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Clemson University

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http://sections.maa.org/southeastern/?2018_Conference

Abstracts for all Talks

WS.3	**Friday 9:00 a.m.**	*The MAA Instructional Practices Guide: A catalyst for community-wide transformation toward meaningful learning*
Martha Abell		Georgia Southern University
A team of over 50 faculty members from varied institutions across the nation developed the MAA Instructional Practices Guide as a companion to the MAA Curriculum 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, and how members of the mathematics community can get involved in the development of future versions of the IP Guide.		

DS.1	**Friday 9:00 a.m.**	*Analytic Explorations*
Kristen Abernathy		Winthrop University
We will begin our analytic explorations by modifying the distance formula in $\mathbb{R}^2$ and observing the effects of the modifications on conic sections, namely circles and parabolas. In particular, these modifications have surprising consequences for the numeric value of π. We'll use this discussion of distance as a platform into analytic ideas such as norms, completeness, and compactness. We assume no prior knowledge of these terms, as we hope to motivate why we need these ideas and how they help us answer fundamental questions from calculus. We'll conclude with a glimpse into functional analysis and how researchers use the ideas from this talk in their work.		

CP1.2	**Friday 2:20 p.m.**	*Proposed Theoretical Model of Understanding Piecewise Functions*
Margaret Adams		South Georgia State College
Patterns of misconceptions among pre-calculus students are revealed for piecewise functions with jump and point discontinuities. Initial research on what students know about limits prompted this more in-depth investigation, to explain the unique altered perceptions of limits of piecewise functions exhibited by students in Calculus I and III courses. Student evidence is categorized into themes and presented in the context of a theoretical model of understanding functions.		

SS6.3	**Friday 2:40 p.m.**	*Iteratively Regularized Gauss Newton Method for Electrical Impedance Tomography Using Complete Electrode Model*
Sanwar U Ahmad		Clemson University
Electrical Impedance Tomography (EIT) is a well-known technique for determining the conductivity parameter of a body from the boundary measurements. The inverse problem of EIT is severely ill-posed. In this presentation, we discuss the implementation of the Iteratively Regularized Gauss-Newton (IRGN) method for the complete electrode model in EIT. We present the results of our algorithm using simulations and perform computational analysis of the convergence and accuracy of the obtained conductivity distributions. We also compare our results using IRGN to statistical inversion algorithm using Markov Chain Monte Carlo technique.		

UP1.1	**Saturday 10:45 a.m.**	*Modeling Displacement Due to Natural Disasters Using Differential Equations*
Muhammad Ammar		University of North Carolina at Wilmington
We plan to explore the population displacements due to natural disasters, specifically hurricanes. The focus is on Hurricane Katrina due to the large amount of data available and the affected population in New Orleans. Based on an existing disaster model, we will generalize, analyze, and simulate a model for hurricane displacements. Creating a model using systems of non-linear ordinary differential equations, changes in population dynamics will be studied. While performing mathematical analysis on the behavior and pattern of the solutions, we also plan to obtain numerical simulations of the model under various scenarios. These conclusions, along with numerical simulations, lead to predictions about pattern of population displacement, impacts to the population in the surrounding areas, and the effect of government initiatives and community supports to the future population growth of the natural disaster area.		

CP8.2	**Saturday 10:20 a.m.**	*Abstract Withdrawn*
Abstract withdrawn		

SS4.1	**Friday** **2:00 p.m.**	*2-BIGs and Chasing the Elusive White Rabbit*
John Asplund		Dalton State College
Often when we go to presentations, we see only the end product of one's multi-year project(s). What goes into an investigation and what holes-of-thought do we get stuck on as we progress through our project? In this talk, I'll focus on the Hamiltonicity of 2-block intersection graphs (2-BIG) of a triple system. Simply put, a triple system is a tool for building a certain class of graphs and we are interested in showing which 2-BIGs contain a cycle that spans the entire graph. This talk will cover this two-plus year project that involves ups-and-downs. Additionally, I will detail some tips and tricks for dealing with research in combinatorics that are useful in other concentrations as well. Were we successful? Did we accomplish what we set out to do? Come and find out!		

SS4.2	**Friday** **2:20 p.m.**	*Odd edge-colorability of subcubic graphs*
Risto Atanasov		Western Carolina University
An edge-coloring of a graph *G* is said to be odd if for each vertex *v* of *G* and each color *c*, the vertex *v* either uses the color *c* an odd number of times or does not use it at all. The minimum number of colors needed for an odd edge-coloring of *G* is the odd chromatic index $\chi_o'(G)$. In this presentation, we consider loopless subcubic graphs, and give a complete characterization in terms of the value of their odd chromatic index. This is joint work with M. Petrusevski and R. Skrekovski.		

UP1.2	**Saturday** **10:45 a.m.**	*Student Exchange Program: Integration of Statistics and Non-Mathematic Disciplines*
Megan Balut		Lee University
The purpose of this presentation will be to discuss the implementation and results of a student-focused program designed to intersect and bridge the gap between statistics and other disciplines (e.g. statistics and social sciences). I, Megan Balut, a sociology student, will be presenting with a mathematic student, Danielle Schilling on the design, purpose and implementation of the Student Exchange Program (SEP) at Lee University. We will be discussing the design of this program which includes four students at Lee University who were chosen to participate in a Student Exchange Program (SEP). This program partnered social science students with mathematics students in order to connect these disciplines through shared goals, tasks, and combined participation. We will discuss the activities and projects undertaken by these student including working together completing activities, participating in biweekly meetings, math-stats student pairing for MATH 161 tutoring, developing a resource website, and discussions on interventions provided to MATH 161 students. We will discuss the results of a survey given to the students in the program, as they were assessed through a pre and post survey given and the results were collected at the end of the semester. We will discuss the results of participating in the SEP, which led to the four students increasing their confidence in explaining statistics to other students in a new, relatable approach, as well as decreasing the level of anxiety associated with completing statistics assessments. We will fully discuss the purpose of this program and discuss its impact on the students who participated in the program.		

SS3.3	**Friday 2:40 p.m.**	*Using and Modifying the Towers of Hanoi Problem to Teach Proof by Induction*
Julie Barnes		Western Carolina University
Determining the minimum number of moves needed to solve a standard Towers of Hanoi problem is an interesting problem for students because they can physically generate their own data and search for patterns. In addition, by physically moving the pieces, students are able to connect the puzzle to the recursive form for counting the number of moves. Once they have a conjecture for a closed form formula that describes the number of moves, students use induction to prove that the closed form formula is equivalent to the recursive form. In this talk we will look at how we can turn the standard puzzle to a dynamic class activity that helps students develop their abilities to use proof by induction. We will also look at various ways of extending the problem to reach students with different backgrounds and abilities. The extensions provide students with more opportunities to analyze patterns, use proof by induction, and understand recursion.		

SS10.2	**Saturday 10:20 a.m.**	*The Taxman Cometh*
Robert A. Beeler		East Tennessee State University
The Taxman is a game developed by Diane Resek around 1970. The player has a list of numbers 1,...,n. The player can take a number from the list, provided that it has at least one proper divisor remaining in the list. These proper divisors are then given to the taxman. When no more legal moves are possible, the taxman receives all of the remaining numbers on the list. If the sum of the player's numbers is higher than the taxman's, then the player wins. Because the game is easy to explain, quick to play, and has unexpected depth, it is ideal fro use in math club or outreach activities. In this talk, we show several strategies for the taxman and give open problems related to the game.		

CP7.2	**Saturday 10:20 a.m.**	*Improper Improper Integrals: An Introduction to the Cauchy Principle Value*
Robert W. Benim		University of Georgia
This expository talk examines a natural extension of certain improper integrals, the Cauchy Principle Value. This talk will be accessible to students who have or are currently taking Calculus 2.		

SS13.4	**Saturday 11:00 a.m.**	*A Comparison of Different Methodologies in the Modeling of Early Stage Tumor Growth*
Caitlin Bernabe		Western Carolina University
This talk will briefly review the history of our research in mathematical models of early-stage tumor growth, while highlighting the Agent Based Model in which the team is focused on. The Agent Based Model approach is particularly worthwhile because of its discrete nature, its ability to reflect accurate dynamics with small numbers of agents, and its clarity for researchers working on early-stage tumor growth. This talk will elaborate on the agents and rules in the Agent Based Model, which we are		

implementing in MatLab. This talk will close by reviewing our progress and discussing predicted future successes.

CP4.5	**Friday 3:20 p.m.**	*The Effect of (Un)Imposed Labor Market Flexibility on Gender Wage Gaps*
Peter Blair		Clemson University
We document the unconditional wage gap between women and men in part-time work from 1975-2015. Over this period, the part-time gender wage gap is consistently smaller than the full-time gap by 10-20 percentage points. This fact, which is robust to a variety of empirical specifications, supports the Goldin (2014) hypothesis that labor market flexibility reduces observed labor market inequality. In fact, we show that attempting to impose labor market flexibility through federal and state-mandated family and medical leave laws, actually retarded gender wage convergence.		

UT4.4	**Friday 3:00 p.m.**	*Half-space similarity: properties and computation*
Joey Bonitati		Clemson University
Similarity is a measure of how alike two geometric objects are. Similarity of points in data sets is useful in machine learning, genome sequencing, and statistical analysis. In current applications, Euclidean distance is often used as a measure of similarity. However, this metric is not preserved under affine transformations. We propose half-space similarity for describing similarities between points with respect to data sets. This quantity is preserved under affine transformations of the data set, and it is robust in the presence of outliers. We use point-line duality to show that for a set of *n* 2-dimensional data points, the half-space similarity of any two points can be computed in *O(n\log n)* time.		

UT3.4	**Friday 3:00 p.m.**	*Impossible LCM's for Carmichael numbers*
JQ Briggs		Wofford College
A Carmichael number is a number n that satisfies Fermat's criterion for primality (a^n=a (mod n)) but is not actually a prime. For a Carmichael number n=p_1p_2..p_r, a particularly important quantity (denoted L) is the LCM of the p_i-1's. In this talk, we show that certain types of L's cannot occur.		

UT2.5	**Friday 3:20 p.m.**	*Upper Bounds on Ropelength for Twist and (p,2) Torus Knots*
Eli Brooks		Birmingham-Southern University
Our work begins by modeling the figure-eight and cinquefoil knots parametrically, with the aim of reducing their ropelength. From there, we expand the lengths of these knots into general equations that estimate the minimum required ropelength needed to tie knots in their respective knot families. Our resulting equations improve upon previous estimates of the ropelength upper bounds for the twist and (p,2) torus knot families.		

SS13.2	**Saturday 10:20 a.m.**	*Examining Drug Resistant vs. Sensitive Tumor Cell Populations with Immunotherapy & Chemotherapy*
John Brotemarkle		Winthrop University
Drug resistance, also known as multidrug resistance (MDR), is the leading cause of chemotherapy failure in treating cancer. This drug resistance in cancer cells can be transferred from resistant cancer cells to sensitive cancer cells. Sensitive cancer cells can become resistant through three main methods: direct cell to cell contact with resistant cancer cells, through a membrane, or through exposure to the treatment drug. In our project, we take into account the transfer of drug resistance from resistant to sensitive cancer cells via direct cell to cell contact. We then introduce an immune response and chemotherapy, and establish conditions on treatment parameters in the resulting system to ensure a globally stable cure state. We conclude with evidence of a limit cycle and conjecture the existence of a Hopf bifurcation.		

UT2.5	**Friday 3:20 p.m.**	*Upper Bounds on Ropelength for Twist and (p,2) Torus Knots*
Andrew Brown		Birmingham-Southern University
"Our work begins by modeling the figure-eight and cinquefoil knots parametrically, with the aim of reducing their ropelength. From there, we expand the lengths of these knots into general equations that estimate the minimum required ropelength needed to tie knots in their respective knot families. Our resulting equations improve upon previous estimates of the ropelength upper bounds for the twist and (p,2) torus knot families."		

CP2.6	**Friday 3:40 p.m.**	*Minimally Connected Hypergraphs*
Mark Budden		Western Carolina University
Unlike the case of graphs, minimally connected r-uniform hypergraphs are not necessarily trees. In this talk, we consider this broad classification of hypergraphs, focusing on their role in extremal problems in graph theory.		

CP12.3	**Saturday 10:40 a.m.**	*Discovering Metamorphic Artwork within non-periodic Penrose & Pinwheel Tilings*
Doug Burkholder		Lenoir-Rhyne University
Both Penrose tilings and Radin-Conway's Pinwheel tilings partition the plane into five very distinctive parts. Imagine a long sidewalk tiled with very tiny tiles using one of these tilings where each of these tiny tiles is labeled A, B, C, D, or E. Our sidewalk starts out with all tiles painted white and progressively moves through all 32 possible combinations of each of these tile types painted either white or black, one combination for each step along the sidewalk, progressively morphing into all black. Since each step consists of thousands of tiny black and white tiles, we see patterns, not tiles.		

Come see the unexpectedly beautiful patterns that immerge from Penrose Tilings and from Radin-Conway's Pinwheel Tilings. This talk is very appropriate for undergraduate students.

UP1.3	**Saturday 10:45 a.m.**	*A Parallel Implementation of the Random Method of Feasible Directions*
Julie Butler		Erskine College
A Probabilistic Method of Feasible Directions is designed to solve nonlinear optimization problems with inequality constraints using a Las Vegas algorithm in the Direction Finding Sub-problem. The algorithm uses multiple search directions in a parallel implementation across multiple computers. The results from a pseudo-parallel version of the algorithm, which used only one core, were presented in 2012. This research presents a truly parallel version of the Method of Feasible Directions. This algorithm is implemented using OpenMPI to parallelize the code. The results presented will compare the accuracy and run time from the sequential and parallel implementations of the Method of Feasible Directions across varying numbers of directions and cores, and will report a speedup factor of the parallel algorithm.		

UT3.3	**Friday 2:40 p.m.**	*Square Sum Problem With Variations*
Michael Byrd		University of North Carolina at Wilmington
Recently, the mathematics YouTube channel Numberphile published a video titled The Square-Sum Problem. This video investigates rearrangement of the sequence of integers from 1 to N in a manner such that each pair of consecutive integers sums to a perfect square. We will explore the original Square-Sum Problem and discuss variations of it from the viewpoint of additive number theory.		

CP10.5	**Saturday 11:20 a.m.**	*Inflation or Deflation? Cronbach's Alpha under Careless Responses*
Trevor Camper		Georgia Southern University
Surveys commonly suffer from insufficient effort responses, which can bias statistical summaries. In particular, Cronbach's alpha has been observed to either deflate or inflate due to such responses. In this paper, we aim to shed light on how Cronbach's alpha will respond to insufficient effort responses in a variety of situations. A general formula is derived, from which special cases corresponding to practical situations are extracted. Of particular interest is a characterization of the conditions under which Cronbach's will deflate or inflate.		

CP11.5	**Saturday 11:20 a.m.**	*Low-discrepancy Action Selection in Markov Decision Processes*
Stephen Carden		Georgia Southern University
In a Markov Decision Process, an agent must learn to choose actions in order to optimally navigate a Markovian environment. When the system dynamics are unknown and the agent's behavior is learned from data, the problem is known as Reinforcement Learning. In theory, for the learned behavior to converge to the optimal behavior, data must be collected from every state-action combination infinitely often. Therefore in practice, the methodology the agent uses to explore the environment is critical to learning approximately optimal behavior from a reasonable amount of data. This paper discusses the benefits of augmenting existing exploration strategies by choosing from actions in a low-discrepancy manner. When the state and action spaces are discrete, actions are selected uniformly from those who have been tried the least number of times. When the state and action spaces are continuous, quasi-random sequences are used to select actions. The superiority of this strategy over purely random action selection is demonstrated by proof for a simple discrete MDP, and empirically for more complex processes.		

CP5.6	**Friday 3:40 p.m.**	*The Adoption of Open Educational Resources by the Mathematics Department at Fort Valley State University.*
Samuel Cartwright		Fort Valley State University
The high cost of textbooks is a concern to both the students and the professors teaching the courses. In order to minimize the cost of textbooks for these courses and to make sure the students had these resources at the beginning of the semester, open stax resources were created in order to help students with online resources such as e-text, videos and quizzes. Open Stax resources were created for students who were in Calculus I, Calculus II, Calculus for Business and Economics, and Differential Equations. These courses were also created to make math resources more affordable and available to all students taking these classes, increase minority achievement and technology usage and share skills with other instructors for adapting open resources in other future high level math courses.		

SS11.1	**Saturday 10:00 a.m.**	*Counting kings and a connection with Catalan numbers*
Shih-Wei Chao		University of North Georgia
Let $f_{m,n}$ be the number of placements of non-attacking kings on a $m \times n$chessboard. We will analyze the generating function $f_{m,n}(x)$using formal power series to (1) find the connection between Catalan numbers and Fibonacci numbers and (2) give the formula for $[x^k]f_{m,n}(x)$for certain *k*, *m*, and *n*. We will finish the talk by introducing some open questions including but not limited to matrices and 3−D chessboard.		

SS6.1	**Friday 2:00 p.m.**	*On conservation laws of Navier–Stokes Galerkin discretizations*
Sergey Charnyi		Clemson University
We study conservation properties of Galerkin methods for the incompressible Navier–Stokes equations, without the divergence constraint strongly enforced. In typical discretizations such as the mixed finite element method, the conservation of mass is enforced only weakly, and this leads to discrete solutions which may not conserve energy, momentum, angular momentum, helicity, or vorticity, even though the physics of the Navier–Stokes equations dictate that they should. We aim to construct discrete formulations that conserve as many physical laws as possible without utilizing a strong enforcement of the divergence constraint, and doing so leads us to a new formulation that conserves each of energy, momentum, angular momentum, enstrophy in 2D, helicity and vorticity (for reference, the usual convective formulation does not conserve most of these quantities). Several numerical experiments are performed, which verify the theory and test the new formulation.		

CP9.1	**Saturday 10:00 a.m.**	*Hitting the streets with math*
Tim Chartier		Davidson College
Since 2010, Maths Busking has hit the streets of Great Britain under the direction of Sara Santos. This year, Axel Brandt, Tanya Chartier and Tim Chartier have worked with Davidson College undergraduates to create their own version of math street performing. When complete, the program is intended to work in a K-12 classroom or interactively on the streets. Come and learn some tricks of the busking trade from Tim and Tanya Chartier.		

CP10.4	**Saturday 11:00 a.m.**	*Preliminary Studies on a Large Face Database MORPH-II*
Cuixian Chen		University of North Carolina at Wilmington
In this paper, we consider a preliminary study on a large face database MORPH-II. First, we present a detailed summary of the inconsistencies in the non-commercial release of the MORPH-II dataset and introduce the steps and strategy taken to clean it. In addition, examples of prior research that made use of the uncleaned data are briefly introduced and the potential implications on their results are discussed. Next, we propose a new subsetting scheme for the longitudinal face aging database MORPH-II. Our subsetting scheme is intended to overcome the unbalanced racial and gender distributions of MORPH-II, while ensuring independence between training and testing sets. Our subsetting scheme can be used for various face analysis tasks, including gender classification, age prediction, and race classification.		

CP1.6	**Friday** **3:40 p.m.**	*Engaging with Primary Sources in a Mathematics for the Liberal Arts Course*
Marcela Chiorescu		Georgia College and State University
During the past two decades the use of primary historical sources in the teaching and learning of mathematics attracted an increased amount of interest. There is evidence that integrating original sources in the mathematics classroom has significant pedagogical value, however, more empirical studies of implementing history of mathematics in teaching are needed. In spring 2017, in two of my sections of a mathematics for liberal arts course I replaced the textbook with projects based on primary historical sources for two topics: the Babylonian numeration and the triangular numbers. My presentation will include the school context in which I developed my projects, the implementation of my projects into the classrooms and some preliminary results.		

SS7.1	**Friday** **2:00 p.m.**	*Creating a coloring book inspired by the golden ratio*
Marcela Chiorescu		Georgia College
A non-disposable assignment enables students to be producers of knowledge, rather than only as consumers. Students creates work for a variety of audiences, beyond just the teacher. When students know that their work will be used by their peers and possible future students, they will invest their time in this work at a different level. In one of my Quantitative Skills and Reason classes, my students created a coloring book inspired by the golden ratio. I will present the design and the implementation of this non-disposable assignment.		

SS10.3	**Saturday** **10:40 a.m.**	*Number Theory in an Integrated STEM Curriculum*
Jeneva Clark		University of Tennessee at Knoxville
High-quality STEM education involves an integrated approach (Johnson, 2013; NRC, 2002). Weaving together science, technology, engineering, and mathematics improves student achievement (Becker & Park, 2011), reflects the integrated nature of STEM professions (Wang et al., 2011), and enables deeper understanding (NRC, 2012). However, in curricular redesign efforts toward integrated STEM, number theory should maintain its footing as an accessible springboard for student inquiry. This talk discusses how number theory plays a part in an integrated STEM curriculum in a general education course like Mathematical Reasoning. This talk will show how students (a) use structural engineering to study triangular, tetrahedral, and Padovan numbers, (b) use technology to see the Goldbach Conjecture in cellular automation, and (c) learn science-related examples of Fibonacci numbers and kissing numbers. Also, this discussion will invite the audience to contribute ideas for further STEM-related number theory examples.		

SS8.4	**Saturday 11:00 a.m.**	*An Effective, Cloud-Based Infrastructure for a Coordinated Course*
April Conner		University of Tennessee at Knoxville
In this presentation I will outline a comprehensive infrastructure for consistent implementation of a coordinated course with common materials which is taught by a large number of instructors with varying teaching experience. The infrastructure is adaptable for any course design and scalable to accommodate any course size. It is currently being used to deliver two gateway mathematics courses in conjunction with a graduate teaching assistant/associate mentorship program. It is also being used to introduce courses to new faculty and to help faculty who want to improve their teaching skills. One of the courses is completely flipped while the other course has two versions: one version that is 100% flipped and the other around 75% flipped. The cloud based framework is built around Google Drive using folders and sheets that allow real-time editing by the coordinator. Instant updates are available to all instructors of the course via the cloud. The Google Drive share capabilities allow the coordinator and instructors to communicate directly through comments and suggestions in the documents. The interactive master spreadsheet and course calendar are the epicenters of the infrastructure, allowing instructors easy access to all course materials from any internet capable device. I will explain how all of these components work together to successfully organize a course that is independent of a learning management system.		

CP3.6	**Friday 3:40 p.m.**	*Using Sage Interacts to Explore Sturm's Method*
William J. Cook		Applachian State University
The rise of technology has caused many beautiful mathematical results to be forgotten. In this talk, we will discuss Descartes' rule of signs, the Budan-Fourier theorem, and Sturm's method. While graphing tools give approximate information about the number of real roots of a polynomial, these results give exact information and can be implemented by hand. The speaker has implemented each technique in Sage with Sage interacts. These interactive demos do not require any specialized software and allow anyone with internet access to explore for themselves.		

UT1.2	**Friday 2:20 p.m.**	*Effects of interaction-mediated dispersal on the persistence of a population*
Emily Cosgrove		Auburn University Montgomery
Dispersal of an organism plays an important role in its individual fitness, population dynamics, and species distribution. In the literature, dispersal is loosely applied to movement over different spatial scales, e.g. movement between habitat patches separated in space from other areas. Recently, ecologists have found that interacting organisms can affect one another's dispersal, a phenomenon known as interaction-mediated dispersal. Little is known regarding the patch-level consequences of habitat fragmentation of interacting species in the presence of interaction-mediated dispersal. In this talk, we will explore effects of habitat fragmentation and interaction-mediated dispersal on patch-level population dynamics through development and study of a model built on the reaction diffusion framework. The focal point of our results will be concerned with a one-dimensional patch and relies upon adaptation of methods from nonlinear analysis such as time map analysis (quadrature method). In particular, we will elaborate on the biological importance of these results.		

UP1.4	**Saturday 10:45 a.m.**	*Planning a Vacation with the Traveling Salesman Problem*
Alison Crisp		Christian Brothers University
The traveling salesman problem is a classic graph theory problem that attempts to find the shortest route for a "salesman" to travel to a set of "cities" without visiting any given "city" more than once. Several algorithms have been developed to solve the traveling salesman problem with varying accuracies and intricacies. I apply the nearest neighbor algorithm for solving the traveling salesman problem to find the shortest route to visit the national parks. The measurements are based on mileage, and for simplicity only the contiguous national parks are considered.		

CP3.4	**Friday 3:00 p.m.**	*Recent developments in monotonicity and convexity in discrete fractional calculus*
Rajendra Dahal		Coastal Carolina University
Discrete Fractional Calculus has been getting a lot of attention these days as the theory has been developed in the last 11 years. In this talk we collect and present recent developments in the area of monotonicity and convexity of discrete fractional operator.		

UP1.5	**Saturday 10:45 a.m.**	*De Branges Extreme Point Method in Analysis*
Biraj Dahal		Clemson University
The Kren-Milman theorem is the infinite dimensional analogue of the well known fact from convex geometry that every compact convex set is the convex hull of its extreme points. This theorem has some interesting applications to some seemingly unconnected problems in analysis. For example, the well known Stone-Weierstrass theorem can be proved using this result. This poster will present that proof (due to De Branges) as well as some newer applications.		

WS.1	**Friday 9:00 a.m.**	*A New Extension of the Riemann Integral: From a Simpler Calculus to Analysis-Level Neat Stuff!*
Bryan Dawson		Union University
This hands-on workshop will include ample opportunity to perform calculus- and analysis-level calculations with the "omega integral," as well as some discovery learning and proof writing. The omega integral, which is introduced in a forthcoming article in the American Mathematical Monthly by the presenter and utilizes the hyperreal numbers, is based on "omega sums," which are much simpler for calculus students to work with than the traditional Riemann sums. The omega integral also extends the Riemann integral in a somewhat different manner than either the Lebesgue integral or other nonstandard integrals. These facts and more, including a fun pathological example, will be explored in the workshop. This workshop is appropriate for both students and faculty.		

SS6.5	**Friday 3:20 p.m.**	*Methods for Locating and Manipulating the Vertical Asymptotes of Solutions to First Order ODEs.*
Davis Deaton		Belmont University
Numerical methods are often the tool of choice for solving complicated differential equations in physical applications but can fail due to unexpected asymptotes, producing nonsensical and physically unrealistic approximations of the solutions. If the locations of asymptotes are known, approximations can be applied with much more confidence. Finding the asymptotes of differential equations whose solutions are known is relatively trivial; however, finding the asymptote of a differential equation whose solution is unknown or does not exist in closed form is significantly more complicated. By using the end behavior of implicit solutions, we are able to find the asymptotes of first order differential equations in many cases, including a closed form of the asymptotes for polynomial defined differential equations in terms of their roots. Further, we can use comparison methods to find classes of equations which do and do not produce asymptotes and to find safe zones where a solution will not have an asymptote. (Undergraduate presenters Davis Deaton and Jordan Sawdy from Belmont University)		

UT7.2	**Saturday 10:20 a.m.**	*Factorization of Polynomials over the Integers*
Elijah DeJonge		Western Carolina University
In this presentation we will consider polynomials of type $p(x) \pm 1$, where *p(x)* is a product of binomials with integer coefficients. Our goal is to determine which of these polynomials are possible to write as a product of two polynomials with integer coefficients.		

CP11.2	**Saturday 10:20 a.m.**	*Cohomogeneity one manifolds whose rational cohomology ring is generated by one element*
Jason DeVito		University of Tennessee at Martin
A smooth closed manifold *M* is called a cohomogeneity one manifold if it admits a smooth action by a compact Lie group *G*, whose orbit space *M/G* is 1-dimensional. We classify all even dimensional simply connected cohomogeneity one manifolds whose rational cohomology ring takes the form $\mathbb{Q}[x]/x^n$. In particular, we show that all such examples are diffeomorphic to a sphere, projective space, Grassmannian of 2-planes in $\mathbb{R}^{2k+1}$, or the homogeneous space $G_2/SO(4)$. The proof uses Rational Homotopy Theory and fiber bundle methods, directly building on work of Frank, Uchida, and Iwata.		

SS1.3	**Friday 2:40 p.m.**	*An Active Learning Model in College Algebra*
Gary Dicks		Abraham Baldwin Agricultural College
We have observed a gradual decline in student engagement and performance in our classrooms. We have redesigned our college algebra course to address these deficiencies. In this model, students are more engaged in their learning and show improvement in performance. The model is based on the flipped classroom ideas, but we felt that the students at this level need more guidance for the		

independent work/study they do prior to coming to class. We will share the motivation for the model, how it is implemented in the classroom, and student performance. The model has been implemented in the college algebra course for five consecutive semesters.

CP5.3	**Friday 2:40 p.m.**	*Two Approaches to Precalculus*
Andrew M. Diener		Christian Brothers University
Christian Brothers University split our precalculus population by ACT scores. Those with higher Math ACT scores take the traditional Precalculus, those with lower scores take a combination of a Functions course and a Trig course. The courses are coordinated and run concurrently which is different from most schools that divide the subject into an algebra and a trig course. Topics are aligned so that circles in the Functions course lead to the unit circle trig definitions. Solving quadratic equations leads to quadratic form equations involving trig functions. Inverse functions in the Functions course lead to the inverse trig functions. This immediate reinforcement helps students see how mathematics builds on itself and promotes student success. CBU is a small school where the majority of students taking precalculus are engineering majors. While half of those that declare engineering as their major begin in precalculus the engineering paradigms begin with Calculus I. The increased need for immediate success in precalculus driven by our structured engineering curriculum led us to explore new options. We will share our experiences in the combination of courses as well as the impact on students in the traditional Precalculus course. This is a follow up to an earlier analysis from data gathered through 2016.		

GS1.1	**Friday 4:15 p.m.**	*How Mathematics is Making Hollywood Movies Better*
Michael Dorff		Brigham Young University
What's your favorite movie? Star Wars? Avatar? The Avengers? Frozen? What do these and all the highest earning Hollywood movies since 2000 have in common? Mathematics! You probably didn't think about it while watching these movies, but math was used to help make them. In this presentation, we will discuss how math is being used to create better and more realistic movies. Along the way we will discuss some specific movies and the mathematics behind them. We will include examples from Disney's 2013 movie Frozen (how to use math to create realistic looking snow) to Pixar's 2004 movie The Incredibles (how to use math to make an animated character move faster). Come and join us and get a better appreciation of mathematics and movies.		

SS9.1	Saturday 10:00 a.m.	*The best jobs in the 21st century? – mathematician/STEM careers!*
Michael Dorff		Brigham Young University
A 2014 ranking from CareerCast.com, a job search website, recently named mathematician the best job of 2014. Many students and professors think that teaching is the main (or only) career option for someone who studies mathematics. But there are hundreds of jobs for math students. However, just graduating with a math degree is not enough to guarantee getting one of these jobs. In this talk, we will talk about some of the exciting things mathematicians in business, industry, and government are doing in their careers. Also, we will reveal the three things that recruiters say every math student should do to get a job.		

SS9.3	Saturday 10:40 a.m.	*A Mathematician's Perspective on Unmanned Air Vehicles*
Aaron Dutle		NASA Langley Research Center
The Radio Technical Commission for Aeronautics (RTCA) recently published a document (DO-365) that details requirements for Unmanned Air Vehicles that wish to operate in the National Airspace System. NASA has developed a suite of algorithms called DAIDALUS, which serves as a reference implementation for meeting these requirements. This talk will describe the author's experience as a mathematician working at NASA on the development and verification of DAIDALUS.		

SS5.6	Friday 3:40 p.m.	*Weighted Sums of Binomial Coefficients with Binomial Coefficients as Weights*
Steven Edwards		Kennesaw State University
Several elementary identities have a natural origin in Pascal's triangle. The Delannoy numbers, which count certain types of lattice paths, can be considered to be the dot product of a row with a part of a column of Pascal's triangle. We recently found an infinite class of generalizations of Delannoy numbers, and all these generalizations can be considered as dot products of rows with columns in Pascal's triangle. We present a selection of identities that result. Some of the identities are generalizations of the most elementary identities that come from Pascal's triangle, namely that the sum of the entries in row n is 2^n, and that the alternating row sum is zero.		

CP1.1	Friday 2:00 p.m.	*Historical homework: integrating history into precalculus homework assignments*
Rachel Epstein		Georgia College and State University
Integrating history into mathematics courses can have a variety of benefits: it can motivate students, encourage them to think of mathematics as a creative human endeavor, expose them to diverse cultures, and teach them how society shaped the mathematics that we now learn. In this talk, I discuss my efforts to integrate history into a precalculus course through a series of historically inspired homework assignments. The intention of the assignments is to provide historical context to		

the material we learn in class while also strengthening the students' understanding of the mathematics through challenging problems. I will discuss my motivations for creating the assignments, how I chose the problems, and the student reception of the assignments. I will also discuss the challenges I encountered and how I hope to proceed in the future.

SS7.3	**Friday** **2:40 p.m.**	*OctaveGT Toolbox: Student Growth Through an Open Software Project*
Jon Ernstberger		Lagrange College
In a collaborative directed study, an engaged student undertook the task of programming a simple graph theory toolbox in the open source programming language Octave. That software was then made openly available for educational use. Insights in to preparation, licensing, distribution, and improvements will be shared along with some learned best practices.		

UT5.6	**Saturday** **11:40 a.m.**	*Singular Caputo Fractional Difference Equations*
James T. Eskew		University of Tennessee at Martin
This talk will discuss a positive solution to the Caputo fractional difference equation($^{c}D^{q}u)(t) = f\big(t,u(t)\big) + g\big(t,u(t)\big), t \in J$, satisfying the initial condition $u(0) = 0$, where $0 < q < 1, J$ is the interval [*0,T*] for some maximal value *T* of $t, f(t,u), g(t,u) \in \mathcal{C}[J \times \mathbb{R}, \mathbb{R}]$ and *f(t,u)* is increasing and *g(t,u)* is decreasing in *u* on *J*, with both *f* and *g* having singularities at *u=0*. We look at an upper and lower solution method for regular problems and how to apply this method to our singular problem. We also discuss the possibility of using perturbation methods to approximate regular problems.		

UP1.6	**Saturday** **10:45 a.m.**	*A Predator-Prey Model for Silverleaf Whitefly(B. tabaci) and Lady Bettle(H convergens)*
Robby Espano		Abraham Baldwin Agricultural College
Bemisia tabaci is a crytic species complex of more than 35 identifiable aphids. Some type of these pests can spread in an environment so quickly that they are considered to be one of the world's top 100 invasive species. Each year, these pests damage plant and crops by feeding on the plants and by transmitting plant viruses costing millions of dollors to farmers and greenhouse growers. Over 600 plant species, including major corps such as peanuts and cutton, are known to be parasitized by these pests. To encounter these pests, several pesticides and synthetic predators are used but they have adverse effects on natural and beneficial organisms. Also, some of the predators are not very effective due to their ability to encounter only adult whiteflies. In this paper, we develop a discrete time predator prey model with lady beetle *Hippodamia convergens* as the predator. These predator has been shown to have extreme predatory effects on various *B. tabaci* biotypes. We will present the stability analysis of our model. Parameters are estimated using experimental data and some numerical results will presented.		

UT6.4	**Saturday 11:00 a.m.**	*MatrixToe: 1s and 0s battle for domination*
Joanna Fass		High Point University
MatrixToe is a game that is similar to Tic-Tac-Toe, but instead of using X's and O's, the two players use 1's and 0's. One player tries to make some m-by-m matrix invertible and the other tries to make the matrix not invertible. We proved optimal strategies, and who the resulting winner will be, for different rules of the game and square matrices up to size 4x4.		

WS.2	**Friday 8:30 a.m.**	Graduate Student Career Development Workshop,
Sarah Ann Fleming		Belmont University
Are you unsure how to proceed after graduation? Do you have questions about teaching? Would you like to expand your network of contacts? This workshop is designed for graduate students at both the Masters and PhD level. Topics include the job search, different types of jobs available, job application materials, interviewing, and negotiating. The workshop will also include a discussion on teaching and offer networking opportunities with those recently and not-so-recently out of graduate school. A limited number of travel grants are available. Visit www.graduatecareerworkshop.com for more information. There is no cost to attend the workshop.		

CP4.6	**Friday 3:40 p.m.**	*Optimal Supplies Delivery under Military Specific Constraints*
Talena Fletcher		Georgia Southern University
We address the problem of optimal supplies delivery under specific military constraints. Throughout the military history, the need to safely and effectively allocating resources to the various military operations and their associated activities was a task of extreme importance. Satisfying the needs of multiple consumers by optimally pairing with appropriate suppliers falls into the category of vehicle routing problems (VRP), which has been intensively studied over the years. In general, finding the optimal solution to VRP is known to be NP-hard. The proposed solutions rely on mathematical programming and the size of the problems that can be optimally solved is typically limited. In military settings, balancing the needs of multiple consumers with the current operational environment has always been a challenge. This balancing is equally crucial to the survivability of the transporters and consumers. The main goal is finding an optimal way of ensuring required delivery while minimizing soldiers risks. We show that under certain assumptions we can formulate this problem as a linear programming problem with specific constraints. We present a solution and experimental results for real life scenarios, which support the applicability of our solution.		

SS5.5	**Friday 3:20 p.m.**	*The Geometry of some Fibonacci identities in the Hosoya triangle*
Rigoberto Florez		The Citadel
The Hosoya triangle is a triangular array (similar to Pascal) where the entries are products of two Fibonacci numbers. In this talk, we give a geometric interpretation --using the Hosoya triangle-- of several Fibonacci identities. Some of them are well known algebraically. For example, we discuss geometrical proofs of Cassini, Catalan, and Johnson identities. We also extend some properties from Pascal triangle to the Hosoya triangle. For instance, we generalized the hockey stick and the T-stick identities given for binomial coefficients to identities for Fibonacci numbers. The symmetry present in the Hosoya triangle helps to explore several patterns and find new identities. Teacher and student that are interested in undergraduate research may find this triangle helpful.		

UT3.1	**Friday 2:00 p.m.**	*Analysis of Modified Fibonacci Sequences, Generalized Golden Ratios and Their Convergence*
Dominique Forbes		Coastal Carolina University
We determine a family of recursively defined sequences and their growth rates. We prove that these growth rates converge to generalized 'golden ratios', and from there we prove that these resulting sequences of generalized 'golden ratios' converge as well. We also present how these recursive sequences can arise by modifying certain assumptions that generated the famous Fibonacci sequence.		

UT4.5	**Friday 3:20 p.m.**	*Gaussian binomial coefficients with negative arguments*
Sam Formichella		University of South Alabama
Loeb showed that a natural extension of the usual binomial coefficient to negative (integer) entries continues to satisfy many of the fundamental properties. In particular, he gave a uniform binomial theorem as well as a combinatorial interpretation in terms of choosing subsets of sets with a negative number of elements. We show that all of this can be extended to the case of Gaussian binomial coefficients. Moreover, we demonstrate that several of the well-known arithmetic properties of binomial coefficients also hold in the case of negative entries. In particular, we show that Lucas' Theorem on binomial coefficients modulo p not only extends naturally to the case of negative entries, but even to the Gaussian case.		

SS2.4	**Friday 3:00 p.m.**	*Watts the Deal With Electric Load Forecasting?*
Emily Forney		SAS Institute
Electricity is a part of daily life. Everyone uses it and everyone wants to pay the cheapest rates possible for it. If a power company is able to plan better for future usage, it can assist with dropping rates. Customers generally expect to have uninterrupted access to electricity. If a company doesn't have good forecasts, their planning can come up short. To make up for the gap, a company would		

have to buy energy in the on-the-spot market and when demand is high, the prices of energy can be very expensive and can result in the customer having to pay higher rates.
SAS Institute has a solution, SAS Energy Forecasting, which is intended to help utilities generate more accurate load forecasts. If the forecasts are more accurate, then planning is more accurate and could lead to the potential for the price of power to decrease.
This presentation looks at the implementation of SAS Energy Forecasting by an electric cooperative. This cooperative was looking to improve their load forecast with a goal of trying to aid in reducing the rates charged out to the members. The implementation included a design to assist overcoming data challenges and simulating numerous models to find optimal settings.

UT6.1	**Saturday 10:00 a.m.**	*A Linear Algebra Perspective on the Second Derivative Test for Functions of Two Variables*
Alex Foster		Coastal Carolina University
The second derivative test for maxima and minima of functions of two variables often goes unexplained in Calculus III courses, but examining the family of normal curves on the surface of such a function provides insight into the workings of this test. Using linear algebra, we will show that the second derivative test for functions of two variables can be understood in terms of the second derivative test for functions of a single variable applied over the family of normal curves.		

SS11.2	**Saturday 10:20 a.m.**	*Minimum Coprime Labelings of Graphs*
N. Bradley Fox		Austin Peay State University
A *prime labeling* of a graph of order n is a way to label the vertices with the integers $\{1,2,\ldots,n\}$ such that the labels of any adjacent vertices are relatively prime. These labelings have been studied for over thirty years with a vast array of graphs having been shown to be prime (i.e. they have a prime labeling), but many graphs have also been found to not be prime. This talk will focus on the latter set of graphs where we expand the set of labels to be from a set $\{1,2,\ldots,m\}$ for some $m>n$ and attempt to label the graph so that we satisfy the relatively prime adjacency condition while minimizing the value m, which we call a *minimum coprime labeling*. Graphs that we will consider include the complete graph, wheels, and the results of applying the union, square, or join operations to paths and cycles.		

UT2.2	**Friday 2:20 p.m.**	*Free Flowing*
Jamie Fravel		Furman University
Flow Free is a popular mobile puzzle game that extends the idea of Hamiltonicity to multiple colored paths on a square grid graph. In this talk, we explore the question, 'What makes such a puzzle possible?		

UP1.7	**Saturday 10:45 a.m.**	*Risk it for the biscuit: How to play the final question to "win" Jeopardy in one of two games*
Ally Fuchs		Belmont University
In this poster, we present formulas on a variation of the game show Jeopardy!. In previous papers, formulas for wagers on the final question of the game show are presented and taught to young students. This poster extends wagering strategies to a tournament setting, where players compete across multiple games and one player can advance to the next round of a tournament with the highest non-winning score. Ally Fuchs, an undergraduate, is the presenting author of the poster, with CC Logan, an undergraduate, as co-presenter; the undergraduate work is done under the supervision of Ryan Fox, a faculty member.		

CP8.3	**Saturday 10:40 a.m.**	*Quantum Field Theories and Factorization Algebras*
Jennifer Garbett		Lenoir-Rhyne University
Physicists use quantum field theories to explain the world around us. Though physicists were thinking about quantum field theories as early as the 1920s, and mathematicians have proposed multiple mathematical descriptions of quantum field theories, with the first appearing in the 1950s, there is still no mathematically rigorous definition of a quantum field theory. In this talk, we will discuss factorization algebras, one mathematical "approximation" to physicists' quantum field theories and relate them to mathematical objects called vertex algebras. The talk should be accessible to a general mathematical audience.		

UT1.3	**Friday 2:40 p.m.**	*Wagering strategies for variations of Final Jeopardy*
Kailee Gerzema		Belmont University
In this presentation, we discuss formulas associated with variations of the game show Jeopardy!. In previous papers, formulas for a single game of the show are developed and then presented as an instructional activity to mathematically motivated middle school students. The proposed paper provides two changes to the original show: in both cases, players play in a tournament setting. In one change, multiple two-players games are played in a sequential order, with all winners and the highest non-winning score advancing to the next round of the tournament. In the second change, four-player games--much like the Math Jeopardy played at MAA-SE--are played in a sequential order, with all winners and the highest non-winning score advancing to the next round. Kailee Gerzema, an undergraduate, is the presenting author; her work is under the supervision of Ryan Fox.		

CP2.1	**Friday** **2:00 p.m.**	*Graph Clustering and Vertex Similarity*
Raven Gilmore		Georgia Southern University
Clustering analysis is an important topic in data mining, where data points that are similar to each other are grouped together. Graph clustering deals with clustering analysis of data points that correspond to vertices on a graph. We first survey some most well known algorithms for clustering analysis. Then for graph clustering we note that one of the fundamental factor the distance measure between vertices. We further examine various known venues for defining such measures and propose some others.		

CP9.2	**Saturday** **10:20 a.m.**	*Alternative Grading Schemes in Linear Algebra*
Timothy Goldberg		Lenoir-Rhyne University
In this talk, the speaker will present several different non-standard course grading schemes he has used in his Linear Algebra course, including standards- based and specifications grading.		

CP2.3	**Friday** **2:40 p.m.**	*Sorting Index and Mahonian-Stirling pairs for labeled forests*
Amy Grady		Clemson University
Bjorner and Wachs defined a major index for labeled plane forests and showed that it has the same distribution as the number of inversions. We will define and study the distributions of a few other natural statistics on labeled forests. Specifically, we introduce the notions of bottom-to-top maxima, cyclic bottom-to-top maxima, sorting index and cycle minima. Then we show that the pairs (inv, Btmax), (sor, Cyc), and (maj, Cbtmax) are equidistributed. Our results extend the result of Bjorner and Wachs and generalize results for permutations.		

CP11.1	**Saturday** **10:00 a.m.**	*An Empirical Resolution of Arrow's Impossibility Theorem*
Adam Graham-Squires		High Point University
Arrow's Impossibility Theorem demonstrates, from a theoretical perspective, that there is no such thing as a fair election method. More specifically, every election method will fail some criterion for fairness given the correct voting conditions. We analyzed freely available empirical data from ranked-choice voting in municipalities across the U.S. and found the fairness anomalies are very rare, or not present at all, in actual elections. In fact, the data suggest one simple voting method that empirically demonstrates no failures in fairness criteria.		

GS2.1	**Saturday** **8:45 a.m.**	*Popular Culture and Mathematics: Gender, Race, and more*
Sarah Greenwald		Applachian State University
Have you ever known anyone who asserted they cannot do mathematics because they do not have the math gene? Where do those messages come from? Popular culture can reveal, reflect, and even shape how society views mathematics and mathematicians. We'll analyze examples from a variety of shows and films and consider the intersections of gender, race, class, and ability. We'll also discuss ways to counter stereotypes.		

UT4.2	**Friday** **2:20 p.m.**	*p-Groups Covered by Powerful p-Subgroups*
Adam Gregory		Western Carolina University
A finite p-group G is called powerful if either p is odd and [G,G] ⊆ G^(p) or p = 2 and [G,G] ⊆ G^(4). A cover for a group is a collection of subgroups whose union is equal to the entire group. In this presentation we will discuss covering p-groups with powerful p-subgroups.		

SS11.3	**Saturday** **10:40 a.m.**	*Double, Double, Recursion and Trouble*
William Griffiths		Kennesaw State University
We establish a family of doubly recursive sequences related to the Delannoy and Fibonacci numbers. This family admits many common properties, most of which can be proved using elementary enumerative methods. Using the Online Encyclopedia of Integer Sequences, we find this family, in turn, enumerates a wide variety of different objects. The objects range from difference in orbitals in quantum particles to orchard crossing numbers of complete graphs to 132-avoiding two-stack sortable permutations that avoid the pattern 4321. We study these previously unconnected concepts and their relationships through properties established on the entire family.		

CP3.2	**Friday** **2:20 p.m.**	*A descent/intercept model with a twist*
Charles Groetsch		The Citadel
We treat a modified model of the classical descent/intercept problem in which the object is ejected rather than released from rest. A sufficient condition for existence and uniqueness of the velocity-dependent intercept angle is established and a lower bound on the rate of change of the intercept angle is derived. Numerical and analytical solutions of the intercept problem are discussed.		

SS13.6	**Saturday** **11:40 a.m.**	*A Nonlinear Biological Inverse Problem*
Charles Groetsch		The Citadel
In an experimental procedure developed by S. Kleene, an olfactory celium is detached at its base and drawn into a recording pipette. The open celium base is then immersed in a bath of ion channel activating agent (cAMP) which diffuses into the celium interior, opening ion channels as it goes, and initiating a trans-membrane current. The total current is recorded as a function of time and serves as data for a nonlinear integral equation of the first kind modeling the spatial distribution of ion channels along the length of the celium. We discuss this model as a tool for assessing the spatial distribution of ion channels. Numerical results using simulated and laboratory data are presented.		

UT4.3	**Friday** **2:40 p.m.**	*Powerful p-Groups and Their Subgroups*
Luke Guatelli		Western Carolina University
A finite p-group G is called powerful if either p is odd and [G, G] ⊆ Gp or p = 2 and [G, G] ⊆ G4. In this presentation we will discuss certain properties of powerful p-groups, their subgroups, and determine all powerful p-groups of order at most 32.		

CP8.6	**Saturday** **11:40 a.m.**	*Free Lie Algebras and Free Leibniz Algebras*
John R. Hall III		Applachian State University
Leibniz algebras are a generalization of Lie algebras. While Lie algebras are well-known, Leibniz algebras are still in development. In this talk, we survey free Lie algebras and their connection to the universal enveloping algebra. We conclude by examining certain analogous results that have been extended to Leibniz algebras.		

CP12.1	**Saturday** **10:00 a.m.**	*On the Gallai-Ramsey number of Brooms.*
Benjamin Hamlin		Georgia Southern University
Given a graph *G*, we consider the problem of finding the minimum number *n* such that any *k* edge colored complete graph on *n* vertices contains either a rainbow colored triangle or a monochromatic copy of the graph *G*, denoted $gr_k(K_3: G)$. More precisely we consider $G = B_{m,n}$ where $B_{m,n}$ is a broom graph with *m* representing the number of vertices on the handle and *n* representing the number of bristle vertices. We develop a technique to reduce the difficulty of finding $gr_k(K_3: B_{m,n})$, and use the technique to prove a few cases with a fixed handle length, but arbitrarily many bristles.		

CP2.4	**Friday** **3:00 p.m.**	*Undergraduate Research in Random Graph Theory*
Arran Hamm		Winthrop University
In this talk I will discuss a line of research I have undertaken with undergraduate students at my institution. Specifically, my students have studied graph parameters of random subgraphs of Kneser graphs. Examining these types of random graphs has yielded results and has served as a culminating experience for my students by tying together several notions from different courses within our curriculum. During the talk, I will discuss results within this research program, the connections to other subjects, special features of Kneser graphs which make this analysis possible, and will list several related open problems. Joint work with Kristen Melton and Justin Groves.		

SS1.4	**Friday** **3:00 p.m.**	*Productive Failure in Teaching IBL*
Jessie Hamm		Winthrop University
Productive failure is a huge part of learning, especially in an IBL classroom. We stress the importance of this to our students but we can learn from our productive failures while teaching as well. In this talk I will discuss my own productive failures in teaching an IBL Intro to Proofs course. I taught this course for the first time fall of 2016 and then again this past fall. I will share changes and improvements made in course design based on initial failures, as well as give general advice to anyone planning to teach an IBL course.		

CP8.1	**Saturday** **10:00 a.m.**	*A proof of the Pythagorean Theorem Using Complex Numbers*
David K. Henderson		Mercer University
This paper will demonstrate how the Pythagorean Theorem can be proven with complex numbers, without incorporating the modulus (or the distance formula), which, of course, is a logical fallacy in that both of these are simply applications of the Pythagorean Theorem. Many claims to a proof of the Pythagorean Theorem using complex numbers have erroneously utilized either the modulus of a complex number or the distance formula. Here, a new proof is given which relies only on viewing complex numbers through two different lenses. In addition, Euler's Identity will play a key role in this proof. This result can be used to spark classroom discussions about the connection between branches of mathematics, and about the process of mathematical proof.		

DS.2	**Friday** **10:00 a.m.**	*The Calculus of Polynomials, without Calculus.*
Mo Hendon		University of Georgia
We all know how to find the tangent line to a polynomial at a given point, using the tools we learned in calculus. However, there's a simple way of spotting tangency without using calculus at all - just simple algebra. We'll answer some questions about tangency - some very simple, and some not so obvious at all. For example, if I give you a line and three points on the line, can you find a polynomial of degree 6 (or higher), which is tangent to the line at those three points?		

CP6.2	**Friday** **2:20 p.m.**	*A Corollary of Zeckendorf's Theorem*
Curtis Herink		Mercer University
Zeckendorf's theorem says that every natural number can be uniquely represented as the sum of nonconsecutive Fibonacci numbers. This sum is called the Zeckendorf representation of the number. We prove that if n can be expressed as the sum of any k Fibonacci numbers, not necessarily distinct, then the Zeckendorf representation of n has at most k terms. We then use this result to address other questions such as: Given k, what is the smallest natural number that cannot be expressed as a sum of k Fibonacci numbers?		

CP7.3	**Saturday** **10:40 a.m.**	*Introducing Elliptic Functions via Simulations of Nonlinear Differential Equations*
Russell Herman		University of North Carolina at Wilmington
We discuss differential equations, such as the nonlinear pendulum equation, which lead to solutions involving elliptic functions and elliptic integrals. These classic forms, accessible to undergraduates, are not often encountered in differential equation courses but are often left for advanced courses in complex analysis. We discuss the connection of elliptic functions to differential equations and show how graphical editors for designing simulations of systems, such as Simulink, can be used to model solutions of nonlinear oscillators.		

SS4.3	**Friday** **2:40 p.m.**	*Modeling cancer data with random walks*
Josh Hiller		Adelphi University
Sixty-five years ago Nordling published a landmark paper, containing a crazy idea which would go on to start a revolution in applied mathematics: cancer is caused by the accumulation of *n* specific mutations. In this talk we will give combinatorial way to view Nordling's model: as a stopping time in a random walk on a directed graph. We will then show that this incredibly simple model does an excellent job of fitting epidemiological data.		

SS10.1	**Saturday** **10:00 a.m.**	*Unlocking Ideas: Using escape room puzzles in a cryptography classroom*
Anne K. Ho		University of Tennessee at Knoxville
Escape rooms have become an increasingly popular game and team building exercise in which participants are locked in a room and asked to use puzzles to get out within a set time limit. According to a article entitled “The Rise of Educational Escape Rooms” (The Atlantic, 2016), educators are starting to use the ideas of escape rooms in classrooms. A natural setting for such puzzles is an undergraduate cryptography course. In this talk, I will discuss the experience of running an interactive class session where my students were asked to use their knowledge of classical ciphers to decrypt ciphertext, unlock padlocks, and determine passwords. Some topics covered included the shift, affine,		

Vigenere, substitution, Playfair, and Hill ciphers. In addition, I will address the logistics of implementing these puzzles with the use of the open-source math software system, SageMath. Lastly, I will briefly mention how I have utilized these ideas in other classes such as Calculus.

CP7.5	**Saturday** **11:20 a.m.**	*Revisiting the Intersection Problem for Maximum Packings of K_{6n+4} with Triples*
Amber Holmes		Auburn University

In 1989, Gaetano Quattrocchi gave a complete solution of the intersection problem for maximum packings of K_{6n+4} with triples when the leave (a tripole) is the same in each maximum packing. Quattrocchi showed that $I(4) = \{1\}$ and for all $n \equiv 4\ mod\ 6 \geq 10$, $I(n) = \left\{0,1,2,\ldots,\frac{\binom{n}{2}-\frac{n+2}{2}}{3} = x\right\} \setminus \{x-1, x-2, x-3, x-5\}$. We extend this result by removing the exceptions $\{x-1, x-2, x-3, x-5\}$when the leaves are not necessarily the same. In particular, we show that $I(n) = \left\{0,1,2,\ldots,\frac{\binom{n}{2}-\frac{n+2}{2}}{3} = x\right\} \setminus \{x-1, x-2, x-3, x-5\}$ for all $n \equiv 4 mod(6)$.

UP1.8	**Saturday** **10:45 a.m.**	*Using Data Assimilation to Accurately Predict Contaminant Transport*
Jacob Honeycutt		Clemson University

We study methods to assimilate data measurements into differential equations that predict contaminant transport in fluids, to improve long time accuracy in simulations. Contaminant transport prediction is very important in applications such as chemical or oil spill cleanup, but current methods rely only on low accuracy initial data to make their predictions. We propose a new method that incorporates measurement data from after the initial time, rigorously prove it provides better long time accuracy, and give results of numerical tests that illustrate its effectiveness.

UT3.5	**Friday** **3:20 p.m.**	*Properties of Fibonacci and Lucas Matrices*
Ching Hsin-Yun		The Citadel

In this presentation, I will show the solution of a problem that I solved from Fibonacci Quarterly. The problem was to find the solution of a system of linear equations with Fibonacci coefficients. I solved this problem using the result of another problem that I solved last year from the same journal. I also used linear algebraic techniques like matrix block multiplication to solve the problem. I have submitted this solution to Fibonacci Quarterly for consideration to be published. In addition, I found two interesting results by replacing Fibonacci numbers with Lucas numbers in the problems mentioned above. I will present these novel results in my presentation as well.

UP1.9	**Saturday 10:45 a.m.**	*Introductory Data Analysis of Pickleball*
Lance Hudson		University of North Carolina at Wilmington
Data acquisition and analysis has become an integral part of sports in the past decade and continues to change the way fans and front offices operate. Unfortunately, the revolution of data acquisition has not reached many competitive activities. In this article we examine some properties of player performance relative the outcome in the sport of pickleball. Specifically, we focus on player errors as they relate to team performance. Parametric and nonparametric methods were used, depending on the characteristics of the sample distributions, for hypothesis testing. The results show that there is significant evidence to suggest that player errors affect team performance.		

SS10.4	**Saturday 11:00 a.m.**	*Hilbert class polynomials and applications*
Duc Huynh		Georgia Southern University, Armstrong Campus
In this talk, we will discuss how the study of Hilbert class polynomials, combined with Sage, is a suitable topic for undergraduate students. Applications of Hilbert class polynomials include constructing elliptic curves of prescribed order over finite fields, constructing irreducible polynomials over finite fields, and solving the Inverse Galois Problem in the case when the group is a dihedral group. The students learn a variety of topics including basic class field theory, *p*-adic numbers, and introductory algebraic geometry. As all constructions are explicit, the study provides undergraduate students a hand-on experience of research. We will also discuss how some of the topics should be introduced to high school curriculum to encourage the students to pursue higher education. We will conclude with a short discussion of our efforts in creating a lower end of vertical integration of research and education: faculty - undergraduate students - high school students.		

CP12.4	**Saturday 11:00 a.m.**	*Ximera and Interactive Web Documents*
Andrew Incognito		Coastal Carolina University
In this talk, we will explore the LaTex package Ximera. Ximera creates html output that makes LaTex look native to the web. Furthermore, it allows for interactivity that one would expect from a typical webpage. I will present my Ximera textbook for Calculus I and demonstrate the interactive features.		

UT6.2	**Saturday 10:20 a.m.**	*The Hungarian Method: Solving the Assignment Problem*
Maggie Ivester		Lagrange College
The assignment problem is a classical problem in linear algebra and operations research, which involves finding the assignment of agents to tasks that optimizes a constraint. In this talk, we solve the assignment problem using the Hungarian method, a process that uses standard matrix operations. We implement this algorithm with MATLAB and make applications to real world scenarios.		

SS8.5	**Saturday 11:20 a.m.**	*A Novel Method for Creating Assessment and Diagnostic Tools in the Classroom*
Russell Jeter		Georgia State University
Creating assessments is one of the most time-consuming and critical aspects of designing and preparing a course. Not only must an assessment properly analyze students' mastery of the concepts, it ideally can isolate particular issues a student is having with those concepts. To this end, creating meaningful exams and then isolating specific issues can be quite challenging and particularly draining. In this talk, we present a novel method for assessment generation that can be used to effectively diagnose student misconceptions of course material, and in turn, instructors can adapt the course design to the students' needs.		

SS8.6	**Saturday 11:40 a.m.**	*A Flipped Approach to Teaching College Geometry*
Ashley Johnson		University of North Alabama
For the past five years, I have taught College Geometry with a flipped classroom approach using reading guides. The course is taught using an axiomatic approach, and while it is required for math education majors, it generally has a mix of math majors and math education majors. During this talk, I will discuss the general format, tweaks made over the years, and overall student reaction.		

UT1.6	**Friday 3:40 p.m.**	*Gene Networks in Cancer Cells: A Mathematical Model*
Allyson Jones		Georgia Southern University
Genes in cancer cells are an important area of study, as being familiar with their specific behavior and how they work is pivotal for understanding cancer and for finding prevention and treatment. It is not beneficial to study the behavior of just one gene at a time, but rather the behavior of many genes at once and how they interact with each other over time. In order to perform such a systematic study, mathematical modeling of complex gene networks is needed. In this study, we propose a mathematical model for 11 genes in a cancer cell and use the concepts of network flow, directed graphs, random walks, and stationary distributions to observe how these 11 genes work together as a network over time. Through this model, we predict the behavior of key genes at specific time periods, which is crucial to understanding the evolution of not only this network but also gene networks in other cancer cells.		

SS9.2	**Saturday 10:20 a.m.**	*Experiences from Implementing an Industrial Partnership, Project-Based Course at East Tennessee State University*
Michele Joyner		East Tennessee State University
We have implemented an industrial project-based course at East Tennessee University as part of the NSF funded Preparation for Industrial Careers in Mathematical Sciences program jointly sponsored by MAA and SIAM. In this talk, we will discuss how we developed industrial partnerships, found projects, recruited students and developed a writing-, oral-, and computationally-intensive course as part of our curriculum. We will discuss the difficulties of such a course and how we overcame or are trying to		

overcome some of those difficulties. We will also talk about the benefits for the students from both a faculty and student perspective as well as the industrial liaison perspective. Furthermore, we will discuss an implemented syllabus which focuses on not only the industrial project but also many different activities implemented to aid in bridging the gap between finishing college and starting in the workforce.

PUB.1	**Friday 11:00 a.m.**	*New Calculus Courseware and Statistics Text to Engage Students*
Emily Judy		Hawkes Learning
Increase student success in both calculus and statistics with new course materials: the full release of Single Variable Calculus with Early Transcendentals courseware and the Discovering Statistics and Data textbook.		

SS11.4	**Saturday 11:00 a.m.**	*Radio Graceful Hamming Graphs*
Jennifer Kaneer		University of Tennessee at Martin
A radio labeling of a graph *G* is any map $f: V(G) \to \mathbb{Z}^+$ that satisfies the following inequality for all distinct vertices *u* and v: $\lvert f(u) - f(v) \rvert \geq diam(G) + 1 - d(u, v)$. The maximal element of the range of a labeling is called the span of the labeling, and the minimal span over all radio labelings of a graph *G* is called the radio number of *G*. We are interested in knowing when the radio number of a graph equals its number of vertices. This is a special type of graph called a radio graceful graph. We were able to find infinitely many new radio graceful examples by looking at a type of graph called a Hamming graph, and fully classify all Hamming graphs of diameter 3. We will discuss these results.		

UT4.6	**Friday 3:40 p.m.**	*An Introduction to the Formal System P*
Zachery Raymond Keisler		Lander University

Abstract: The main objective for this lecture is to give formal proofs of seven basic theorems found within mathematical logic, specifically in the subfield of prepositional logic. The secondary objective for this lecture is to give a working vocabulary of the five major axioms found within propositional logic and a look at one of the fundamental problems that arises within the study of propositional logic.

Outline of Lecture:

· Main Symbols: ¬,∨

· Defined symbol: ⇒

· Five Axioms of Propositional Logic: Propositional axiom, Associative Rule, Expansion Rule, Cut Rule, Contraction Rule

· Theorems: Commutative Rule, New Expansion Rule, New Associative Rule, Modus Ponens, Modus Tollens, Hypothetical Syllogism, Disjunctive Syllogism

UT3.2	**Friday 2:20 p.m.**	*Friendly Numbers, Solitary Numbers, and the Abundancy Index*
Logan Key		Cumberland University
The abundancy index for a natural number *n* is defined to be the ratio of the sum of the positive divisors of *n* and *n* itself. Friendly numbers are numbers that have the same abundancy index. For my presentation, I will give an overview of numbers that are known to have friends, that are known to be solitary (have no friends), and that are as of yet unknown either way. I will be going through some of the basic properties of the abundancy index in general and then relate those properties to the number 10 in particular. Ten is the smallest positive integer that is not known to be friendly or solitary. I will present several results that give restrictions required for a potential friend of ten to exist.		

SS6.6	**Friday 3:40 p.m.**	*Some solutions to functional differential equations arising in a novel queuing model with line jumping*
Nicholas Kirby		Austin Peay State University
We present some results from an investigation of a queuing model in which new customers join lines at uniformly distributed positions, and those customers who have been skipped over by a new arrival leave the line independently with the same probability. Customers are served and arrive at given rates. The model is an extension of the M/M/1 queue. The task of finding the stationary distribution of line lengths can be framed as solving a functional differential equation and will be the primary subject of the talk. Closed-form stationary results will be presented for some special cases.		

SS1.1	**Friday 2:00 p.m.**	*Mathematics Education Through College Algebra and Calculus*
Bailey Kirk		Georgia Southern University
During the 2014-2015 and 2015-2016 school year, Georgia Southern University and its faculty conducted assessments in College Algebra and a study on prerequisite skills in Calculus classes. The results show the number of students that answered the problems correctly or incorrectly in different classes. My research focuses on taking this data and further analyzing it to try to discover where students struggle the most in College Algebra and the prerequisite skills required for Calculus and whether there are any common trends. From these concepts in College Algebra and prerequisite skills required for Calculus, teaching suggestions have been devised to help improve the teaching and learning of these concepts and skills.		

SS7.2	**Friday 2:20 p.m.**	*Helping students help each other prepare for exams*
Vicky Klima		Applachian State University
This talk presents a method for exam review designed to encourage cooperation and reflection. Students work in groups to create review material for their classmates. For each exam, three groups create topic summaries with detailed examples, three groups create practice exams with solutions, and three groups create comprehensive flashcards. Throughout the course of the semester, every student participates in each type of exam prep activity. Exposing the students to varied methods of exam prep allows for interesting class discussions concerning our individual preferences for study while working in groups for this required assignment helps students find study partners. In this talk I review the assignments in detail, share student reactions, and discuss some of the trade-offs necessary to create class time for group work and discussion.		

CP6.4	**Friday 3:00 p.m.**	*Some Theorems Involving Partitions with Gap Conditions*
Louis Kolitsch		University of Tennessee at Martin
In this talk some theorems involving partitions with gap conditions will be presented and explained combinatorially.		

CP7.4	**Saturday 11:00 a.m.**	*Closed Form Solutions of Second Order Differential Equations*
Vijay Kunwar		Albany State University
Closed form solutions of second order differential equations are exact solutions expressed in terms of special functions; Airy, Bessel, Kummer, Whittaker, Hypergeometric, Liouvillian etc. with operations; field operations, algebraic extentions, composition, differentiation, and integration. Such solutions are very common in Physics, Combinatorics, and Engineering. For example, second order Fuchsian equations, and differential equations arising from convergent generating functions with (near) integer coefficients are found to have closed form solutions in terms of 2F1 hypergeometric functions. In this presentation, we will discuss about classical equations solvable in terms of closed form and explain our algorithms to find closed form solutions in terms of 2F1 hypergeometric functions.		

UT5.5	**Saturday 11:20 a.m.**	*The effects of minimum wage increases*
Adam Kurbansho		Methodist University
This paper studies the effects of the recent minimum wage increases above the federal rate of $7.25 in West Virginia. It focuses on its fast-food industry, and then compares it to the fast food industry in Kentucky to derive pure effects of the price floor due to the resemblance of the economic structure and demographics of these two state. This investigation has demonstrated that the current minimum wage in West Virginia has not lead to significant dis-employment in the short-term since employers		

decided to compensate for minimum wage costs by increasing prices. Nevertheless, human labor is inelastic only in the short-term, which implies an increased potential for structural unemployment in West Virginia. Some cities across the United States are already under the threat of complete automation of the limited-service industry. Hence, the follow-up interviews with the 17 sampled restaurants in West Virginia and Kentucky will be arranged to measure the long-run effects of the minimum wage increases in West Virginia.

SS5.2	**Friday 2:20 p.m.**	*Proving Nesbitt Type Inequalities Using Power Series*
Wei-Kai Lai		University of South Carolina, Salkehatchie
In 2012 February, Mortici introduced a new proof of Nesbitt's inequality using convergent power series. This method was then adopted by Jeong in June, and was used to prove more inequalities with cyclic variables. In this talk, I will introduce this technique, go through some of the inequalities proved by Mortici and Jeong, and present some inequalities I developed using the same technique.		

SS4.4	**Friday 3:00 p.m.**	*The Evolution of the Crossing Number*
Joshua Lambert		Georgia Southern University
While the roots of the crossing number stem from Paul Turan's problems at a brick factory during World War II, the evolution of these ideas has spread into applications in chemistry and electrical engineering in today's society. Alongside these changes in applications of this concept, the study of the crossing number has evolved from drawings in the plane. In particular, we shall explore the extensions into k-planar crossing numbers and explain the difficulty in making associated calculations for given families of graphs.		

UP1.10	**Saturday 10:45 a.m.**	*Distribution of Zeros in Various Polynomials*
Hope LaRosa		University of North Carolina at Wilmington
Littlewood polynomial is a polynomial where each coefficient, is equal to 0 or 1. We are able to graphically represent the zeros of the polynomial in a visually stimulating anomaly. The objective of this study is to define a generalized Littlewood Polynomial, and graphically represent its zero set and analyze the graph of the set. We extend the Littlewood polynomials to polynomials with coefficients -1,0,1 and use Python to produce the roots of the extended Littlewood polynomials, Matlab to produce graphs and also take an axiomatic approach in order to evaluate their components in the complex plane.		

SS6.4	**Friday** **3:00 p.m.**	*Sweeping gestures: A control theory model for curling*
Jeffrey Lawson		Western Carolina University
In the sport of curling, a polished stone is thrown along the ice toward a target (the house). In a type of throw called a draw, the thrower releases the stone with just enough velocity to allow friction to slow the stone to a halt at the desired position in the house. However, the usual curling strategy is to underthrow the stone and then call for teammates to sweep the ice with brooms to reduce friction until the stone arrives at its target. In this talk, we model the throw with a simple ODE, first uncontrolled (no sweeping) and then with a control. This is an atypical control problem for a mechanical system because, unlike braking or damping controls, the sweeping actually decreases friction. We demonstrate a suboptimal geometrical solution to the boundary value problem and discuss implications for optimal control.		

UT5.1	**Saturday** **10:00 a.m.**	*The Phony Express*
Carol Lewis		Furman University
The Phony Express examines a problem in dynamic programming: how can a group of people cooperate to get their letters to the post office with minimal effort? This work was inspired by a problem from Averbach and Chein's classic text Problem Solving though Recreational Mathematics. After developing helpful visuals, schema, and terminology, we will examine a few cases and develop an algorithm to address the general case. Lastly, we will compare the computation times of brute force methods and the algorithm and test our intuition against a Python program written to perform the algorithm.		

CP6.5	**Friday** **3:20 p.m.**	*Domination Number and Hamiltonicity of Graphs*
Rao Li		University of South Carolina Aiken
A sufficient condition based on the domination number for the Hamiltonicity of a graph will be presented in this talk.		

UT7.1	**Saturday** **10:00 a.m.**	*1-Wasserstein distance between self-similar measures*
Emily Lichtenegger		University of Tennessee at Martin
We compute the 1-Wasserstein distance between certain approximations of self-similar measures associated to an iterated function system of two non-overlapping linear contractions of the unit interval. As a corollary we obtain the distance between those self-similar measures.		

UT3.6	**Friday** **3:40 p.m.**	*Budapest Semesters in Mathematics (BSM)*
Nicole Lidzbarski		Converse College
In this talk, I will discuss my experience in the program Budapest Semesters in Mathematics. In this program, college students and graduates can spend a semester or two studying under eminent mathematicians in Budapest, Hungary. The program was established specifically for North American mathematics and computer science majors who wish to rigorously study mathematics without the language barrier		

SS2.2	**Friday** **2:20 p.m.**	*Guiding Students to Solve a Business Problem in an Independent Study Course*
Robin Lovgren Lovgren		Belmont University
Sometimes a problem can turn into an opportunity. When three students needed credit for a course not currently being taught, the solution was not the traditional independent study, but rather, a depth versus breadth approach to the course. An example will be given of how an independent study Mathematical Modeling and Simulation course lead to three students working together in solving an industry problem. The faculty perspective will be presented including how the problem was identified, the process for the students, and the final results including a sample of the conclusions that were obtained through a multiple regression analysis of human resources data from an architectural and engineering firm.		

SS2.3	**Friday** **2:40 p.m.**	*Facilitating mathematics majors on conducting projects in Business, Industry and Government*
Yongjin Lu		Virginia State University
As the amount of data generated in business, industry and government (BIG) continues to grow, the demand of making sense of the data gives rise to projects that mathematicians could participate. In this talk, we will share the experiences of research projects from BIG done in the past few years. Undergraduate mathematics major students were involved in some of these projects, including the one supported by the Preparation for Industrial Careers in Mathematical Sciences (PIC Math) program. We would discuss the differences of solving a BIG problem from a traditional mathematical problem and the lessons learned from teaching a BIG project-oriented course.		

CP8.4	**Saturday 11:00 a.m.**	*The Delian Problem, Platonic Solids, and Finite Fields*
Matt Lunsford		Union University
The question of performing, by straightedge and compass only, the classical Greek construction problem of duplicating a cube remained a significant open problem in mathematics until the first half of the 19th century. Using Wantzel's algebraic characterization of this problem, we consider the question of duplicating the Platonic solids over prime finite fields.		

SS3.1	**Friday 2:00 p.m.**	*Reed-Solomon codes and the information lottery*
Gretchen Matthews		Clemson University
Error-correcting codes allow for the reconstruction of information from partial information. Reed-Solomon codes have the amazing property that any codeword can be reconstructed using any k coordinates. This allows for multiple users to obtain the same information by accessing different coordinates, a property that is important when considering delays caused by server overload. In this talk, we discuss a student activity that demonstrates this and the role of polynomial interpolation in the process.		

SS8.3	**Saturday 10:40 a.m.**	*Active Learning with Mathematica*
Kristen Mazur		Elon University
Mathematica is a powerful computational tool and has the potential to also be a powerful teaching tool. However, effective integration of technology in the classroom is challenging, and bringing Mathematica into a calculus lesson can be daunting. In this talk I will discuss Mathematica-based lesson templates that allow students to explore concepts, perform calculations and take notes in an easy-to-use and easy-to-create format. These templates not only reduce technology anxiety for both students and instructors, they also become cohesive notes that students can revisit after class. Moreover, the templates support discovery-based and active learning. I will demonstrate the templates themselves and how to create one from a blank Mathematica file. I will also discuss some advantages and disadvantages for both students and instructors.		

SS13.3	**Saturday 10:40 a.m.**	*Immunotherapy as a Treatment for Cervical Cancer*
Sydney McCall		Winthrop University
Human Papilloma Virus (HPV) is the known root cause for the vast majority of cervical cancers. Cervical cancer is the fourth most common cancer in women worldwide, and it has become the number one cancer in some developing countries. Immunotherapy is a treatment used to stimulate or restore the ability of the immune system to fight infection and disease. Implementing immunotherapy to slow/eliminate the growth of cervical cancer cells is less harmful to the patient		

than other treatments such as radiation and chemotherapy. Our model seeks to better understand the dynamics among HPV, cervical cancer, and immunotherapy. Furthermore, through global stability techniques, we provide sufficient conditions on immunotherapy treatment to ensure the eradication of HPV and cervical cancer cells while allowing a positive population of healthy and immune cells to remain.

UT7.5	**Saturday 11:20 a.m.**	*Comparative Analysis of Students' Performance Between Online and on Campus in an Introductory Statistics Course*
Kendal McDonald		Georgia College and State University
In this research, we compare students' performance in an online and on campus introductory statistics and probability course. MyStatLab is the learning management system used in both an online and on campus courses for homework and quizzes. The online data is produced by five summer courses between Summer 2014 to Summer 2017 and the on-campus data is produced from nine on campus courses from Spring 2014, Spring 2016, and Spring 2017. For homework, the research compares the scores made, and how early a student completed the homework in the online and on campus courses. For quizzes, we tested if the scores are same, if there is a difference in how early a student completed the quiz, and the number of attempts taken out of the five attempts granted in the online and on campus courses. We also analyzed the difference between the first attempt score and highest score to see if there is significant improvement in scores by taking the assignments again. In addition, we also modeled the final quiz average as a function of number of attempts and the number of days a student attempted the quiz before the due date which we found are correlated with the final quiz average. Also by using the Wilcoxon Rank Sum Test, we showed that there is no significant difference between online and on campus for both first attempt quiz scores and final quiz scores. However, for homework scores there was a significant difference between online and on campus.		

UT2.1	**Friday 2:00 p.m.**	*Quantifying Gerrymandering in North Carolina*
Sergei Miles		Applachian State University
In the United Sates, state legislatures generally shoulder the responsibility for determining congressional district maps. As the district maps are drawn they can often be gerrymandered to favor one political party over another. In recent news, North Carolina had been called into question for gerrymandering as a federal three-judge panel deemed the current congressional map unconstitutional. Traditional mathematical approaches to studying the practice of gerrymandering involve quantifying compactness of districts in order to determine the likelihood that a map was drawn to favor one party over another. A new approach instead calculates an efficiency gap using voting results from the districts. Compactness considerations rely heavily on geometric analysis that can be cumbersome for the layperson to understand. The efficiency gap provides a less technical approach. In this talk, we compare and contrast compactness and efficiency gap results for North Carolina congressional districts and explore the robustness of efficiency gap measures in North Carolina using random map techniques drawn from the study of compactness.		

SS4.5	**Friday 3:20 p.m.**	*Circulant Hadamard matrices and Barker sequences*
Michael Mossinghoff		Davidson College
Can you design a square matrix whose entries are all ± 1, whose columns are mutually orthogonal, and with the property that each row after the first is a cyclic shift, by one position to the right, of the row immediately above it? Yes! Start with the row (+, +, +, -) and shift it to make the subsequent rows. Are there examples with *n>4*? No one knows! A matrix with these special properties is called a *circulant Hadamard matrix*, and the problem of their existence has attracted a lot of study in combinatorics and algebra. If there is one of size *n > 4*, then it is known that the integer *n* must satisfy a number of special properties. We describe a search for integers *n* that are consistent with every known constraint in this problem, in joint work with an undergraduate student, Brooke Logan (now a graduate student at Rutgers). We find there are fewer than 4500 integers with $4 < n < 4 \cdot 10^{30}$ which cannot be eliminated as the order of a circulant Hadamard matrix. This work extends computations on this problem by a factor of 10000, while reducing memory requirements by a factor of nearly 100. We will also describe a related problem concerning *Barker sequences* that would benefit from some similar work.		

SS11.5	**Saturday 11:20 a.m.**	*Ghostbusters: Ghost, Goo, and Graph Theory!*
Andrew Mosteller		Lenoir Rhyne University
Imagine you are hired by the owner of a haunted hotel with k rooms, each containing an infinite number of ghosts. The kicker? All the surviving ghosts move about the hotel each night. Is it possible to kill all ghosts from all rooms in a finite number of days? To help the owner, we hope to rid the hotel of its unwanted guests. In this presentation, we will divulge the findings of our investigations thus far.		

UT6.3	**Saturday 10:40 a.m.**	*Hadamard Majorization and its linear preservers*
Sara Motlaghian		Georgia State University
Let M be the set of all n-by-n real matrices. A matrix D ϵM with non negative entries is called a doubly stochastic matrix if in each row and column, the sum of the entries is 1. For X, YϵM, we say that X is Hadamard-majorized by Y, if there exists an n-by-n doubly stochastic matrix Dsuch that X = D ∘ Y, where ∘ denotes Hadamard product. The (strong) linearpreservers of Hadamard majorization is studied. Also, for $n \geq 3$, it is shown that the strong linear preservers of Hadamard majorization are precisely the invertible linear maps on M which preserve the set of matrices of term rank 1.		

UT7.3	**Saturday** **10:40 a.m.**	*Determining Unique Local Minima in Complex Systems*
Amy Murdaugh		Union University
When fitting models of complex systems, local minima of the cost function, which measures the fit of the model to the data, pose problems both for fitting algorithms and for model interpretation. The surface of the cost function is usually assumed to be rough, but this characteristic may be overstated. Local minima produced by a fitting algorithm may actually lie in the same basin of attraction, due to differences in the algorithm's stopping criteria and numerical resolution. To examine this, we construct geodesic paths between local minima produced by a fitting algorithm. We solve the geodesic equation numerically in Julia as a boundary value problem, using the Shooting Method and Multiple Shooting Method. Convergence is improved by interpolating between parameter space and the model manifold using a Levenberg-Marquardt parameter, λ. Evaluating the cost function along the geodesic paths allows us to differentiate between distinct minima and find unique basins of attraction. This work has implications for characterizing models based on the number of distinct local minima present and technical results for algorithm development. It also may provide insight into the existence of low-dimensional effective theories in the complex system.		

CP8.5	**Saturday** **11:20 a.m.**	*Dihedral Leibniz Algebras*
Carter Murray		Applachian State University
The notion of an object being cyclic is familiar in many areas of algebra, including Leibniz algebras. This research will briefly examine the current research on cyclic Leibniz Algebras and present findings on Leibniz algebras generated by two elements. We examine bracket structures that parallel dihedral groups and explore their implication on the basis of the algebra.		

UT4.1	**Friday** **2:00 p.m.**	*Almost Positive Sectional Curvature Using Octonions and Group Actions*
Ezra Nance		University of Tennessee at Martin
This presentation will begin by discussing different types of sectional curvature. Then by using Lie Groups and octonions we construct a Riemannian metric of almost positive sectional curvature on the Grassmannian of 2-planes in $\mathbb{R}^7$. We achieve this by deforming the standard metric using group actions. This result is the first known example of almost positive curvature on an irreducible compact symmetric space of rank 2 or higher.		

UP1.11	**Saturday** **10:45 a.m.**	*Neural Networks*
Orlando Nawade		Cumberland University

In my senior project we will look into neural networks. Neural networks are a growing field and already have many real world applications and are still being extensively researched. We will begin by comparing neural networks and biological neurons. Next, we shall introduce the mathematics and how we use them in neural networks. I will illustrate some calculations and models to show the underlying mathematics in the developments of neural networks.

SS13.1	**Saturday 10:00 a.m.**	*What some anaesthetics may be doing to your brain*
Israel Ncube		Alabama A&M University
General mechanisms underlying how different anaesthetics act at various targets in the central nervous system to produce altered states of arousal are currently poorly understood. Using a combination of Hodgkin-Huxley type mathematical modelling of individual neurons and numerical simulations of coupled networks of artificial neurons, we investigate how the α_2-adrenoceptor agonist dexmedetomidine could potentially be interacting with particular neural circuits to generate signature oscillations seen clinically in the electroencephalogram and experimentally in the local field potential.		

SS6.2	**Friday 2:20 p.m.**	*An arbitrary-order Taylor series method DE solver in MATLAB*
Richard Neidinger		Davidson College
We introduce an application of, and methods behind, a numerical solver that uses high-order series solutions that are automatically computed for any ordinary differential equations of the (vector) form Y' = f(t,Y). We focus on the model of a forced damped pendulum that exhibits chaos and we show how 20th order series on each step enables high accuracy with relatively few steps, compared to a built-in MATLAB solver with equivalently low tolerance. The method amounts to using the f(t,Y) evaluation directly as a recurrence relation, where each operation corresponds to arithmetically combining previous series values. Each transcendental function is automatically handled by treating it as a simple system of derivatives. The author's original code is available, and others have done similar implementations in the past, though not in commercial tools. Our goal is to make the ideas accessible, so that this method is more widely understood as a practical option.		

CP12.2	**Saturday 10:20 a.m.**	*On combinatorics involving the Permutohedra and Associahedra.*
Michael Nelson		Georgia Southern University
In 1995, Tonks found a natural cellular quotient map of *n*-dimensional complexes from the permutohedron to the associahedron, and that this map can be understood through the combinatorics of trees. More specifically, we can associate a specific tree on *n*-leaves, which we call non-degenerate *P*-trees, with each cell of the *n*-dimensional permutohedron. Similarly we can also associate a specific tree on *n*-leaves, which we call *A*-trees, with each cell of the *n*-dimensional associahedron. By contracting the internal nodes with only one child, we obtain a map from the set of non-degenerate *P*-trees on *n+2* leaves to the set of *A*-trees on *n+2* leaves, which corresponds precisely to the cellular quotient map. In this talk, we study the number of *k*-cells of the *n*-		

dimensional permutohedron which collapses to a 0-cell of the *n*-dimensional associahedron by counting the number of non-degenerate *P*-trees which collapses to the *A*-tree attached to that 0-cell. We also consider algebraic structures generated from these concepts, where individual *P*-trees and *A*-trees define compositions of binary and unary operations.

SS1.2	**Friday 2:20 p.m.**	*Reading Journals: Assignments that Promote Student Engagement, Productive Struggle, and Ultimate Success in Undergraduate Mathematics Courses*
Sarah A. Nelson		Lenoir Rhyne University
We spend a lot of time searching for the *best* textbook for students so that our students have a reliable and useful resource to reference. While we do ask them to read over certain material before classes, we often fail to guide our students in how to read that textbook productively. Having students journal about reading their mathematics textbooks allows us to help students struggle and persevere when encountering new problems, help students develop strategies for reading mathematical text productively, and help capitalize on what the students already have to offer. In this talk, we will look at how *Reading Journals* motivate students in a variety of mathematics courses across the undergraduate curriculum. We will further share how to develop different types of prompts for journal entries and important lessons learned.		

SS11.6	**Saturday 11:40 a.m.**	*Permutations: Reaching the Pinnacle Beyond the Peak*
Sarah A. Nelson		Lenoir-Rhyne University
A permutation of *{1,2,…,n}* is any ordering of these *n* integers without repetition. Permutations have long been studied by paying attention to what happens at specific placeholders, called indices. We will briefly review these ideas and look at particularly revealing examples. Then we will introduce the notion of a pinnacle set, which focuses on the values that occur at the highest point(s) in a permutation. We will revisit illustrative examples and discuss some new results.		

UT2.3	**Friday 2:40 p.m.**	*Prime Graph Labelings on n-hairy 4-cycles*
Alexis Newton		High Point University
In graph theory, a graph labeling is a way of labeling all vertices of the graph with integers, subject to certain conditions. A wide variety of labelings have been studied in the field since the 1960s. A prime labeling of a vertex set V={1,2,…,|V|} is one for which every vertex can be labeled such that adjacent vertices are relatively prime, and graphs admitting prime labelings are called prime graphs. In this presentation, we will be exploring a family of graphs and proving through construction that a specific graph type will always admit a prime graph labeling.		

CP2.2	**Friday 2:20 p.m.**	*A useful generalization of the Petersen graph.*
Amanda Niedzialomski		University of Tennessee at Martin
The Petersen graph is an interesting example in graph theory for several reasons. For those who study radio labeling of graphs, the Petersen graph falls into an important class called radio graceful graphs. We will make some observations about the structure of the Petersen graph that make it desirable in this context, then use these observations to generalize the Petersen graph to an infinite collection of radio graceful graphs.		

SS8.1	**Saturday 10:00 a.m.**	*Using Active Learning Strategies to increase Student Engagement and Understanding in Pre-Calculus*
Benedict K. Nmah		Morehouse College
At the 2016 Joint Mathematics Meetings in Seattle, Washington, I took a four-hour MAA minicourse (Minicourse #9) on 'Increasing Student Engagement and Understanding through Active Learning Strategies in Calculus'; it was ran by Dr. Debbie Gochenaur et al. Immediately after the conference, I decided to implement the strategies in one of my pre-calculus courses at Morehouse College. In this talk, I will discuss what is working and where improvements are needed. I will also share comparative success rates of my classes where I used active learning strategies verses my classes where I did not.		

CP7.1	**Saturday 10:00 a.m.**	*Parameter space of certain compact sub-varieties off Flag manifolds*
Ben Ntatin		Austin Peay State University
Lie groups acting on flag manifolds normally give rise to induced actions on the parameter spaces of certain geometric objects related to the manifolds in question. In this talk, we give a definition and a characterization of the parameter spaces of certain compact subvarieties (cycles) in the natural setting of group action of real forms of semi-simple Lie groups acting on flag manifolds. We will only consider low-dimensional examples.		

UT5.3	**Saturday 10:40 a.m.**	*Fisher's Equation: Modeling Gene Flow through Populations*
Sarah Oldfield		Sewanee: The University of the South
Advantageous genes spread through populations in a wave-like manner. Fisher's equation, proposed by Ronald Fisher in 1937, is a partial differential equation used to model this gene flow. In this talk, I will give an approximation of the solution to Fisher's Equation using the method of finite differences, and I will show Matlab code of the traveling wave solution. I will also explore how Fisher's equation has been used in other disciplines such as conservation biology and medicine.		

CP4.1	**Friday 2:00 p.m.**	*Optimal Control Applied to Visceral Leishmaniasis Model*
Buddhi Pantha		Abraham Baldwin Agricultural College
Leishmaniasis is a vector borne disease caused by a protozoan parasite and transmitted by a bite of an infected sandflies. In this talk, I will present a deterministic model for transmission dynamics of Visceral Leishmaniasis in humans and canine reservoirs. The basic reproduction number is calculated. We performed sensitivity analysis to determine the most impacted parameter and apply intervention strategies based on the sensitivity result. Three time dependent controls: personal protection, insecticide spraying and culling of the infected reservoirs are implemented and we present optimal control analysis. Some simulation results for the model will be presented.		

SS9.4	**Saturday 11:00 a.m.**	*Undergraduate Internships in Business Analytics*
Michael Piper		Lee University
This presentation highlights potential field choices for mathematics majors citing examples within the field of Data Analytics, specifically my personal experience with Regal Cinemas this past summer. The material presented will include the different uses of data analytics in order to inform business decisions within the company. The mathematical skills required for an undergraduate internship with Regal Cinemas Data Analytics department will be discussed, as well as the necessary steps to take in order to pursue an internship.		

SS4.6	**Friday 3:40 p.m.**	*Properties of the promotion Markov chain on linear extensions of posets*
Svetlana Poznanovic		Clemson University
The Tsetlin library is a well studied model of how an arrangement of *n* books on a shelf evolves over time. It assumes that a reader picks up a book *i* with probability *p_i* and then returns is at the end of the shelf. Its stationary distribution, convergence to stationarity, and eigenvalues have been explicitly found. In this talk we will present a variation of this model in which the state space is restricted to the set of linear extensions of a fixed poset and the moves are based on the promotion operator. We will discuss what is known about the eigenvalues of this promotion Markov chain and state a related conjecture.		

SS8.2	**Saturday 10:20 a.m.**	*Flipping the Math Classroom*
J.C. Price		Georgia Gwinnett College
In this talk we will discuss our four years of experience with flipping classes. In particular, we will review how 21st century technologies were used to screencast and distribute traditional lectures, which are available at www.youtube.com/user/drprice765, and we will elaborate on our classroom and instructional design. The main outcome is an active learning environment that encourages		

students to openly discuss mathematics, compare and contrast ideas, and work together to solve problems.

UT1.4	**Friday 3:00 p.m.**	*Mathematical Modeling with Advanced Engineering Implications; Heat Transfer along the Human Arm in Electric Arc Phenomenon*
Adam Price		Clemson University

The main objective behind this creative inquiry course is to develop experience in mathematical modeling of advanced engineering problems. This paper reviews the study done in Heat Transfer Along the Human Arm in Electric Arc "Creative Inquiry 4990" at Clemson University in the Fall 2017 and Spring 2018 semesters. The Creative Inquiry classes of Fall 2017 and Spring 2018 have studied topics including but not limited to mechanical vibrations, thermodynamics, and physics of electric arc. Additionally, time has been taken to arrange research trips and workshops for class members. In the Fall 2017 semester, research was dedicated to generalized study. In the Spring 2018 semester, research has been compartmentalized, allowing groups of students to focus on particular topics. In this paper, we give overviews of our experience in this class as well as brief looks into the topics we individually focused on studying. Further, we delve into our plans for the future of the Creative Inquiry and research that we intend to conduct in the coming semesters. Within the next few semesters, we intended to have expanded our research topics to several topics within the fields touched on by this Creative Inquiry.

CP4.3	**Friday 2:40 p.m.**	*Decision Heuristics in Two-Player Games: Psychology, Sympathy, and Selection*
Jacon Quinley		University of Tuebingen

Game Theory as seen classically in economic and mathematical modeling presents agents as purely self-interested and with infinite introspection. We present here a contrast with novel decision heuristics for games like the repeated Prisoner's Dilemma, Stag Hunt, and Symmetric Trust Game. We first begin with a review of sympathy- and spite-based utility functions. For instance, a sympathetic agent *A* in a game against *B* will evaluate his utility as $V_A(s) = (1-s)U_A + sU_B$, where *s* is the sympathy parameter and *U* is the original utility function. As $V_A$is increasing according to $U_B$and *s*, a highly sympathetic agent may choose outcomes that favor the other player to his own material detriment. We then introduce our heuristics based on psychological data from relationships of dominance, reciprocity, and communality as mechanisms for solving the equilibrium selection problem. Last, we invite discussion on the following topics: the topology of the space of strategies as affected by sympathetic payoffs; the basin of attraction for differential equations in family of the replicator dynamics for these games; stochastic methods for dynamic inference of an opponent's decision function.

CP9.4	**Saturday** **11:00 a.m.**	*Teaching Arrow's Theorem with Arrow's Theorem: Computational Social Choice in Undergraduate Game Theory*
Jason Quinley		University of Tuebingen
In this talk we give several highlights from teaching a *Game Theory* seminar to advanced high-schoolers at a college-prep school. In particular, we discuss a white paper assignment exploring Arrow's Impossibility Theorem using \LaTeX, Google Polls, and spreadsheet software. The essence of the theorem states that ranked preference systems for voting break down when there are three or more candidates. To explore the paradox with the paradox, students were assigned three candidates for voting systems, leading to the inevitable impossibility of a perfect choice. We discuss their construction of polling data, policy papers, and the subsequent debate. We also open the floor for discussions of alternative math electives for the advanced secondary and undergraduate audience, collaboration with social sciences and humanities departments, and aligning standards with objectives in technology and business.		

CP3.3	**Friday** **2:40 p.m.**	*Fractional derivatives and the method of lower and upper solutions for fractional differential equations*
Diego Ramirez		Savannah State University
In this talk we first introduce two definitions of a fractional derivative given by Riemann-Liouville and Caputo as well as some results of fractional calculus. In the second part we will present the method of lower and upper solutions combined with a monotone iterative technique in order to prove the existence of coupled minimal and maximal solutions of fractional differential equations with initial condition.		

CP4.2	**Friday 2:20 p.m.**	*Multiclass Classification using Support Vector Machines*
Duleep Rathgamage Don		Georgia Southern University

The curse of dimensionality refers to various phenomena that arise when analyzing and organizing data in high-dimensional spaces (often with hundreds or thousands of dimensions) that do not occur in low-dimensional settings such as the three-dimensional physical space of everyday experience. The expression was coined by Richard E. Bellman when considering problems in dynamic optimization. There are multiple phenomena referred to by this name in domains such as numerical analysis, sampling, combinatorics, machine learning, data mining, and databases. The common theme of these problems is that when the dimensionality increases, the volume of the space increases so fast that the available data become sparse. This sparsity is problematic for any method that requires statistical significance. In order to obtain a statistically sound and reliable result, the amount of data needed to support the result often grows exponentially with the dimensionality. Also, organizing and searching data often relies on detecting areas where objects form groups with similar properties; in high dimensional data, however, all objects appear to be sparse and dissimilar in many ways, which prevents common data organization strategies from being efficient. Since its introduction the Support Vector Machines (SVM) has quickly become a popular tool for classification which has attracted a lot of interest in the machine learning community. However, SVM is primarily a binary classification tool. The multiclass classification with SVM is still an ongoing research problem. In this thesis we discuss different methods for multiclass classification using SVM and we introduce Divide and Conquer Support Vector Machine (DCSVM), a fast algorithm for multiclass classification using Support Vector Machines. Our method relies on dividing the whole training data set into partitions that are easily separable. Then, a prediction between two training set partitions would eliminate two or more classes at the time. Our algorithm performs consistently better than the existent methods on average. In the best case scenario, our algorithm makes a final decision between N classes in O(logN) decision steps between different partitions of the training data set. In the worst case scenario, DCSVM makes a final decision in at most N-1 steps, which is not worse than the existent techniques.

SS2.1	**Friday 2:00 p.m.**	*Clemson's Sophomore Seminar for Mathematical Sciences Majors*
Leo Rebholz		Clemson University

We discuss the Clemson Sophomore Seminar for Mathematical Sciences majors. This course is a 1 credit seminar intended to help students learn about different career options for Mathematical Scientists, and to help them choose an `emphasis area' for their major. Each week a speaker from a different area of Mathematical Sciences will tell the students `here is what I do'. Often the speakers are alums, and include those who are, e.g., Actuaries, Data Scientists, Investment Bankers, and many more. We will give an overview of the Fall 2017 course speakers.

CP1.3	**Friday** **2:40 p.m.**	*Service Learning and Statistics - A Real World Connection*
Gina Reed		University of North Georgia
This presentation focuses on how to incorporate a service learning research project into statistics courses. Service-learning is a concrete application of statistical methods using real data with the analysis and interpretation that is useful to a community agency. Many organizations and agencies produce data that need to be analyzed and interpreted in order to be of use to the group. This presentation will include discussion about locating potential agencies, initiating contact, examples of student projects, and assessment and evaluation of the project from students and agencies.		

CP12.5	**Saturday** **11:20 a.m.**	*Reviewing for Mathematical Reviews*
Norm Richert		Mathematical Reviews/AMS
Writing reviews for Mathematical Reviews/MathSciNet is a great service to the mathematical community, but the work of reading and composing a review of a published paper can also be personally rewarding. The serendipity of reading a paper slightly out of one's own research focus can lead to new research problems and new connections to other mathematicians. Many published papers can be traced back to the reviewing in Mathematical Reviews of another paper by one of the authors. This can be true no matter what type of institution one is in, but it can be especially true for those whose first responsibility is teaching. It is very easy to become a reviewer. The talk will give an overview of the reviewing process at Mathematical Reviews/MathSciNet.		

SS5.1	**Friday** **2:00 p.m.**	*Generalizations of Some Inequalities with Symmetric Fractions*
John Risher		University of South Carolina
In Cvetkovski's book "Inequalities: Theorems, Techniques and Selected Problems", we found a pattern of several inequalities involving sums of symmetric fractions with three variables. While the exponents in these inequalities remain integers, we can easily prove them using fundamental algebra and mathematical induction, as suggested in the book. However, regarding the case when exponents are real numbers, we have to find a new method. In this talk, we will introduce the pattern we found among these inequalities, and then we will use our own method to prove the generalizations when the exponents are real numbers.		

CP5.5	**Friday** **3:20 p.m.**	*An incentivized early remediation program in Calculus I*
Lake Ritter		Kennesaw State University
Strong prerequisite skills are essential to student success in the calculus sequence; however, many students arrive in Calculus I with weaknesses that are difficult for them to overcome. In this paper, we describe an approach to early incentivized remediation of prerequisite material in a Calculus I course. We present data that supports the idea that a lack of prerequisite knowledge is a significant hurdle for students, but also that participation in the remediation program is correlated with student		

success. In addition, the program allows for the very early identification of students at high risk of failing. The program is easy to implement, and it would be adaptable to a variety of other courses for which prerequisite knowledge is essential for success including science courses, engineering courses, and other mathematics courses.

UP1.12	**Saturday** **10:45 a.m.**	*The Geometry of Boolean Functions on Five Variables*
Wesley Rogers		Western Carolina University
Modern Cryptography is dependent on boolean functions for security. In order to be a suitable candidate for cryptographic use, a function must be both resilient and nonlinear. We verified the existence of 8 classes of 2-resilient boolean functions on 5 variables. We established the diameter and minimal non-zero distance between the boolean functions of interest. Additionally, we defined the Hausdorff Distance between all 28 combinations of these functions. We also identified several other interesting characteristics of these boolean functions and their applications to Cryptography and other fields, and produced a Python library to assist in the finding of additional functions with similar characteristics.		

UP1.13	**Saturday** **10:45 a.m.**	*The Comparison of the Trapezoid and Gaussian Methods*
Margo Rothstein		Georgia College and State University
In this project, we compare the Gaussian Quadrature and Trapezoid Rule methods that are both used to approximate integrals. We prove the accuracy of the Gaussian method is 2n-1 using a method that is simple other than the Legendre polynomials. We also discuss some applications of the Gaussian Quadrature.		

CP1.4	**Friday** **3:00 p.m.**	*Taking the Grind out of Group Grading: A System to Improve Efficiency, Consistency & Pedagogy*
Jack Ryan		University of Tennessee Knoxville
Within the past year, the use of an online grading system has transformed the way that lower division tests are graded in the math department at the University of Tennessee, Knoxville. Students take their tests on paper as usual. Once the tests are administered, they are scanned into an online program from which the instructors and TAs can grade the tests. This allows the instructors to grade the tests remotely and eliminates the physical transfer of tests when multiple instructors have to grade the same set of exams. While this specific program is not available for use outside of the university, there are other for-profit companies claiming FERPA compliance that have created online grading systems. In this talk, we will discuss the general advantages of using an online grading program and suggest why instructors or departments might consider switching to an online grading system. Speaking from practical experience, we will share how the program eliminates post-test cheating, reduces grading time, and allows course administrators to ensure consistency as well as target commonly missed concepts so that teaching methodology can be adjusted in the future. We include a demonstration of the grading system we use, and highlight key features currently enjoyed by instructors and students.		

This will enable prospective online graders to create a wishlist if they decide to create a similar system or explore commercial products.

CP10.2	**Saturday 10:20 a.m.**	*Using St. Augustine's On Free Choice of the Will and Plato's Meno (and other authors) to Talk About Mathematics*
Josie Ryan		Lander University
Students have the tendency to reduce mathematics to formulas and rules, to want all mathematics to follow known structures. Whether mathematics majors or not, they limit their discussions in these ways. As a result, we lose much of the intuition and creativity that makes mathematics possible. The thinking of those who are not generally seen to be mathematicians can enlighten majors to the point of proof- the reason for the endless "How do you know?" The reasoning of philosophers can teach non-mathematical students to analyze mathematical writing with confidence- to think logically about unfamiliar prose. This talk is a look at how I have used Plato and St. Augustine and other authors in classes to initiate discussions leading to answering the question "Why do mathematicians do what we do the way we do?"		

PUB.3	**Friday 3:00 p.m.**	*Using WebAssign to Drive Unlimited Potential for Students in Calculus, Precalculus and Statistics*
Michael Saver		Cengage
In this session we explore tips, tricks and unique tools in WebAssign that help students visualize math and develop conceptual understanding in Calculus and Precalculus. We will also explore WebAssign's unlimited flexibility and a new approach with Statistics Learning By Objective to teach what you want in whatever order you want and how this could assist in remediation, standard courses or co-requisite courses.		

UP1.6	**Saturday 10:45 a.m.**	*A Predator-Prey Model for Silverleaf Whitefly(B. tabaci) and Lady Bettle(H convergens)*
William Schalch		Abraham Baldwin Agricultural College
Bemisia tabaci is a crytic species complex of more than 35 identifiable aphids. Some type of these pests can spread in an environment so quickly that they are considered to be one of the world's top 100 invasive species. Each year, these pests damage plant and crops by feeding on the plants and by transmitting plant viruses costing millions of dollors to farmers and greenhouse growers. Over 600 plant species, including major corps such as peanuts and cutton, are known to be parasitized by these pests. To encounter these pests, several pesticides and synthetic predators are used but they have adverse effects on natural and beneficial organisms. Also, some of the predators are not very effective due to their ability to encounter only adult whiteflies. In this paper, we develop a discrete time predator prey model with lady beetle *Hippodamia convergens* as the predator. These predator has been shown to have extreme predatory effects on various *B. tabaci* biotypes. We will present the		

stability analysis of our model. Parameters are estimated using experimental data and some numerical results will presented.

CP9.5	**Saturday** **11:20 a.m.**	*Assisted Oral Exams and Student Perceptions of Deep Learning and Confidence*
Bradford Schleben		Belmont University
Communicating challenging concepts is an important aspect of engaging in deep learning. We are interested in not only providing such opportunities, but also in determining how to appropriately assess students participating in an interactive classroom that focuses on effectively communicating difficult material. We discuss how assisted oral exams – an approach to oral examinations that prioritizes effective communication and flexibility of conceptual application – aligns with active learning experiences. In particular, we look to assess conceptual understanding in high-level undergraduate math students, as well as provide support for improving students' ability to communicate difficult concepts. We then examine student attitudes concerning the value of assessments with regards to deep learning and confidence.		

SS1.6	**Friday** **3:40 p.m.**	*Using Mathematics to Enrich Cross-Cultural Experiences*
Bradford Schleben		Belmont University
This article will look at mathematics courses designed to provide cross-cultural experiences, potentially to serve Study Abroad programs. The main example we will look at, Math for Social Justice, is a course centered around discussion and active learning experiences where mathematical reasoning and tools are applied beyond the walls of classroom and country. We explore issues of social, political, and economic justice on local, national, and global levels, utilizing mathematics as an analytical tool in understanding these issues across would-be boundaries. Through the synthesis of mathematical content, engaging course design and assessment, and experience abroad, these courses aim to develop the ability and inclination to apply mathematics to the world beyond the comfort of one's own experiences and culture.		

UT5.4	**Saturday** **11:00 a.m.**	*Deep Convolutional Neural Networks and Gender Classification*
Devan Sestito		University of North Carolina at Wilmington
Deep Neural Networks (DNN) are a relatively new machine learning system which have gained traction the past few years. DNNs can be generalized as a type of artificial neural network – denoted as such due to their resemblance to neural networks in animal brains. Since the concept of DNNs was first conceived advancements in the performance – such as backpropogation to update network parameters - of such systems incited a great deal of interest in deep learning. DNNs have been used to solve a variety of problems – primarily artificial intelligence and object/symbol recognition. Human		

brains are highly capable of differentiating certain characteristics like gender with little more than optical information. With a well-trained DNN these complex features can be classified. Our preliminary studies show promising results, and we are working toward improving our accuracy on gender classification using a DNN on the MORPH-II dataset. In future research convolutional manipulation will be implemented to create a more powerful classification system.

UP1.18	**Saturday 10:45 a.m.**	*Legacy of Srinivasa Ramanujan*
Dmitry Shipsey		Lander University
India's greatest mathematician in the 19th and early 20th century, Srinivasa Ramanujan, lived an interesting and admirable life. While it was also a short and poor life, he managed to live it to the fullest, never asking too much of his friends and family as he pursued his prime interest: performing and sharing mathematics that, at many times, came to him in his dreams. In my presentation I shall delve into his personal life while sharing the multitude of contributions he made through mathematics that are still used in society today.		

UT5.2	**Saturday 10:20 a.m.**	*Disease spread on networks*
Isaac Shore		High Point University
We begin with an overview of various disease models such as SIR and SIRS. Next we build a small network of individuals and their links between them, and on these networks we run the models to observe the dispersion of various diseases. To simulate the disease spread the models must be adapted to accommodate the restrictiveness of network properties. From these small examples similar methods can be extended to real life networks.		

CP10.3	**Saturday 10:40 a.m.**	*Newton's 501 Jeans*
Andrew Simoson		King University
In the Principia, Isaac Newton showed that if the polar radius of Earth is to its equatorial radius as 100 is to 101 then gravity at the north pole is to gravity at the equator as 501 is to 500. We retrace Newton's steps using modern notation and ask, Is 501/500 the best possible gravity ratio over all fractions with denominator near 500? (The use of the anachronistic title for this talk is because 501 jeans are somewhat iconic in America.)		

UT7.4	**Saturday 11:00 a.m.**	*College Football Recruiting Rankings and On-Field Success*
Sydney Singleton		Applachian State University
Every year there is significant national interest among college football fans in the recruiting rankings for their team. These rankings are interesting, but are they predictive of on-field success? For Division 1 college football teams in the largest six conference, and for the seasons from 2007 to 2017,		

we present a data set with information about team recruiting rankings, returning starters, coaching experience, and the team's recent on-field performances to help predict the team's end of season rating in the Sagarin rating system for teams. We use different statistical model selection approaches to create a set of candidate models for predicting team performance. These candidate models are evaluated using an approach related to cross-validation where an individual season is held out of the original data, and then each candidate model is used to predict the outcomes of that season as an assessment of the model's predictive accuracy. Our models show that recruiting rankings are predictive of team success, but also that other factors are important in these predictive models, and that roughly half of the variation of team performance is attributable to random variation even after accounting for recruiting and other differences between team profiles.

CP9.3	**Saturday 10:40 a.m.**	*Lesson Studies in Calculus I*
Brittany Stephenson		University of Tennessee
Originating in Japan, “lesson studies” involve teacher-led research in which a group of teachers work together to target an identified area for development in their students’ learning. Based on existing evidence, participants collaboratively research, plan, teach, and observe a series of lessons making continuous improvements and updates based on feedback and input from fellow teachers and students alike. In this talk, I will discuss my work doing a version lesson studies on particularly difficult topics in Calculus I at the University of Tennessee. This has involved developing lesson plans that incorporate evidence-based strategies, observing fellow Calculus I teachers using the lesson plans, and then modifying the lessons after observations and feedback. As a result of this process, we as a team of Calculus I TA's and mentors have created resources that will be useful to future UTK Calculus I teachers. These materials will serve as a base on which future teachers can build and continue the cycle by updating the lessons each semester based on their own results and feedback.		

SS13.5	**Saturday 11:20 a.m.**	*A Mathematical Model for Tumor Growth and Treatment using Virotherapy*
Jessica Stevens		Winthrop University
We present a system of four nonlinear ordinary differential equations to model the use of virotherapy as a treatment for cancer. This model specifically describes the interactions among infected tumor cells, uninfected tumor cells, effector T-cells, and virons. Using local and global stability analysis techniques, we establish conditions on model parameters to ensure a stable cure state of the full model as well as various submodels. We illustrate these dynamics through numerical simulations of the model using estimated parameter values from the literature, and we conclude with a discussion on the biological implications of our results.		

SS5.4	**Friday 3:00 p.m.**	*The Ubiquity of Identity Verification*
David Stone		Georgia Southern University
The process of verifying an identity first makes it appearance in pre-calculus, particularly in trigonometry. Identities show up in many subsequent courses, but students often concentrate on algebraic manipulations and do not have a clear understanding of the logic involved in their verification (even though it seems second nature to mathematicians). We give many examples of the types of identities that appear and carefully spell out the differing plans of attack that students should understand and use as they develop more mathematical maturity. We also show how the same ideas are appropriate for verifying inequalities and give examples.		

CP11.4	**Saturday 11:00 a.m.**	*Geometric Representations of Dedekind's Proof of Irrationality*
Kimberly Stubbs		College of Charleston
In *Essays on the Theory of Numbers*, Richard Dedekind gives a general algebraic proof that if D is a positive integer that is not the square of an integer, then $\sqrt{D}$ is irrational. In the 1960's, Stanley Tennenbaum gives the geometric representation of Dedekind's proof for which *D = 2*. In this talk we'll look at the geometric representations of Dedekind's proof for which *D = 3, 5, 6, 8, 12, 24* and *48* and their constructions which are similar to the construction for the *D = 2* case.		

CP7.6	**Saturday 11:40 a.m.**	*Mitigating IoT Insecurity with Inoculation Epidemics*
Jillian Stupiansky		University of North Alabama
Internet of Things (IoT) devices, such as DVRs, refrigerators, and other consumer goods, have become a significant source of internet insecurity. Attackers have quickly assembled large-scale botnets that use IoT devices to disable internet infrastructure. This IoT malware is often transmitted from host to host in a manner similar to the spread of biological viruses through a population. Like a vaccine, we propose a technique to create an inoculation epidemic for IoT devices. We model the spread of the malware using a system of differential equations that is a variation of the SIS epidemic model. Our unique model incorporates an extra feature to account for devices infected with the benevolent malware. We will discuss theoretical results as well as simulations, and how this relates to improved internet security.		

UT1.5	**Friday 3:20 p.m.**	*Modeling Epidemic Measles and the Advantages of Stochastic and Population Models*
Abigail Sweet		Converse College
Measles is a highly contagious virus often associated with childhood. It was thought to be eradicated from the United States in the 1990's due to high vaccination rates of the MMR vaccine. In recent years, however, the anti-vaccination movement has caused the vaccination rates to drop below the 93 % necessary for herd immunity to be effective causing new outbreaks to occur. While no epidemics have happened so far, the threat is real. Without prior exposure to the disease, there is a 10-30% mortality rate depending on the strength of the individual's immune system. These simulations modify a basic SIR model and Stochastic model making use of NetLogo to model an outbreak of measles with varying levels of vaccinations. The NetLogo model supports the differential equations derived from the SIR model as well as the equations necessary for the stochastic model. The NetLogo simulation gives a visual for the spread of measles through a population with some fundamental assumptions. This paper then compares the effectiveness of the models using several runs of data and draws conclusions based on different situations.		

CP6.3	**Friday 2:40 p.m.**	*Toy trains and polyplets*
Douglas A. Torrance		Piedmont College
Suppose we have a toy train set with a given number of pieces of track. In how many ways can we form a track from these pieces? We show that if the pieces are all in the shape of a quarter circle, then we may enumerate the possible track shapes using vertex colorings of polyplets. A polyplet is a combinatorial object formed by gluing together squares at their edges or corners.		

SS9.5	**Saturday 11:20 a.m.**	*Complete 2DPCA Paired with Feature Extraction for Gender Classification*
Rachel Towner		University of North Carolina at Wilmington
Multiple feature extraction techniques are explored on the MORPH-II image dataset. Complete two-dimensional principal component analysis is applied to these feature extraction techniques in order to optimize performance of gender recognition using support vector machines.		

SS3.2	**Friday 2:20 p.m.**	*Some Variations on Liar's Bingo*
Sarah Trebat-Leder		Emory University

In working with middle schoolers, I've found that a great way to introduce the concept of error-detecting and correcting codes is through magic tricks that involve detecting or correcting lies. I'll start by describing "Liar's Bingo", a well-known activity in the math circle world, and then discuss some variations that introduce coding schemes such as Hamming codes.

PUB.3	**Friday 3:00 p.m.**	*Using WebAssign to Drive Unlimited Potential for Students in Calculus, Precalculus and Statistics*
Melissa Turbeville		Cengage

CP3.1	**Friday 2:00 p.m.**	*A new ADI method for the Poisson-Boltzmann equation with a two component regularization*
Sheik Ahmad Ullah		University of Alabama

The Poisson Boltzmann equation (PBE) is a well-established implicit solvent continuum model for the electrostatic analysis of solvated biomolecules. Its numerical solution is still a challenge due to its strong singularity by the source terms, dielectrically distinct regions, and exponential nonlinear terms. In this paper, a new alternating direction implicit(ADI) method is proposed for solving the nonlinear PBE using a two-component regularization. This scheme inherits all the advantages of the two-component regularization and the time-dependent PBE with the ADI method while possessing a novel approach to combine them. A modified version of 1D ghost fluid method(GFM) has been introduced to incorporate the nonzero jump condition into a new ADI method. The proposed scheme produced better accuracy compared to the previous ADI methods for a benchmark problem and simpler to implement by circumventing the work necessary to apply the MIB method with the regularization for a 3D problem. Though this scheme can use larger time increments than the previous ADI methods, it still blows up for large time increments. Later to address this issue with the stability, Locally One Dimensional (LOD) method has been used to replace the ADI method as the operator splitting part. The LOD method remains stable even for very large time increments. This is numerically verified by calculating the electrostatic potential and solvation energy on the benchmark problem whose analytical solutions are available and on a series of proteins with various sizes.

UP1.14	**Saturday 10:45 a.m.**	*Asymptotic Quantification of Regular and Semi-Regular Round Robin Tournaments*
Aaron Vankempen		Piedmont College

Applying mathematics to sports, we examine the number of different ways to schedule a home/away round robin tournament of n teams. If n is even, the number of home games minus the number of away games should equal the absolute value of 1 for each team (semi-regular). If n is odd, each team should play the same number of home games and away games (regular). The schedule can be split up into weeks, represented by edge colorings. The number of edge colorings for a tournament of n teams is represented asymptotically by $S_k \sim k^{\frac{3}{8}k^2}$, where k=n if n is odd, and k=n-1 if n is even. The number of labeled semi-regular tournaments is represented by $\binom{n}{\frac{n}{2}} \times coefficient\left(\frac{x_1 x_2 \dots x_{\frac{n}{2}}}{x_{\frac{n}{2}+1} \dots x_n}\right)$ for n

even. If n is odd, the number of regular tournaments is represented in the same fashion, only replace n with n-1. We arrive at the asymptotic result by multiplying the edge coloring approximation by the number of regular/semi-regular labeled tournaments of n teams.

CP6.1	**Friday 2:00 p.m.**	*Integer Solutions for Triangles*
Barrett Walls		Perimeter College at Georgia State Universtiy
We solve a problem for integer sided triangles with prescribed angle conditions. We discuss ways this problem can be presented as a project for precalculus classes.		

CP10.1	**Saturday 10:00 a.m.**	*Crown Jewel of Mathematics: A Historical Look at the Pythagorean Theorem*
Jing Wang		Christian Brothers University
Known to humankind since 4000 years ago, the Pythagorean Theorem has never ceased to fascinate the mathematics lovers. We will first trace its history back to the Egyptians of 2000 BC, the Babylonians of 1500 BC and the Chinese of 1100 BC, all of whom showed knowledge of the relationship between right triangles and side lengths. We then visit historically interesting proofs including the ones constructed by Pythagoras, Euclid, Leonardo da Vinci, Einstein and a special one by President Garfield. There even exists a calculus proof. Lastly, we seek to shed some light on exploring opportunities for both in-class and after-class activities for students who are interested in this topic.		

UP1.15	**Saturday 10:45 a.m.**	*Coprime Labelings of Graphs*
Alan Way		Winthrop University
Graph labeling problems date back to the beginning of Graph Theory itself (see the Four Color Theorem). Roughly 40 years ago the notion of a prime labeling of a graph was introduced; a graph on n vertices has a prime labeling if its vertices can be labeled by the numbers 1, 2, … , n so that each edge spans a coprime pair (i.e. each edge's labels have greatest common divisor one). In the 1980's Entriger conjectured that a certain family of graphs all have prime labelings; our work furthered the progress on this conjecture by giving a prime labeling for several members of this family. Additionally, we studied graph parameters related to the coprime graph. The coprime graph on n vertices is the graph whose vertices are numbered 1, 2, … , n with i~j if and only if i and j are coprime. Using the graph parameters we calculated, we were able to conclude that several classes of graphs are not prime. We concluded our work by examining this notion generalized to hypergraphs (which allow "edges" to have size larger than two) and give a class of hypergraphs which are not prime. Joint work with Arran Hamm and Justin McCullough.		

UP1.16	**Saturday** **10:45 a.m.**	*Using Different Distance Metrics to Create Conic Sections*
Jessica Wellington		Valdosta State University
The conic sections are classically defined by a locus of points. The most common distance metric to generate conic sections is the Euclidean metric but in the literature; one finds the taxicab and maximum modulus metrics can be used to also produce an ellipse. We wanted to take this a step further. An ellipse involves two measurements, what if two different metrics are used for each of the two measurements? This method of using multiple metrics can be applied to other conic sections, as well as special quadric surfaces. This idea led to some surprising discoveries, such as proving a "parabola" that is really an ellipse as well as a non-simply connected ellipsoid.		

UT1.1	**Friday** **2:00 p.m.**	*Facial Recognition Optimization on the MORPH-II Database*
Caroline Werther		University of North Carolina at Wilmington
Face recognition is the process of identifying a facial image as a known or unknown individual in a given database. By utilizing the MORPH-II database, this project works to optimize the facial recognition system by analyzing how the choice of subspace projection algorithm (dimension reduction method) and various distance metrics impact accuracy. Eigenfaces (using Principal Component Analysis) and Fisherfaces (using Linear Discriminant Analysis) are analyzed against different classifying techniques, Support Vector Machine and Nearest Neighbor. Due to the variability of human faces and image quality, as well as the size of MORPH-II, the complete database struggles with poor face recognition accuracy and faces problems related to computational time. However, we propose using a face categorization method in order to perform gender classification as a preliminary step to face recognition. By running several experiments, we are able to identify the potential for reducing computational times for these various methods as well as improve accuracy rates when it comes to correctly identifying an individual in the database.		

CP5.1	**Friday** **2:00 p.m.**	*The Concept Definition of Numeral*
Ben Westcoatt		Valdosta State University
David Tall's Three Worlds of Mathematics provides a framework through which to study the development of mathematical thought, the three worlds being the Embodied, the Symbolic, and the Formal. In this talk, I will share my initial investigations and findings into how the concept of numeral is situated in the symbolic world. As a first step, I am developing a concept definition for numeral. I analyzed the definitions of numeral provided in numerous mathematics textbooks for pre-service teachers. Additionally, I conducted a survey of college students. The participants in the survey were given several images and prompted to respond whether or not they believed the image represented a numeral. Results of the textbook analysis and the survey will be discussed.		

CP1.5	**Friday 3:20 p.m.**	*Strategies for Reducing the Resistance in a Liberal Arts Math Course*
Cathy Whitlock		University of North Carolina Asheville
Anyone who has ever taught a Liberal Arts Math Course or Quantitative Literacy Course understands that no matter how practical, relevant, or even necessary our subject matter is, some of our students still manage to feel oppressed by the reality of being required to take a math course of any description. Can some of these feelings being lessened by giving students a few choices that matter to them without altering the course learning objectives or lowering standards? Two instructors at UNC Asheville are engaged in an experiment that involves letting students make a few decisions. The preliminary results are in. We have been surprised both by the choices our students made and how pleased they were to be given options in the first place.		

UT2.4	**Friday** **3:00 p.m.**	*Enumeration in Peisert Graphs*
Anthony Wilkie		Western Carolina University
In his investigation into strongly-regular graphs, Peisert uncovered a class of graphs whose structure makes them useful in the study of designs. Unlike the other well-known class of strongly-regular graphs (Paley graphs), Peisert graphs have not yet had their properties scrutinized. In this talk, we develop the properties of Peisert, focusing on enumeration.		

PUB.2	**Friday 2:00 p.m.**	*Increasing Student Math Performance and Confidence with Data Driven Adaptive Learning Technologies*
Dennie Williams		McGraw-Hill/ALEKS Math
Today's student desires adaptive technology not only in their personal world, but in their education experience. How can we meet this need in the classroom and utilize the data to improve our teaching experience? Using ALEKS Math's Artificial Intelligence Engine and Adaptive platform, you will see how we can create a modern education experience in any classroom setting.		

SS1.5	**Friday 3:20 p.m.**	*Transitioning from lecture to IBL*
Jessica Williams		Converse College
Encouraged by research supporting the effectiveness of inquiry-based learning in undergraduate proof-based courses, undergraduate Number Theory and Modern Geometry courses at a small college were re-designed to be taught in IBL fashion. The courses were previously taught in a primarily lecture format and based upon a selected textbook. This talk will describe a general method for transitioning proof-based courses from lecture style to IBL style while still using a central text. Structure of the overall courses, strategies for designing problem sets, breakdowns of typical class periods, and modifications made will be discussed. Course-specific materials and templates will be shared. A practical approach to efficiently re-designing a course to be taught in inquiry-based learning style for the first time will be the focus.		

UT6.5	**Saturday 11:20 a.m.**	*Color-Recursive Visual Cryptography*
Lindsey Wise		Applachian State University
Marvin Jones, graduate student at Clemson University, and Lindsey Wise, undergraduate student at Appalachian State University, have used Naor and Shamir's visual cryptography scheme to create a more secure cryptography scheme via extensions involving color visual cryptography and recursive visual cryptography. Lindsey Wise will be presenting on the construction of this scheme. This involves a combination of two algorithms in order to produce a recursive image with colors. Techniques use are from linear algebra, Boolean logic, and cryptology.		

CP3.5	**Friday 3:20 p.m.**	*Closed-Form Solution for vibration of Timoshenko beams with single discontinuity*
Leina Wu		Queens University of Charlotte
Vibration functions of a Timoshenko beam with arbitrary discontinuities are derived. Heaviside's function is employed here to account for the discontinuity points in the beam so that the modal displacement and rotation can be described by a single function. Consequently the solution of vibration is significantly simplified. The application of present model to smart structure lead-zirconate-titanate (PZT) actuator and damage detection are presented.		

SS5.3	**Friday 2:40 p.m.**	*On Random Entire Functions*
Zhuan Ye		University of North Carolina at Wilmington
Let $G_n = \sum_{\alpha\in\Lambda} a_\alpha f_1^{\alpha_1} f_2^{\alpha_2} \dots f_l^{\alpha_l}$ be a polynomial in terms of analytic functions $\{f_1, f_2, \dots f_l\}$ from a region $\Omega \subset \mathbb{C}^m$ to $\mathbb{C}$, where Λ is an index set and a_α are independent complex-valued random variables defined on a probability space with standard Gaussian distribution. We find the limit of the sequence of the expectation of the normalized zero current $\frac{i}{n\pi}\partial\overline{\partial}\log\lvert G_n(x)\rvert$ in the sense of currents. In this talk, we will start with simple and nice random polynomials and demonstrate the limit of its zeros is a unit disc.		

CP5.2	**Friday 2:20 p.m.**	*An Inside Look at AMC Development*
Carl Yerger		Davidson College
In this talk, I plan to talk about my experience as co-chair of the AMC (American Mathematics Competition) 10/12 committee with developing and finalizing the AMC 10 and AMC 12 exams over the past few years. I hope to give an inside view into the process a problem goes from being proposed to ultimately included in one of the tests. In addition, I plan to give some insights into how the committee works, what I thinks makes a good competition problem and how you can get involved with AMC contests. We are always looking for interesting problems.		

UP1.17	**Saturday 10:45 a.m.**	*Enumerating Traingle and Diamond Subgraphs.*
Stephen Young		Piedmont College
In the study of complete graphs and complete subgraphs, certain properties can be ascertained from the number of triangle and diamond shaped subgraphs. In graphs of higher order where straight counting methods prove difficult, a combinatoric algorithm can be used. Subgraphs of either type can be enumerated directly or simplified by separation.		