanding to a wide range of students in a general education context.
Content Area: Pedagogy/Quantitative Reasoning
Recommended for Students: Yes

Abstracts

Bud Brown, Virginia Tech
Ten Mathematical Landmarks, 1967-2017
9:25 AM, Room 221, Gira Center
The ten will include sensational proofs, game-changing developments, giant structural theorems, and magical geniuses, all having happened since the speaker's less-than-sensational start --fifty years ago -- of his mathematical career. Definitely recommended for students.
Content Area: History of Mathematics
Recommended for Students: Yes

Elizabeth Brown, James Madison University
Haley Dewey, James Madison University
Aaron Fowlkes, James Madison University
Jonathan Gerhard, James Madison University
Ian Hill, James Madison University
Richie Holden, James Madison University
Sophie Mancini, James Madison University
Channing Parker, James Madison University
Alison Sall, James Madison University
Cameron Stopak, James Madison University
Nicole Sutherland, James Madison University
Field Report: Students as Instructors of Mathematics, Creators of Community
9:00 AM, Room 223, Gira Center
We describe a one-credit topics course in mathematics, designed and taught by undergraduate students at James Madison University. The course, which is finishing its fourth successful semester, introduces lower division students to exciting topics in mathematics while developing students' mathematical community.
Several student instructors will participate in the presentation.
Content Area: varied
Recommended for Students: Yes

Hongwei Chen, Christopher Newport University
Evaluation of Euler Sums by Euler's Beta Function
2:50 PM, Room 245, Gira Center
In response to a letter from Goldbach, Euler considered sums of the form
$$\sum_{n=1}^\infty\left(1 + \frac{1}{2^p} + \cdots+\frac{1}{n^p}\right)n^{-q},$$
where p and q are positive integer. By a process of extrapolation,Euler evaluated these sums in terms of Riemann ζ function. In this talk, we recover Euler's discovery based on his beta function.
Content Area: Analysis
Recommended for Students: Yes

Ray Cheng, Old Dominion University
The Pythagorean Comma
3:15 PM, Room 286, Gira Center
The Pythagorean Comma is a phenomenon that lies in the intersection of mathematics and music. We'll review how musical tones arise from the natural harmonics of a vibrating object. Then we'll look at the surprising challenges, due to the Pythagorean Comma, of defining a major scale, and some consequences to music composition, the tuning of musical instruments, and even our daily enjoyment of music.
Content Area: General mathematics; music

Recommended for Students: Yes

Randall E. Cone, Salisbury University
Getting an Assist: Artificial Intelligence in Mathematics
3:15 PM, Room 264, Gira Center
Some Partial Differential Equations (PDE) are difficult to solve. Fick's Law is often a basis for creating mathematical models for the diffusion of substances through the human body. Fick's Law is typically expressed as a PDE. In this presentation, we examine how Artificial Intelligence is being used to help better understand PDE of pharmacokinetic models, providing possible direction into families of solutions.
Content Area: Computational Mathematics
Recommended for Students: Yes

Donna Dietz, American University
Dan Kalman, American University
"Dangers" and Surprises of Secret Gift-Giving Games
3:15 PM, Room 221, Gira Center
Permutations and their cycles play an important role is certain ice-breaker games and seasonal gift swaps. Often, mathematical results surprise the participants. I look at a few examples of such games where I've seen fellow participants surprised by the results. Should we have been surprised?
Content Area: group theory
Recommended for Students: Yes

Justin Dunmyre, Frostburg State University
Quick and Easy Random Groups
2:50 PM, Room 223, Gira Center
Two frequently talked about components of active classrooms are group work and student presentations. This talk will focus on the logistics of how one might manage in-class group work and presentations. There are many ways one might decide to form groups. Should they be based on GPA? Should the students choose their own groups? In my classes, I randomize the groups for each class meeting. We will discuss the relative merits of this choice and a quick method that can be used to form groups while minimizing in-class organization time. Once the logistics of forming the groups are discussed, we will briefly discuss the types of work you might collect from groups. Finally, we will turn to address the logistics of student presentation of group work and some easy adjustments that I have made that have made a big difference.
Content Area: Classroom management
Recommended for Students: No

Ming Fang, Norfolk State University
Cherng-Tiao Perng, Norfolk State University
Use Calculus to Investigate Price Yield Function
9:25 AM, Room 286, Gira Center
Price Yield Function is one of the most widely used functions in finance. In this talk, we will use the first (duration) and second derivatives (convexity) to study the sensitivity of a price to interest rate (i.e. yield) movements. We will demonstrate how the Calculus concepts can be applied to immunize duration mismatched balance sheet and create more beneficial Barbell portfolio.
Content Area: Applied Mathematics
Recommended for Students: Yes

Rachel Grotheer, Goucher College
Finding the Right Foundation: Three Methods for Basis Generation in the Reduced Basis Method
3:15 PM, Room 245, Gira Center
The Reduced Basis Method (RBM) is a model reduction technique commonly applied to solving parameter-dependent partial differential equations. To generate a reduced basis, a set of a small number of parameter values must be strategically chosen. We apply a novel Markov Chain Monte Carlo method for finding the set of parameters, as well as a gradient algorithm, and compare them to the standard greedy algorithm most commonly used in the RBM. We numerically compare the effectiveness of each method by applying the RBM to solving the governing PDE for hyperspectral diffuse optical tomography (hyDOT), an emerging medical imaging modality, which is an elliptic PDE parameterized by the wavelength of the laser source.
Content Area: Applied Analysis
Recommended for Students: No

Laxman Hegde, Frostburg State University
Fisher's Information
2:25 PM, Room 264, Gira Center
Given a data set, say y, from a population governed by a probability function f(y;t) where t is some unknown parameter. Then maximum likelihood estimate of t is based on sample log-likelihood function. Fisher's information is connected to expected value of the curvature of the log-likelihood function. And, in turn, Fisher's information is related to the variance of an estimator of t. WIth the emergence of new field of statistical machine learning (SML) is gaining importance. The concept of Fishers's Information is an important part of SML.
Content Area: Statistics
Recommended for Students: Yes

Dan Kalman, American University
Donna Dietz, American University
John Nolan, American University
Dan Pritikin, Miami University
Game of Stones: Knight's Tour
2:50 PM, Room 221, Gira Center
Queen Regent Cursei λ-stir has 100 knights in her dungeon, and wants to execute all of them. Her advisors π-celle and Ferrous warn her that she cannot just execute them on a whim. By rights that have to be given an opportunity to prove their innocence, by evidence, armed contest, or a suitable game of chance. Together, Cursei and the advisors agree on a game of chance that seems to offer the knights a plausible chance to escape, but in reality condemns them all with near certainty: the probability of any of the knights escaping is computed to be about .000000000000000000000000000006. But unbeknownst to Cursei, Assistant Meister Sumwell Tarley knows a secret strategy by which the knights can all escape with better than 92% probability. If he can only get the knights to follow this strategy …
Content Area: Probability & Combinatorics
Recommended for Students: Yes

Roland Minton, Roanoke College
Sports Referees and Cognitive Illusions
2:50 PM, Room 286, Gira Center
Sports referees must make rapid calls that require judgments of spatial relationships of multiple objects in motion. The flash-lag effect and the Wundt effect are well-documented cognitive illusions that make decisions such as offside in soccer and safe/out in baseball difficult. The classic advice to “keep your eye on the ball” also runs afoul of cognitive limitations in the human brain. These and other sports illusions will be discussed.

Content Area: Mathematics of Sports
Recommended for Students: Yes

Jessica OShaughnessy, Shenandoah University
Town Hall Research Projects in Introductory Statistics
9:25 AM, Room 223, Gira Center
As part of a general education initiative, guided research projects have been introduced in selected general education courses, including introductory statistics. The project involves students delving into independent research using a topic related to social concerns and coming up with a solution to a particular problem. The students then gather with students from other general education courses to discuss their research and debate solutions along with community consultants. This talk explains how the research project works in introductory statistics and some of the advantages and challenges of this type of project in a lower level math course. This project is funded by a Teagle Consortium Grant.
Content Area: Math education
Recommended for Students: No

Edwin O'Shea, James Madison University
The Euclidean States of America: Geometry's Influence on Lincoln
9:00 AM, Room 221, Gira Center
It was Abraham Lincoln who effectively described Thomas Jefferson as the Euclid of a free society. This talk aims to examine Euclid's influence on the thinking and rhetoric of Lincoln.
Content Area: History of Mathematics and Culture
Recommended for Students: Yes

Jason Rosenhouse, James Madison University
The Saga of the Hardest Logic Puzzle Ever
2:25 PM, Room 221, Gira Center
The Hardest Logic Puzzle Ever was first presented by George Boolos in a 1996 paper. The title of the paper was, "The Hardest Logic Puzzle Ever." Since its first appearance, it has spawned a small industry of ever more ingenious solutions, and, in defiance of Boolos' title, ever more difficult variants. In the puzzle, you are presented with three Gods: one who always speaks truthfully, one who always speaks falsely, and one chooses randomly whether to speak truly or falsely. They will respond to any yes/no question put to them, but will do so in their own language. Their words for yes and no are da and ja, but you do not know which word is which. You must determine the identities of the Gods by asking just three questions. We shall consider Boolos' original solution, other possible solutions, and recent extensions of the puzzle into multi-valued logics.
Content Area: Logic, Recreational Math
Recommended for Students: Yes

Bonita Saunders, National Institute of Standards and Technology (NIST)
Who Needs Standard Reference Tables on Demand?
8:10 AM, Room 264, Gira Center
In 1964 the National Bureau of Standards (NBS) published the NBS Handbook of Mathematical Functions. The NBS Handbook, also called Abramowitz and Stegun, for the editors, contained informative formulas, graphs and tables to assist mathematicians and physical scientists who needed special mathematical functions for their everyday work. More than half of its 1000+ pages consisted of fixed precision tables of mathematical function values primarily used to approximate unknown values through interpolation. When in 2010 the NBS Handbook was expanded, and replaced by a new web-based compendium called the Digital Library of Mathematical Functions (DLMF), most of the tables were dropped because computer algebra systems have made the computation of function values through table interpolation obsolete.

However, there is a smaller group who can still benefit from tables of reference values, not for interpolation, but high precision tables to test their own software. This group includes not just individual scientists conducting their own research, but also software developers for big companies and even developers of computer algebra systems. NIST has created the DLMF Standard Reference Tables on Demand Project to address this need. This talk will discuss our collaboration with the University of Antwerp to create an online testing service where users can generate high precision tables of mathematical function values with an error certification.
Content Area: high precision function computations, mathematical software testing
Recommended for Students: Yes

Prasad Senesi, The Catholic University of America
The Geometry of Voting Theory: Root Systems and Reversal Symmetry
8:35 AM, Room 333, Gira Center
Previous work by the author, in collaboration with Tim Ridenour, demonstrated how one can use the standard dot product in Euclidean space to describe and understand various phenomena and criteria in voting theory. In this talk, we will use this framework to associate to any linear voting method an important - and ubiquitous - collection of vectors called a root system, which satisfies some simple combinatorial properties. This combinatorial approach allows us to find the dimension of the 'effective space' of our voting method, and also to understand which voting methods satisfy an important and compelling criterion known as 'reversal symmetry'.
Content area: Voting theory, group theory, combinatorics
Recommended for Students: Yes

Amy Shell-Gellasch, Montgomery College
Smithsonian Learning Lab: an Introduction
8:35 AM, Room 223, Gira Center
The Smithsonian Learning Lab is an online resource platform for educators. Launched in 2016, the Learning Lab is ideal for objected based learning in and outside of class. College educators have used this platform in all courses, including mathematics and the sciences. Choose from over 2 million images and resources at the Smithsonian or import materials from other sources. Create a collection of items and resources for your course that students then access in class or at home for discussion or assignments. Students can also create their own collections for assignments or portfolios. In this talk you will be introduced to the ways to use the Learning Lab and get you started creating your own collections.
Content Area: education
Recommended for Students: Yes

David Taylor, Roanoke College
Hannah Robbins, Roanoke College
Curing the High DFW Rate in First Year Calculus
2:25 PM, Room 223, Gira Center
Our department recently restructured our first calculus course to address the fact that it has perennially had one of the highest DFW rates at the college. Our solution was to offer both a one semester and a two semester version of calculus 1. Both versions cover the same calculus material as our previous calculus 1 course, and the two semester version also contains just-in-time algebra review. We use a placement test, along with SAT math scores and high school GPAs, to place students into the appropriate version. Additionally, we allow students to switch from the one semester version back to the two semester version after the first test.
The goal of our study is to see how successful this new course structure is in helping students succeed in first and second year calculus. We collected and analyzed students' grades, placement test scores, and final exams in the first two years of the restructured course, and compared them to data from the last year of our old version of calculus. Additionally, we collected grades for those students who continued on into our second calculus course. In this talk, we will give details about implementing this new calculus curriculum and discuss the preliminary results of our assessment.

Content Area: Mathematics Education
Recommended for Students: Yes

G. Gerard Wojnar, Frostburg State University
Following Richard Guy-- Treats from a Triangle's Orthocentric System's Fermat-Torricelli Points!
3:15 PM, Room 223, Gira Center
At MathFest 2015, Richard Guy advocated that a proper way to think about a triangle is in terms of its orthocentric system formed by augmenting the original triangle with its orthocenter, thus giving a configuration of 4 triangles and their common "9 Point Circle". We follow Guy's guidance and explore the system of 8 Fermat-Torricelli points obtained, finding a network of circles, axes, & associated points culminating in the Steiner circumellipse of the system's orthic triangle. We also find connections to the system's 4 Jerabek hyperbolas at points where 5 lines are concurrent.
Content Area: Triangle Geometry
Recommended for Students: Yes

Student Abstracts by Author

Volkan Bakirdan, James Madison University
Ben Rhodes, James Madison University
Kenny Temsupasiri, James Madison University
JMU COMAP: The Kariba Dam
2:25 PM, Room 286, Gira Center
As part of the 2017 COMAP contest, our presentation concerns the assessment of the Kariba Dam located on the Zambezi river in Africa. The Kariba Dam is currently in emergency need of repair. If it is not repaired soon, a potential collapse of the dam is highly probable, leading to lives lost and large loss of hydroelectric power to south African countries. We assessed options for repairing the dam, rebuilding the dam, and building a series of dams along the Zambezi river. We assessed the option of a multi-dam system using mathematical modeling of three parameters, and with topographical analysis of the river, determined optimal locations for strengthening the protection against heavy rainfall and increasing the potential for more hydroelectric power for South African countries. We utilized the Manning's equation to estimate water levels at various points along river segments, and also calculated optimal dam specifications by considering properties of a fixed water channel. Overall we provided evidence towards a multi-dam system being an economically viable solution to the current threat of the collapse of the Kariba Dam.

Chelsey Clement, Salisbury University
Artificial Intelligence Research on Type One Diabetes Data Using Statistical Software Package R
2:50 PM, Room 264, Gira Center
During this Spring Semester of 2017, I am working with Dr. Randall E. Cone in using artificial intelligence to research Type One Diabetes(T1D) Data, using the statistical software package R. Type 1 diabetes strikes both children and adults at any age. It comes on suddenly, causes dependence on injected or pumped insulin for life, and carries the constant threat of devastating complications. It occurs when the body's immune system attacks and destroys the insulin-producing cells in the pancreas, called beta cells. While its causes are not yet entirely understood, scientists believe that both genetic factors and environmental triggers are involved. I was diagnosed with T1D at the age of sixteen and so I am ecstatic to develop data mining techniques to determine any significant models to suggest factors which may influence the development of the disease or better moderation.
As of now, I have obtained data sets from reliable health websites which provide important information such as severe hypoglycemia in older adults, hypoglycemia unawareness, diabetes history/management, and much more. I am formulating questions for each set of data comparatively, e.g.: (1) is there a correlation between gender/ethnicity/race

with the diagnosis of T1D (2) how is action being taken for the chronic disease and is there a more effective approach (3) and how is the average type one diabetic handling the disease and where can improvement be made. While generating such inquires, I am also strengthening my knowledge of important processes such as: of creating appropriate models for the information, using the most beneficial descriptive graphs, and machine learning capabilities of R. Software package R is a powerful integrated development environment for statistical computing and graphics. Most data analysts in the fields use this package because of its ability to handle massive data sets, the graphical workspace, cross-platform interface, and it's seamless Rmarkdown and knitr integration. One of my present goals, to be completed by April 2017, is to be able to predict, from the models generated, possible contributing factors to the development of T1D.

El Hadji Ibrahima Ndiaye, Montgomery College
Perspective of a Calculus Student: A Fluid Mechanic Model
2:25 PM, Room 333, Gira Center
Mathematical models in fluid mechanics usually involve complex concepts that are beyond the scope of a student in a first or second semester calculus course. A simplified mathematical model in fluid mechanic would help a freshman or sophomore student have a better grasp of concepts such as velocity and acceleration of fluids. To illustrate this, we use differential equations to explore the effect the profile of a pipe has on the fluid flowing through it. In particular, we use a mathematical model of the fluid's acceleration, which is the first derivative of the velocity. Based on our model we can see that if the section of a pipe reduces, the velocity of the fluid augments. If the section augments, the velocity reduces. Using different mathematical functions and their first derivative, we can compare the acceleration resulting from the profile. In conclusion, tools such as differential equations taught during a second semester calculus course can help a freshman or sophomore student in fluid mechanics have a better comprehension of concepts of fluid behaviors.

Dani Harris, Longwood University
A Different MGM: Movies, Graphs, and Math
8:35 AM, Room 264, Gira Center
In this talk, we'll explore how mathematics, specifically graph theory, helps answer questions about society. With the use of R, the movie Dear White People has been turned into a character interaction graph. We analyze the resulting graph structure of the characters using centralities and community detection. Changing movie scripts into visually-simple, interaction graphs allows for analysis on character interactions and the demographics of those characters. By analyzing the the centralities of each of the characters, then one can see whether a character is main character or supporting. This analysis grants potential checks on discrimination in both writing and casting, which can then lead to movies and castings with more representative characters and actors/actresses.

Trevor Karn, United States Naval Academy
The Flag Counting Problem for Partition Lattices
9:00 AM, Room 333, Gira Center
In early 2016, Dr. Max D. Wakefield wrote a paper which contributed to the field of matroid Kazhdan-Lusztig theory by defining "multi-indexed Whitney numbers" of both kinds. Looking for a way to compute these generalized Whitney numbers, for partition lattices in particular, we used SAGE freeware and OEIS to find a closed formula for four specific cases of total flag size, as well as a strikingly beautiful exponential generating function related to the Bell numbers. It was not immediately apparent, but these ideas did arise in other work, notably in papers by R.P. Stanley (1979) and Hogg and Huberman (1985). This talk gives a background on the flag-size problem, discusses the techniques and results of our late 2016 work, and draws connections to the work of Stanley, Hogg, and Huberman.

Taraneh Kelishadi, Montgomery College
An Attempt at Undergraduate Research in Combinatorial Game Theory
8:35 AM, Room 286, Gira Center

Game theory is the study of conflict and cooperation between two rational agents. Following David Wolfe's "Undergraduate Research Opportunities in Combinatorial Games", we have conducted research inspired by the game "Quoridor", in which two players attempt to be the first to reach the opposite side of a game board while placing fences to hinder the other player's movements. Since Quoridor has the same level of complexity as the game of chess, we created two simplified versions of the game. In one version, the game becomes deterministic, and the possibility of any strategy is eliminated. In the other, more interesting version, we have built part of the game tree and obtained some preliminary results.

Skyler Layton, Shenandoah University
Crossing Numbers of Complete Bipartite Graphs
8:10 AM, Room 333, Gira Center
During my research I worked to find the crossing number of the complete bipartite graph K(9,9). I was able to find an optimal drawing and I'm currently working to find a formula to give you the crossing numbers. In my presentation I will be explaining the different approaches I took and the results I found.

Gerald de Jesus Roman-Gonzalez, Stevenson University
A Mathematical Analysis of Languages
8:10 AM, Room 286, Gira Center
Using concepts from information theory such as entropy, we analyze the complexity of several natural and fictional languages. The entropy of a written language, as defined by Claude C. Shannon in his landmark 1948 paper, A Mathematical Theory of Communication, measures how much information is produced on average for each letter of text in the language. Shannon's work led to the foundation of information theory which has shaped the ways in which we communicate today. In a subsequent paper, Prediction and Entropy of Printed English, Shannon estimated the entropy of written English by doing experiments to approximate word and letter frequencies. Since Shannon's work, a multitude of attempts have been made to estimate the entropy of different written languages such as English, Spanish,and Russian. We will analyze and compare the entropy and other similar quantities of constructed languages such as Dothraki (Game of Thrones), Tengwar (Lord of the Rings), Na'vi (Avatar), Klingon (Star Trek), Esperanto, and Lojban as well natural languages such as English, French, and Spanish.

Jacob Mathews, Montgomery College
Mathematically Mitigating Risk and Optimizing Returns
9:00 AM, Room 286, Gira Center
Around 60 years ago, Harry Markowitz introduced the concept of the efficient frontier, a curve that designates optimal asset allocation in a portfolio. About a decade later, William Sharpe developed the Sharpe Ratio, the inverse slope of a point on the efficient frontier that describes how much an investor is compensated for the risk taken. Using daily returns of three stocks, I computed the portfolio's efficient frontier using the methodology Markowitz outlined. Furthermore, I found the optimal asset allocation percentages by optimizing the Sharpe Ratio and compared how the portfolio performed over next three months to its expected return. This project explains the mathematical justification for portfolio diversification.

Amanda Shultz, Shenandoah University
Building an Automatic License Plate Reader Using Geometric Comparisons
2:50 PM, Room 333, Gira Center
Automatic license plate readers often utilize intricate mathematical methods in an attempt to most accurately read each character on a license plate. In an attempt to simplify the necessary mathematics, and potentially quicken response time without losing significant accuracy, a geometric approach was performed. With relatively constant variables, a license plate can be geometrically extracted from a preprocessed image and optical character recognition can be utilized to

automatically read the characters on the license plate with surprising efficiency and correctness. Eliminating costly mathematical algorithms and utilizing the geometric attributes within the image could prove beneficial in the future of optimized automatic license plate readers.

Aranje Sripanjalingam, Montgomery College
Perspectives on Boolean Algebra
2:25 PM, Room 245, Gira Center
This will be an expository talk that will look at Boolean Algebras from various mathematical perspectives, both pure and applied. We will touch on different topics such as finite Boolean Algebras, Boolean functions, digital circuitry, the Satisfiability problem, and Boolean Algebras generated by a topological space.

Nicholas Tuck, Shenandoah University
Quantum Computing: Constructing Quantum Error Correcting Codes via Python
9:00 AM, Room 264, Gira Center
Through the use of quantum superposition- when something is in two states at once, quantum computing has the potential to solve certain problems exponentially faster than classical computers. To ensure reliable computations however, quantum error correction is needed. The goal of this project was to create a program using the programming language Python to find new quantum error correcting codes by employing techniques from coding theory and quantum mechanics.

Student (Poster) Abstracts by Author

Emily Adams, Virginia Military Institute
Modeling Commercialization of Crop Varieties and Predicting Market Success
Using various testing and crop characteristics to predict the overall success the crop on the market.

Jaclyn Bealer, Hood College
Cayley and Frobenius Characters in an Equation: An investigation into the Solution of the Cayley-Hermite Problem
My poster will be investigating who should be attributed to the general proof of the solution to the Cayley-Hermite problem. It will discuss the complex history of creating the Cayley-Hermite problem from other mathematicians roadblocks, the differences in general versus generic proofs of his time and how this affected Cayley's work, and finally review Frobenius's contribution to the proof by adding a linkage from spectral theory to symbolic algebra based off of Cayley's general proof of the solution to the Cayley-Hermite problem.

Joseph Bobay, Virginia Military Institute
Henry Wiswall, Virginia Military Institute
Optimizing Airport Security Throughput
Our task was to observe data taken from airport security and analyze it to identify bottlenecks in the process in order to make recommendations for improvement. We wrote a program in MATLAB to model the flow of traffic through airport security to identify slow points. We were ultimately unable to finish our project, but performed powerful analysis on the data to reveal issues in the system.

Jonathan Chu, Virginia Military Institute
Trey Chapman, Virginia Military Institute

Abstracts

Evaluating and Planning Smart Cities
Our poster will cover the 2017 Interdisciplinary Contest in Modeling Problem E: Sustainable Cities Needed! We will present our methods for evaluating the "smart" initiatives for two cities. We will also present our smart growth plans for each city along with the potential impacts.

Joseph Fawley, Hood College
The Jesuits and Chinese Mathematics: 17th Century Contacts
The Jesuits were mathematical pioneers during the 16th and 17th centuries. At the same time, the Jesuits' China missions brought European mathematical developments to China. My poster will examine the effect (or lack of effect) this contact had on Chinese mathematics.

Sarah Hood, Hood College
Black Math: An Investigation of the Under Appreciation of African American in the 20th Century
My poster is about different reasons that African American mathematicians of the 1900s achievements and existence were closeted from all. I will explore details of why through biographical evidence of racial oppression, statistical evidence of less number of black doctorates compared to number of other doctorates and other numbers, and the limited opportunities available in societal evidence after slavery ended.

Yu-Hsiang Liu, Virginia Military Institute
Shang Cheng Su, Virginia Military Institute
Sustainable Cities Needed!
We defined a metric to measure the success of smart growth of a city. We measure the success of smart growth of each city considering three main principles: Economic prosperity, Social Equitability and Environmental Sustainability. And we use the smart growth principles to develop a growth plan for both cities over the next few decades and compare our growth plans to the existing growth plans developed by governments so as to evaluate the success of our metric and our growth plans.

Skyler Layton, Shenandoah University
Crossing Numbers of Complete Bipartite Graphs
During my research I worked to find the crossing number of the complete bipartite graph K(9,9). I was able to find an optimal drawing and I'm currently working to find a formula to give you the crossing numbers. In my presentation I will be explaining the different approaches I took and the results I found.

Sophie Mancini, James Madison University
Unyoung Park, James Madison University
Singular Value Decomposition and its Applications
Singular Value Decomposition (SVD) is a method of factorization that decomposes a matrix into three meaningful components. In this poster presentation, we will explore the diverse applications of SVD, and evaluate its utility in mathematical and scientific fields.

Zachary Melvin, Virginia Military Institute
Mike van Duinen, Virginia Military Institute
TSA Optimization
An exploration into TSA security checkpoints: How we used a discrete model to identify bottlenecks and areas of improvement.

Abstracts

Joshua McPherson, Hood College

To Infinity and Beyond: An Analysis of the Struggle to Approach Infinity

I will discuss infinity as it had just begun to be understood by Georg Cantor and the roots of infinity as an unfathomable concept. I argue that the view on infinity as unreachable prevented Cantor's theories of transfinite numbers to be rejected by the mathematical and religious communities of the time. By presenting two wildly different concepts of infinity, I hope to clear up certain misunderstandings and simplify the concept.

Amber Ngo, Salisbury University

Andrea Carmack, Salisbury University

Investigating the Effects of Self-Driving Cars on Traffic Flow

In our project, we analyze the effects self-driving cars have on the traffic flow of four roadways: state road 520 and interstates 5, 90, and 405, in Thurston, Pierce, King, and Snohomish counties of Washington State, respectively. For our investigation, we use cellular automata to illustrate the interactions between self-driving and non-self-driving autos on two- and three-lane highways. We also use traffic flow theory, traffic counts and milepost data from the year 2015, and procedures for estimating highway capacity to quantify recent and projected traffic flow for the specified highways. We find that autonomous cars maintain their speeds and distances between other vehicles on the same road exceedingly well. We also conclude driverless cars reduce traffic flow on highways.

Sarah Risinger, Christopher Newport University

Integer Sequences Characterized by Certain Summation Identities

From the set of all integer sequences generated by two-term recurrence relations, we identified all sequences that satisfy a give summation property. The summation of consecutive terms, of even-subscripted terms, of odd-subscripted terms and of squares of consecutive terms are considered. The specific summation properties included in this study are generalizations of properties associated with the Fibonacci numbers. Combinations of properties that uniquely determine the Fibonacci numbers are identified.

Timothy Taylor, Hood College

The Divergence of Mathematics and Physics: How Physics Developed Out of France

Physics from the time of Galileo to the time of Euler was highly mathematical, and its practitioners were all mathematicians. By the late 19th century, however, physics was unmistakably a separate field from mathematics. My poster examines how the two disciplines split, focusing on developments in France in the 18th and early 19th centuries.

Amy Vennos, Salisbury University

Adam Jump, Salisbury University

Utilizations of Queuing Theory and Digraphs for More Efficient Merging in Tollways

We use queuing theory and directed graphs to analyze toll plaza designs. We propose a model that optimizes toll plaza design for maximum throughput, showing improvement by more than a standard deviation in mean system time. Furthermore, we describe how this system will function using driverless vehicles and electronic toll collection. A cost-benefit analysis of installation shows that the implementation cost for refitting existing toll plazas with electronic toll collection equipment is completely offset by the staffing and maintenance cost savings in the scenario of demolition of a manual toll collection booth and replacement with a completely new electronic toll collection booth.

Pengrui Wang, Washington and Lee University

Direct Product of Directed Semi-Cycles

Abstracts

A directed semi-cycle is a directed graph which is a cycle as an undirected graph (i.e. If directions are ignored). In this poster, we investigate the properties of a direct product of two directed semi-cycles G and H. In the special case that G and H are directed cycles, or are directed cycles with at most one edge direction reversed, we obtain an explicit characterization of the components of product G × H. Our characterization allows us to bypass the tedious computation of a direct product, especially when the number of nodes in each factor digraph is large, by determining the components of G × H directly without computation.

Matthew Welte, McDaniel College

A Mathematical Perspective of Neo-Riemannian Transformations

This paper will explore Neo-Riemannian Theory and the operations performed on triads from a mathematical perspective. By using the principles of the theory, the hope is to develop different operations on chords with four notes, while maintaining rules and concepts based in music theory from previous papers written about the subject.