MAA SOUTHEASTERN SECTION

MATHEMATICAL ASSOCIATION OF AMERICA

Ninety-Eighth Annual Meeting

Lee University

Cleveland, Tennessee

Thursday—Saturday, March 7-9, 2019

Abstracts for all Talks

SS2.1	**Friday 2:00 p.m.**	*Numerical computation of transverse Mercator projection coefficients using complex Fourier analysis*
Pierre Abbat		
The Gauss-Krüger transverse Mercator projection is used in various coordinate grids, including about half the United States state plane zones and UTM. The original method, Krüger-n, which is conformal by construction, was not widely adopted because it requires hyperbolic functions or sines of complex numbers, neither of which was available on early calculators. The Krüger-λ series and its descendants Redfearn and Thomas use nothing more complicated than trig functions and were therefore widely adopted, even though they are accurate only over a few degrees of longitude. It is not obvious from looking at the latter series why they are conformal. I present a method of computing the equivalent of the Krüger-n coefficients, giving millimeter accuracy over 80% of the globe with only four terms. The method consists of taking the Fourier transform of the forward and inverse function from length along the meridian of the sphere to that of the ellipsoid. The projection is then computed by composing three projections, of which the first two are well-known and the third is obtained by passing a complex number to the resulting Fourier series.		

SS8.6	**Saturday 11:40 a.m.**	*The MAA Instructional Practices Guide in Action*
Martha Abell		Georgia Southern University
A team of over 50 faculty members from varied institutions across the nation developed the MAA Instructional Practices Guide to share effective, evidence-based practices instructors can use to facilitate meaningful learning for mathematics students. The hope is that the IP Guide will serve as a catalyst for community-wide transformation toward improved learning experiences and equitable access to mathematics for all students. The presentation will be an overview of the IP Guide, describing the topics covered, how it can be used to promote student learning and access, how it can be used in professional development programs, and how members of the mathematics community can get involved in the development of future editions of the IP Guide.		

DS.1	**Friday** **9:00 a.m.**	*Modeling Infectious Disease: A Mathematician's Playground*
Zachary Abernathy		Winthrop University
How can mathematical models help us gain insight into the spread of an infectious disease within a host? We'll begin by showcasing useful techniques for describing disease pathogenesis through the lens of a simple HIV model, introducing tools such as basic reproductive ratio and local/global stability analysis. From there, we'll discuss ways to expand upon this model to address additional questions, such as why our immune systems can naturally fight off some viruses but not others. Along the way, we'll touch on how studying these models can lead to a variety of interesting research questions in both applied and theoretical mathematics.		

UP1.1	**Saturday** **10:10 a.m.**	*Counting Integer Sequences with Restrictions*
Skyler Addy		The Citadel
A problem posed in Mathematics Magazine (Problem 2050) asked for the number of sequences for the form a_1...a_9 given a_i in {1,2,3} and other criteria. In this poster we describe the process we used to count the sequences and how it was simplified into a readable proof. We have submitted the solution to the problem to Mathematics Magazine for consideration to be published.		

SS9.5	**Saturday** **11:20 a.m.**	*Experiences of Murray State University PICMath Students*
Donald Adongo		Murray State University
We discuss four problems from four distinct businesses that students worked on. We look at the challenges faced by the different groups in addition to the highlights. The problems ranged from conserving energy to evaluating whether company expected production hours were attainable to minimizing commuting times.		

CP1.2	**Friday** **2:20 p.m.**	*Modeling Immune-Mediated Activations and Interactions in Breast Cancer Progression*
Kodwo Annan		Georgia Gwinnett College
Mathematical model that describes the interactions between breast cancer cells and immune microenvironment were presented using a system of differential equations. The parameters of the model were based on experimental and clinical results from published articles. The model allowed qualitative and quantitative description of the interactions between the host immune system key components (cytotoxic T lymphocytes (CTLs), macrophages, Natural Killer (NK) and helper T cells) and the breast cancer cells. Data generated throgh MATLAB software tool were used to discuss the impact of each of the key components on the cancer cells and the different effects of immunosuppression at various stages of the tumor development. Results supported clinical studies that maximal breast cancer immunity is required and it depended on each of the key immune cell discussed in this paper. Thus, for a given breast cancer growth rate, there was an optimal activation that maximized the response of the immune system. The effectiveness of the immune system was enhanced by cancer		

vaccines and resulted in the decrease in breast cancer killing rates. It was also observed that given a sufficiently high rate of CTLs or helper T cells infiltration responded with tumor elimination. In addition, the importance of optimizing large M1:M2 ratios verses large/small numbers of tumor-infiltrating macrophages on long term patient survival were necessary in improving breast cancer therapies. These observations highlighted the importance of more studies to better understand and improve breast cancer morphology and immunity through immunotherapy.

SS1.1	**Friday** **2:00 p.m.**	*Math Success for STEM Majors: Active Learning Strategies and Engineering Contexts*
Holly Anthony		Tennessee Tech University
The Math Success for STEM Majors (2010–16) project (NSF STEP) was designed to increase the number of STEM graduates at Tennessee Tech University by pursuing six main strategies based in education research. The two strategies relevant for this paper were: (1) incorporating active learning in the redesign of precalculus course and (2) integrating the STEM disciplines through context-driven mathematics applications within an "introduction to university life" course for entering STEM freshmen. This paper describes the active learning strategies/modules that were designed and implemented by interdisciplinary teams of engineers, educators, mathematicians, and physics researchers in these redesign efforts. The strategies/modules have proven effective at motivating and retaining STEM majors at TTU and are transferable to other courses/institutions. Engineering educators can adapt/modify these for use in their respective contexts/settings.		

CP3.5	**Friday** **3:20 p.m.**	*Toward an Understanding of Skewed-Top Corridors*
Shaun Ault		Valdosta State University
Consider lattice paths in the plane starting at the point (0, 1) that remain strictly above the x-axis, below a line of positive slope in the first quadrant, and whose allowable moves are up-right and down-right. We say that such lattice paths exist within a skewed-top corridor. The number such paths ending at each point within the skewed-top corridor may be arranged into an array. We have found that the diagonal sequences within a dualized version of this array exhibit a predictable pattern in which certain subsequences have degree given by an explicit formula. The formulas for starting/ending points of each subsequence and degree depend only on the parameters of the skewed-top corridor and not the values of the corridor numbers themselves.		

DS.2	**Friday** **10:00 a.m.**	*Is That a Cylinder or a Moebius Band? Seven Ways to See the Difference*
Tom Banchoff		Brown University
This talk will discuss seven different ways of seeing the difference between these two strips of paper, using ideas from calculus of one and more variables and elementary geometry of smooth and polyhedral surfaces. Criteria include fold edges of projections, self-intersection curves of surfaces, and a new characterization involving inflection triangles of polyhedral strips. The talk will be accompanied by models and computer graphics illustrations.		

CP8.1	**Saturday 10:00 a.m.**	*How the study of complex functions produced coloring book and calendar images*
Julie Barnes		Western Carolina University
Julia sets of complex polynomials are the well-known sets of points where the functions are bounded under iteration. Roughly ten years ago, we began exploring two sets related to Julia sets: the set of points bounded in the real direction under iteration and the set of points bounded in the imaginary direction under iteration. This led us to look at the surfaces obtained by the real part and the imaginary part of iterated complex rational functions. To better analyze the dynamical properties of the functions behind these surfaces, we started generating the associated contour plots. Stunning artistic designs appeared. This has led us back to the mathematics to learn more about what the contour lines themselves indicate, and what properties are necessary to produce more intricate designs from contours. We end this presentation by discussing how this research turned into a coloring book and how we are working to produce more images for a mathematical calendar.		

UT4.1	**Saturday 10:00 a.m.**	*Recognizing Ant Colonies through Graph Invariants*
Katherine Barrs		Georgia Southern University, Department of Mathematical Sciences and Department of Biology
Chemical graph theory is a quickly growing interdisciplinary field involving the graphical analysis of chemical compounds through molecular structure. Chemical indices are one of the main tenets of chemical graph theory and are a way of describing chemical structures. Chemical indices assign a numerical value to a graph structure which often correlates with the chemical's properties. In this study, we propose the development of a chemical index to predict the behavioral response in a biological system. Argentine Ants are a globally invasive species that displaces native species and facilitates agricultural pests. It is known that colony aggression is related to unique chemical blends/profiles among colonies. The cuticular hydrocarbon (CHC) profiles of certain colonies contain over 70 chemicals, but it is unclear which components of this profile are most important for recognition. Using previously collected data, we plan to analyze the known chemical components of CHC profiles. For this purpose, we will define a chemical index to apply to chemical structures to predict colony recognition in previously untested colonies. Overall, we expect our finding to contribute to better understanding of the differences between colonies and may be key to stopping the spread of these highly invasive insects.		

UT5.5	**Saturday 11:20 a.m.**	*Matrices in the Hosoya Triangle*
Matthew Blair		The Citadel
A triangular array where the entries are products of two Fibonacci numbers is Hosoya. The matrices within this triangle are of rank one (product of two vectors; located on the sides of the triangle). In this talk, we discuss properties and the behaviors of the eigenvalues, eigenvectors, characteristic polynomial, determinants, and their connection with graph theory. The non-zero eigenvalue is a combination of Lucas and Fibonacci numbers. In addition, these matrices are diagonalizable where		

the entries of the eigenvectors are points within the Hosoya Triangle. The components of the graphs (when matrices are seen mod 2) are complete graphs with loops and isolated vertices.

SS1.2	**Friday 2:20 p.m.**	*Critiquing Peers' Arguments: Learning in an Introduction to Proof Course*
Sarah Bleiler-Baxter		Middle Tennessee State University
Introductory proof concepts are frequently taught through instructor demonstration, followed by student replication of form and representation to similar problems. When students learn about proof primarily through seeing a "polished" completed proof, they may miss opportunities to make sense of why a particular mode of argumentation (e.g., direct or indirect proof) is appropriate, how a particular mode of argument representation (e.g., visual or symbolic) most clearly communicates a mathematical idea, or when a proof can be considered complete. The purpose of this presentation is to share the design of my introduction to proofs course, where evaluating student arguments serves as the primary catalyst for engaging students in making sense of some of these essential proof-writing concepts. Student work was collected before each class session and used to inform the design of subsequent class activities. We worked to establish a communal understanding of what counts as proof. Based on this evolving understanding, students actively engaged in evaluating their peers' arguments, which in turn encouraged them to take a critical stance toward their own proof writing. In this presentation, I share student work and describe class activities that promoted students' learning of proof.		

SS11.5	**Saturday 11:20 a.m.**	*Mathematics Immersion at UNG*
Karen Briggs		University of North Georgia
In this talk, we will discuss our pilot study of the Mathematics Immersion Project at the University of North Georgia. To participate in this project, Immersion students were required to be concurrently enrolled in four bundled courses: Introduction to Proofs, Abstract Algebra, Linear Algebra, and Probability and Statistics. The common enrollment not only allowed flexibility in teaching but also the ability to focus on cross-cutting topics and connections between the courses that would be difficult to include in a stand-alone course. Moreover, we found that integrating topics addressing three or more courses at once actually fostered improved acquisition of conceptual understanding in all the courses. In our experience, we found that the intensive approach provided unique opportunities to improve learning outcomes for undergraduate mathematics majors and supported the transition-to-proofs better than traditional stand-alone courses.		

UT3.5	**Friday 3:20 p.m.**	*How Often is the Conclusion of Euclid's Lemma True?*
Steven W. Buchanan		Tennessee Tech University

Euclid's lemma is one of the oldest results in number theory, and it describes a fundamental property of prime numbers. The lemma says that if a product of two positive integers is divisible by a prime number, then one of the two integers must itself be divisible by the prime. A recent paper by Adrian Dudek calculates the probability of the lemma being true when applied to three randomly chosen positive integers. Specifically, Dudek finds that the probability is asymptotic to π^2/log(N), where N is the upper bound on the dividend. We develop an asymptotic answer for the more general question: how often does the lemma hold if the product of two randomly chosen positive integers is replaced by a product of an arbitrary, but fixed, number of positive integers?

CP4.5	**Friday 3:20 p.m.**	*Gallai-Ramsey Numbers for Hypergraphs*
Mark Budden		Western Carolina University
The Gallai-Ramsey number for graphs $G_1,G_2,\ldots,G_t$ is defined to be the least natural number p such that every t-coloring of the edges in K_p that avoids rainbow triangles contains a copy of G_i in color i for some $i \in \{1,2,\ldots,t\}$. This talk will focus on how this concept can be generalized to the setting of r-uniform hypergraphs and we will offer some constructions that lead to lower bounds for such numbers.		

SS2.4	**Friday 3:00 p.m.**	*A Student's Experience in Mathematical Research*
Kaitlyn Burk		University of Alabama at Birmingham
Problems in Business, Industry, and Government often entail more than just completing mathematical equations; they often involve interpreting vast amounts of data and discovering trends and anomalies within that data. While at Lee University, I participated in two separate projects in the PIC Math Program, one in each of the spring semesters in two consecutive years. My first PIC Math research experience involved working on a problem given to our class by National Securities Technologies. We improved upon the analysis methods used in their Broadband Laser Ranging diagnostic. In my second PIC Math research experience, our task was to assist Good Grit magazine with ways to increase their profits through sales and subscriptions. We analyzed geographical data for their typical subscriber, and recommended methods for determining and eliminating low-selling vendors. Both experiences involved working with large amounts of data and applying problem solving and communication skills to complete the tasks at hand.		

CP6.6	**Saturday 11:40 a.m.**	*Transitioning to Open-Source Materials in a General Education Mathematics Course*
Philip T. Carroll		Mars Hill University
The consistent increase in prices for textbooks and other course materials presents a substantial economic challenge for students in modern higher education. Utilizing open source texts and content delivery systems can provide a financial benefit for students or, in some cases, educational institutions themselves. In this talk, we describe our experiences in shifting to open source course content in our first year calculus course at Mars Hill University.		

UT5.4	**Saturday** **11:00 a.m.**	*Matrices in a Hosoya-like Triangle*
Hsin-Yun Ching		
A Hosoya-like triangle is triangular array where the entries are determinants Fibonacci numbers. The matrices within this triangle are of rank two. In this talk, we discuss properties of square persymmetric and symmetric matrices found in this triangle. We present closed formulas in terms of Fibonacci and Lucas numbers for the eigenvalues, eigenvectors, and characteristic polynomials using linear algebra techniques. We give some conjectures on the prime numbers present in the triangle (are there infinitely many primes in this triangle?).		

SS1.6	**Friday** **3:40 p.m.**	*Engaging students in reflective thinking*
Marcela Chiorescu		Georgia College
Students often believe that learning mathematics means getting the right answer without reflecting too much on their learning. In fall 2018, to encourage reflection in my Precalculus course, I introduced assignments that required students to reflect and self-assess their learning of concepts. For most of the students this was something new. This talk will be a reflection of my experience with this type of pedagogical approach.		

CP9.1	**Saturday** **10:00 a.m.**	*Our Jewel: Using Euler's Formula to Make Our Mathematical Lives Slightly Easier*
Jonathan Matthew Clark		University of Tennessee, Knoxville
College mathematics students who are not exposed to complex numbers in high school may not be aware of their utility until they take more advanced courses such as differential equations. In particular, one of the central results of complex analysis relates the imaginary exponential function to the two fundamental trigonometric functions. The significance of Euler's formula cannot be overstated. In this talk, we'll demonstrate how this jewel of mathematics trivializes trigonometric identities, simplifies trigonometric integrals, and forms a foundational pillar for the field of differential equations. We'll also provide several concrete examples of how Euler's formula is used in mathematics graduate work. Thus, this talk will function as an argument for far more inclusion of complex numbers, including Euler's formula, into the curricula of both high school and college mathematics classrooms.		

UT1.5	**Friday** **3:20 p.m.**	$G\square K_n$ radio graceful for certain G
Samantha Clayton		University of Tennessee Martin

Within the graph labeling field of radio labeling, a significant and sought-after example is called a radio graceful graph. A graph is radio graceful if there exists an ordering $x_1,x_2,\ldots,x_m$ of its vertices such that $d(x_i,x_j) \geq \text{diam}(G) - |i-j| + 1$ for all distinct i and j. Many of the results that prove the existence of infinite families of radio graceful graphs use a Cartesian product with a complete graph K_n. We are expanding upon those results by determining sufficient conditions for a graph G such that $G\square K_n$ is radio graceful.

UP1.2	**Saturday 10:10 a.m.**	*Modeling Changes in Atmospheric Carbon Dioxide*
Elizabeth Compton		LaGrange College
The concentration of carbon dioxide in the Earth's atmosphere is continually in flux with natural and artificial sources and sinks. For this poster, a known model will be implemented that quantifies the underlying behavior of atmospheric carbon dioxide concentrations. This model is then compared to data collected from the NOAA Mauna Loa Observatory.		

CP3.2	**Friday 2:20 p.m.**	*Leibniz algebras with low dimensional maximal Lie quotients*
William J. Cook		Appalachian State University
Leibniz algebras generalize Lie algebras in the same kind of way that non-commutative rings generalize commutative rings. In this talk, we will look at the definition of Lie and Leibniz algebras. Then we will consider cyclic Leibniz algebras. These give us the simplest examples of (non-Lie) Leibniz algebras. After discussing the construction and classification of cyclic Leibniz algebras, we will explore two families of non-cyclic Leibniz algebras.		

SS10.4	**Saturday 11:00 a.m.**	*Solution to AMM Problem 12008*
Benjamin Cook		Nipissing University
We partially solve problem 12008 from American Mathematical Monthly 124, December 2017. The problem, proposed by P. Kórus of the University of Szeged, is as follows: You hold in your hand a deck of n cards, numbered 1 to n from top to bottom. Shuffle them as follows. Put the top card in the deck on the bottom and the second card on the table. Repeat this step until all the cards are on the table. For which n does card number 1 end up at the top of the deck on the table? Shuffle the deck a second time in the same way. For which n does card number 1 end up at the top of the cards on the table? Shuffle the deck a third time in the same way. For which n does card number 1 end up at the top of the cards on the table? For which n does this shuffle amount to a permutation consisting of a single cycle?		

UT2.3	**Friday 2:40 p.m.**	*Theoretical Notions of Ecological Stability and Their Relation to Temporal Variability*

Chace Covington	Francis Marion University
Ecological stability describes how populations of species in an ecosystem behave after a disturbance and can be measured by empirically and theoretically. Our experiment uses a first-order multivariate autoregressive model framework to explore the possible relationships between empirical and theoretical measures of ecological stability and the possible relationships between different theoretical measures of ecological stability. The empirical measures of stability included in this study are the average population coefficient of variation, the weighted average population coefficient of variation, and the community coefficient of variation. All theoretical measures of stability included are derived from a theoretical community matrix and include asymptotic resilience, initial resilience and reactivity, and intrinsic stochastic invariability. We find no evidence for any relationship between empirical and theoretical measures of ecological stability. This result is in agreement with previous experimental research by Downing, Jackson, and Plunket. However, we do observe clear relationships between different theoretical measures of ecological stability. We formalize these relationships with inequalities similar to those derived by Arnoldi et al. for continuous models.	

UT6.2	**Saturday 10:20 a.m.**	*A Combinatorial Approach to Euchre*
Brent Crane		
A description of the game of Euchre will be presented including all relevant terms, and the goals of such research. It will address the combinatorial problems ingrained within this examination and the adaptation of such problems to the game itself.		

SS10.2	**Saturday 10:20 a.m.**	*N Disks Walk onto a Peg*
Katherine Craven		Lenoir-Rhyne University
The Towers of Hanoi is a classic puzzle that involves moving disks from one peg to another, according to certain rules. The player can only move one disk at a time and can never place a bigger disk on top of a smaller one. In this talk, I will discuss the original puzzle and then describe my work on a related puzzle, where the pegs are arranged in a triangle and disks can only be moved in a fixed direction between adjacent pegs. I will relate my results on how many moves are needed to solve this puzzle, in the form of both recursive and closed formulas.		

UP1.3	**Saturday 10:10 a.m.**	*Water Quality of Rivers and Related Applied Mathematical Projects*
Alicia Crewey		Georgia Gwinnett College
In this research we present a classical coupled differential equations mathematical model for river pollution. The development of the model is studied starting with a single water quality component C(x, t). Further, the interaction between a pollutant P(x, t) and dissolved oxygen Q(x, t) is shown, modeling the diffusion, advection and the reaction between them. Steady state solutions of simplified models as well as the general coupled system of differential equations are shown. For the latter, closed form formulas can be obtained for different components: the velocity of the stream, dissolved oxygen levels etc. They are used to compute values that are		

compared against results obtained by implementing other models. Lastly, changes of the model in the part of the differential equation that is responsible for the reactions between the studied components are implemented and the effect of those changes to the model and the computed results is studied.

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SS9.3	**Saturday 10:40 a.m.**	*My Journey from Mathematics to Materials Analyst*
Joshua Crumbliss		
This presentation will focus on my career journey using mathematics in a non-academic field, specifically my transition from a career in logistics into analytics. I will cover multiple projects that have utilized my mathematics background, both in my previous position and in my current career as a Materials Analyst. I will also go over skills that will make students more marketable for positions in this field, as well as best practices for getting into this type of position.		

UP1.4	**Saturday 10:10 a.m.**	*Continuous Frames and the Discretization Problem*
Biraj Dahal		Clemson University
This poster presents an introduction to continuous frames and the discretization problem. A frame is a generalization of a basis in an inner product space that may be linearly dependent. Frames enjoy nice properties that are useful in signal processing and error recovery. In infinite dimensional Hilbert spaces, many natural frames are continuous, which makes them difficult to work with in practical applications. It was an open problem for a long time whether it is always possible to sample a discrete frame from a continuous frame and maintain the desired useful properties. A very recent result of Freeman and Speegle claims that this is always the case (under some very mild assumptions). Their proof is closely connected to the recent resolution of the Kadison-Singer and Fechtinger conjectures.		

UT5.3	**Saturday 10:40 a.m.**	*Unstacking Tortoise Shells with Math: Factoring Multivariate Polynomials in the Tropical Semiring*
Davis Deaton		Belmont University
The real numbers endowed with the operations of min and + form an idempotent semiring referred to as the Tropical Semiring. Factorizations of the multivariate polynomials over this semiring are not unique. Our goal is to provide an algorithm to produce all the factorizations of any given multivariate tropical polynomial. To do so, we associate each polynomial with a polyhedral complex such that multiplication of the polynomials corresponds to Minkowski addition of the complexes. We use a dual complex to describe each factor as a polyhedral complex satisfying a certain zero tension condition. This condition allows us to frame the irreducible factors as the Hilbert basis of a system of Diophantine linear equalities, which can be computed using known algorithms. These irreducible factors are then easily stitched together to form all possible factorizations.		

UT1.3	**Friday 2:40 p.m.**	*Deleting Edges from Complete Graphs to Destroy the Ramsey Property*
Elijah Dejonge		Western Carolina University
A Ramsey Number $R(G,H)$ is the least natural number n such that every two-coloring (red and blue) of the edges of a complete graph on n vertices, K_n, must contain a red copy of G or a blue copy of H. We investigate the number of edges that must be removed from such colorings of K_n in order to destroy this Ramsey Property for various pairs of graphs.		

CP2.3	**Friday 2:40 p.m.**	*Similarity Solutions to a Class of Mixed Convection Flows*
Anilkumar Devarapu		Albany State University
This paper deals with the new self-similar solution of the unsteady mixed convection boundary layer flow in the stagnation point region. With the help of a set of suitable similarity transformations, the nonlinear coupled partial differential equations governing select phenomena (such as flow, thermal and concentration field) have been reduced to a set of nonlinear coupled ordinary differential equations. Numerical solution of the resultant system of nonlinear ordinary differential equations is derived using an implicit finite difference scheme along with quasilinearisation technique.		

UT5.2	**Saturday 10:20 a.m.**	*Generalized Commutator Probability for Group Elements*
Dalen T. Dockery		Tennessee Tech University
In this project, we look at a probabilistic question in group theory: let G be a group with H a subgroup of G, and define the commutator of two group elements x and y to be [x,y]=xyx-1y-1. We analyze the probability that this commutator lies in H for an arbitrary choice of x and y. Additionally, we provide special cases of this probability for certain types of groups G and subgroups H, as well as probabilistic bounds for this condition. We conclude by looking at a few interesting questions regarding this probability, particularly its extremes under various conditions.		

CP7.3	**Saturday 10:40 a.m.**	*Capturing Persistent Homotopic Information*
Ivan Dungan		Francis Marion University
With the popularity of persistent homology and its applications, there has been growing interest in a persistent homotopy theory. Of course, there are the immediate computational difficulties to make it an immediate success like the prior. We will focus on the differences and identify how to capture some homotopic information that may advance current applications of persistent homology.		

SS8.1	**Saturday 10:00 a.m.**	*An Alternative Calculus Sequencing for increasing Math Majors*
Ivan Dungan		Francis Marion University
We will discuss a calculus sequencing where an introductory ordinary differential equations course is introduced immediately after a single variable calculus course. This is a slight variation of the usual sequencing of calculus courses, but we propose that the benefits are great especially when modeling real-world phenomena is integrated into the course. We will highlight these benefits which give students an early understanding of the power of mathematics in the academic and professional world with hope to create more math majors and in general, more STEM graduates.		

UT6.6	**Saturday 11:40 a.m.**	*Nevanlinna-Pick Interpolation on Certain Subalgebras of Bounded Analytic Functions*
Jeremiah Dunivin		Coastal Carolina University
Let $\emptyset \neq K \subseteq \mathbb{Z}_+$ and define $H_K^\infty(\mathbb{D}) = \{ f \in H^\infty(\mathbb{D}) : f^{(k)}(0) = 0 \text{ for all } k \in K\}$. It is not necessary that all the subsets K form an algebra $H_K^\infty(\mathbb{D})$; for example, take the set $K = \{2\}$. We consider those sets K for which $H_\infty^K(\mathbb{D})$ is an algebra under the usual product of functions. In this paper, we extend the Nevanllina-Pick interpolation theorem to $H_K^\infty(\mathbb{D})$.		

UT1.4	**Friday 3:00 p.m.**	*On Game Chromatic Number: Mycielskians*
Hannah Elser		Winthrop University
A graph is a collection of vertices and edges. A proper coloring of a graph is an assignment of color to each vertex so that no edge has the same color on both ends. The chromatic number of a graph is the least amount of colors that must be used in order for the graph to have a proper coloring. The Mycielski construction on a graph results in a new graph which requires one additional color to properly color. Shifting gears, consider the following game played by Alice and Bob on a graph. The players will take turns (with Alice going first) coloring the vertices from a common color set so that no edge has its two vertices colored the same color (i.e. after each player's turn, the partial coloring is proper). Alice wins if the entire graph is colored and Bob wins otherwise. Thus the question: given a graph G and a color set C, who has a winning strategy (i.e. can win independently of the other player's moves)? Our work		

focused on finding a relationship between the game chromatic number of a graph and that of its Mycielskian.

SS4.2	**Friday 2:20 p.m.**	*NFL Rule Changes: Have they Really Made an Impact for the Future of the Game?*
Sarah Fleischer		University of North Carolina Asheville
In recent years there has been growing documentation that continuous hits to the head can lead to chronic traumatic encephalopathy (CTE). Athletes playing contact sports such as football have an increased risk of developing CTE due to repeated blows to the head during practice and game play. As a result, the NFL has regularly made adjustments to the rules to increase player safety, especially attempting to reduce concussions in players during game play. During this talk we will explore the relationship between penalties and concussions and consider if rule changes are having an impact on reducing head injuries.		

UP1.5	**Saturday 10:10 a.m.**	*What's a DRACKN?*
Alex Foster		Coastal Carolina University
Equiangular Tight Frames, or ETFs, are sets of vectors that correspond to complex equiangular lines, which have sought after applications in various digital communication and coding theory contexts. This sparks an ongoing search to identify and classify ETFs, and a common strategy to obtain classes of ETFs is to utilize properties of certain simple graphs. This motivates the study of Distance Regular Antipodal Covers of Kn, or DRACKNs, which maintain properties that can be used to construct ETFs. Here we elaborate on the properties of these graphs and how they can be used to construct ETFs.		

UT2.4	**Friday 3:00 p.m.**	*Modeling Protection Strategies Against Chikungunya Virus on Reunion Island*
Alex Foster		Coastal Carolina University
Chikungunya virus is a mosquito-borne virus that is often accompanied by chronic arthritis. The disease was relatively unstudied until an outbreak on Reunion Island in 2004 infected nearly a third of the population. This led to the creation of systems of differential equations to model transmission on this island. Here we look at preventing transmission with the use of mosquito repellent, and we construct a game-theoretic model where individuals choose how often they spray themselves with repellent. We find that as the cost of insect repellent decreases, compared to the cost of infection, the strategies of rational individuals results in a reduction of infectivity of the disease, but does not eliminate it.		

UT3.1	**Friday 2:00 p.m.**	*Generalizing Random Fibonacci Sequences*
Alex Foster		Coastal Carolina University

Ever since the Four Color Theorem was proved in 1976, proofs using computers have become increasingly influential and controversial. In 1999, Viswanath determined a convergent nth root for random Fibonacci sequences (1.13198824…), but his technique required a computation using floating-point arithmetic. Here we present a generalization of these sequences and an interesting observation for the apparent convergence of the nth root for these generalizations, the proof of which we leave as an open question for the audience to explore.

CP4.3	**Friday** **2:40 p.m.**	*Neighborhood-Prime Labelings of Graphs*
Brad Fox		Austin Peay State University
A *neighborhood-prime labeling* of a graph of order n is a variation of a prime labeling in which the vertices are labeled with the integers $\{1, 2, \dots, n\}$ so that the following is true. For each vertex v with degree greater than 1, the gcd of the set of labels assigned to the vertices in the neighborhood of v is 1. In this talk, we will discuss evidence toward a conjecture that all trees have a neighborhood-prime labeling, demonstrating labelings for graphs such as caterpillars, spiders, and firecrackers. Finally, neighborhood-prime labelings will be examined for Hamiltonian graphs including generalized Peterson graphs and grid graphs.		

SS8.2	**Saturday** **10:20 a.m.**	*Pedagogical Pitfalls and Promises of a QLR Project*
Ryan Fox		Belmont University
In developing a relevant, real-world task for a introductory Quantitative Literacy and Reasoning course, I must update the same task frequently to meet the changing context of the task. In my talk, I want to discuss the original task, computing income taxes for hypothetical wage earners, and the changing contexts, as described in news articles of the changing rules regarding these taxes. I hope to get feedback from audience members regarding modifications of the task that support students' mathematical growth while maintaining a relevancy to their post-academic interests.		

SS1.4	**Friday** **3:00 p.m.**	*Effectiveness of metacognitive study skills intervention in first-year math courses*
Jenny Fuselier		High Point University
One promising method of improving performance in math courses is through interventions with students who perform poorly at an early stage of the course. For students scoring an 80% or below on their first test, we conducted a study skills intervention workshop. The workshop lasted less than an hour, and focused on using metacognitive techniques (thinking about thinking) to improve student's study habits. Similar work has been done by Saundra Yancey McGuire, with impressive results in Chemistry courses. We will discuss an outline of the workshop and preliminary results from our study to see if the intervention actually improved students' performance in their courses.		

SS10.5	**Saturday**	*A Mathematical Exploration of Enemy-Protector*

	11:20 a.m.	
Edward Fuselier		High Point University
In this talk we mathematically explore the summer camp activity "Enemy-Protector." Participants of Enemy-Protector try to arrange themselves according to "enemy" and "protector" assignments, and these assignments can lead to interesting behavior as the players move. In an effort to better understand the dynamics involved, we modeled Enemy-Protector as a dynamical system in MATLAB. We will share several observations from our simulations and investigate some of Enemy-Protector's underlying mathematical structures.		

SS3.3	**Friday 2:40 p.m.**	*Symmetric Arrangements in SET Space*
Nathan Gaby		Berry College
SET is a game played with a deck of 81 cards, each of which have 4 attributes: number, color, shading and shape. Gameplay is focused on finding collections of 3 cards so that in each attribute all three cards match, or all three cards differ. This gives the SET deck a 4D geometric structure based on the algebra of $Z_3 \times Z_3 \times Z_3 \times Z_3$.The nature of affine spaces in this geometry has been studied extensively. In this presentation we will consider the nature of nonaffine sets in the geometry of SET. We will use the Hamming distance between cards to classify the different possible symmetric arrangements of circles in a SET plane. Additionally, we will discuss operations on the SET plane that give these arrangements while preserving Sets.		

UT3.2	**Friday 2:20 p.m.**	*The Fourier Transform and Signal Processing*
Cain Gantt		Georgia College
In this project, we explore the Fourier transform and its applications to signal processing. We begin from the definitions of the space of functions under consideration and several of its orthonormal bases, then summarize the Fourier transform and its properties. After that, we discuss the Convolution Theorem and its relationship to the physics behind problems in signal processing. Finally, we investigate the multidimensional Fourier transform; in particular, we consider the 2-dimensional transform and its use in image processing and other problems. We include an example of a typical image processing task and demonstrate how the Convolution Theorem is applied to obtain a solution.		

CP2.6	**Friday 3:40 p.m.**	*Inverse problems related to the Steiner-Wiener indices*
Matthew Gentry		
In a graph, the generalized distance between multiple vertices is the minimum number of edges in an induced graph that contains these vertices. When we consider such distances between all subsets of k vertices and take the sum, it is called the Steiner k-Wiener index and has important applications in chemical graph theory. In this presentation we consider the inverse problems related to the Steiner Wiener index, i.e. for what positive integers is there a graph with Steiner Wiener index of that value?		

SS2.3	**Friday** **2:40 p.m.**	*PIC Math and Beyond*
Debra Gladden		Lee University
The authors are both former recipients of PIC Math grants. The PIC Math program prepares students for careers in industry via engaging them in problems that come directly from industry. We will discuss our experiences with the program and offer a model of embedding the substance of the program into curriculum after the grant has expired.		

UP1.6	**Saturday** **10:10 a.m.**	*Statistical Models for Predicting Single-Game Win-Expectation for NHL Teams*
Mira Grcevich		Belmont University
Predictive analytics models function to make sense of data, clarify relationships, and estimate future behaviors; they give logical and accessible projections of otherwise unknown events, and can be applied in a wide range of contexts — particularly, in our case, NHL hockey. The movement to integrate statistics with traditional evaluations of sport performance began nearly fifty years ago, yet "advanced stats" are considered an emergent and polarizing element of modern ice hockey. Furthermore, hockey is the most unpredictable of the four major North American sports, the outcomes of single games are more sensitive to random chance than the outcomes of entire seasons, and the metrics/models created by those leading the advanced stats movement are often indigestible to the casual fan. With this project, I aim to provide a clear explanation of how analytics can be used to make inferences about something as unpredictable as hockey by creating a model to predict win expectation ("Win" or "Loss"); one NHL team's likelihood of winning a specific single-game matchup against another NHL team.		

UT4.4	**Saturday** **11:00 a.m.**	*A Mathematical Model for Controlling the Spread of Cholera through Disinfection, Vaccination, and Quarantine*
Olivia Greathouse		Winthrop University
Cholera is a water-borne gastrointestinal disease that poses major health concerns and can be fatal. The spread of cholera can be controlled with proper treatment and prevention methods. In this talk, we present a mathematical model for the spread of cholera throughout a population, with basic control strategies of disinfection, vaccination, and quarantine. For our proposed model, we calculate the basic reproductive ratio, R_0, and prove global stability of the disease-free and endemic equilibria based on the value of R_0. We conclude with numerical simulations and a discussion of the effectiveness of the control strategies on the spread of cholera.		

UT1.1	**Friday** **2:00 p.m.**	*The Asymmetric Index of a Graph and Families of Asymmetric Graphs*
Adam Gregory		Western Carolina University
A graph G is asymmetric if its automorphism group of vertices is trivial. Asymmetric graphs were introduced by Erdős and Rényi in 1963. For a sufficient graph G we can remove some r number of edges and/or add some s number of edges to G in a way that yields an asymmetric graph. We define the asymmetric index of the graph G, denoted ai(G), to be the minimum of r+s so that the resulting		

graph is asymmetric. We present the asymmetric index of various connected and disconnected graphs and establish the existence of k-regular asymmetric Hamiltonian graphs for all k > 2.

SS2.4	**Friday 3:00 p.m.**	*Chess Master Delannoy and the Switching Lattice Paths*
William Griffiths		Kennesaw State University
In the late 19th century, Henri-Auguste Delannoy corresponded with Lucas on a number of recreational mathematics problems. Delannoy solved a number of these problems with the chessboard. He introduced the Delannoy numbers, the number of paths from the origin to (m,n) using only the steps (1,0), (0,1), or (1,1). These were called 'Queen's Walks', as they represent ways in which the Queen might move. We generalize these 'walks', or lattice paths, discovering an infinite collection of sequences with intriguing connections. Proofs of Identities amongst this collection are described by bijections even the novice player can master!		

CP5.5	**Friday 3:20 p.m.**	*To infinity and beyond*
Pawel Grzegrzolka		the University of Tennessee
In this talk, we will provide an introduction to the theory of coarse proximity spaces. We will start with recalling what it means for two sets to be "close." Then, we will discuss what it means for two sets to be "coarsely" (or "large-scale") close. After showing a few examples of spaces capturing coarse closeness (i.e., coarse proximity spaces), we will present selected recent results regarding coarse proximities. In particular, we will show how coarse proximities capture "closeness at infinity." No prior knowledge of coarse proximities will be assumed. This is joint work with Jeremy Siegert.		

UP1.7	**Saturday 10:10 a.m.**	*Cayley Graphs on Billiard Surfaces*
Asia Grzegrzolka		Lee University
Billiard surfaces are flat surfaces with Euclidean symmetry groups that are dihedral groups. Cayley graphs of the symmetry groups can be drawn on the surfaces in a natural way. We explore the relationship between the genera of Cayley graphs of the symmetry groups and the genera of the surfaces themselves.		

UT5.6	**Saturday 11:40 a.m.**	*On Covers of Dihedral 2-Groups by Powerful Subgroups*
Luke Guatelli		Western Carolina University
A finite p-group G is called powerful if either p is odd and $[G,G] \subseteq Gp$ or p=2 and $[G,G] \subseteq G4$. A cover for a group is a collection of subgroups whose union is equal to the entire group. We will discuss covers of p-groups by powerful subgroups. The size of the smallest cover of a p-group by powerful subgroups is called the powerful subgroup covering number. Our focus in this presentation is to determine the powerful subgroup covering number of the Dihedral 2-groups.		

UT4.3	**Saturday 10:40 a.m.**	*Mathematical models for Decapentaplegic (Dpp) scaling and pattern formation in the common fruit fly*
Noah Hallman		Georgia Southern University
Members of the same or closely related species can vary substantially in size, yet the proportions within and between tissues are precisely kept. Drosophila melanogaster, often referred to as the common fruit fly, is a widely-used model organism in biology. Many basic biological, physiological, and neurological properties are conserved between mammals and Drosophila, and nearly 75% of human disease-causing genes are believed to have a functional homolog in the common fruit fly. Morphogens are signaling molecules secreted from a localized source in tissue that regulate gene expression in a concentration-dependent manner. Decapentaplegic (Dpp) is a morphogen that plays a key role in the development of Drosophila. In particular, growth regulation of the Drosophila wing imaginal disc critically depends on the Dpp concentration gradient. It has been experimentally verified that both Dpp concentration and signaling gradients scale with tissue size in the developing Drosophila wing imaginal disc. Using mathematical models and computer simulations, we have been investigating the pattern formation and scaling of Dpp and its activities in the Drosophila wing imaginal disc. In this talk, an introduction to the pattern formation and scaling of Dpp will be given and some preliminary results shown.		

PUB.1	**Friday 2 p.m.**	*Practice, Practice, Practice in Calculus and Statistics*
Hawkes Learning		Hawkes Learning
Learn about new calculus and statistics software that ensures practice makes permanent through unlimited problem solving. Customized exercise sets and targeted practice sessions built from 27,858 calculus question variations are now available to improve student comprehension. Discover how software can provide error-specific feedback, recognize alternative equivalent answers, and teach students through annotated step-by-step tutorials. Find out how the new edition of Discovering Statistics and Data pays homage to modern day's technology-driven data explosion and engages students in the real-world applications of statistics. A free online resource containing more than 30 data sets, 17 chapter projects, 32 data visualization tools, and technology instructions for tools ranging from Excel to R will be shown. Learn about these new course materials and enter to win an Amazon gift card! Learn about new calculus and statistics software that ensures practice makes permanent through unlimited problem solving. Customized exercise sets and targeted practice sessions built from 27,858 calculus question variations are now available to improve student comprehension. Discover how software can provide error-specific feedback, recognize alternative equivalent answers, and teach students through annotated step-by-step tutorials. Find out how the new edition of Discovering Statistics and Data pays homage to modern day's technology-driven data explosion and engages students in the real-world applications of statistics. A		

free online resource containing more than 30 data sets, 17 chapter projects, 32 data visualization tools, and technology instructions for tools ranging from Excel to R will be shown.

Learn about these new course materials and enter to win an Amazon gift card!

CP4.4	**Friday** **3:00 p.m.**	*Restricted n-color Cyclic Compositions*
Elizabeth Hawkins		Georgia Southern University
Suppose you have a pile of colored squares of fabric. Now, suppose you don't know what colors they are or how many there are of each color. If you arranged the colored square into a straight line of some unknown length, how many unique patterns can you make with these colored tiles for each length line? Of course the answer depends on what colors you allow, the length of the line, the number of parts, and the meaning of unique. For this question unique means they are not cyclic equivalent. In this talk we will introduce the basic concepts related to n-color cyclic compositions and enumeration problems which address problems like the one above. We then focus on different restrictions one can put on the allowed colors and study the properties of the corresponding counting sequences.		

SS5.1	**Friday** **2:00 p.m.**	*Start – Stop – Continue: A Mid-Semester Course Retrospective*
Amanda Lake Heath		University of Tennessee
Many universities or departments require students to complete course and instructor evaluations at the end of a term; however, very few employ mid-semester evaluations or reflections. Requesting student feedback during a course allows the opportunity for an instructor to adjust the classroom environment while it is still relevant to their current students. The "Start – Stop - Continue" activity asks that students suggest something to start, something to stop, and something to continue, but there are two columns that they must complete: one regarding "the course" but another regarding themselves. This way, students are not simply given a chance to give the course feedback, but also asked to reflect upon their own behaviors in the course.		

CP5.2	**Friday** **2:20 p.m.**	*There are continuum-many integer sequences with the Zeckendorf property*
Curtis Herink		Mercer University
We say that a sequence has the Zeckendorf property if every positive integer can be uniquely expressed as a sum of distinct nonconsecutive terms of the sequence. Thus Zeckendorf's theorem can be paraphrased as the Fibonacci sequence 1, 2, 3, 5, 8, 13, ... has the Zeckendorf property. To each subset A of the set of natural numbers we associate a distinct integer sequence in such a way that (i) if A is infinite the associated sequence has the Zeckendorf property, and (ii) if A is both infinite and co-infinite the associated sequence has the stronger property that every integer, positive or negative, can be uniquely expressed as a sum of distinct nonconsecutive terms of the sequence.		

UT2.6	**Friday 3:40 p.m.**	*Predicting Lung Cancer Death Rates by County through Demographic Variables*
Jordan G Hoffman		Belmont University
The onset of lung cancer is often considered to be the result of individual lifestyle choices, such as smoking. However, lung cancer differentially affects minorities and individuals of low socioeconomic status, suggesting that external stressors may also contribute to the onset of lung cancer. In 2015, the Center for Disease Control published Community Health Status Indicators, an extensive database recording birth and death rates, risk factors, environmental and demographic data for every county in the US. For my capstone project in Predictive Analytics, I utilized this database to predict lung cancer death rates per 100,000 individuals in a county based on the county's demographic makeup and occurrence of other chronic disorders. After merging and cleaning the data files, I used R software to train a multiple regression linear model. To refine the model, I eliminated variables with minuscule correlation coefficients to the predictor variable, such as obesity, and added an interaction term between race and poverty. The final predictor variables included percentage of racial minorities in the county and poverty level, and small p-values suggest their correlations to lung cancer deaths are unlikely to be due to chance. Running the model on test data resulted in an R-squared value of 0.54, meaning that the model explains 54% of the variance in lung cancer death rates. While lifestyle factors such as smoking, diet and exercise definitely affect an individual's likelihood to contract lung cancer, this model suggests that racial and socioeconomic inequality are structural risk factors for this terminal disease.		

UP1.8	**Saturday 10:10 a.m.**	*The Domination Ideal of a Finite Simple Graph*
Jacob Honeycutt		Clemson University
Let G be a finite simple graph with vertex set {v_1,…,v_d }. We study G algebraically by introducing its domination ideal D_G⊂K[v_1,…,v_d] where K is a field. The generators for D_G are S_1,…,S_d where S_i is the largest substar of G centered at vertex v_i. We prove that the irredundant, irreducible decomposition of D_G is determined by the minimal dominating sets of G.		

CP4.6	**Friday 3:40 p.m.**	*A Generalization of a Result of Catlin: 2-Factors in Line Graphs*
Emily Hynds		Samford University
A 2-factor of a graph *G* consists of a spanning collection of vertex disjoint cycles. In particular, a hamiltonian cycle is an example of a 2-factor consisting of precisely one cycle. Harary and Nash-Williams described graphs with hamiltonian line graphs. Gould and Hynds generalized this result, describing those graphs whose line graphs contain a 2-factor with exactly *k* ($k \geq 1$) cycles. With this tool, we show that certain properties of a graph *G*, that were formerly shown to imply the hamiltonicity of the line graph, *L*(*G*), are actually strong enough to imply that *L*(*G*) has a 2-factor with *k* cycles for $1 \leq k \leq f(n)$ where *n* is the order of the graph *G*.		

SS2.2	**Friday** **2:20 p.m.**	*Math in Software Development*
Bridget Jones		
Finding your first job out of college can be challenging. This presentation will focus on the challenges I faced during my job search and how a positive attitude and willingness to try something new helped me land a role in software development. I will discuss how math is used in my daily tasks as well as discuss how my background in math and doing research as an undergraduate set me up for success as a software developer.		

SS11.1	**Saturday** **10:00 a.m.**	*Combining Resubmission with Reflection to Increase Understanding*
Vicky Klima		Appalachian State University
We are all busy people! Our students are no different and often, due to increased pressures on their time, students do not absorb feedback in the way we would hope. In this talk we present methods of encouraging students to engage meaningfully with feedback provided both directly by the instructor and indirectly through an online homework system. In addition to discussing the nuts and bolts of implementing the feedback loop we also discuss student reaction concerning the effectiveness of this system.		

UT3.4	**Friday** **3:00 p.m.**	*How to Stop a Nazi: Ranked-choice Remixed*
Matt Knipfer		High Point University
Ranked-choice is an alternative voting method to our current Plurality model, the former trending towards promoting more moderate candidates and third-parties. However, with every voting model comes limitations and inherent features that are favorable in candidates. In this paper, I propose two augmentations to Ranked-choice that have potential to mitigate some of these issues and promote candidates with greater mean and median favorability.		

CP5.3	**Friday** **2:40 p.m.**	*Partitions with largest part repeated*
Louis Kolitsch		The University of Tennessee at Martin
In this talk a theorem about partitions where the largest part in the partition is repeated will be presented. Results will be looked at both analytically and combinatorially.		

CP7.2	**Saturday** **10:20 a.m.**	*Computing Dessins for a Given Branching Pattern*
Vijay Jung Kunwar		Albany State University

Branching pattern gives the combinatoric structure of a rational function, it does not tell anything about the existence of the function. For example, there is no rational function for the following branching pattern of order (degree) eight: $(2^4), (2^4), (2, 3^2)$. We can use dessins to verify the existence of rational functions for a given branching pattern.
For Riemann spheres (genus 0), there is a one-one correspondence between dessins, permutation triples, and belyi maps of degree n. Basic method to compute dessins of degree n involves the following two components: (i) start from the dessin of degree 1, (ii) add an edge on each successive step to find dessins of the next degree. This method has a huge growth of $\frac{(n-1)!(n+1)!}{2}$ which makes it impossible to compute all dessins of degree as small as 12 without imposing additional restrictions or constraints.
In this presentation we will discuss about an efficient way to compute dessins for a given branching pattern using multi-step method. The new approach is very fast and efficient on computing dessins, and thus on proving the existence of belyi maps for a given branching pattern.

SS2.5	**Friday 3:20 p.m.**	*Actuarial Science*
Allyse Lamon		
Actuaries use mathematical concepts and models to estimate reserves that insurers must keep on hand to pay out claims and to set appropriate premiums for those insurers' policies. Most actuaries generally work either in life and health at a firm like MetLife or Blue Cross or in property casualty at a firm like Allstate. But the field is broader than you might expect – I work at Caterpillar's office in Nashville where the machinery manufacturer's financial operations are headquartered – and I highlight some actuarial career opportunities for graduates with mathematics backgrounds. I've worked in the actuarial field for several years and outline the actuarial paths graduates can take, the preferred qualifications they will need for an entry-level job after graduation, and the ongoing education requirements and advancement opportunities available in the field. Using one of the more recent projects I have been working on as an example, I also walk through the interesting, fun, and challenging types of things an actuary may do on a day-to-day basis.		

UP1.9	**Saturday 10:10 a.m.**	*Positive solutions to singular second order boundary value problems for dynamic equations*
Alex Lancaster		University of Tennessee Martin
We study singular second order boundary value problems with mixed boundary conditions on an infinitely discrete time scale. We prove the existence of a positive solution by means of a lower and upper solutions method and the Brouwer fixed point theorem, in conjunction with perturbation methods used to approximate regular problems.		

SS10.1	**Saturday 10:00 a.m.**	*Geometric phase of an analog clock*
Jeffrey Lawson		Western Carolina University

How many times in a day does the minute hand of an analog clock cross the hour hand? What about if we also consider the second hand? Although this is an old puzzler, we will present a solution using the geometric phase. We also show that the center of mass of the system traces out Spirograph-like curves that help to visualize the problem.

CP9.3	**Saturday 10:40 a.m.**	*Data patterns discovery using unsupervised learning*
Rachel Lewis		Georgia Southern University
Cluster analysis (clustering) is an exploratory data mining task of creating groups (clusters) of similar objects. Clustering is typically a difficult unsupervised learning task: there are many methods and many similarity/dissimilarity measures to choose from and the results typically vary with these methods. We use hierarchical clustering on binary data, using a few popular similarity measures to discover interesting information from self-care problems of children with physical and motor disability data. We show how using different similarity measures one can perform automatic classification of such binary data, and, in general, discover outliers and rare occurrences in data.		

SS1.3	**Friday 2:40 p.m.**	*A course redesign of Differential Calculus using adaptive learning courseware at an HBCU*
Torina Lewis		
In fall 2017, Clark Atlanta University conducted a comprehensive review and evaluation of student performance in foundational STEM courses offered in AY 2014-15 to AY 2016-17. During the three years, we found that approximately 60% of the students enrolled in these courses earned a C, D, F, or W, with about 30% of the students receiving a C. The data showed that students were not mastering the concepts at a high level in these courses. Since Calculus I is the foundation of STEM, we redesigned the Calculus I course using adaptive learning courseware. The purpose of the study was to determine the effectiveness of utilizing the platform Assessment and LEarning in Knowledge Spaces (ALEKS) as a corequisite model in Calculus I to improve mastery of student learning outcomes. One-hundred thirty-six students enrolled in four sections of Calculus I. A section of 32 students was exposed to the intervention, while the remaining 104 students formed the control group. Students in the experimental group earned an average of 64% on the final assessment while students in the control group averaged 46%. Results also indicated that students exposed to the intervention were more than two times more likely to score a 70% or above on the final assessment (52% vs 20%).		

SS1.5	**Friday 3:20 p.m.**	*Designing a Corequisite Class to Increase Student Success in Calculus I*
Elizabeth Lewis		UNCG
This talk discusses our Foundations of Calculus class which is designed to increase undergraduate degree efficiency for STEM students by reducing barriers to academic progress through curriculum updates and course design. This corequisite course provides supplemental instruction for Calculus I, a gateway mathematics course for STEM majors that has a history of low success, causing a significant		

hindrance to timely graduation. Many students (over 40%) who attempt Calculus I never achieve a grade of C or better in their program of study. Even among those who do have success, very few succeed in their first year of study. We discuss design, implementation, successes and challenges and next steps.

SS11.4	**Saturday 11:00 a.m.**	*Steps in Teaching Students to use Excel for Solving Quantitative Problems*
Robin Lovgren		Belmont University
An outline will be presented to give an organized method for incorporating Excel in the classroom as a tool for solving quantitative problems. Should the instructor demonstrate from the front of the class or should the exercise be self-guided? There will be a discussion of the role of the instructor and the role of the student during this process. A variety of ways to lead the class will be discussed along with results and a suggested final format. There will also be a discussion of the required mathematical skills and the required spreadsheet skills for the students as the course progresses. After changing to this recommended method, there has been a noticeable increase in the number of students who can correctly use Excel on Problem Sets and who can identify and state the Excel functions properly on a test.		

UT2.1	**Friday 2:00 p.m.**	*Introduction to Multiplayer Nash Equilibrium and Applications*
Candace Luong		Georgia Southern University
From planned trips to the theater, to the capture of consumer interests, Game Theory lends its utility to many aspects of life. By observing its core concepts, such as Nash equilibrium, best response functions, and mixed strategy, participants (players) in various scenarios (games) can optimize their decision. In this presentation, we will discuss these particular examples, and generalize them to cases with more players. Moreover, we will use these models to ultimately demonstrate game theory's applications in some practical applications. For instance, Investors depend on a certain clairvoyance to guide their investment decisions. Through the study of game theory, we can model the groundwork for the firm-to-firm interactions that govern their shrewdest investments. In particular, 3-dimensional "tables'' will be constructed, in which we introduce the concept of "sub-equilibrium" to help facilitate the decision-making process.		

UP1.10	**Saturday 10:10 a.m.**	*Analyzing Power Usage Data at a Growing Rural University*
Jonathan Mashburn		Western Carolina University
This project was to determine if an unexpected rise with Western Carolina University's Power Usage was due to weather. We fit the data to a model using a variety of regression methods to predict the usage. We also used a time series model to predict the future usages.		

GS1.1	**Friday**	*Tales of Success From Mathematical Malpractice*

	12:45 p.m.	
Kristen Mazur		Elon University
Have you ever thought about the value of mathematical failure? Errors and failure are inevitable and invaluable aspects of learning mathematics, yet they are often forgotten elements of the research process. In math history lessons we discuss Lobachevsky's and Bolyai's discovery of hyperbolic geometry while ignoring the many erroneous attempts to prove the parallel postulate that inspired their work. We celebrate Tait's first classification of basic knots but never mention its origination as part of a debunked theory of the atomic model. However, mathematicians inherently appreciate that learning from failure leads to long-term success. In this celebration of failure, we discuss moments in history in which wrong ideas inspired something right: beautiful new mathematics.		

UP1.11	**Saturday 10:10 a.m.**	*Dynamics of an HIV-1 Virotherapy Model*
Mary McBride		Winthrop University
In this project, we consider the dynamics of the HIV-1 virus under the effects of viortherapy and an immune response. We calculate basic reproductive ratios for the HIV-1 virus and recombinant virus, and use these ratios to establish existence and stability criteria for disease-free, single infection, and double-infection equilibria. We utilize Lyapunov functions to prove the global asymptotic stability of the disease-free and single-infection equilibrium. For the double-infection equilibria, we explore its stability through numerical simulations and provide evidence of a Hopf bifurcation. We conclude with a discussion on the effects of using a recombinant virus to control HIV-1 cell populations.		

UT4.5	**Saturday 11:20 a.m.**	*Planetary Motion determined by Mary Somerville*
Sydney McCall		Winthrop University
This talk will be a historical review of the life and work of Mary Somerville. Mary was well-known among the scientific and mathematical communities. One of her biggest accomplishments was her book "Mechanism of the Heavens." This talk gives an overview of one chapter of this book entitled "On the differential equations of the motion of a system of bodies, subjected to their mutual attractions", which discusses how distances and force are used to estimate the location and movement of planets.		

SS5.2	**Friday 2:20 p.m.**	*Using a Flipped Format in Core Mathematics Classes*
Beth McClanahan		LaGrange College
This session will examine the use of the flipped classroom format in Elementary Algebra and College Algebra courses. Specifically, we will discuss how a flipped course may be structured, some of the ways in which students have responded to this format, and some of the unintended benefits of this style of teaching in the classroom. Topics include the use of videos outside of class, tests/quizzes, increases in student engagement, and juggling different levels in the same classroom.		

SS4.4	**Friday** **3:00 p.m.**	*Humans vs. Zombies: A Phase Plane Analysis Activity*
Hope McIlwain		Mercer University
The game Humans versus Zombies has recently been popular on many college campuses. In this game, which reflects a larger interest in human-zombie behavior, two populations (Humans and Zombies) interact. As a part of a SIMIODE workshop, I developed a mathematical modeling activity which models the interaction between humans and zombies using the SIR model. In this talk, I will discuss how I developed the model as well as how I use the activity in my Differential Equations classroom.		

UT5.1	**Saturday** **10:00 a.m.**	*Chipkill: The Power of Finite Fields*
Cannon McIntosh		Coastal Carolina University
In coding theory, SECDED codes are commonly used and capable of detecting up to two bit errors and correcting one bit error. We will explore the mathematics behind Chipkill error correction and demonstrate how it outperforms SECDED correction via clever use of finite fields.		

CP8.4	**Saturday** **11:00 a.m.**	*Incorporating Stochasticity into Models*
Erin McNelis		Western Carolina University
Our Introduction to Scientific Computing course uses modeling to motivate the investigation of different mathematical technology and tools. We typically start with standard discrete models, such as a predator-prey or disease model, and transition into continuous models and stage-based models. To make models more realistic, we can add stochasticity to the model by introducing some variability to parameter values. This talk will introduce some ways you can do this in your models and simulations. We will also explore how numerical methods would need to change when working with stochastic models.		

UT6.5	**Saturday** **11:20 a.m.**	*Symmetry in Atonal Music*
Sergei Miles		Appalachian State University
Atonal music is composed by re-playing permutations of a given twelve-tone row. By including complete re-orderings a twelve-tone row the composer guarantees that each of the twelve pitch-classes repeat equally in a composition. Therefore, the composer gives no preference to a particular subset of notes and avoids key-structure in the music. We investigate symmetry in twelve-tone rows and then apply these ideas to n-tone rows for microtonal systems.		

UP1.12	**Saturday** **10:10 a.m.**	*Improved convergence of fixed point iterations with Anderson acceleration*
Allison Miller		Clemson University

We study theory and applications for Anderson accelerated fixed point methods. We prove an improved convergence rate for the 1D setting, and apply the method to several test problems, including the lid driven cavity for incompressible fluid flow.

CP2.5	**Friday 3:20 p.m.**	*Time Delays in Differential Equations*
George Moss		Union University
In an ordinary differential equation the rate of change is based on the state at present, but many models include information about past states of the system. These models can be formulated as delay differential equations (DDE). We present a brief introduction to the field of DDE and then examine the phenomenon of drug absorption delays. We compare this to a compartment model technique used in pharmacokinetics.		

SS10.3	**Saturday 10:40 a.m.**	*Abracadabra: Math, Magic, and More!*
Andrew Mosteller		Lenoir-Rhyne University
In this talk, we will briefly discuss the history of math, magic, and how they interact. We will also explore two very powerful, self-working card tricks (relying fully on mathematics, no sleight of hand required). In addition, we will reveal the underlying mathematics and method behind these tricks which use key concepts from Group Theory and Number Theory. We will also go over how generalizations of this method can be used to create new possibilities of self-working card tricks.		

CP3.6	**Friday 3:40 p.m.**	*The Distance to a Squarefree Polynomial*
Richard Moy		Lee University
In the 1960's, Turán asked whether there exists a constant C such that for every polynomial $\mathrm{f(x)} = \sum_{i=0}^{n} \mathrm{a_i}\, x^{n-i}$ (a_i integers, $a_0 \neq 0$), there is a polynomial $\mathrm{g(x)} = \sum_{i=0}^{n} \mathrm{b_i}\, x^{n-i}$ (b_i integers) irreducible over the rationals satisfying $L(f-g) \coloneqq \sum_{i=0}^{n} \lvert \mathrm{b_i} - a_i \rvert \leq C$? We investigate the analogous problem where $f(x)$ is a polynomial over $\mathbb{Q}$ or $\mathbb{F}_p$ and $g(x)$ is squarefree. We prove a bound of $O(n^{\epsilon})$ for C and prove that one can choose $C = 1$ for small n.		

CP6.4	**Saturday 11:00 a.m.**	*Improving Program Assessment of the Mathematics Major*
Bernadette Mullins		Birmingham-Southern College
The mathematics faculty has collaborated on programmatic assessment of the major to improve both the process for selecting assessment problems and inter-rater reliability for rubric-based scoring. We describe our efforts and preliminary results.		

CP5.6	**Friday** **3:40 p.m.**	*Radio Graceful Cartesian Powers*
Amanda Niedzialomski		University of Tennessee Martin
Radio graceful graphs are graphs that can be radio labeled with consecutive integers, and therefore have the minimal radio number of any graph of specified order. It has been shown that the Cartesian product of *t* copies of the complete graph K_n, denoted K_n^t, is radio graceful. We will explore what we can say about G^t for an incomplete graph *G*.		

CP8.2	**Saturday** **10:20 a.m.**	*2-Wasserstein distance between self-similar measures*
Robert Niedzialomski		University of Tennessee at Martin
We study the 2-Wasserstein distance between self-similar measures via approximation by certain discrete iterations of the Hutchinson operator. The main goal is to derive nontrivial bounds for the distances between these approximations and the self-similar measures.		

CP7.1	**Saturday** **10:00 a.m.**	*Group Actions of Llie Groups on Flag Manifolds: Orbits*
Ben Ntation		Austin Peay State University
Lie group action on manifolds usually give rise to induced actions on the parameter spaces of certain geometric objects related to the manifolds in question. For instance, from the canonical representation of complex linear group on the n-dimensional complex plane, one obtains actions on the parameter spaces of linear subspaces, that is, Grassmannians of k-dimensional subspaces, flag manifolds, and so on. We will consider in particular, the parameter space of orbits of real forms of semi-simple Lie groups acting on flag manifolds.		

SS11.6	**Saturday** **11:40 a.m.**	*An Examination of the Impact of Affordable Learning Georgia Textbook Transformation Projects on Instruction, Learning, and Student Achievement at Albany State University*
Zephyrinus C. Okonkwo		Albany State University
University System of Georgia (USG) encourages faculty members to apply and receive the Affordable Learning Textbook Transformation Grants which enable them to develop resources as well as utilize Open Education Resources (OER) for course instruction. In most cases, these courses are zero-cost textbook courses, whereby every student in the class has access to an ebook. The ebook is usually reposed on the course learning platform (GeorgiaView). This state-wide grant has saved students millions of Dollars. In this presentation, we discuss the data collected on such grant activities on three distinct courses which have led to positive outcomes.		

CP5.4	**Friday** **3:00 p.m.**	*A Scalable Pluggable Cryptographic Algorithm for Enterprise Blockchain Sub-Channels.*

Robert Steven Owor	Albany State University
In this paper, we review the state of pluggable Cryptographic algorithms for Enterprise Blockchains. Cash Fault Tolerant (CFT) and/or several variants of Byzantine Fault Tolerant (BFT) protocols are increasing being used in enterprise blockchain systems. Privacy and Security in Enterprise-Grade Permissioned Blockchain networks is accomplished by the use of sub channels which are set up to enable communication among only approved blockchain nodes. When the number of transactions becomes large, initiation, establishment, communication, and dissolution of sub-channels can become expensive, time consuming and prohibitively slow for Enterprises requiring fast and efficient smart contracts and transaction processing. We propose the development of pluggable pre-programmed standardized sub-channels which can greatly increase the efficiency and speed of initiation, establishment, communication, and dissolution of communications sub-channels.	

CP1.3	**Friday 2:40 p.m.**	*A Follicle Wave Model with Applications*
Nicole Panza		Francis Marion University
Ovarian follicle waves have been reported in women by Baerwald et al. (2003). Typically two or three waves occur per menstrual cycle. A nonlinear differential equation model representing the hormonal regulation of the menstrual cycle for a two-wave and a three-wave cycle are presented. The model exhibits waves of antral follicles during a woman's cycle using a Follicle Stimulating Hormone threshold function. The model is used to explore phenomenon such as early menopause and superfecundation.		

UT3.6	**Friday 3:40 p.m.**	*A Series of Series Topologies on N*
Zachary Parker		University of Tennessee-Martin
Each series of real positive terms gives rise to a topology on N = {1, 2, 3, ...} by declaring a proper subset A $\subseteq$ N to be closed if the series converges. We explore the relationship between analytic properties of the series and topological properties on N.		

SS4.3	**Friday 2:40 p.m.**	*Prevalence of Obesity Among Adults and Youth in the Southeastern Region and a Dire Need of Effective Intervention*
Laxmi Paudel		Albany State University
Overweight and obesity has been a major health problem in the United States. The severity is highest in the southeastern region. Contagious effect is a significant factor for the progression of the obesity and its identification can lead to effective planning in the intervention of the obesity epidemic. In this paper, we present a simple mathematical model for the current epidemiological dynamics of obesity in the southeastern region. We discuss the contagious nature of obesity in its transmission among friends and relatives. We also purpose some affirmative actions to the public health policy makers, the city planning authority, and the community itself that could minimize and even reverse the pattern of obesity.		

CP6.5	**Saturday 11:20 a.m.**	*Mahematics at Black Mountain College*
David Peifer		UNC Asheville
Black Mountain College (BMC) was a small liberal arts college, located near Asheville, NC. The college operated from 1933-1957. Despite it's short life, BMC has had a tremendous influence on modern and contemporary art. Most people assume that BMC was an art school. However, the college attracted some amazing science and mathematics faculty. In this talk, we will investigate some of the mathematics faculty and topics taught at BMC.		

SS3.1	**Friday 2:00 p.m.**	*Human Cellular Automata Activities*
Andrew Penland		Western Carolina University
Cellular automata are simple systems that produce complex and fascinating results. They have been used to describe the growth of human embryos, the synchronizing of firefly lights, and the construction of prehistoric temples. We will show an "explanation by experience" of cellular automata, ideal for non-experts. People who come to this talk should expect to become part of a cellular automaton.		

SS11.2	**Saturday 10:20 a.m.**	*Designing and Evaluating OERs in Mathematics Modeling*
Marnie Phipps		University of North Georgia
This study describes the design and evaluation of open educational resources for mathematics modeling students. In a single academic year, we sought to use the NCTM's (2014) eight effective teaching and learning practices as a guide to develop course materials, pilot, modify and compare these materials to those that are currently in use at our institution. We use students' content growth, dispositions and mathematical views to make comparisons and conclusions. As we share our positive outcomes and highlight the affordances and challenges of the project, we focus on how open educational resources fit into instructional reform efforts.		

SS11.3	**Saturday 10:40 a.m.**	*Using Historical Timeline Exercises in a Mathematics Course*
Mike Pinter		Belmont University
In a mathematics course that fulfills the general education requirement for Honors Program students, I include a variety of topics and influential people from within mathematics and outside of mathematics. The majority of the topics and people are associated with the time period from 1850 to 1950; examples include symbolic logic, voting methods, Bertrand Russell, Kurt Godel and Kenneth Arrow. I will share some interactive timeline exercises that I have used in class, including a fun activity for the last day of class, to help students solidify connections between various topics, academic disciplines, and specific people involved.		

SS3.2	**Friday** **2:20 p.m.**	*Set Squares*
Sarah Poiani		High Point University
Set is a popular card game with many fascinating mathematical properties. We will discuss how sets can be used to create an analog for word ladders and squares. The length of Set Ladders will be examined and the new structure, Set Squares, will be introduced. A method for constructing Set Squares is demonstrated.		

SS4.1	**Friday** **2:00 p.m.**	*Can NFL Overtime Be Made Fair?*
Megan Powell		University of North Carolina Asheville
In recent years, there have been multiple NFL playoff games that have gone into overtime, renewing a long standing call that the overtime system was still not fair despite recent modifications to overtime rules. In this talk, we look at fairness of overtime by considering a Markov chain model of the current modified sudden death overtime format and propose an alternative modified sudden death format where both teams are guaranteed possession of the ball at least once. Additionally, we consider how the reduction of overtime length from 15 minutes to 10 minutes may affect the fairness of the game based on length of the first possession of the ball.		

UP1.13	**Saturday** **10:10 a.m.**	*Painting Polyhedra: An Application of Burnside's Formula*
Alec Powers		
There is an activity that involves figuring out the number of different cubes a person could get if they were coloring the faces of the cube with three different colors. This activity is lengthy and tedious to most, because most people list out all the different possibilities. Is there a way to generalize this activity or change it in any way? The answer to this question can be found by looking at an abstract algebra topic, groups acting on sets. In this research, we will use Burnside's formula and groups acting on sets to find the number of distinct colorings for different shapes. We will vary parameters such as dimension and number of colors.		

C9.5	**Saturday** **11:20 a.m.**	*Regression to the Nice: Support Vector Machines, Politeness Strategies, and Game Theory in Online Message Boards*
Jason Quinley		Uni Tuebingen/ Quintessence Consulting
Mathematicians and programmers often use online fora from the *Stack Exchange* community to request help answering questions in their field. This includes the two most popular sub-communities like *Mathematics* (1.1 million questions) and *Stack Overflow*, a forum for programmers with over 17 million questions.		

Preliminary statistics like those seen in the *Stanford Politeness Corpus Study* suggest that the reputation of a user may impact their style of request. This dovetails with two game-theoretic models of requests: costly signaling and reciprocal exchange. Each has documented mathematical formalisms, signaling games and trust games, with equilibrium conditions determined by relative weights of game parameters. For instance, costly signals stabilize if they allow receivers to distinguish between senders and reciprocal exchange stabilizes with sufficiently patient players or high risk of investment.
We present multiple regression analyses using mean length utterance and a politeness classifier to test whether an utterance's score on either of these measures positively correlates to an increased probability of being answered or upvoted. The classifier is a support vector machine trained on the Stanford Politeness Corpus to detect the probability that an utterance is polite, given its values on a linguistically determined feature vector. We use these results to evaluate whether conditions are appropriately weighted to sustain the aforementioned equilibria.

CP9.4	**Saturday 11:00 a.m.**	*The Evolution of Exploitation: Sympathetic Utility Functions in Evolutionary Games*
Jason Quinley		Uni Tuebingen/ Quintessence Consulting

Evolutionary game theory models behavior via the replicator equation $\frac{dx}{dt}=x(EU_x-\overline{EU})$. I.e. a variant's growth rate ($\frac{dx}{dt}$) is the product of its current proportion x and its fitness (EU_x) relative to the population as a whole ($\overline{EU}$). Evolution is not merely biological, however. We can model cultural evolution with sympathetic agents by a weighted utility function $V_A=(1-s)U_A+sU_B$, where U is the payoff to the agents A and B in the original game, and V determines the payoff they experience. For instance, players with 20% sympathy receiving respective payoffs of 5 and 0 will *experience* payoffs of 4 and 1.
Although much attention has been paid to the conditions necessary to change a player's behavior to a cooperative type, sympathy may lead to exploited players, as a player may have no incentive to change behaviors. We give several examples from two- and three-strategy games, including a game of *weak commitment* based on the *Stag Hunt* and *Prisoner's Dilemma*. In the game of weak commitment, we see that sympathy removes the evolutionary stability of the exploited outcome. We contrast this with the stability of exploited outcomes predicted under the Folk Theorem. Applications to marriage markets and verbal contracts will be discussed. We will present our results using an interactive Jupyter notebook.

SS5.5	**Friday 3:20 p.m.**	*Social Science and Service: Reflections on Teaching Game Theory*
Jason Quinley		Uni Tuebingen/ Quintessence Consulting

In this talk we give several highlights from teaching a Game Theory seminar to advanced high-schoolers at a Southern college-prep school with a focus on Servant Leadership. Notable assignments include using NetLogo for simulating Schelling's segregation model in the week of the Martin Luther King Jr. holiday, white paper assignments exploring Arrow's Impossibility Theorem using LATEX, and classroom experiments on the repeated Prisoner's Dilemma.

SS9.1	**Saturday 10:00 a.m.**	*BIG Data Meets Small-Town Issues: Python, Pandas, Politics, and Policy Consulting*
Jason Quinley		Uni Tuebingen/ Quintessence Consulting
The era of Big Data and BIG jobs has brought newfound attention to mathematics and mathematicians. Leveraging mathematical insight requires coding ability, community buy-in, and, inter alia, a strong pipeline between local governments, academia, and industry. To that end, our company works to strengthen quantitative literacy among local governments, citizens, and STEM educators. This effort not only includes working with community organizations but also strategic analytics for political campaigns including school board, mayoral, and Congressional races. We will present three highlights from our company's recent efforts: • Voter database manipulation and strategy using relational algebra and Jupyter notebooks. • Advocacy and awareness building for adopting ranked-choice voting and improving voter turnout. • Professional development via open-membership data science meetings. We welcome discussion on all of these issues and solicit feedback into our current efforts with crime prevention. We will also discuss the benefits of community involvement for the research-oriented mathematician and data scientist.		

UT4.2	**Saturday 10:20 a.m.**	*A Graph Theory Approach to Gerrymandering*
Kelsey Quinn		High Point University
Gerrymandering is the manipulating of district boundaries to favor one party over another. District maps can be modeled in various ways such as graphs and corresponding matrices. The focus of this talk will be on connections between gerrymandering, graph theory, and matrix observations. We are also including findings that represent hamming distances, matrix differences, and upper triangular differences and their relationships to district maps.		

CP2.4	**Friday 3:00 p.m.**	*Existence of minimal and maximal solutions for Caputo fractional differential equations with bounded delay*
Diego Ramirez		Savannah State University
In this presentation we consider a fractional differential with bounded delay with Caputo derivative or order q, $0<q<1$.After defining different sets of coupled lower and upper solutions we prove that there exist two sequences of iterates that converge uniformly and monotonically to minimal and maximal solutions of the problem. Furthermore, we state conditions that guarantee that both sequences converge to a unique solution.		

SS9.2	**Saturday 10:20 a.m.**	*Mentored Teams of Undergraduates in Real World Consulting*
John R Ramsay		The College of Wooster

One of the difficulties in mathematics education is providing a good answer to the “What can I do with mathematics?” question. Applied examples and projects within existing mathematics courses can help answer this but often aren’t close enough to real world applications and they can consume considerable course time. We have addressed this difficulty with a summer program that gets students solving real world problems. The College of Wooster Applied Methods & Research Experience is a summer program that employs students to work as consultants in the local community. Students generally work in teams of three with a mathematics or computer science faculty member acting as mentor. Clients of the program come from business, industry, government agencies, and service organizations. The program, funded primarily by client fees for services rendered, is a model that demonstrates that even at early undergraduate level, mathematics students have marketable skills that can be leveraged into experiential eduation opportunities.

CP3.3	**Friday 2:40 p.m.**	*Singularity of Nilpotent Lie Algebras Constructed From Graphs*
Allie Ray		Birmingham-Southern College
Starting with a directed edge-labelled graph, we introduce two methods for constructing a two-step nilpotent metric Lie algebra. We will see how the singularity of these Lie algebras, as well as other aspects of their geometry, can be determined by properties of the graphs.		

GS1.2	**Friday 4:15 p.m.**	*Tales of Impossibility*
David Richeson		Dickinson College
"Nothing is impossible!" It is comforting to believe this greeting card sentiment; it is the American dream. Yet there are impossible things, and it is possible to prove that they are so. In this talk we will look at some of the most famous impossibility theorems—the so-called "problems of antiquity." The ancient Greek geometers and future generations of mathematicians tried and failed to square circles, trisect angles, double cubes, and construct regular polygons using only a compass and straightedge. It took two thousand years to prove conclusively that all four of these are mathematically impossible.		

CP6.3	**Saturday 10:40 a.m.**	*A study of student perceptions of office hours*
Lake Rylie Ritter		Kennesaw State University
Faculty-student interactions are positively correlated with a variety of student outcomes, and office hours are an essential component of the faculty-student relationship. At present, few rigorous studies are available to guide faculty towards best practices in office hour implementation. This talk reports on a study conducted to address three questions related to this area: How do students entering an introductory course understand office hours (their use, value, and academic role)? Does office hour attendance affect student perceptions of office hours? Do demographic factors, such as gender or race, correlate with the answers to these first two questions?		

SS8.4	**Saturday 11:00 a.m**	*Discussing the Definition of Limits in Calculus*
Iason Rusodimos		Perimeter College at Georgia State University
The problem of deciding how to evaluate the limit of a function depends on how the definition is posed. When presenting limits to calculus students we often de-emphasize the definition which can cause a series of problems. We show with an example that that is not easily calculated unless the definition is clear. We also discuss ways of teaching limits, particularly in multivariate calculus courses to avoid these problems.		

CP1.6	**Friday 3:40 p.m.**	*Real World Application of Numerical Solution of Complex Equations*
Jayanti Rani Saha		Albany State University
An algorithm is developed to solve different types of complex equations and results from proposed algorithm are verified by the results obtained from commercially available software Wolfram Alpha. Finally the algorithm is used to extract experimentally complex effective permittivity of several Teflon blocks placing inside a WR-284 rectangular waveguide and exciting with microwave frequencies from 2.6 to 3.95 GHz.		

SS5.3	**Friday 2:40 p.m.**	*Statistics Reimagined: The Courage to Make Substantial Changes*
Brandon Samples		Georgia College
Every educator wants their classes to be impactful. Moreover, every educator knows that students have to take ownership of their learning for this to be realized. Often our teaching is - at least initially - a reflection of our own past learning experiences. In time, our teaching evolves as we implement modest, incremental changes based on the theories of ourselves and others. For myself, many years of modest changes produced modest positive improvements. During this talk, I will share with the audience my new probability and statistics inquiry-based course. I will share my course text and materials, my student-centered instructional methodologies, and some comparative analysis of past and present. Ultimately, I will discuss my decision to break free from the incremental changes in favor of having the courage to make a substantial change.		

CP2.2	**Friday 2:20 p.m.**	*DAMPED INFINITE ENERGY SOLUTIONS OF THE 3D EULER AND BOUSSINESQ EQUATIONS*
Alejandro Sarria		University of North Georgia
We revisit a family of infinite-energy solutions of the 3D incompressible Euler equations proposed by Gibbon et al. and shown to blowup in finite time by Constantin. By adding a damping term to the momentum equation we examine how the damping coefficient can arrest this blowup. Further, we show that similar infinite-energy solutions of the inviscid 3D Boussinesq system with damping can develop a singularity in finite time as long as the damping effects are insufficient to arrest the (undamped) 3D Euler blowup in the associated damped 3D Euler system.		

CP6.1	**Saturday** **10:00 a.m.**	*Using 3D Technology in a Calculus Course*
Jason Schmurr		Lee University
We will discuss ways of incorporating 3D printing and virtual reality technology into a multivariable calculus course.		

GS2.1	**Saturday** **8:45 a.m.**	*All Tangled Up*
Carol Schumacher		Kenyon College
: Toys have inspired a lot of interesting mathematics. The SpirographTM helps children create lovely curves by rolling a small circle around the inside or the outside of a larger circle. These curves are called hypotrochoids and epitrochoids and are special cases of mathematical curves called roulettes. A roulette is created by following a point attached to one curve as that curve "rolls" along another curve. Another children's toy, the TangleTM, inspired some students and me to investigate roulettes that we get by rolling a circle around the inside of a "tangle curve," which is made up of quarter circles. The resulting roulettes we named "tangloids." In this talk, we will look at many pretty pictures and animations of these curves and discuss some of their interesting properties. As a bonus, I will discuss the nature of generalization, which is very important in mathematics.		

CP9.2	**Saturday** **10:20 a.m.**	*Analog Computers for the Present Time*
Damon Scott		Francis Marion University
Without doubt, analog computers are things of the past, but they are also things of the present and future for those who know how to create and appreciate them. We will show some analog computers of our own construction for computing the time of sunrise and sunset as a function of time of year, the sun's altitude in the local sky as a function of time of day, and how sunniness and warmth vary on an annual cycle. If time permits, attendees will be given circular analog computers for the trigonometric functions, together with a plea that these still have an important place in trigonometry classes even in the present day.		

UT3.3	**Friday** **2:40 p.m.**	*Using Graphing to Test a Topological Space*
Edie Shillum		
It is an open question if there exists a 1/3-homogeneous fan that is not smooth. A not smooth fan is a fan where the arms tend to bend back towards the vertex. I will discuss an attempt to construct a 1/3-homogeneous non-smooth fan. Then I will describe how I created sequences and graphing programs in Python to help determine whether this construction is correct.		

CP5.1	**Friday** **2:00 p.m.**	*The primes of* $\mathbb{Z}[\sqrt{10}]$

Andrew J. Simoson	King University
What are the units, irreducibles, and primes of the ring $\mathbb{Z}[\sqrt{n}]$---the set of all numbers $a + b\sqrt{n}$ where *a* and *b* are integers and *n* is a fixed positive square-free integer? In the ring $\mathbb{Z}$, primes and irreducibles are synonymous and its units are ± 1. $\mathbb{Z}[\sqrt{n}]$ is wilder, and our modest goal is to catalog all such numbers for $\mathbb{Z}[\sqrt{10}]$, where *a* and *b* range from 0 through 10. Here are few teasers: $3 + \sqrt{10}$ is a unit; 2, 3, 5, and 7 are irreducibles, but not 31; and 7 is the least positive integer that is prime in both $\mathbb{Z}$ and $\mathbb{Z}[\sqrt{10}]$.	

CP1.5	**Friday 3:20 p.m.**	*Nonlinear Time Series for Modeling Ancient Climates*
Justin R. Sims		University of Tennessee at Martin
A vector momentum threshold autoregressive (VMTAR) model is proposed as a useful tool in aiding geologist with paleoclimate reconstructions. Geologists hypothesize that the layers of a speleothem (stalactites and stalagmites) correspond to annual deposits, similar to tree rings. In these same layers, the ratios of carbon-13 isotopes and of oxygen-18 isotopes provide information on the types of vegetation, which in turn, gives information into the climate at the time that vegetation lived. We illustrate the model using data collected from Raccoon Mountain Cave, TN, and show improvements over the common linear model from both a statistical and geological perspective.		

UT6.4	**Saturday 11:00 a.m.**	*The Quaternions, a 4-Dimensional Playground*
Freeman Slaughter		
This is an exposition on the interesting properties of the quaternions. We plan to delve into the more curious traits of these four-dimensional extensions on the complex numbers, and demonstrate why they're worth studying.		

UT6.3	**Saturday 10:40 a.m.**	*A Fibonacci and Lucas Identity*
Elizabeth Spoehel		The Citadel
In this talk, we give an overview of Fibonacci and Lucas numbers as well as show the steps used to solve Problem B-1218 from the Fibonacci Quarterly. We also show the identities used in solving the problem mentioned above and explain the process used to arrive at the solution.		

SS5.4	**Friday 3:00 p.m.**	*Activity Based Learning for Statistics*
Catherine Starnes		Belmont University

Statistics is a challenging area of mathematics for many students to learn. The field of statistics exists in an overlap between math and science which can cause students to feel as though it consists of a different "language". There have long been observations in the Statistical Education literature that students may gain a more thorough understanding of statistical concepts through class activities rather than traditional lectures. This presentation will describe specific class activities that may be utilized in a basic statistics course and will provide reflections over the benefits and challenges of using such activities.

UP1.14	**Saturday 10:10 a.m.**	*Domination in Hexagonal Grid Graphs*
Luke Steel		Berry College
In a graph G with vertex set V, a dominating set D is a subset of the vertex set such that every vertex in the graph is either an element of D or adjacent to an element of D. The domination number of a graph is the minimum cardinality of a dominating set. In this poster we consider the domination number of graphs in a hexagonal grid. In particular, we consider concentric rings of hexagons and determine the domination number of each graph based on the number of rings.		

UT2.5	**Friday 3:20 p.m.**	*A Mathematical Model for Tumor Growth and Treatment Using Virotherapy*
Jessica Stevens		Winthrop University
We present a system of four nonlinear differential equations to model the use of virotherapy as a treatment for cancer. This model describes interactions among infected tumor cells, uninfected tumor cells, effector T-cells, and virions. Using various stability analysis techniques, we establish a necessary and sufficient treatment condition to ensure a globally stable cure state. We additionally show the existence of a cancer persistence state when this condition is violated and provide numerical evidence of a Hopf bifurcation under estimated parameter values from the literature. We conclude with a discussion on the biological implications of our results.		

UT1.6	**Friday 3:40 p.m.**	*Anti-Ramsey Numbers for Hypergraphs*
Will Stiles		Western Carolina University
An r-uniform hypergraph $H = (V,E)$ consists of a nonempty set V of vertices and a collection E of unordered r-tuples of vertices that form hyperedges. The anti-Ramsey number $ar_n(H)$ is the maximum number of colors that can be used to color the hyperedges of a complete r-uniform hypergraph on n vertices without producing a rainbow copy of H. In this talk we will explain how complimentary colorings of hypergraphs can be used in the evaluation of anti-Ramsey numbers.		

CP8.5	**Saturday 11:20 a.m.**	*Support Sets of Nonlinear Functionals*
Jessica E. Stovall		University of North Alabama

Any Dedekind complete Banach lattice with a quasi-interior point is lattice isomorphic to a space of continuous, extended real-valued functions defined on a compact Hausdorff space. An orthogonally additive, continuous, monotonic, and subhomogeneous nonlinear functional is studied. In this case, the concept of integration is no longer valid. In a 2017 paper with William A. Feldman (University of Arkansas), a measure related to the nonlinear operator was constructed and the associated linear operator was studied. This talk discusses the results from a recently accepted paper where it is shown that these associated linear operators are unique. Additional results using these associated linear operators to study the support sets of nonlinear functionals will also be presented.

CP1.4	**Friday 3:00 p.m.**	*Modeling the Devastation of Hemlock Trees in the Great Smoky Mountains*
Jillian Stupiansky		University of North Alabama
The Hemlock Woolly Adelgid has caused a steep decline in both the health and number of hemlock trees in the Great Smoky Mountains National Park. HWA is an insect that feeds on a hemlock's sap, preventing the spread of nutrients throughout the tree and eventually causing the tree's death. We have created a mathematical model to represent the spread of the devastation. Analysis and simulations of our original model indicated some discrepancies with the real-world behavior of the infestation, so with input from a park biologist, we have updated and improved the accuracy of our model. We will discuss the creation of both models, as well as the resulting analysis and simulations. Our ultimate goal is that the theoretical model can be used to help find a solution that will revive the hemlock population.		

CP1.1	**Friday 2:00 p.m.**	*Modeling the Immune Response of Celiac Disease*
Cara Sulyok		University of Tennessee, Knoxville
Celiac disease is a hereditary autoimmune disease that affects approximately 1 in 133 Americans. It is caused by a reaction to the protein gluten found in wheat, rye, and barley. After ingesting gluten, a patient with celiac disease may experience a range of unpleasant symptoms while small intestinal villi, essential to nutrient absorption, are destroyed in an immune process mediated by T cells. The only known treatment for this disease is a lifelong gluten-free diet and there is currently no drug treatment. A gluten-free diet will not address the damage in all cases; this is referred to as refractory celiac disease. This preliminary work provides a mathematical framework to better understand the biological and immunological mechanisms in celiac disease. The model will be able to analyze various theories behind the progression of this disease by capturing the dynamics of a healthy subject, a patient with celiac disease, and a patient with refractory celiac disease. By doing so, we can evaluate and suggest potential therapies to mitigate the effects of celiac disease.		

SS9.4	**Saturday 11:00 a.m.**	*My Transition into the Defense Industry*
James Sunkes		Dynetics, Inc. and The University of Alabama - Huntsville

For as long as I can remember, my career goals were to get a doctorate and become a tenured professor at a university. In late 2015 and early 2016, several months before I was going to graduate with my doctorate, I applied to roughly 100 academic jobs of various types with the hopes of continuing my journey towards getting a tenure track position. I had a phone interviews for some of these jobs, but come early April 2016, I had not gotten an in-person interview for any job and I had not received an offer from anywhere. Fearing that I had missed out on an academic job, I started looking for jobs in industry where I found the job that I currently have today. In this talk, I want to discuss my transition from academic jobs into industry, my experience and satisfaction working at my current company Dynetics, and my advice and encouragement to students who are considering the same transition.

CP4.2	**Friday** **2:20 p.m.**	*Order Properties of Unlabeled Induced Subgraphs*
Scott R Sykes		University of West Georgia
The set of all unlabeled induced subgraphs of a finite graph G can be made into a poset by defining H_1≤H_2 iff H_1 is an induced subgraph of H_2. In this presentation, we will show some relationships between the order theoretic properties of this poset and the properties of the graph G. In particular, we will be discussing the concept of similar and pseudo-similar vertices in G and showing how they are related to the structure of the poset.		

CP2.1	**Friday** **2:00 p.m.**	*Mathematical model for the fabrication of quantum dots*
Wondimu Tekalign		Department of Mathematics, Savannah state university
We consider a continuum model for the evolution of an epitaxially-strained dislocation-free thin solid film on a deformable substrate in the absence of vapor deposition. By using a thin film approximation we derived a nonlinear evolution equation. We examined the nonlinear evolution equation and found that there is a critical film thickness below which every film thickness isstable and a critical wave number above which every film thickness is stable. And we developed a numerical method for the evolution of strained solid films under the thin film approximation. We tested our numerical method using known cases, and further characterized the family of equilibrium shapes in terms of the film thickness and the spatial periodicity for both two-dimensional (island ridge) and three-dimensional (quantum dot) morphologies.		

UP1.15	**Saturday** **10:10 a.m.**	*Experimenting with Electricity: Analyzing Irreversibly Electroporated 293-T and HeLa cells*
Leah Terrian		Lee University
Irreversible Electroporation (IRE) is an ablation technique being studied recently for its unique ability to destroy cancer cells without damaging the surrounding tissue. IRE is administered through short electric pulses that creates holes or “pores” in the lipid bilayer of the cell membrane. The cells then swell with excess fluid and burst. IRE is an especially promising method for treating unresectable pancreatic cancer. This experiment was designed to compare three different variables in vitro; cell line, voltage, and time. Three trials of both 293-T (kidney cancer) and HeLa (cervical cancer) cells were		

run with shock voltages of 100V, 300V, 500V, 700V, and 900V. Cell viability was then measured by hand at 1 and 6 hours after electroporation. By analyzing the collected experimental data, this project aims to better understand how changing variables affects viability after IRE.

CP3.4	**Friday 3:00 p.m.**	*Biconal subspace arrangements*
Douglas A. Torrance		Piedmont College
Suppose we have an arrangement of codimension two linear subspaces in some projective space. These subspaces will either intersect in codimension three or codimension four. For example, if we have an arrangement of lines in three-dimensional space, then these lines either intersect in points or not at all. We can visualize such an arrangement using an incidence graph, i.e., a graph whose vertex set is the set of all subspaces in the arrangement and whose edges correspond to pairs of subspaces which intercect in codimension three. It turns out that subspace arrangements whose incidence graphs are biconal, i.e., there exist two vertices which are adjacent to all other vertices in the graph except each other, have an interesting property -- all subspaces in the arrangement intersect in the same codimension four subspace.		

SS8.5	**Saturday 11:20 a.m**	*Using Peer Instruction in Vector Calculus to Promote Conceptual Understanding*
Alan Von Herrmann		University of Tennessee
Peer Instruction (Mazur 1997), an interactive lecture format, has been tailored for Calculus III courses at the University of Tennessee. Presenters will demonstrate ConcepTest polling, allowing MAA-SE attendees to experience the interactive polling, and will then discuss how Peer Instruction impacted students' attendance, students' attitudes, and students' performance.		

CP4.1	**Friday 2:00 p.m.**	*Ascending Subgraph Decompositions in Tournaments of Order 6n+5*
Brian Wagner		University of Tennessee at Martin
In 1987, Alavi, Boals, Chartrand, Erdős, and Oellermann conjectured that all graphs have an ascending subgraph decomposition (ASD). In this talk, we will consider the case of a tournament with order congruent to 5 mod 6.		

CP6.2	**Saturday 10:20 a.m.**	*Exploring pre-service teachers' understanding of integer multiplication through stories*
Ben Westcoatt		Valdosta State University
Understanding integers and their operations is an important step in abstraction as learners continue their journeys from whole number arithmetic to algebraic thinking. Research into how young learners apprehend integers exists. However, accompanying research into teachers' conceptual understanding of integers remains relatively sparse. This sparsity has importance due to the link between student learning and teacher understanding. In this current study, I explored pre-service teachers' conceptual		

understanding of integer multiplication. Participants wrote short stories that modeled specified integer multiplication problems. I analyzed the stories to determine the ways students actualized multipliers and multiplicands, specifically when the multipliers or the multiplicands were negative. I will share results of the analysis and if time permits, entertaining stories that the students wrote.

SS8.3	**Saturday 10:40 a.m.**	*Graded Homework in 100-level Mathematics courses: Should the students decide ?*
Cathy Whitlock		UNC Asheville
A year ago two instructors at UNC Asheville allowed individual students in their Quantitative Literacy course to choose whether or not they wanted their daily homework to be graded and included in the computation of the final grade. The experiment was an effort to try to reduce the anxiety and resentment commonly expressed by students in this course without altering learning objectives or lowering standards. The results were so surprising that we expanded the trial to include Precalculus, Calculus I and Intro. Statistics. We were not shocked when we found that the students in Calculus classes were more likely to choose the homework option, but we were still surprised by how many students chose homework and how pleased they were to be given options in the first place.		

SS5.6	**Friday 3:40 p.m.**	*Reflection Assignments in IBL Courses*
Jessica Williams		Converse College
Encouraged by research supporting the effectiveness of inquiry-based learning in undergraduate proof-based courses, several undergraduate math courses at a small college were re-designed to be taught in an inquiry-based learning fashion. To promote student buy-in and self-assessment multiple written reflection assignments were incorporated into the course notes and assignments. Reflection prompts correspond to different points in the course progression and address potential student frustration with inquiry-based learning, student attitudes towards learning and mathematical ability, and performance on exams. This talk will describe the general structure of these IBL courses and methods of incorporating reflection assignments. Specific written reflection prompts and assignments will be shared.		

UT4.6	**Saturday 11:40 a.m.**	*Modeling Traffic Flow using Finite Difference Approximations*
William E. Wooten		LaGrange College
It is often useful to model traffic flow using fluid dynamics, where interactions between vehicles can be represented using systems of differential equations. In this talk we will derive a model that simulates traffic flow on a single lane road with various boundary and initial conditions, and then use the method of finite differences to approximate the solutions.		

CP8.3	**Saturday**	*The fractal dimension of the Rudin-Shapiro Function*

	10:40 a.m.	
Hong Yue		Georgia College
We study a function which is introduced to estimate the exponential sum of the Rudin-Shapiro sequence. We calculated the fractal dimension of the function as well as that of two related functions. We also present the Maple codes used to generate the functions.		