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http://sections.maa.org/southeastern/?2016_Conference

Abstracts for all Talks

GS3.1	**Saturday 8:45**	*Modeling the Cancer Stem Cell Hypothesis*	
Kristen Abernathy		Winthrop University	
Despite improvements in cancer therapy and treatments, tumor recurrence is a common event in cancer patients. One explanation of recurrence is that cancer therapy focuses on treatment of tumor cells and does not eradicate cancer stem cells (CSCs). CSCs are postulated to behave similar to normal stem cells in that their role is to maintain homeostasis. That is, when the population of tumor cells is reduced or depleted by treatment, CSCs will repopulate the tumor, causing recurrence. In this talk, we'll explore how incorporating the dynamics of CSCs in cancer modeling leads to a better understanding of solid tumors. We'll also study specific treatment options and provide an analysis of possible cancerous states and their dependence on treatment levels.			

UT4.2	**Friday 2:20**	*Bidding Connect Four*	
Amanda Amerson		Birmingham-Southern College	
Connect Four is a traditional 2-player board game on a vertical, rectangular board consisting of 7 vertical columns of 6 squares each in which the two players alternate taking turns strategically placing his/her game chip in a square with the intention of connecting four adjacent squares in a row, column, or diagonally. By introducing discrete bidding into the traditional Connect Four game, each player will have bidding chips. The total number of bidding chips remains constant throughout the game. We must analyze the optimal move of each position in a game in order to de- termine the necessary chips a player will need to have a winning strategy. In a traditional game of Connect Four, it is known that an optimal strategy exists. However, by introducing bidding, this is no longer true. With bidding it is now possible for a player to make moves in consecutive turns. I analyze discrete bidding of Connect Four on a 4×4 board.			

SS5.4*	**Friday 3:00**	*DI-pathological graphs and the link to inverse domination*	
John Asplund		Dalton State College	Joe Chaffee, Kaiser Permanente James Hammer, Cedar Crest College Ossama Saleh, University of Tennessee at Chattanooga Lucas Van der Merwe, University of Tennessee at Chattanooga Terry Walters, University of Tennessee at Chattanooga
Minimum dominating sets (smallest set of vertices adjacent to each other vertex in the graph) and maximum independent sets (largest set of vertices that are not adjacent to each other vertex) are interlinked in principle and within the literature. There are many natural questions that have been asked in relation to both of these concepts. One such concept are DI-pathological graphs. A graph in which each maximal (Yes, maximal!) independent set intersects each minimum dominating set is called DI-pathological. Investigating these graphs may lead to solving Hedetniemi's conjecture on inverse domination. In this talk we will discuss the link between this conjecture and DI-pathological graphs as well as some recent results on the smallest such graph. If there is enough time, we will also examine recent results on Hedetniemi's conjecture for inverse domination.			

SS4.1*	**Friday 2:00**	*Using Math Club Activities to Create a Dynamic Departmental Learning Community*	
Julie Barnes		Western Carolina University	Bethany Molokach Western Carolina University
In regular classes, students typically experience standard course topics like functions, equations, computational techniques, proofs, applications, and other topics that have been studied for hundreds of years. What students often do not see in class is that mathematicians are real people and mathematics is a vibrant subject with fascinating topics and interesting questions. In this talk, we share ideas on how to bring mathematics to life through math club activities. Some specific topics we will discuss are: getting students and faculty involved, providing events that expose students to topics not covered in class, and creating activities to increase faculty student interactions and develop a cohesive departmental learning community.			

UT3.2	**Friday 2:20**	*Modeling habitat fragmentation at the landscape level via reaction diffusion equations*	
Alyssa Barnett		Auburn University Montgomery	Dexter Harrell, Auburn University Montgomery (co-presenter) Jerome Goddard II, Auburn University Montgomery

Habitat fragmentation affects a population in two key aspects, namely, the size of fragmented patches of habitat and inferior habitat surrounding the patches, called the matrix. Ecologists have confirmed that an organism's survival in a system is often linked to the size of the patches, quality of its surrounding matrix, and distance between patches. In this talk, we will model the effects of habitat fragmentation at the landscape level using a reaction diffusion system. We will explore dynamics of the model via study of the model's positive steady state solutions. Our results are obtained through the quadrature method and Mathematica computations. We will briefly explore their biological implications.

SS1.2*	**Friday 2:20**	*Areas of Fibonacci and Lucas Polygons*	
Jeremiah Bartz		Francis Marion University	
In this talk, we present a compact formula for computing the area of polygons whose vertices are comprised of consecutive Fibonacci numbers. In addition, we discuss related formulas for the area of triangles whose vertices involve certain subsequences of Fibonacci and Lucas numbers.			

UT8.3	**Saturday 10:40**	*Effectiveness of a Supplemental Instruction Program in a Statistics Classroom*	
Emily Baum		Georgia College	Brandon Samples Georgia College
At most universities, an introductory statistics course is required for the majority of the students before they begin their specific major classes. Roughly 25% of undergraduate students at a given university will take a statistics class during a single academic year. Of these students, several will fail to retain the information, making future classes more difficult, or fail to successfully pass the course, increasing the likelihood a student will not graduate on time. Providing academic support through the implementation of a Supplemental Instruction (SI) Program gives students the opportunity to receive free, out-of-class help focused on student achievement in this course. Lead by a SI Leader, students are able to attend sessions to receive conceptual help while reviewing class material, developing study strategies, and collaborating with classmates. We will be focusing on the effects SI can have on student achievement in a statistics classroom. Since statistics is a necessary and important course in several disciplines, proper academic help is crucial for the success of the students. We will share our data analysis for using SI in a statistics course over a 4-year period, providing participants the opportunity to identify the positive effects SI has on student success.			

SS6.4*	**Saturday 11:00**	*Comparing 2-adic Orders of Factorials and Fibonacci Products*	
Brian Beasley		Presbyterian College	

A recent entry in the Problems Section of *Crux Mathematicorum* offered an interesting challenge to readers: Determine when the highest powers of 2 in a factorial and a corresponding product of Fibonacci numbers will be the same. Using a result of Lengyel from *The Fibonacci Quarterly*, we outline the solution of this problem. Lengyel's theorem also allows us to extend the original problem by examining the difference of the 2-adic orders of the given numbers.

CP6.5	**Saturday 11:00**	Linear Algebra in compressed sensing	
Ghan S. Bhatt		Tennessee State University	
The signals, images and other data live in a Hilbert space. This space is equipped with several useful basis needed for applications. Frames generalize the same concepts except they are redundant but there is flexibility in construction. The compressed sensing uses basis, frame and optimizing tools to recover the signal from a fewer measurements of the signal. We study a mathematical formulation of the problem and possible solutions. Some challenging problems will be presented.			

SS7.2*	**Saturday 10:20**	*Note-Taking: One Step Ahead*	
Cindy Box		Perimeter College @ Georgia State University	
Effective note-taking is a necessary skill that students need to have in order to keep up with the fast pace of college lectures. However, students often lose focus of the concept being taught because they are too busy trying to write down every word that the professor is saying. As instructors, we can help students use the classroom time more efficiently by freeing them from intensive note-taking time and allowing them to engage in more discussion and problem-solving. Examples of note-taking templates and classroom teaching strategies will be presented.			

CP1.3	**Friday 2:40**	*Abstract Algebra Discovery Projects*	
Karen Briggs		University of North Georgia	
Abstract Algebra is one of the most challenging courses taken by our undergraduate mathematics and mathematics-secondary education majors. Because of the depth of abstraction of the course content and students' resistance to proof-writing, I also find it to be one of the most challenging courses to teach. In this presentation, I will share a collection of discovery projects I have used to introduce fundamental concepts in group theory such as the definition of a group, cyclic groups, group isomorphisms, cosets, and quotient groups.			

GW1.2	**Friday 2:20**	*Students' Performance, Challenges and Needs in High School Mathematics in the Southwest Georgia*	
Courtney Brown		Albany State University	Dr. Li Feng, Math Faculty @ Albany State University
In this research project, we use descriptive and inferential statistics to systematic study all the past five year End-Of-Course Tests (EOCT) math scores of the county school systems in southwest Georgia region. The data analysis on the test scores shows that, averagely, the math performance of the high school students in southwest Georgia was significantly lower than the state average. The low level performance appeared in all the math courses in 9th and 10th grades, the topics covers algebra, geometry, data analysis, statistics and probability. There were also significant higher percentage of do-not-meet-standard students in the southwest region than the state's, Those students demonstrated a minimal understanding of and proficiency with the procedures and concepts in 9th and 10th grade math courses. Hence a substantial effort needs to be made to improve the math teaching and learning in all the math courses and improve the students' math performance. We will discuss the pedagogical needs and technology needs to improve the high school math teaching and learning in the Southwest Georgia.			

UT6.5	**Saturday 11:20**	*A Decomposition of Parking Functions By Undesired Spaces*	
Melody Bruce		Western Carolina University	Ian Nicolas, Pacific University Michael Dougherty, University of California, Santa Barbara Max Hlavacek, Harvey Mudd College Ryo Kudo, University of California, Los Angeles
There is a well-known bijection between parking functions of a fixed length and maximal chains of the noncrossing partition lattice. Using this, we associate to each set of parking functions a poset whose Hasse diagram is the union of the corresponding maximal chains. We introduce a decomposition of parking functions based on the largest number omitted and prove several theorems about the corresponding posets. In particular, they share properties with the noncrossing partition lattice including local self-duality, a nice characterization of intervals, and a readily computable M\"{o}bius function. We also explore connections with order complexes, labeled Dyck paths, and rooted forests.			

CP4.1	**Friday 2:00**	*Hypergraph Ramsey Numbers Involving Paths and Stars*	
Mark Budden		Western Carolina University	Josh Hiller (University of Florida) Aaron Rapp (University of North Carolina Greensboro)
In 1974, Parsons determined the values of Ramsey numbers of the form $R(P_m, K_{1,n})$, where P_m is a path on m vertices and $K_{1,n}$ is a star having partite sets with cardinalities 1 and n. In the setting of r-uniform hypergraphs, many generalizations of paths and stars exist. In this talk, we will consider hypergraph Ramsey numbers for t-tight paths and stars having t vertices in their centers.			

UT2.6	**Friday 3:40**	*Distributions of Twin, Cousin, & Sexy Primes and Conjectures*	
Cydney Caldwell		Lenoir-Rhyne University	
One of the greatest problems in mathematics is whether twin, cousin, and/or sexy primes are infinite. The mathematics community has proven that at least one is infinite, but are not sure which. This presentation tries to figure out if they all are infinite, just two are, or just one. Sage is used to test new ideas by calculating what large numbers are prime, creating graphs, and equations. Large prime numbers are run through sage and formed into a graph based on grouping. After, the graph is used to calculate a line of best fit to mainly see the tail end of the graph. Another test is done by groupings of intervals that increase by a power of ten as you look at more graphs. This gives a better picture on how these methods and computer tools are helpful in finding the answers and conjectures on how to move forward based on the data found. None of these methods proves that any one of them is infinite, but leads to a new direction that look promising.			

UT6.4	**Saturday 11:00**	*Complete Graph Decompositions and P-Groupoids*	
John Carr		University of North Alabama	
Kotzig gave a correspondence between decompositions of complete graphs and certain groupoids (called P-Groupoids). Our main goal is to characterize these groupoids when the corresponding decomposition is a Hamiltonian decomposition. We also study a specific example of a P-Quasigroup constructed from cyclic groups of odd order due Denes and Keedwell. We show such P-Quasigroups have characteristic left and right multiplication groups, as well as the right multiplication group is isomorphic to the dihedral group.			

UT5.1	**Saturday 10:00**	*Elliptic Curve Cryptography and the Lenstra Algorithm*	
Moses Chandiga		Methodist University	
The increase in the level of threats on data security has prompted the adaptation of efficient and secure cryptographic techniques like the Elliptic Curve Cryptography (ECC). ECC, based on the principle of elliptic curves defined over finite fields, is an example of asymmetric cryptography that uses shorter keys and easy implementation protocols in data manipulation. Implementing ECC requires finding the Elliptic Curve discrete logarithm (ECDL) of a random elliptic curve element with respect to a publicly known base point; hence, creating a Trapdoor function. ECDL is significantly harder than factoring; therefore, a more computationally intensive problem means a stronger cryptographic system. The security of ECC depends on the ability to compute a point multiplication, and the size of the elliptic curve determines the difficulty of the discrete logarithm problem. Hence,			

using Lenstra elliptic curve factorization algorithm, I will demonstrate how to find the ECDL value. In order to build a secure ECC protocol the ECDL value has to be large enough so that its computation is made infeasible. In this session, I will set the constant parameters of the Elliptic curve equation to be smaller, and ECC will be defined over a smaller finite field.

CP2.2	**Friday 2:20**	*Abel's Identity, Vandermonde Matrices, and Proof*	
Sungkon Chang		Armstrong State University	
There are several mathematical problems where a Vandermonde matrix rises naturally, and in this talk we consider examples where the matrix rises from the Wronskian of a basis of the homogeneous solutions to an ordinary linear differential equation with constant coefficients. When the characteristic polynomials of such differential equations have multiple roots the matrix specialized at an initial value can be considered as a {\it generalized Vandermonde matrix}. In this talk we introduce the well-known formula for the determinant of the matrix and a new proof of the formula that uses the theory of differential equations.			

CP2.5	**Friday 3:20**	*Double Negative Behavior in Metamaterials*	
Yue Chen		Auburn University at Montgomery	Robert Lipton Department of Mathematics, Louisiana State University
Metamaterials are a new form of structured materials designed to have electromagnetic properties not generally found in nature. This talk will introduce a rigorous mathematical framework for controlling localized resonances and predicting exotic behavior inside optical metamaterials. The theory is multiscale in nature and provides a rational basis for designing microstructure using multiphase nonmagnetic materials to create backward wave behavior across prescribed frequency ranges.			

UT6.3	**Saturday 10:40**	*Random Visibility in Unit Bars*	
Jiarui Chu		Davidson College	Dr. Laurie J. Heyer, Davidson College
Two unit bars are visible to each other if an unobstructed vertical sightline can be drawn between them. The study of visibility in bars is motivated by Very-Large-Scale-Integration (VLSI) layout problems, and has applications in robot navigation, hidden-surface removal, and computer-aided software-engineering (CASE) tools. Although there is a rich body of research on visibility in bars, the existing research is mainly done in fields of computational geometry and graph theory. No result has been published on the probability aspects of visibility problems. Our research focuses on three major problems. Assuming n unit bars have uniformly distributed locations within width w, we first			

conjecture and prove the probability of having zero visibility among the n bars. Then we conjecture the probability density function and expected value for the number of bars required to cover the top bar. At last, we derive the expression for the maximum number of visible pairs among the n bars.

UT4.1	**Friday 2:00**	*Momentum Term for the Modified Spectral Projected Subgradient Method (MSPS)*	
Samantha Clapp		Georgia College and State University	Milagros Loreto, University of Washington, Bothell Charles Cratty, Westminster College Breeanna Page, Eastern Washington University
The phenomenon of Zigzagging of Kind I is present in pure subgradient optimization algorithms when, at an iterate p_k, the subgradient direction s_k forms an obtuse angle with the previous movement m_k. Our goal is to identify and correct this phenomenon for the Modified Spectral Projected Subgradient method. We do this by adding a proportion of m_k to s_k; this proportion is called the momentum term and is denoted by τ. Also, we conduct numerical experimentation showing improved numerical results when compared to those of the original MSPS algorithm.			

CP3.2	**Friday 2:20**	*No Fractions: Integer Solutions for Linear Equations*	
Jeffrey Clark		Elon University	
This talk will discuss the Smith normal form for matrices and describe how it can be used for problems requiring integer solutions. It will also describe generalizations to more advanced problems in computing with abelian groups.			

UT7.2	**Saturday 10:20**	*Graphical Modeling of Time Sensitive Resource Allocation*	
Nikolas Colbrook		Georgia Southern University	
In this presentation we will discuss creating a graphical model to show the allocation of time sensitive resources given certain constraints. While following the classic flow network construction, we incorporate various new concepts such as the transaction nodes and varying flow capacities to create our graphical model and show how these resources and materials flow through time. We will also explain how different constraints added to the model will affect the model and its optimization.			

SS3.2	**Friday 2:20**	*Incorporating Real Data Sets and Writing into an Introductory Statistics Course Focused on Sports and Games*	
Joe DeMaio		Kennesaw State University	Amy Hillen Kennesaw State University
The ability to reason statistically is critical to becoming an informed citizen and intelligent consumer (Aliaga, et al., 2010). Despite its importance, research indicates that students struggle to reason statistically and that students typically enter introductory statistics courses "under sufferance, with levels of resistance related to their beliefs of the relevance of statistics" (Howley, 2008). One approach for helping students make sense of complex mathematical ideas is to situate the ideas in real-world contexts that have meaning for students. We contend that the context of sports and games might be particularly promising, because: 1) it is a rich site for studying statistical ideas (e.g., probabilities in card and board games; correlation of player and/or team statistics); and 2) it is likely of interest to a wide range of students. In this talk, we describe writing assignments that use real data sets in a general education elementary statistics course focused on sports and games, and discuss student reflections on the efficacy of such assignments.			

SS6.1*	**Saturday 10:00**	*The Fibonacci Number of Tadpole and Jellyfish Graphs*	
Joe DeMaio		Kennesaw State University	
Given a graph G, a set S is an independent set of vertices if no two vertices in S are adjacent. Prodinger and Tichy define the Fibonacci number of a graph G to be the number of independent sets of the graph. They do so because there are a Fibonacci number of independent sets on the path graph and a Lucas number of independent sets on the cycle graph. The tadpole graph is created by placing an edge from any vertex of a cycle to either pendent of a path. The resulting triangular array of Fibonacci numbers of tadpole graphs yields many interesting properties. Generalizing tadpoles, we define the jellyfish graph as the concatenation of a single cycle and multiple paths.			

CP7.4	**Saturday 11:00**	*New examples of almost positive curvature*	
Jason DeVito		The University of Tennessee at Martin	
A Riemannian manifold is said to be almost positively curved if the set of points for which all 2-planes are positively curved is open and dense. We show the \$15\$ dimensional homogeneous space $M = Sp(3)/Sp(1)^2$ admits a metric of almost positive curvature. Further, this metrics admits two distinct free isometric S^1 actions, giving two new examples of 14 dimensional almost positively curved manifolds. More specifically, we show the quasi-positively curved metric on M which was			

constructed by Kris Tapp is almost positively curved. By way of contrast, we also show that many of the examples constructed by Tapp have open sets of points containing 0 curvature planes.

CP8.5	**Saturday 11:20**	*The Cuban Challenge, A Linear Algebra Problem?*	
Lothar Dohse		UNC Asheville	
In 2015 Obama relaxed travel restrictions to Cuba, and the United States may soon have normalized relations with its neighbor to the south. The result of this shift in policy will impact the social and economic structure of this once isolated island nation. The author will use economic & demographic data, first hand observations, and dynamic matrix models to highlight the challenges that Cuba faces. The models will shed some light on the potential of this Caribbean island, and what it needs to reach that potential.			

UT1.2	**Friday 2:20**	*Exploring Ramsey Theory*	
Tucker Dowell		Belmont University	
Ramsey theory is often first viewed in the form of a simple problem: finding the minimum number (called the Ramsey number) of people one would have to invite to a party to ensure there are either three mutual strangers or three mutual acquaintances. By using graphs, we are able to easily answer several variations of this question; however, there are still many open problems. When considering complete graphs (graphs where every vertex is connected to every other vertex), we only know nine Ramsey numbers! Finding Ramsey numbers has proven difficult, but we hope to benefit from a new approach. Join us in trying to view Ramsey numbers through a new lens.			

CP7.2	**Saturday 10:20**	*The locus of "median lines" of Sierpinski's triangle*	
Eduardo Dueñez		University of Texas at San Antonio	
For a euclidean triangle ABC, the geometric envelope of lines L that cut sides AB, AC and split the triangle in two parts of equal area is part of a hyperbola. In this talk we consider the question: ¿What happens if, instead of splitting a euclidean triangle ABC in two parts with equal area, we split Sierpinski's triangle ABC in two parts with equal (fractal) measure? The answer leads to a fractal curve analogue to the hyperbola. We include pictures and animations. We also raise some arithmetic questions related to an "unbalanced binary" number system arising from the geometry of Sierpinski's triangle.			

SS1.1*	**Friday 2:00**	*Fibonacci Series Seriously*	
Steven Edwards		Kennesaw State University	
We give a survey of infinite series that involve the Fibonacci numbers. We examine the methods used to show whether various such types of series converge, and in some cases what the series converge to. We examine the interplay between results from research articles and problems published in journals.			

CP2.6	**Friday 3:40**	*ADRC Control of Lorenz Systems with Uncertainties*	
Zachary Espe		Georgia Southern University Math Department	Dr. Yan Wu-Advisor and Professor at GSU Math Department
In this work, we study the stability property of a chaotic Lorenz system stabilized by an ADRC (Active Disturbance Rejection Control) controller. The Lorenz system is known as a benchmark nonlinear dynamical system, which is widely seen in many applications such as thermosyphon and lasers. In practice, the disturbances to the system are usually ignored during the modeling process. Higher order terms are dropped due to simplification. All these factors contribute to the so-called uncertainties associated with the system. A robust controller should take the uncertainties into consideration. An ADRC controller is shown to be effective in annihilating the unmodeled components of the system while regulating the flow pattern. An ADRC controller consists of an ESO (extended state observer), which is designed to approximate the uncertainties, and an annihilator along with a PI-controller used to cancel the disturbances and stabilize the state trajectories. In particular, we first prove the asymptotic stability of the ESO of the y-state in the sense of Lyapunov. We then establish the asymptotic stability of the y-state controlled by an ADRC controller. This leads to the global stability of all three states of the Lorenz system.			

UT3.1	**Friday 2:00**	*A 15 Puzzle Game*	
W. Dalton Ethridge		University of South Carolina Salkehatchie	
In a sequence, a bigger number comes before a smaller number is called an inversion. If we read a 15 puzzle in a certain way, we can create a unique sequence. In our talk, we will discuss the solvability of a 15 puzzle by analyzing the inversion number of the sequence created by that puzzle. We also discuss the solution of an unconventional 15 puzzle we found in two of our references.			

UT6.2	**Saturday 10:20**	*Convergence rates for high-dimensional half-space depth*	
Robert Fabrizio		Clemson University	Michael A. Burr, Clemson University

Data Depth is a non-parametric and geometric measure for quantifying the centrality of a point relative to a probability distribution or a finite sample. Depth contours enclose successive regions of increasing depth. Donoho and Gasko (1992) prove that the sample contours converge to the continuous contours as the sample size approaches infinity. We provide explicit estimates of the rate of convergence in specific cases.

UT2.4	**Friday 3:00**	*Triangles in Cayley Graphs*	
C. Matthew Farmer		Dr. Jessie Hamm	
Cayley Graphs were introduced by Author Cayley in 1878. Since then, they have been studied extensively due to their connection to group theory, graph theory, computer science, and other fields. In this presentation, we will briefly review Cayley graphs and then introduce two new parameters for Cayley Graphs: Cay^n (G) and Cay_n (G). When n=3, these parameters tell us about the existence of triangles within Cayley Graphs. We find Cay^3 (G) for all groups G and gives some results for Cay_3 (G) along with future directions.			

CP6.2	**Saturday 10:20**	*Global Asymptotic Stability in a Model of Networks*	
Hassan Fathallah-Shaykh		UAB	
Global asymptotic stability is of importance for theory and application in several in mathematics, physics, engineering, economics, and biology. We study a system of cubic polynomials that models networks. We show that the property that the interconnection matrix is Lyapunov diagonally stable is a key feature that determines convergence to a single equilibrium.			

UT6.1	**Saturday 10:00**	*Logistic Regression Analysis in the NFL*	
Alex Fawal		Birmingham Southern College	Jordan McKnight - Birmingham Southern College
Teams in the National Football League (NFL) are always looking for ways to attain an edge over their opponents and as football has evolved, many have turned to statistical analysis as a way to maximize their chances of success. Statistics are meticulously recorded for every game, providing insight to the habits of teams and players. Because of this, there is an increased interest in determining the reliability of the statistics, as well as discovering how the data can applied to get a win on the scoreboard. In this talk, we will predict a team's probability of making it to the Super Bowl, prior to the first round of the playoffs, by using logistic regression and a wide variety of collected data from the past fifteen seasons of the NFL.			
GW1.3	**Friday 2:40**	*Conditions for the Existence of Gorenstein Projective Precovers*	
Michael Fox		Georgia Southern University	Dr. Alina Iacob Georgia Southern University

The existence of the Gorenstein projective precovers is one of the main open problems in Gorenstein Homological algebra. We give sufifcient conditions in order for the class of Gorenstein projective complexes to be special precovering in the category of complexes of R-modules Ch(R). More precisely, we prove that if every complex in Ch(R) has a special Gorenstein flat cover, every Gorenstein projective complex is Gorenstein flat, and every Gorenstein flat complex has finite Goenstein projective dimension, then the class of Gorenstein projective complexes, GP(C), is special precovering in Ch(R).

SS4.2*	**Friday 2:20**	*Unique Opportunities for Growth and Collaboration via a Math/CS Club*	
Kailee Gerzema		Belmont University	Katie Kruzan, Belmont University Savannah Halliday, Belmont University
At Belmont, our math club strives to not only provide traditional opportunities for scholarly growth, but to serve the student as a whole . Through events such as Pizza, Problem Solving, and HackNight, we increase students' exposure to math and the ability to communicate math effectively. We pride ourselves in uniquely fostering relationships among students and professors by providing recreational activities that are extensions of our academic platform. In addition to typical club activities such as monthly meetings and lectures, we aim to produce social structures that allow students to thrive outside of the classroom through events like CRAM JAM. Moreover, our involvement in events that serve both Belmont and Nashville's communities produces well-rounded students that have a passion for math/computer science, as well as a serving heart.			

DS1.1	**Friday 9:00**	*How small is too small? Modeling the effects of habitat fragmentation via reaction diffusion equations*	
Jerome Goddard		Auburn University Montgomery	
Habitat fragmentation occurs when an organism's preferred habitat is divided or broken into smaller fragments (called patches) and can be caused by natural events, such as geological processes, or human activity, such as land conversion. Habitat fragmentation is often cited as a contributor to animal species becoming threatened or endangered. Two important aspects of habitat fragmentation are the size of fragmented patches of preferred habitat and the inferior habitat surrounding the patches, called the matrix. Ecological field studies have indicated that an organism's survival in a patch is often linked to both the size of the patch and the quality of its surrounding matrix. In this talk, we will focus on modeling the effects of habitat fragmentation via the reaction diffusion framework. The reaction diffusion framework has been extensively employed in population dynamics providing important biological insight into the patch-level consequences of various assumptions made on individual behavior in ecological systems. Such models have seen enormous success both in their empirical validation with actual spatio-temporal distribution data and their ability to yield general conclusions about an eco-system based on the analytical results of these theoretical models. First, we will introduce the reaction diffusion framework and a specific reaction			

diffusion model with logistic growth and Robin boundary condition (which will model the negative effects of the patch matrix). Second, we will use mathematics to explore the dynamics of the model via the well-known quadrature method and ultimately obtain a causal relationship between the size of the patch and the quality of the matrix versus the maximum population density sustainable by that patch. This important example regarding habitat fragmentation will hopefully serve to illustrate the usefulness of mathematical models in helping to understand complex biological relationships.

CP4.3	**Friday 2:40**	*Monotonicity Violations in Instant Runoff Voting*	
Adam Graham-Squire		High Point University	
It is well-known that the instant runoff voting method violates that Monotonicity Criterion--that is, it is possible that in an instant runoff election, raising a candidate higher on your ballot could have the contradictory effect of making that candidate perform worse in the election. We call this a monotonicity anomaly. It is not well-known, however, how frequently monotonicity anomalies arise in real-world data. As the prevalence of instant runoff voting increases in the U.S., more instant runoff election data is available for analysis to search for monotonicity anomalies. We will present our construction of a computer program to find such anomalies, as well as our results regarding the prevalence of monotonicity anomalies in the real-world data.			

SS2.1*	**Friday 2:00**	*Differentiated Calculus: How does prior Calculus knowledge of peers affect students' experience in Calculus?*	
Adam Graham-Squire		High Point University	Lindsay Piechnik, High Point University Karen O'Hara, High Point University
Undergraduate calculus courses generally have a mix of students, some who have taken calculus before (often AP calculus in high school) and others who have not had calculus before. This can lead to first-time calculus students feeling "lost" in comparison to their peers who have already had calculus, potentially leading to negative attitudes toward the material and/or lower performance in the course. To test this, we split up some calculus sections into sections of only students who had calculus before, and other sections of only students who had no prior calculus experience. Both sections were taught in an identical manner, and we will present our preliminary findings about comparisons between the two sections and to control sections of the course (that is, sections that had a mix of the two types of students).			

CP1.2	**Friday 2:20**	*Quasigroups and Undergraduate Research Projects*	
Mark Greer		University Of North Alabama	

A quasigroup $(Q,\cdot)$ is simply a set Q and binary operation $\cdot$ whose multiplication table is a latin square. This immediately gives a simple algebraic connection to many well-known combinatorial objects accessible to undergraduates, with lots of open questions. This talk will focus on several undergraduate research projects that focused on this idea. We'll discuss Sudoku Quasigroups, decompositions of complete graphs and P-quasigroups, and Zero-Knowledge cryptography using isotopy.

SS7.4*	**Saturday 11:00 & 11:20**	*Easy To Use GeoGebra Functions*	
William Griffin		GSU-Perimeter College	Joanna Wilson GSU-Perimeter College
GeoGebra is free software that can easily be used in the classroom to help students visualize mathematical concepts. This presentation will demonstrate commands that can be used in College Algebra, Pre-calculus, and Calculus.			

CP7.1	**Saturday 10:00**	*Circling the Triangle: Constructing a Class of Delta Curves*	
William Griffiths		Kennesaw State University	William Selman, Kennesaw State University, Undergraduate Student Philip Davis, Kennesaw State University, Undergraduate Student
We begin with an equilateral triangle, and wish to inscribe a curve inside of it. Demanding more of these curves, we require that, as they rotate, they at all times remained inscribed inside our triangle. Such a curve is called a delta curve. An appropriate circle springs to mind as a basic case of such a curve's existence. The curve of least area that satisfies the condition is known as the delta biangle. Both of these simple cases can be constructed using a straight edge and compass. We present a construction of an infinite class of such curves, which exist 'between' the circle and the biangle.			

SS9.3*	**Saturday 10:40**	*What's Your Bid? Encouraging Creativity and Teamwork by Holding a Math Auction*

Rachel Grotheer	Clemson University	
It's not easy to get undergraduate students to be engaged and excited to think about open-ended math problems, especially those who are simply trying to ``get through" the math class required for their major. In attempt to encourage engagement and excitement, the student chapter of the Association for Women in Mathematics at Clemson decided to hold a Math Auction during a Math Club meeting. The concept of a Math Auction is to divide students into teams, give them open-ended problems (that is, problems with no one ``correct" answer), and have them bid on their solutions, based on their confidence of their solution being the best one. We found that combining teamwork, an exciting bidding process, and prizes, caused otherwise mildly interested students think deeply, and even be excited about mathematics on a Friday afternoon.		

UT5.4	**Saturday 11:00**	*Augmented Happy Functions of Higher Power*	
Marcus Harbol		The Citadel	Dr. Breeanne Swart - Adviser
The presentation investigates Augmented Happy Functions of Higher Power, defined as $T_{[c,q]}\left(\sum_{i=0}^{n} a_i 10^i\right) = \sum_{i=0}^{n} a_i^q + c$, $0 \le a_i \le 9$ with $c, q \in \square^+$. This function takes the digits of a positive integer, raises each digit to the power q, sums the results, and adds a constant, c, to the sum. In particular, the iterative properties of this function are investigated for a range of values of c and q as well as other number systems.			

SS1.4*	**Friday 3:00**	*Covering Systems Concerning the Fibonacci Numbers*	
Wilson Harvey		University of South Carolina	Michael Filaseta, University of South Carolina Ognian Trifonov, University of South Carolina
Erd\"{o}s asked if there existed a covering system of the integers with arbitrarily large moduli and if there existed a covering system of the integers with all moduli odd. The first question has been answered; the second remains open. We consider similar questions concerning covering systems of the Fibonacci numbers and show that both questions can be answered in the affirmative for the Fibonacci numbers.			

GS3.2	**Saturday**	*Some of my favorite problems from the UGA Math Tournament*

	8:45		
Mo Hendon		University of Georgia	
I'll show a few of the questions we have used in the annual UGA High School Math Tournament, and discuss the act of creating interesting and challenging problems. As an example, can you find the slope of the line that bisects the angle in the first quadrant between the lines y = x and y = 3x?			

UT4.6	**Friday 3:40**	*3D Hyperstereo Image Stitching*	
Jonathan Hesser		Belmont University	Michelle Guinn, Assistant Professor, Mathematics, Belmont University
Current techniques and programs for stitching hyper stereo images for three dimensional encoding leaves gaps and blind spots in the product image. Using fundamentals of multivariable Calculus it is possible to more accurately construct depth maps for hyper stereo images and render more accurate three-dimensional images.			

CP5.5	**Saturday 11:20**	*Jumping in the shark tank for community-based learning*	
Laurie Heyer		Davidson College	
The mathematical modeling course at Davidson is a sophomore level class on discrete modeling techniques that emphasizes real-world problem solving and team projects. For the second year in a row, I am taking a "shark tank" entrepreneur-style pitch approach to developing ideas for community-based projects. The first attempt was a huge success, leading to better projects, more engaged students, and one exhilarating day of class. I will discuss the projects that won the day, and how one of them turned into a public relations bonanza.			

UT6.6	**Saturday 11:40**	*On Bond Percolation in the Infinite Knight Graph*	
Kristin Hinson		Winthrop University	Dr Arran Hamm, Winthrop University
Imagine placing a knight (the chess piece) on an infinite chessboard. Suppose we now use coin flips ('Yes' and 'No' with probabilities p and 1-p respectively) to restrict which moves the knight can make from any given square. We may now as the classic bond percolation question; for which values of p will the knight have an infinitely long path after every restriction is made? Consider the following subcase of this question. Namely, fix an "origin" square and only allow certain types of moves. The first uses two horizontal squares (and thus one vertically) and the second uses two vertical squares. Now consider the structure generated by starting at the origin and taking all possible type one moves and separately all possible type two moves. By using an identical randomization scheme to the one described above, we may again ask the bond percolation question. We provide nontrivial bounds on p-values which have an affirmative/negative answer. Joint work with Dr. Arran Hamm.			
CP5.3	**Saturday**	*Use of Internship Experiences to Recruit Pre-service Math and*	

	10:40	*Science Teachers*	
Tim Howard		Columbus State University	Deborah Gober, Kimberly Shaw, Cindy Ticknor - Columbus State University
The Columbus Region Academy of Future Teachers of STEM (CRAFT-STEM) utilizes an internship program for university freshmen and sophomores and a STEM camp for pre-college students to encourage the interns to consider careers in teaching. Interns assist with camp activities and other projects, supported by funding from the National Science Foundation's Robert Noyce Teacher Scholarship Program (award #1136356). As part of an ongoing research project, we examine four years' worth of data to identify strengths and weaknesses of the experience, and propose adaptations based on these findings.			

SS6.2*	**Saturday 10:20**	*On the number of decompositions of* $0 = \pm F_0 \pm F_1 \pm F_2 \pm \cdots \pm F_n$	
Eugen Ionascu		CSU, Columbus, GA	Dorin Andrica, Babes Bolyai University
For an Erdös-Surányi sequence it is customary to consider its signum equation. Based on some classical heuristic arguments, we conjecture the asymptotic behavior for the number of solutions of this signum equation in the case of the sequence $\{n^k\}_n$ ($k \geq 2$) and the sequence of primes. Surprisingly, we show that this method does not apply at all for the Fibonacci sequence. By computing the precise number of solutions, in this case, we obtain an exponential growth, which shows, in particular, the limitations of such an intuition.			

UT8.5	**Saturday 11:20**	*Using Hierarchical Linear Models to Measure Resin Growth on trees in the Peruvian Amazon*	
Vaibhav Jain		George Washington University	
Weevils continue to be an evolving yet valuable species since it produces Breu resin that sells as a viable non-timber forest product in the Peruvian Amazon. Some challenges surrounding Breu resin include determining the optimal conditions in which to harvest this substance and identifying significant factors contributing to its growth. This study uses hierarchical linear modeling to predict Breu resin growth and identify those significant predictors. The study concludes with recommendations that can maximize resin production.			

PUB1.1	**Friday**	*Hawkes Learning: Revolutionizing Math Courseware*

	2:00		
Emily Judy		Hawkes Learning	
Hawkes Learning has enhanced its courseware, building new functionality for customization with the feedback of instructors from across the country! Exciting innovations are now available with our tablet-friendly learning platform. Check out the new customization tools to individualize your curriculum and tailor the student experience in the learning path, including single sign-on from Blackboard, Canvas, and D2L. Join us to learn more about these exciting developments, including several brand-new courses available for review, and enter to win a $25 Amazon gift card!			

UT4.3	**Friday 2:40**	*Optimizing power and efficiency of a model heat engine*	
Erez Kaminski		Birmingham-Southern College	
In this paper we study a model heat engine composed of a particle in an harmonic potential well whose width and temperature are both cyclically modulated in time. The model in questions is one which assumes that the system is well defined by a series of energy levels. We will use the non-equilibrium Markov chain formulation to describe the time evolution of the system. We then construct a computational model of the system and use it to optimize two system parameters, power and efficiency. We show that a protocol can be created in which power and efficiency are both maximized together.			

CP4.2	**Friday 2:20**	*Extremal Graph Theory for Graph Substructures*	
Lauren Keough		Western Carolina University	Jamie Radcliffe, University of Nebraska-Lincoln
Given an empty graph on n vertices, how many edges can we stuff in before we're forced to make a complete graph on r vertices? Turán answered this question for all n and r in 1941, but, as with many mathematical questions, we are led to more questions. Let's flip Turán's theorem on its head and ask instead: how could we arrange a given number of edges among n vertices so that we have the maximum number of complete graphs? Should we arrange them differently if we want the smallest possible number of independent sets? In this talk we will explore questions of the form "What is the maximum or minimum number of a particular substructure a graph G can have if G must satisfy certain conditions?"			

CP3.4	**Friday 3:00**	*Investigating the Truncated Jacobi Triple Product*	
Louis Kolitsch		The University of Tennessee at Martin	
Derivatives of particular partition generating functions will be used to investigate the truncated Jacobi triple product.			

UT1.1	**Friday 2:00**	*State Space Graphs and the N-Queens Problem*	
Abrahim Ladha		Armstrong State University	Dr. Tricia Brown (Mentor)
In this project, we study a change of rules to the traditional n-queens problem, and observe both symmetric and chaotic properties of $n \times n$ chess boards and state-space trees.			

SS8.3*	**Saturday 10:40**	*Symmetry, geometric phase, and holonomy: falling cats and swinging clocks*	
Jeffrey Lawson		Western Carolina University	Matthew Rave Western Carolina University
Geometric phase in a dynamical system appears when two competing frequencies in a closed orbit go in and out of "synch". In many simple mechanical systems with rotational symmetry we can compute geometric phase by integrating a differential form obtained from the energy function and a single conservation law. The dynamical information required is minimal - we never even have to solve a differential equation! Geometric phase can be used to explain how cats (almost) always land on their feet and how that big pendulum at the science museum tells us the time of day. We conclude with an interpretation of geometric phase in terms of the concepts of holonomy and curvature.			

CP3.1	**Friday 2:00**	*Runs of Consecutive Abundant Numbers*	
Bill Linderman		King University	
A natural number n is said to be {\bf abundant} if the sum of its proper divisors is greater than n. Long runs of abundant numbers are scarce. For example, the starting term of the smallest known set of four consecutive abundant numbers has 39 digits. We present a method for constructing runs of abundant numbers.			

UT1.5	**Friday 3:20**	*The Radio Number of* $K_n \square P$	
Sarah Locke		University of Tennessee at Martin	Amanda Niedzialomski, University of Tennessee at Martin
For a simple, connected graph G, we consider $f : V(G) \to \square_+$ that satisfies $\lvert f(u) - f(v) \rvert \geq diam(G) + 1 - d(u,v)$ for all distinct vertices *u,v.* Such an f is a radio labeling of G. The largest element in the range of f is called the span of f, and the smallest possible span of any radio labeling of G is called the radio number of G. We will talk about $K_n \square P$, a family of graphs whose radio numbers we have recently found.			

CP3.5	**Friday 3:20**	*Capelli-Rédei Theorem, Solvable Quintics, and Finite Fields*	
Matt Lunsford		Union University	
A situation analogous to the classic casus irreducibilis exists in the context of irreducible cubic polynomials over finite fields if it is required that solvability by radicals means solvability by irreducible radicals. In this talk, we extend this analogy to irreducible quartics and quintics over finite fields by use of the Capelli-Redei Theorem.			

GW1.4	**Friday 3:00**	*An Improved Modal Interval Algorithm for Unconstrained Continuous Minimax Problems*	
Xin Luo		University of Alabama	Min Sun, University of Alabama
Continuous minimax problems can be applied to engineering, finance and other fields. Based on Miguel Á. Sainz, we introduced a new definition of semantic extensions and developed an improved algorithm using modal intervals to solve unconstrained continuous minimax problems. Inspired by Maurice Sion, we also applied a maxmin version and combined with the minimax version of the algorithm to solve unconstrained continuous minimax problems. A uniform partition is introduced. The convergence of the algorithm and more deletion conditions are proposed in this paper. Numerical results of several typical examples show that the algorithm is reliable and efficient.			

SS7.1*	**Saturday 10:00**	*Engaging Non-Majors in Quantitative Reasoning Students*	
Laura Lynch		College of Coastal Georgia	
Quantitative Reasoning is a math course in Georgia for non-STEM students. This talk will present research conducted over the last two years into the efficacy of two different teaching strategies for this freshmen course: (1) incorporating student group projects and (2) incorporating a Service-Learning project where students paired with local middle schools to run math-based fantasy football competitions. Results on student retention and performance as well as student perceptions will be discussed.			

SS9.4*	**Saturday 11:00**	*Service Projects for Math Clubs*	
Laura Lynch		College of Coastal Georgia	
All clubs at the College of Coastal Georgia are required to participate in community service each semester. The Math and Engineering Club members at CCGA have satisfied this requirement through robotics training using Lego Mindstorms NXT kits and through free public tutoring to the community. This talk will share the development and outcomes of these two projects.			

UT8.2	**Saturday 10:20**	*Fermat and Descartes: An Unlikely Collaboration*	
Caleb Macdonald		UNC Asheville	Gregory Boudreaux
The animosity between Pierre de Fermat and Renee Descartes is well known. Both developed methods for finding the tangent to a point at relatively the same time. Fermat's method, using his own notion of 'adequality', was full of logical leaps that left many of his contemporaries skeptical - the argument he made only held water if you already believed it was true. Descartes method was intricate in detail and required many steps. However, In a letter to Claude Hardy, Descartes clearly explains how Fermat's method works using the same steps, with one key exception: starting with a secant line instead of a tangent line. This key difference was likely inspired by Descartes original method, in which the chords of circles drawn to find the tangent are also secants on the curve of interest.			

SS4.3*	**Friday 2:40**	*Math Club Events at the University of North Alabama*	
Emily Malone		University of North Alabama	
The Kappa Mu Epsilon chapter at the University of North Alabama is establishing/creating many events for not only mathematics majors but the entire student body. This talk will present a few of the events and activities that we as a club have hosted and participated in over the last couple of years, including our celebration for Pi Day and our final exam tutoring day.			

UT5.6	**Saturday 11:40**	*A new quasi-positively curved biquotient of Sp(3)*	
Wesley Martin		The University of Tennessee at Martin	Jason DeVito
In 2014, DeVito, DeYeso, Ruddy, and Wesner classified biquotients of the form Sp(3)//Sp(1) and showed that 8 of them admit metrics of quasi-positive curvature. We show their general methods apply to a 9th example and no more, finding a ninth biquotient of Sp(3) with quasi-positive curvature.			

DS1.2	**Friday 10:00**	*Partitions and compositions: A tale of two symmetries*	
Sarah Mason		Wake Forest University	
Big questions in mathematics are often solved through a series of smaller contributions. Sometimes, when we set out to solve one problem, we end up making progress on other problems along the way! This talk is the story of a result that connects two different types of symmetries and ends up helping to prove a conjecture that arose from a completely different and seemingly unrelated problem.			

SS9.2*	**Saturday 10:20**	*Successful Math Club Activities at UNG*	
Catrina May		University of North Georgia	Brandon Myers, University of North Georgia Shae Lecroy, University of North Georgia Miranda Booker, University of North Georgia Karen Briggs, University of North Georgia
The University of North Georgia's Mathematics Club hosts weekly activities that encourage the development of mathematical skills, intellectual growth, and positive student-faculty relationships within our mathematics department. The organization schedules activities, guest speakers, and informational sessions that contribute to the academic success of our mathematics students. The nature of these activities makes them compatible with mathematics organizations on almost any type of campus. This presentation will cover the planning and implementation of several of our most popular, entertaining, and successful events including the Battle of the Professors, Math Baseball, and a Scavenger Hunt.			

SS8.2	**Saturday 10:20**	*A Non-Hereditary Realization [via a Kolmogorov-Einstein Type Diffusion Equation] of Fractional Derivatives with Respect to an Arbitrary Function: An Application to the Stabilization of a One-Dimensional Euler-Bernoulli Equation.*
Brahima Mbodje		Lenoir-Rhyne University

In this paper, we consider the idea of a fractional derivative operator [with respect to an arbitrary function]. We show that such an operator may be modeled by or realized via a [Kolmogorov-Einstein type] diffusion equation.
We then present a nontrivial application of our non-hereditary realization. The application in question is to the study of a one dimensional Euler-Bernoulli beam which is subjected to boundary fractional derivative controls. The investigation is fivefold:

1. Proof the well-posedness of the partial differential equations describing the control system [Existence and uniqueness of a solution.]
2. Proof of the asymptotic stability of the system.
3. Proof of the lack of exponential stability of the system. [In fact, we will sharpen this result by showing that even for partial state variables exponential stability remains impossibility.]
4. Proof of an energy decay rate for sufficiently smooth solutions.
5. And finally, in the remainder of this paper, we will also demonstrate how our approach carry over to other more computationally involved models such as the Timoshenko beam equation, the so-called fluid-filled porous media equation, the nonlinear Schrodinger equation, and the nonlinear reaction diffusion equation.

UT5.5	**Saturday 11:20**	*A Series of Four Sums of a Fibonacci Number to the Fourth Power*
Nathan McAnally		The Citadel

The Fibonacci Numbers provide a unique sequence observable in many different areas of nature and applicable in a significant portion of theoretical mathematics. These numbers provide a definition for the aesthetically appealing golden ratio and can define the growth of a population. They can be heard in music and observed in the petals of a flower. Due to the numerous applications of this sequence in the physical world and theoretical mathematics, it is important to find identities related to this unique set of numbers.

In 1965 Graham published a closed formula for the sequence of four sums of squares of Fibonacci numbers. Since then, as far as I know, there has been no other similar results for these type of natural questions. However, in 2015 the Fibonacci Quarterly proposed a problem, which was classified by the journal as an Advanced Problem related to Graham's result. In the problem, instead of power two, the Fibonacci number was raised to power four. I found a proof for the proposed problem and also found that it gives rise to a potential future research problem.

In this talk I discuss the proof of the problem described above. I submitted this problem for publication in the Fibonacci Quarterly.

UT4.4	**Friday 3:00**	*Using Weighted Bipartite Matchings to Decrease Profit Loss*	
Kevin McCarey		Coastal Carolina University	
A farming company owns n farms and n plants and wants to know how to make the most profit by sending one farm's crop to one of the plants. The problem can be expressed as a weighted bipartite graph. We will look into what methods there are to solve this problem and how to optimize this problem for the best result possible.			

UT1.4	**Friday 3:00**	*Strategy for a Closed Knight's Tour in the Fourth Dimension*	
Taylor McCracken		Mathmatics department, Birmingham-Southern College, 900 Arkadelphia Rd, Birmingham, AL,35254	Xiaokun Ye Mathmatics department, Birmingham-Southern College, 900 Arkadelphia Rd, Birmingham, AL,35254, xye@bsc.edu
The closed knight's tour problem has been around for nearly three hundred years. In 2012, Erde, B. Golenia, and S. Golenia gave the solution for n-dimensional rectangular boards to have a closed knight's tour, for n≥4, using a (1,2) knight's move. In 2010, Bai, Yang, Zhu, Jiang, and Huang found a solution to a generalized knight's tour problem in three dimensions using a (1,2,2) knight's move. In this talk, we focus on a (1,2,2) closed knight's tour on a four dimensional board.			

SS2.2	**Friday 2:20**	*Review Revisited*	
Diana McGinnis		Perimeter College, Georgia State University	
Deep learning requires that students have the opportunity to revisit the same concept in a variety of forms. Rather than simply reviewing before a test, infuse review into each lesson in a way that will augment student understanding. Examples from Calculus I and Calculus II will be provided.			

CP3.3	**Friday 2:40**	*Progress on the Perfect Cuboid*	
John McKinley			
Computers have been humming for the past fifty years laboriously failing to find a ‘small’ perfect cuboid. Finally some progress on proving a perfect cuboid doesn’t exist! It’s not the whole solution, but it’s an infinite part out of the infinite entirety. What if someone used a different Pythagorean triple parameterization than the traditional (m^2-n^2, 2mn, m^2+n^2)? What if this approach led to a polynomial in one variable instead of four variables? Come see how this polynomial with leading and trailing numerical coefficients of 1 cannot have natural number solutions greater than one.			

CP2.4	**Friday 3:00**	*Mathematical and Computational Modeling of Certain Biological Systems*	
Marrisa Merrell		Albany State University	Dr. Anilkumar Devarapu Albany State University Albany GA
Mathematical Biology is one of the fastest growing fields of science and engineering. In this paper our goal is to develop mathematical models to certain biological systems using the deterministic and the stochastic analysis approach. Then we will try to find analytical and numerical approximations to the mathematical systems using MATLAB software. Furthermore, we will discuss about their linear stability analysis of their respective systems.			

CP1.5	**Friday 3:20**	*Encouraging Higher Level Thinking in an Inverted Multivariable Calculus Class*	
Joshua Mike		University of Tennessee, Knoxville	
We will describe how we are using Mathematica to supplement both the in-class and out-of-class experiences of students enrolled in an inverted multivariable calculus course. In particular, we will focus on the creation of flexible modular course materials including notes, guided pre-class practice, structured group work, and homework. Branching off from work done in this area by our coordinator, Dr. Brodskiy at UTK, our approach focuses on delegating the lower cognitive thinking outside class using notes and short practice, and developing higher level thinking in-class through Mathematica based conceptual activities. Our goal is to focus our students on the mathematical concepts and processes, while they use Mathematica to perform most of the calculations and as an aid for visualization and exploration during in-class activities and homework. This semester, we are sharing our method with more instructors and look forward to seeing the modular structure of the class evolve.			

UT2.5	**Friday 3:20**	*Determining the Rank of a Kronecker Sum and Characterizing Its Generalized Eigenvectors*	
Kirsten Morris		Georgia College & State University	Dr. Brandon Samples, Georgia College & State University
Sylvester equations of the form $AX - XB = C$, for given matrices A, B, and C, play an important role in control theory and stability theory. Let vec(X) denote the function that takes a matrix X and creates a vector from its columns. Using the Kronecker sum of matrices we rewrite $AX - XB = C$ as the linear equation $(I \otimes A - B^T \otimes I)\text{vec}(X) = \text{vex}(C)$, where I is the identity matrix. We present a result regarding the rank of the Kronecker sum $(I \otimes A - B^T \otimes I)$, where A and B are similar matrices. We also present a partial characterization for generalized eigenvectors of this Kronecker sum for certain matrices A and B.			

UT2.3	**Friday 2:40**	*On the Sequences of Exponents in Prime Factorization*	
Safa Motallebi		Auburn University at Montgomery	Dr. Luis Alberto Cueva-Parra, Auburn University at Montgomery
Since the patterns of the exponents in prime factorization of numbers has not been studied in depth, we have examined these patterns in even numbers for their first prime factor. We will present a formula which generates a sequence of the exponents of the first factor in the prime factorization of even numbers as well as the product of two consecutive even numbers. Eventually, we could use a similar approach to study the behavior of the exponents of other factors, odd numbers and factorials.			

CP1.4	**Friday 3:00**	*Introducing Students to Conjectures, Exploration and Visual Proofs using Experiments in Topology*	
Antara Mukherjee		The Citadel	Rigoberto Florez (The Citadel)
In this presentation I will talk about some classical experiments in topology, my collaborator Dr. R. Flórez and I used to stimulate the curiosity of students in our freshman level math classes. We designed some experiments where the student could ask questions, conjecture results and ultimately reconstruct some visual proofs which helped them gain better understanding of what a mathematical proof is. The classical experiments involved construction of topological objects like the Möbius band, projective plane band and the Klein bottle band, observing their properties, stating conjectures, verifying the conjectures and writing sketch of proofs. I will also discuss how the students discovered via experiments that altering topological objects by cutting do not preserve their hereditary properties. These experiments encouraged them to learn more about topology and other complex mathematical topics.			

UT7.5	**Saturday 11:20**	*Balancing Skeletal Chemical Equations Using Matrices*	
Emir Nazdrajic		Methodist University	
Balancing skeletal chemical equations is necessary due to the law of conservation of mass. In such way, one is able to determine the quantitative ratio of reactants and products required. Majority of chemical equations are very easy to balance, using one of the most common methods – balancing by inspection. This talk will discuss how matrices can be used to balance difficult skeletal chemical equations. Furthermore, by finding the kernels of matrices, we will get the family of balancing solutions. Extracting the family of balancing solutions, one can use it to discover unique way of making reaction feasible, yet under unfamiliar conditions to today's knowledge.			

SS8.1*	**Saturday 10:00**	*Stability in a scalar differential equation with multiple, distributed time delays*	
Israel Ncube		Alabama A & M University and Massachusetts Institute of Technology	
We consider a linear scalar delay differential equation (DDE), consisting of two arbitrary distributed time delays. We study the stability of the trivial solution as well as the explicit effects of a specified distribution on some qualitative features of the DDE. This represents joint work with S.A. Campbell.			

CP8.2	**Saturday 10:20**	*A fair-bold gambling function is simply singular*	
Richard Neidinger		Davidson College	
A singular function from [0,1] onto [0,1] is continuous, increasing, and never has a positive derivative (the derivative is zero almost everywhere and does not exist elsewhere). The graphs of such functions have fractal structure. For strictly increasing examples, derivative results are usually existential and are limited in saying exactly where the derivative exists and where it is zero. One classic example has been described as a probability of success in a gambling scenario. We modify the scenario and produce a new graph where we can exploit the fractal structure to characterize where the derivative is zero and where it doesn't exist.			

SS2.4*	**Friday 3:00**	*Why Undergraduate Students cannot Execute Their own Global Plans for Solving Mathematical Problems in In-class Assignments.*	
Kedar Nepal		Mercer University	
This qualitative study examines undergraduate students' execution behaviors of their own global plans for solving the problems. Undergraduate students enrolled in Calculus I, Calculus II, and Introduction to Differential Equations courses were required to write their global plans for solving the mathematical problems and follow their own plans to solve problems in their in-class quizzes and tests. First phase of data analysis involves only those student works that have valid global plans for solving the problems. Less than half of the students with valid global plans were able to solve their problems successfully. Student errors were categorized into many pre-determined and other new categories that emerged from data analysis. Student errors that had the significant impact in their abilities to execute their own global plans will be discussed.			

UT1.3	**Friday 2:40**	*On the 6-cordiality of trees*	
Michelle Nguyen		Clayton State University	Elliot Krop- PH.D -Clayton State University Keith Driscoll -PH.D - Clayton State University
In 1991, M. Hovey defined the k-cordial labeling of a graph as a function from the set of vertices to Zk so that i. Each label appears on at most one more vertex than any other ii. The induced edge-weights are found by summing the labels on vertices incident to a given edge, modulo k iii. Each edge-weight appears on at most one more edge than any other. He conjectured that for any positive integer k, all trees are k-cordial, and showed this holds for $3 \leq k \leq 5$. We discuss the problem of showing all trees are 6-cordial without the aid of a computer.			

CP6.1	**Saturday 10:00**	*A New Algorithm for Maximum Flow Distribution Networks: The Modified Push Algorithm*	
Allan Pangburn		UNCW Thesis	Dr. John Karlof
In this presentation, we present a new method to determine an initial feasible flow by revising: Goldberg and Tarjan's algorithm of 1988, and Sheu, Ting, and Wang's algorithm of 2006. Major revisions include: defining a pre-determined search order, resetting capacities on arcs, two formulas to lessen the amount of excess flow, and defining a new subgraph.			

UT3.3	**Friday 2:40**	*Finding Fractional Order Derivatives on Discrete Domains*	
Philip Paynter		Coastal Carolina University	
Using basic difference calculus, can develop the theory needed to find fractional order sums and differences on discrete sets of natural numbers.			

SS5.1	**Friday 2:00**	*Essential Pattern Groups of Finite Tree Automorphisms*	
Andrew Penland		Western Carolina University	
Every automorphism of a finite binary tree can be represented via a labeled binary tree called a \textit{pattern}, and so groups of finite binary tree automorphisms correspond to collections of labeled trees. Recently, this fact has been used to define a class of finite groups of tree automorphisms known as \textit{essential pattern groups}, which can be studied using combinatorial properties of their patterns. We will describe the patterns of certain classes of these groups, and use this information to characterize the count certain types of essential pattern groups.			

UT8.5	**Saturday 11:20**	*Using Hierarchical Linear Models to Measure Resin Growth on trees in the Peruvian Amazon*	
Luke Plowden		George Washington University	
Weevils continue to be an evolving yet valuable species since it produces Breu resin that sells as a viable non-timber forest product in the Peruvian Amazon. Some challenges surrounding Breu resin include determining the optimal conditions in which to harvest this substance and identifying significant factors contributing to its growth. This study uses hierarchical linear modeling to predict Breu resin growth and identify those significant predictors. The study concludes with recommendations that can maximize resin production.			

UT8.4	**Saturday 11:00**	*A Mathematical Model for Predicting 300 Meter Hurdle Race Times*	
Marquis Pratt		Birmingham-Southern College	Conner Young. Birmingham-Southern College
Previous researchers created models for predicting sprint race times for 300 and 400 meter races as well as 110 meter hurdle races. By manipulating their equations, we created a model combining these concepts to predict a world record race time for the 300 meter hurdles.			

SS5.5*	**Friday 3:20**	*Undergraduate Research in Permutation Groups and Sliding Disk Puzzles*	
Lee Raney		University of North Alabama	W. Andrew Craft, University of North Alabama; Austin Oldag, University of North Alabama; Andrew Penland, Western Carolina University
A sliding disk puzzle is a graph-generalization of Sam Loyd's famous 15-puzzle. Here, we discuss the arrangement group, a finite permutation group which controls the collection of legal arrangements of a sliding disk puzzle. We summarize results from an undergraduate research project on the structure of arrangement groups such puzzles, including constructions and a conjecture affirmed by a 1974 theorem of Richard Wilson.			

GS1.1	**Friday 12:45**	*Graph Labelings for Everyone!*	
Christopher Raridan		Clayton State University	
In this talk, we will explore a few of the many graph labelings that have been developed over the years.			

UT7.1	**Saturday 10:00**	*A Generalization of an Inequality with Harmonic Means*	
John Risher		USC Salkehatchie	

For positive sequences $\{a_i\}_{i=1}^n$ and $\{b_i\}_{i=1}^n$, we consider the series $\sum_{i=1}^{n} 1/(a_i + b_i)$. Using AM-HM inequality, we proved that $\frac{n}{\alpha_a + \alpha_b}$ is a lower bound of this sequence, where α_a and α_b are the arithmetic means of sequences $\{a_i\}_{i=1}^n$ and $\{b_i\}_{i=1}^n$. Using a technique introduce by Cauchy, we also proved that $\frac{n}{\gamma_a + \gamma_b}$ is an upper bound of this sequence, where γ_a and γ_b are the harmonic means of sequences $\{a_i\}_{i=1}^n$ and $\{b_i\}_{i=1}^n$.

CP2.3	**Friday 2:40**	*A delay differential equation model of phosphorylation of endothelial nitric oxide synthase*	
Lake Ritter		Kennesaw State University	John Salerno, Kennesaw State University Carol Chrestensen, Kennesaw State University

Nitric Oxide (NO) is a gaseous compound that serves as a signaling molecule in cellular interactions. In the vasculature, NO is synthesized from endogenous agents by endothelial nitric oxide synthase (eNOS) where it plays key roles in several functions related to homeostasis, adaptation, and development. Recent experimental studies have revealed repeated increases and decreases in NO production when eNOS is subjected to various stimuli (e.g. glucose and insulin). In this talk, we present a model of eNOS site activation via phosphorylation by a pair of kinase and phosphatase species. The model presents as a system of ordinary differential equations with time delay. We show that under conditions on the model parameters, varying the delay time may give rise to a Hopf bifurcation. Properties of the bifurcating solutions are explored via a center manifold reduction, and a numerical illustration is provided.

SS8.4*	**Saturday 11:00**	*Mixed mode oscillations in a stochastic two-trophic ecological model*	
Susmita Sadhu		Georgia College & State University	

We consider a three dimensional stochastic system comprising of two predators competing for the same prey under Holling type II functional response. Assuming that the growth rate of the prey is much faster than the growth rates of the predators, the problem is viewed as a singular perturbed system with two slow and one fast variables. As the mortality rate of one of the predators is varied, the deterministic model undergoes a singular Hopf bifurcation, in addition to exhibiting a variety of complex dynamics such as mixed mode oscillations, relaxation oscillations and chaos. In presence of environmental variations, the model is viewed as a slow-fast stochastic system. We study this system, and in particular show numerical simulations of the effect of noise on mixed mode oscillations.

CP5.2	**Saturday 10:20**	*Supplemental Instruction Shaping Student Success*	
Brandon Samples		Georgia College	Emily Baum - Georgia College
Academic support programs are essential when it comes to increasing student success. Such programs are particularly vital for the mathematical sciences, which have historically lower success rates. Building a program that provides effective academic enhancement opportunities for all students requires a consideration of many factors. One must identify the areas of greatest need and provide high impact instructional support while considering a myriad of resource limitations. In this talk, we will examine a supplemental instruction program and highlight the key factors that contribute to quality academic enhancement. We will provide both statistical evidence and qualitative feedback about the effectiveness of such a program. We will also highlight the mentorship and professional development opportunities afforded our Supplemental Instruction (SI) Leaders that truly make learning a vertically integrated, dynamic collaborative experience.			

SS4.4*	**Friday 3:00**	*Using Popular Games to Promote Mathematics*	
Ronda Sanders		University of South Carolina	
Our math club uses popular games to promote mathematics to students regardless of their mathematical background. Students who enjoy mathematics find it interesting to see the connections between popular games like Sudoku and Graph Theory or The Price is Right and Combinatorics. Students who enjoy the games themselves benefit from seeing mathematics in everyday life and higher level mathematics hidden in the most obvious places. Our largest game is the Integration Bee, which was started in 2003 by one of our graduate students. The competition is similar to a spelling bee, but students compete by solving integration problems. We have held Sudoku Championships annually for seven years in conjunction with student seminars on the mathematics behind the game. For the competition, students compete to see who can solve the most, the hardest, and the quickest Sudoku puzzles. For the seminar, we discuss the basics of Sudoku vs graph theory, how to choose a random Sudoku board, the best known bounds on generating a fair puzzle, Sudoku vs. Latin Squares, and critical sets. For the last three years, we have held a local Math Jeopardy competition in preparation for the MAA-SE Math Jeopardy competition. One of our professors gave a talk on the Mathematics of the Price is Right and let students play a mock game to test their skills. One of our undergraduate students gave a talk on the mathematics of juggling. One of our emeritus professors gave a talk on the mathematics behind the peg puzzle at Cracker Barrel. We also hold an annual Dessert and Games night where the students get together to play board games - one of the most popular games is Set and nearly all the games are strategy and logic games. We secure funding from our department, the Honor's College, Student Organizations, the Residence Hall Association, and national PME. I will discuss the challenges involved in organizing and hosting competitions such as those described above.			

SS5.2	**Friday 2:20**	*Infinite Wedge Representations of a Lie Superalgebra*	
Brad Schleben		Belmont University	
In this talk, we look at an infinite wedge representation of the Lie superalgebra gl∞|∞, along with its associated Clifford algebra. This serves as an analogue to Victor Kac's construction of the basic representation of the Lie algebra gl∞, which is of fundamental importance for mathematical physics in the context of the boson-fermion correspondence. We hope to discuss open questions involving this construction, as well as related structures that may be accessible for undergraduate or graduate research.			

CP7.3	**Saturday 10:40**	*Triangular billiard surfaces*	
Jason Schmurr		Dalton State College	
"Rational triangular billiards" involves associating a topological surface with the dynamical system of a point bouncing around inside a triangle. We will discuss some basic tools in this area and present recent results on maps between billiard surfaces.			

UT7.4	**Saturday 11:00**	*Codes in Higher Dimensions*	
Samantha Scoggins		Methodist University	
Golay's codes have played a significant role in the research and development of error correction coding. The Perfect binary Golay Code and the Extended binary Golay Code, which actually "extends" from the former, are two such codes. This project will study and compare the origins, properties, and applications of the mentioned codes as they relate to Group Theory and Linear Algebra.			

UT4.5	**Friday 3:20**	*Integrating 3D Printing and Computational Tools in Synthetic Biology*	
Erica Shook		Davidson College	Dr. A. Malcolm Campbell & Dr. Laurie J. Heyer
Our research focused on identifying new riboswitches for molecules in the xanthine family. We started with a theophylline riboswitch and mutated bases in the hopes of identifying new riboswitches. PDB files were used to determine which bases were interacting with the theophylline. A PDB file contains all necessary information to render a 3D model of a molecule. The actual positioning of atoms is determined experimentally. After we determined which bases were interacting with the theophylline we used Chimera software to view the RNA molecule bound to theophylline. We then 3D Printed the RNA molecule and four ligands from the xanthine family. An important tool used in our lab is the Oligator. The Oligator is a web based tool that takes a DNA sequence and cuts it into smaller segments termed oligos. Ideally the overlaps of the oligos have similar melting temperatures and therefore anneal at a similar temperature. However, sometimes users of the Oligator will get results of full length oligos, or the may want to specify certain oligo sequences. The Do-It-Yourself Oligator was developed to give a user tools to determine Oligos on their own interactively.			

SS6.3*	Saturday 10:40	*A greedy continued fraction*	
andrew simoson		king university	

Just as the Fibonacci sequence f_n is determined by the difference equation $f_{n+2} = f_{n+1} + f_n$, so in the same spirit when finding fractions $F_n = a_n / b_n$ that approximate the irrational number x, the fraction F_n is determined by the {\em general mediant} $F_{n+2} = kF_{n+1} + F_n$, where $kA + B = (ka + c)/(kb + d)$ with $A = a/b$ and $B = c/d$; a,b,c,d,k,m are integers; b and d are positive, $(a,b) = 1 = (c,d)$; k is either m or $m+1$, and x is between $mF_{n+1} + F_n$ and $(m+1)Fn+1+F_n$. When all of the m's are positive, ever taking k as m is equivalent to the classical continued algorithm appearing in any elementary number theory text. However, this choice fails in general to select that fraction (between the two fractions from which to choose) closer to x. We develop a simple dynamic cut-off rule which selects the fraction giving the better approximation---and call it the {\em greedy} continued fraction algorithm. Furthermore, define the signature of x to be the set of all points $(n, sin(2\pi nx))$---which is also known in the literature as a *strange Strang graph*---where n is any integer. When looking at the signature over a large span of consecutive integers, the points in the signature seem to align themselves as a collection of m sine-like branches, each of which appear to be arithmetic translates of one another. For example the signature of e (the natural number) aligns itself as a collection of 7 branches with arithmetic translate 39. Similarly, the signature of e can also be perceived as a collection of 39 branches with arithmetic translate 71, and so on. That is, these branch numbers are the denominators q of fractions approximating e, which in turn allows us to find the numerators p of the fractions by taking $p = \text{round}(qx)$. Surpisingly, this procedure is equivalent to the greedy algorithm.

SS2.6*	Friday 3:40	*Application of Cycloid to Techniques of Integration*	
Dana Stanfill		University of Tennessee at Martin	

In Calculus II, various applications of integration are studied, followed by techniques of integration including parts and trigonometric integrals. Parametric representation of curves follows with the cycloid as the lead example. In this talk, it will be shown that problems involving the cycloid with the applications previously studied lead to integration requiring the use of parts and the trigonometric integrals (including the sum to product formula).

UT3.5	Friday 3:20	*Modeling the Dynamics of Glioblastoma Multiforme and Cancer Stem Cells*	
Stephen Steward		Winthrop University	Maria Voelstad, Dr. Kristen Abernathy, Dr. Zachary Abernathy

In this talk, we extend the work of Kronik, Kogan, Vainstein, and Agur (2008) by incorporating the cancer stem cell hypothesis into a treatment model for Glioblastoma Multiforme. Cancer Stem Cells (CSCs) are a specialized form of tumor cell with normal adult stem cell properties. CSCs are believed to be one of the primary reasons for cancer recurrence since they are more resilient to current treatment practices and are able to repopulate the tumor. We present a system of nonlinear ordinary differential equations that describes the interaction between cancer stem cells, tumor cells, and alloreactive cytotoxic-T-lymphocytes (CTLs). Under the assumption of constant treatment, we present conditions on the treatment amount that leads to a locally stable cure state. We also explore a more biologically accurate treatment schedule in which CTLs are injected periodically. In the case of periodic treatment, we numerically establish treatment schedules that lead to cancer persistence, cancer recurrence, and cancer eradication. We conclude with a discussion of biological implications.

SS2.3*	**Friday 2:40**	*Computer-Based Precalculus and Calculus*	
Francesco Strazzullo		Reinhardt University	

Shouldn't we use computers to explore, understand, and apply Calculus concepts? Algebraic and trigonometric manipulations are a burden in Calculus courses. Let's lift these burdens with CAGS' (Computer Algebra and Graphing Systems) like GeoGebra, starting in Precalculus, thus improving the learning experience in Calculus.

During this presentation, a ``non-standard'' syllabus for Calculus I, using the ``local linearity'' approach, will be discussed. The presenter will provide statistics about his ongoing pedagogical project, which includes two computer based Calculus cycles.

Attendees will see some of the tools provided by GeoGebra (version 5 or newer). The regression analysis tool will be reviewed, by presenting a rate of change exercise that includes data collection, model building, and differentiation.

UT8.1	**Saturday 10:00**	*Dynamics of Co-orbital Moons Near Collision*	
Kimberly Stubbs		UNC Asheville	Fahd El Yahiaoui, UNC Asheville Samuel R. Kaplan, UNC Asheville

This project is about celestial mechanics and dynamical systems. Specifically, the goal is to explore the techniques used in modern celestial mechanics to analyze near-collision dynamics and chaos. The model we're working with is a 3-body co-orbital system. Josep Cors and Glen Hall wrote a paper on 3-body co-orbital systems and determined when the moons will pass each other and/or change orbits. They were only interested in these two occurrences, and so they left out the dynamics of near-collision. We're interested in finding out what happens near collision of the two moons and have done the necessary change of variables to allow analysis of the dynamics and chaos.
We'll look into the dynamics and what they mean for the entire system.

SS5.3*	**Friday 2:40**	*Statistical Analysis of Sedimentological and Paleontological Data from the Blackwater Draw Formation*	
Jillian Stupiansky		University of North Alabama	David Schmidt, Westminster College; Brian Steffen, South Louisiana Community College
A fossil-bearing stratum within the Blackwater Draw Formation has revealed new information about the ancient channel of Running Water Draw (RWD) in Texas. Textural changes in sediments and fossil mollusc abundances occur laterally along the fossil-bearing stratum. Statistical analyses were performed on the sediments and fossils from three sampled intervals along the stratum, and the results suggest that different microenvironments exist within the channel. To further support this conclusion, statistical comparisons were made between the stratum of RWD and different regions of the Double Mountain Fork Brazos River channel. Our study used integrated sedimentology, invertebrate paleontology, and statistics to demonstrate a more complex depositional history of RWD channel than was previously known. The focus of this talk will be on the statistical analysis.			

GS2.1	**Friday 4:15**	*Voting in Agreeable Societies*	
Francis Su		Harvey Mudd College	
When does a majority exist? How does the geometry of the political spectrum influence the outcome? What does mathematics have to say about how people behave? When mathematical objects have a social interpretation, the associated results have social applications. We will show how some classical mathematics about the geometry of convex sets and their intersections can be used to model people's preferences and understand voting in "agreeable" societies. This talk also features research with undergraduates.			

CP8.1	**Saturday 10:00**	*Reality Math*	
Dot Sulock		University of North Carolina at Asheville	
Math education has taken an unfortunate turn towards the abstract. Citizens often cannot benefit from or understand abstract mathematics. In the old days, practical mathematics regarding agriculture, units, money, etc. was taught and produced a reasonably numerate population. Now graduates of college as well as graduates of high school often do not understand the mathematics of personal finance, of energy, of government, of health and nutrition, etc. We are failing to produce numeracy in our citizens, a serious drawback for a democracy. Reality Math is an approach for middle-school, secondary, and non-STEM college math that might help with this problem.			

CP5.1	**Saturday 10:00**	*Analyzing the Factors of Predections on Student Performance in the HBCU in the Calculus*	
Mohammed Hanif Talukder		Elizabeth City State University	
Calculus sequence are fundamental courses for STEM program. Failure in calculus sequence is one of the main reason student leave STEM program during their academic years. This paper focuses on the academic and socio-economic reasons of failure of STEM students entering in HBCU in the calculus sequence. The quantitative methods of various statistical analysis was performed to identify the important factors on performance in calculus sequence.			

SS9.1*	**Saturday 10:00**	*Dead Poets Society*	
Ron Taylor		Berry College	Robert Vallin, Lamar University
In this talk we describe a model for extracurricular mathematical engagement that combines aspects of journal problem solving groups, Putnam competition preparation, math clubs and community service organizations. This model is based around creating a collaborative setting where people can focus on having fun while interacting with mathematical questions and other people who enjoy mathematics. The activities of this group provide a safe place for students, and faculty, to experience some camaraderie and have some fun thinking about interesting problems and discussing alternative solutions. This allows for an atmosphere that is communal without being as passive as listening to lecture and also intellectually stimulating without being as solitary as working alone on contest problems.			

GW1.1*	**Friday 2:00**	*On the Density of Reciprocal Bases*	
Keith Terrill		Tennessee Technological University	
Inspired by the unit fractions used in ancient Egypt, a set S is considered to be a reciprocal basis over the positive rational numbers when every positive rational number can be expressed as a sum of reciprocals of distinct elements from S. After some preliminary work with arithmetic progressions, we will show that there exist sets of any natural density that are reciprocal bases, as well as sets of density less than 1 that fail to be reciprocal bases. Then, in the context of rings of formal polynomials in one indeterminate over a finite field , we will present analogous definitions for reciprocal bases and natural density, and we will show that there are sets of any nonzero density that are reciprocal bases and sets that fail to be reciprocal bases.			

UT5.3	**Saturday 10:40**	*Figure Eight Sidewalk Patterns: Let's Count with Fibonacci and Lucas Numbers*	
Thinh Truong		Student	Chelsea Noel, undergraduate student
Wondering how many patterns we can form on a sidewalk? In this talk, we explore the number of all possible "Figure Eight" sidewalk patterns created by square and domino pieces. From exploration, we notice interesting relationships emerged between Figure Eight sidewalk pattern and "Straight" sidewalk and "Circular" sidewalk patterns. It is known that the Fibonacci numbers enumerate all attainable patterns of a Straight sidewalk created by square and domino pieces. Similarly, the Lucas numbers count for the total of unique Circular sidewalk patterns. As a result, we demonstrate a recursive formula of the Figure Eight sidewalk patterns and derive explicit formulas in terms of Fibonacci and Lucas numbers.			

SS7.3*	**Saturday 10:40**	*Elementary Preservice Teacher Education: Facilitating a Focus on Student Thinking*	
Patty Anne Wagner		University of North Georgia	
This talk will focus on the often difficult task of increasing elementary preservice teachers' (PST) mathematical knowledge for teaching. By facilitating an environment in which PSTs are frequently required to analyze the thinking of their fellow classmates as if the classmate is an elementary student, PSTs are motivated to analyze errors and to consider alternative solution paths, multiple representations, and the consequences of language choices. I will share some of the activities that I have used in my mathematics content courses for elementary PSTs that have facilitated deeper understandings of mathematics and increased the focus on student thinking.			

UT2.2	**Friday 2:20**	*Matrix Group Representation of Music Compositions*	
Jack Wagner		Armstrong State University	
The connection between mathematics and music has been apparent and studied as far back as Ancient Greece with plenty of overlap between great and mathematicians and great musicians. In this talk we will generate a representation of the tools of musical composition as a transformation group. Several group theoretic properties will be illustrated in the context of musical thematic development. It will be shown that element order, cyclic subgroups, orbits, and eigenspaces each have a meaningful interpretation in the field of musical composition.			

UT2.1	**Friday 2:00**	*Intermingled ascending wave M-sets with three colors*	
Takuya Wakayama		Davidson College Undergraduate Student	Dr. Carl Yerger (Davidson College Associate Professor)
Let [a, b] denote the integers between a and b inclusive and, for a finite subset X ⊆ Z, let diam (X) = max(X) − min(X). We write X <p Y provided max(X) < min(Y). For a positive integer m, let n(m;3) be the least integer N such that any 3-coloring Δ : [1,N] → {1,2,3} has two monochromatic m-sets A, B ⊆ [1,N] (not necessarily of the same color) with A <p B, diam (A) ≤ diam (B), and bj − aj ≤ bj+1 − aj+1 for j ∈ [1,m−1]. We show that for m ≥ 27, 12m−23 ≤ n(m;3) ≤ 12m−11, and give conjectures for the value of n(m; 3) when m < 27.			

CP8.4	**Saturday 11:00**	*Some Unusual Calculus Problems*	
Barrett Walls		Georgia State University	Iason Rusodimos iason.rusodimos@gpc.edu Georgia State University
Calculus class sometimes gets tedious for both students and instructors. We present several problems that are very different from the majority of problems in a beginning calculus course. Though unusual these problems can be solved with a clever use of calculus either as part of a lecture or by the student's themselves as a project.			

UT3.4	**Friday 3:00**	*Periodic Billiards Paths in Rational Approximations of Non-Rational Triangles*	
Harrison Watts		Dalton State College	Dr. Jason Schmurr, Dalton State College
Dynamical billiards describe a particle moving at constant speed in a region with specular reflections off the boundary: the angle of incidence equals the angle of reflection. In this presentation, we investigate the unsolved problem of establishing periodic billiards paths in non-rational triangles. The approach: use computer modeling to approximate irrational angles by sequences which converge to their binary representations and to explore the relationships between the existent closed paths in triangles constructed from these rational expressions.			

UT7.3	**Saturday 10:40**	*Modeling infectious disease epidemics in discrete time with stochastic simulation for measles*	
Valerie Welty		Georgia Southern University	Faculty Advisor - Dr. Patricia Humphrey, Georgia Southern University
As they are the leading cause of death among children and adolescents worldwide, it is of extreme importance to control the spread of infectious diseases. Information gained from mathematical modeling of these events often proves quite useful in establishing policy decisions to accomplish this goal. Human behavior, however, is quite difficult to recreate when using equations with pre-determined results, such as deterministic differential equations often used with epidemic models. Because of this, the focus of the research was to create a program using JavaScript to more accurately simulate an epidemic, specifically of measles, by using an imaginary population experiencing simulated stochastic events on a discrete time scale. This allows us to model a more complex population, which includes various levels of immunization as well as different stages of infection. Another major factor that the program accounts for is the phenomenon of self-quarantine during a disease outbreak. An important supplement to mathematical analysis, the results from the program may provide new insight on dynamics of epidemics such as herd immunity and effective disease transmission.			

SS3.1	**Friday 2:00**	*Low Tech Student Engagement Techniques*	
Cathy Whitlock		UNC Asheville	
In an age of clickers and flipping and online homework, are there any simple, low-tech techniques for increasing student engagement that are still worthy of consideration? A recent encounter with a cadet from the Citadel helped one instructor reconsider the benefits of a few decidedly old-school techniques. Adventures in chanting and doing clicker problems without clickers in an Introductory Statistics Class will be shared.			

SS2.5*	**Friday 3:20**	*Creating Connections in an Online Classroom*	
Allison Williams		Perimeter College at Georgia State University	
Retention is an issue that we deal with in our online mathematics courses. The presenter will share different methods that she uses to engage her students. From Weekly Helpful Hints to quick responses to an engaging Discussion Board, the online classroom can be inclusive and supportive.			

UT5.2	**Saturday 10:20**	*Weaker Forms of Lehmer Numbers*	
Tyler Woolley		Wofford College	
A Lehmer number is a composite integer m such that $\varphi(m) \mid m-1$. As of today there are no examples of non-prime integers which satisfy this condition. However, in this presentation we will explore weaker forms of Lehmer numbers, such as k-radimichael numbers and ℓ-k-Lehmer numbers. Unlike Lehmer numbers, we *can* find and prove interesting things about these types of numbers. Specifically, we will investigate certain forms of products of primes which can either yield k-radimichael numbers or make them impossible to construct. Following up on the work of Thomas Wright and Nathan McNew, we will then demonstrate that there are infinitely many $[-1]$-k-Lehmer numbers which are not $[-1]$-$(k-1)$-Lehmer numbers for any natural number k.			

SS1.5*	**Friday 3:20**	*Fibonacci in Cantor's Proof of Uncountability*	
Tom Wright		Wofford College	Mike Krebs - Cal State, LA
In this talk, we find a surprising appearance of the Fibonacci numbers, stemming from Cantor's original attempt to prove the uncountability of the real numbers.			

SS8.5*	**Saturday 11:20**	*A problem on global stability of a ratio-dependent predator-prey model*	
Yinshu Wu		Alabama A&M University	Dr. Wenzhang Huang The University of Alabama in Huntsville
The models of predator-prey systems have played an important role in the research of ecological problems. In many cases, when predators are searching for food, the ratio-dependent functional response may best describe the dynamical interaction between the prey and predator species. Y. Kuang and E. Beretta investigated a class of ratio-dependent predator-prey, in which they gave a complete analysis of local stability of the co-existence equilibrium E^*. However, the issue of global stability has not been resolved except some partial results. In this paper, we use some transformations and the Liapunov function method to show the equivalence of local and global stabilities of E^* under certain parametric conditions. Our result gives a positive answer to a question posted in the paper by Y. Kuang and E. Beretta.			

GW1.5	**Friday 3:20**	*On linear list r-hued colorings of sparse graphs*	
Murong Xu		West Virginia University	
For an integer $r > 0$, and a k-list assignment L to vertices of a graph G, a linear (L, r)-coloring of a graph G is a coloring c of the vertices of G such that for every vertex v of degree $d(v)$, $c(v) \in L(v)$, the number of colors used by the neighbors of v is at least $\min\{d_G(v), r\}$, and such that for any two distinct colors i and j, every component of $G[c^{-1}(\{i, j\})]$ must be a path. The linear list r-hued chromatic number of a graph G, denoted $\chi^{\ell}_{L,r}(G)$, is the smallest integer k such that for every k-list L, G has a linear (L, r)-coloring. We will present some of the recently achieved results on linear list r-hued coloring of graphs with bounded maximum subgraph average degrees.			

CP8.3	**Saturday 10:40**	*Handicapping No-Tap Bowling*	
Carl Yerger		Davidson College	Richard Yan, Davidson College
In the alternative no-tap bowling scoring system, bowlers earn a strike if they knock over nine or all ten pins on their first ball. For many no-tap tournaments, organizers use averages and handicaps based on standard bowling scoring to equalize differences in skill. We investigate whether modifications to these systems should be made for no-tap competition and whether these modifications should depend upon the difficulty of the tournament's oil pattern.			

CP6.3	**Saturday 10:40**	*Feasibility Sampling in Interval Methods for Special Multi-Constrained Global Optimization*	
Mengyi Ying		University of North Goergia	
A supplementary feasibility sampling procedure is added to the framework of interval method for finding optimal solutions of global optimization problem over a bounded interval domain subject to multiple linear constraints. Its main feature is the ability to detect infeasibility or actually locate a feasible sample in any working subinterval. Thus it provides tighter upper bounds of the optimal objective function value than the standard methods. Numerical results will be provided to demonstrate its effectiveness.			

SS1.3*	**Friday 2:40**	*From Fibonacci Sequence to Solving Polynomials. Preliminary Report.*	
Soowhan Yoon		Mercer University	Curtis Herink, Mercer University (advisor)
A careful examination of the Fibonacci sequence lead to an idea to solve polynomials in the form of infinite series. This talk presents how such an idea was formed and developed over time. The derivation of the general formula for the roots of polynomials involves making use of the properties of polynomial sequences of binomial type and the Lagrange inversion formula.			

CP2.1	**Friday 2:00**	*Compute the exponential of matrix with new scaling-squaring Chebyshev algorithm*	
Yilian Zhang		University of South Carolina Aiken	
The calculation of matrix exponential is extensively studied due to the key role of matrix exponential in differential equation. One of the most widely used method is a scaling and squaring methods with Padé approximations. New implementations of the scaling and squaring method based on Padé approximation and Taylor series are proposed in recent literature. In this paper, we present a similar modification that is based on Chebyshev series. Numerical tests show that it is comparable to other effective methods.			

CP6.4	**Saturday 11:00**	*Construction of compactly supported tight wavelet frames*	
Jie Zhou		Methodist University	
Frames have been widely used in signal processing. In this talk, I will discuss a particular way to construct compactly supported tight wavelet frames and show an example by using the symbol of B-spline of degree 1 as the trigonometric polynomial.			

CP5.4	**Saturday 11:00**	*Using Formative Assessment with Pre-service Teachers to Develop a Conceptual Knowledge of "Arithmetic & Algebraic" Fractions and Operations*	
Darley		Georgia Southern University	Ha Nguyen (Georgia Southern University): hnguyen@georgiasouthern.edu
In this session, the presenters will demonstrate formative assessment tasks used with pre-service teachers. These tasks are designed to develop a conceptual knowledge of fractions and fraction operations so that this knowledge with transfer to algebraic fractions and operations. Fraction Bars and Fraction Circles will be used along with number lines in order to make sense of fraction definitions and operations. Mathematical Communication while connecting algorithms with the models will be emphasized.			