MAA-SE at Elon University, March 26-27, 2010

Abstracts of Talks

Sequence by Primary Author Last Name

Data Mining: How Companies Use Linear Algebra, Ralph Abbey, NCSU
Abstract: Data mining is a field in which computer science, statistics, and mathematics all collide to solve major problems worth major amounts of money. Companies everywhere have immense amounts of data, and mining the data for relevant patterns, trends, and discoveries, is necessary to lead companies to growth and expansion. At the heart of all of this lies linear algebra. In this talk we will explore some of the basics of how linear algebra is used in data mining, as well as see some concrete examples of linear algebra in action to mine real data.

Steps To Improving Student Retention and Progression, Martha Abell, Georgia Southern University, Sharon Barrs, Georgia Southern University, Patricia Humphrey, Georgia Southern University, Bridgett Lee, Georgia Southern University, Jim Braselton, Georgia Southern University, Lori Braselton, Georgia Southern University
Abstract: In recent years, mathematics departments at colleges and universities across the country have been faced with the challenges of improving student retention and progression towards graduation. Georgia Southern University is no different. In this talk, the authors will describe measures taken to address high rates of withdrawals and non-passing grades in core mathematics courses. Some of the approaches include a redesign of some courses using a hybrid course model, use of linked courses with the Academic Success Center on campus, use of a predictive model to place students in their first college mathematics course and use of undergraduate research to improve retention of majors.

A Note on the Schwarz Reflection Principle for Polyharmonic Functions, Dawit Aberra, Fort Valley State University
Abstract: In 1907, E. Study gave a geometric interpretation of the classical Schwarz reflection principle for harmonic functions. We start by presenting his method for a slightly wider class of functions, that of solutions of a special case of Poisson's equation, obtaining a point-to-point reflection formula. The obtained formula is interesting in its own rights (regardless of the method used). We then demonstrate that the same idea can be used to obtain a known point-to-point reflection formula for polyharmonic functions.

Bootstrapping Autoregressive Time Series, Mosisa Aga, Auburn University Montgomery
Abstract: Invented in 1979 by Bradley Efron, the relatively new topic of bootstrap approximation technique is becoming one of the most efficient and fast expanding methods of statistical analysis, used not only by statisticians, but also by other researchers in economics, finance, medical sciences, life sciences, social sciences, and business. In this talk we will discuss the general bootstrap methodology and its application to an autoregressive time series.

The Effects of Fire on Red-tailed Leafhoppers, Jasmine Alexander, UNC-Greensboro
Abstract: Experiment (Panzer, 2003) showed that the post-fire recovery of the endangered red-tailed leafhopper (Aflexia rubranura) depends on the number, quality, and proximity of neighboring unburned patches. We use a mathematical model to describe the local colonization-extinction dynamics of this species before and after the fire. We test our model?s validity using the data from the experiment as well as using simulations.

The Amazing Mathematical Beauty Of The Lucas Numbers, Jorris Alford, Savannah State University
Abstract: The Lucas number, sequences of numbers of the form: $2, 1, 3, 4, 7, 11, 18, 29, 47, 76, 123, \ldots$ have been of great interest to mathematicians for more than a century. In this paper, we look over the Lucas number and deeply examine some of the properties and patterns of the Lucas numbers themselves as well as investigate its close relationship with the properties and patterns of the Fibonacci numbers. Some important theorems dealing with the mathematical concepts of the Lucas numbers will also be investigated. By experimenting various methods from many references, one observes that the Lucas numbers have many mathematical properties and pattern that are worthy of exploration in today's mathematical research territory. Our future mathematical research will be to study more facts about these fascinating and amazing numbers at higher level.

The Use of WileyPLUS in Freshman-level Math Courses, Shemsi Alhaddad, University of S. Carolina Lancaster
Abstract: I will give an overview of how I use WileyPLUS (online homework system) in College Algebra, Trigonometry and Calculus 1. I will discuss several advantages and disadvantages of the homework system, as well as remedies for the system's shortcomings. I will also provide some insight into the students' point of view via survey results.

Modeling the Effect of Dung Age on the Kleptoparasitic Behavior of Dung Beetles , Heather Allmond, University of North Carolina Greensboro

Abstract: A dung beetle may steal a brood ball that another beetle has prepared for its own egg. This is an extreme form of stealing behavior, kleptoparasitism, since it involves a total loss for one beetle and a gain for the other. We develop a mathematical model to see how the desiccation rate of dung affects the kleptoparasitic behavior of dung beetles. We assume beetles are genetically predetermined to land on dung that is either 1, 2, or 3 days old, then choose to stay and protect their balls for 0-4 days. When the beetles land they kleptoparasitize or strictly make their own broods balls. This leads to many possible strategies. We determine the fitness, reproductive success, of any particular strategy and search for Evolutionary Stable Strategies. We found out that there is no ESS. Therefore we also study the underlying replicator dynamics and find out that over time the population of beetles all tend toward using one particular strategy. This presentation is based on the work done for a Master thesis directed by Jan Rychtar.

Higher-Order Automatic Differentiation Methods in MATLAB, Ben Altman, Davidson College

Abstract: Automatic Differentiation (AD) uses computer code to numerically calculate derivative values such that there is no approximation error. It is ideal when symbolic differentiation is cumbersome or the function cannot be expressed in a concise form (defined by a large program code). Standard operators are overloaded to return not just function values but Taylor polynomial coefficient values as well. Implementing higher-order AD of multivariate functions can be quite difficult. Enormous amounts of data must be stored and operated on repeatedly. While there is no approximation error, the large number of operations can increase round-off error. There are different methods to that attempt to minimize these complications. Three different methods of higher-order AD of multivariate functions were implemented in MATLAB. These methods were compared for their efficiency and accuracy on test runs.

Distance Related Labelings of Graphs, Holly Arrowood, Furman University

Abstract: Vertex labeling has been a widely studied concept in the field of graph theory. The type of labeling studied in this project is called L(3,2,1)-labeling, and it is related to distances between vertices in the graph. In my project, I determine optimal L(3,2,1)-labelings for several different types of graphs.

Teaching Capstone Seminar Course, Risto Atanasov, Western Carolina University

Abstract: I have taught Capstone seminar for the last two years. In the Fall semester of 2008 I required each student to complete two projects based on research-oriented articles. In order to improve students' performance in the course, in Fall 2009, instead of working on two major projects during the semester, each student worked on three smaller projects and one final project. Two of the projects were chosen from the book *Proofs From the Book* by M. Aigner and G.M.Ziegler. I will discuss how did I incorporate the book into this class. I will also talk about my students' final projects.

Sowing the Seeds: a Panel Discussion of REU Directors, Patrick Bahls, University of North Carolina, Asheville, Mary Crowe, UNC Greensboro, Kevin James, Clemson U, Betty Mayfield, Hood College

Abstract: Nationwide there are several dozen summer programs offering undergraduate mathematics students the opportunity to perform original research in close quarters with professional mathematicians. Although the primary goals of each of these programs are very similar, the means by which those goals are accomplished vary tremendously. This panel will bring the directors of four different undergraduate research programs together to talk about the ways in which they help to usher undergraduate students into the research mathematics community.

The Role of Trust in Teaching and Learning, Patrick Bahls, University of North Carolina, Asheville

Abstract: All too often in a discipline like mathematics the affective aspects of teaching and learning get lost in the struggle to come to grips with the cognitive aspects of the discipline. We're so busy trying to master the challenging facts and formulas we're confronted in math that we tend to overlook how we feel about the subject and our mastery of it. But how we feel is crucial: both teaching and learning are difficult and sometimes terrifying acts! In these acts teacher and learner come together to confront the unknown, and in these acts we are greatly assisted by mutual trust, respect, and understanding. In my brief talk I hope to describe a few ways in which trust plays a role in teaching and learning, and to indicate means by which teacher and learner can come to more readily trust one another.

Basic Operations on Khmer Numbers, Paul Baker, Catawba College

Abstract: There are no existent examples of how ancient Khmers (Cambodians) performed addition and subtraction, much less multiplication and division. However, the format of the way ancient Khmers wrote their numbers lends itself to a natural manner of addition and subtraction. In other words, we will consider how the ancient Khmers should have added (even if they may not have). Possible algorithms for multiplication and division are also considered along with difficulties associated with each.

The Median Value of a Continuous Function, Irl Bivens, Davidson College
Abstract: Let $f(x)$ denote a continuous function on a closed interval $[a, b]$. Partition $[a, b]$ into n equal subintervals and let $med(n)$ denote the median of the n values of f at the midpoints of the subintervals. It is natural to define the median value of f over $[a, b]$ to be the limit of $med(n)$ as n approaches infinity. We will prove that this limit exists and is equal to the unique value of c that minimizes the area between a horizontal line $y = c$ and the graph of $y = f(x)$.

Generalized Hopf Bifurcations in a Laser Diode System with Self-sustained Pulsations, John Bobo, Berry College
Abstract: Generalized Hopf bifurcations in a laser diode system are considered. The periodic orbit immediately following the generalized Hopf bifurcation is constructed using the method of multiple scales, and its stability is analyzed. Numerical solutions reveal the existence of stable periodic attractors, attractors at infinity, and bounded chaotic dynamics in various cases. The dynamics are explained on the basis of the bifurcations occurring. Chaotic regimes are characterized using power spectra, auto-correlation functions and fractal dimensions.

Self-Avoiding Walks and Polygons on Hyperbolic Coxeter Groups, Jason Bode, Lander University
Abstract: We begin by considering the Cayley graphs of rank three hyperbolic Coxeter groups. These graphs give tilings of the hyperbolic plane. We define self-avoiding walks and self-avoiding polygons, their connective constants, and the isoperimetric constant of a graph. Using isoperimetric constant results we prove that there are exponentially fewer self-avoiding polygons than self-avoiding walks.

Discrete Time Optimal Control of Species Augmentation: Augment then Grow, Erin N. Bodine, University of Tennessee, Knoxville, Louis J. Gross, University of Tennessee, Knoxville, Suzanne Lenhart, University of Tennessee, Knoxville
Abstract: Species augmentation is a method of reducing species loss via augmenting declining/threatened populations with individuals from captive-bred or stable, wild populations. We developed a difference equations model and optimal control formulation for discrete time augmentation of a general declining population. We show numerical results for scenarios of different illustrative parameter sets.

Finding Meaning in Friendships, Jennings Boley, Davidson College, Mark Trawick, Davidson College
Abstract: Social networks hold a vast amount of data. Normally, these networks are utilized for finding more information about a friend, relative or your new favorite band, but by clustering this data, it is possible to draw some additional conclusions. Using clustering techniques on friendship data from Facebook interesting new trends can be identified.

Cards, Codes, and Kangaroos, Lindsey Bosko, North Carolina State University
Abstract: I will demonstrate a card trick and discuss how the mathematics behind this card trick can lead to the Pollard Kangaroo Method to attack cryptosystems. Come hear how a basic knowledge of algebra can be used to amaze your friends and break codes.

Statistical Literacy Project: Identifying and Evaluating Statistics Found in Popular Media, Karen Briggs, North Georgia College & State University
Abstract: If Mark Twain correctly equated "damn lies" and statistics, the reason is the lack of societys statistical literacy. To dispel the notion that any damn lies" can be proven with statistics, we are currently implementing the following Statistical Literacy Project in our Elementary Statistics course: Each student is asked to find a current popular media article of personal interest which cites statistics-based research. After obtaining a copy of the cited article, each student then provides a written analysis that contrasts the conclusions reported in both the research and media articles. Students are assessed upon how they use the concepts they have learned in class to evaluate the validity of the statistical argument reported in the media article. As a consequence of this project, we hope that students will reflect upon how the process of gathering relevant information and using statistical knowledge has changed or strengthened their opinions and values, and how they will approach media articles in the future.

Analytical Modeling of Magnetic Resonance Imaging(MRI) Techniques, Benjamin D. Briscoe, Cumberland University, Christopher C. Quarles, Vanderbilt University
Abstract: My presentation will cover research performed at Vanderbilt University's Institute of Imaging Science from the summer of 2009 to the present. Dynamic Susceptibility Contrast Magnetic Resonance Imaging, DSC-MRI, is a method commonly used to compute tissue blood flow and blood volume in humans but its application to tumor tissue is confounded by the leakage of contrast agent from highly permeable blood vessels. Recently, a theoretical model was proposed to describe DSC-MRI signals acquired in the presence of contrast agent extravasation (Quarles, CC et al, Phys Med Biol, 2009). Using this model we have systematically evaluated the influence of physiological and physical parameters on the reliability of tumor blood flow and blood volume measurements. The work has been

carried out using the technical computing language, MATLAB. This presentation will provide a brief overview of the mathematical basis for generating and interpreting MRI signals. Also, this presentation will discuss the coding logic behind the generation and analysis of over a million data points created by varying over ten independent parameters.

An Agent-Based Model of Insecticide Treated Nets and Their Impact on Populations at Risk for Malaria, Amanda Brown, Elon University

Abstract: One of the major diseases in sub-Saharan Africa, malaria causes millions of death across the continent every year. The current study explores malaria transmission from a mathematical point of view, creating an agent-based simulation based on a differential model. The agent-based simulation, allows for investigation of the use of insecticide-treated bed nets (ITNs) as a prospective preventative measure for malaria. Using mosquitoes and humans as interacting agents under set parameters, the simulation provided time-based graphs showing the infection rates of the infected human and mosquito populations. The findings showed that protecting 60% of a population with ITNs will provide almost 90% infection reduction among that population, and increasing protection to 70% will almost entirely eliminate infection.

Release from the Horns of a Dilemma: Homework Made Easy?, Douglas Brown, Catawba College

Abstract: One of the most important ways students achieve mastery of mathematical skills is through practice, typically by doing homework assignments. Unfortunately, most students (especially in General Education courses) will only attempt these problems if a grade is at stake. Difficulties arise, however, in collecting homework for a grade, not the least of which are strains on faculty time and the temptation for students to copy someone else's work. We will discuss an attempted solution in two General Education courses at Catawba College, the use of a online homework system (WeBWorK).

Estimate of Order of Error of Numerical Solution of Infinite-Dimensional Volterra Integral Equation, Yuriy Bulka, APSU

Abstract: We look at the Infinite-dimensional extension of the Multiple Nonlinear Volterra Integral Equation of the 2^{nd} kind. These equations arise when a nonlinear system is modeled with a polynomial Volterra series. Under certain conditions there is an interval where this equation has a unique solution in the class of continuous real-valued functions on an interval. Here we present a discrete-time finite-difference approximation of this equation, and estimate the order of global error of the numerical solution of the equation.

Mathematical Modeling of Human Arm Motion for Optimization, Ericka Butler, Savannah State University

Abstract: In much literature scientists have challenged to describe human motion because of its extraordinary adaptability to many applicable areas including the clinical study of locomotion, ergonomics, and sporting activities. As one of these challenges, this study mainly concerns on the development of mathematical modeling of optimized human right arm motion. Based on the understanding of biomechanical theories, one collects the arm movement data in position from the actual experiment. Initially obtained position-based 3-dimensional vectors are converted to the angle-based data by using the inverse dynamics theory. This process is required for examination of various cost functions, which describe the distinct restriction of the human movement. To implement the smoothness of human motion, the discrete data is reestablished as differentiable functions through the numerical interpolation methods. The velocity and acceleration functions in angle changes are also shown. Various existent cost functions, such as energy efficiency, musculoskeletal discomfort, fatigue, stress, etc. are examined with the data. In order to find the most ideal combination of the cost functions, we impose the weight to these functions so that it can define well the most natural human motion. The generated results then are expected to contribute to the biomedical related areas as well as modeling of human motion and optimized paths in mathematics.

Epidemiology and the Kermack-McKendrick Method, Scott Robert Campbell, Catawba College

Abstract: In this presentation we examine the Kermack-McKendrick method, a variation of the SIR model. Rather than the usual continuous model that uses differential equations, we utilize discrete difference equations to model the spread of the Swine Flu [H1N1] at two universities. We determine the replication rates at the two schools and consider factors that cause a difference in the rates. The replication rate of the Swine Flu is also compared with the rates of other significant diseases. Further, we examine how the model can be used to help contain epidemics.

Student Profiles in the Mathematics Classroom: Learned Helplessness and Asperger's Syndrome, Lisa Carnell, High Point University

Abstract: As more students enter college with psychological and developmental issues, it is important for instructors to create learning opportunities for these populations. In this presentation, the characteristics of students with Learned Helplessness and Asperger's Syndrome will be discussed. In addition, some instructional strategies will be presented to assist these students in being successful in your classroom.

An Examination of Mathematics Proficiency of Minority Students in Precalculus , Samuel Cartwright, Fort Valley State University, Dawit Aberra, Fort Valley State University

Abstract: Precalculus is commonly viewed as a gatekeeper course for potential STEM majors. Students are challenged to demonstrate proficiencies in the key concepts deemed essential for later success in STEM disciplines. Most entering freshmen who completed pre-assessment of college algebra skills and concepts deemed essential for precalculus did not meet departmental expectations. As intervention, a required mathematics laboratory component, was integrated into the precalculus course experience. Results show that prepared students as well as underprepared students who complied with attendance and mathematics laboratory policies were able to improve.

BLAM! Creating a Summer Math Camp Unlike Any Other, Matthew Cathey, Wofford College, Spivey Joseph, Wofford College

Abstract: A quick survey of summer math camps reveals that most are aimed at academically gifted students, and feature curricula geared toward helping their students "get ahead" of their peers. Our goal in creating "BLAM: Bridging the Liberal Arts and Mathematics" is to focus instead on the relationships among mathematics, literature, music, visual arts, philosophy, and the other liberal arts. By avoiding the rote, algorithmic, computational mathematics that students are accustomed to seeing, we hope to give students a taste of the beauty of mathematics in a non-threatening, natural way. Our talk will focus on the advantages, difficulties, and challenges involved in creating and planning this summer program.

An Example of a Crossed Product by an Endomorphism, Amy Chambers, Tennessee Tech University

Abstract: In this talk we will look at an example of a spatial crossed product of a C*-algebra by an endomorphism. Specifically, we will show that the tensor product of Cuntz algebras $\mathcal{O}_{d_1} \otimes \mathcal{O}_{d_2}$ is the spatial crossed product of $\mathcal{O}_{d_1 d_2}$ by an endomorphism. We will then discuss the definition of a universal crossed product by an endomorphism.

Existing Cycles of Length of Power of 2 in Planar Graphs with a Minimum Degree of At Least Four, Guantao Chen, Georgia State University, Robert Xu, Georgia State University, Nana Li, Georgia State University

Abstract: The Erdős-Gyárfás Conjecture states that any graph with minimum degree at least 3 contains a cycle of length 2^k for some positive integer $k \geq 0$. A weaker version of their conjecture is that there exists a universal constant c such that every graph G with minimum degree at least c contains a cycle of length 2^k for some positive integer k. In this paper, we prove that every planar graph with minimum degree at least 4 contains either a cycle of length 4 or a cycle of length 8 by the discharging method. Consequently, the weaker version of the conjecture is true for planar graphs with minimum degree at least 4.

Eigenpairs of Adjacency Matrices of Balanced Signed Graphs, Mei-Qin Chen, The Citadel, Spencer Hurd, The Citadel

Abstract: We study the effects of warm water on the local penguin population. The major finding is that it is extremely difficult to induce penguins to drink warm water. The success factor is approximately $-e^{-i\pi} - 1$. In this paper, we present results on eigenvalues λ and their associated eigenvectors x of an adjacency matrix A of a balanced signed graph. A graph $G = (V, E)$ consists of a set V of vertices and a set E of edges between two adjoined vertices. A signed graph is a graph for which each edge is labeled with either $+$ or $-$. A signed graph is said to be balanced if there are an even number of negative signs in each cycle (a simple closed path). Signed graphs were first introduced and studied by F. Harary to handle a problem in social psychology. It was shown by Harary in 1953 that a signed graph is balanced if and only if its vertex set V can be divided into two sets (either of which may be empty), X and Y, so that each edge between the sets is negative and each within a set is positive. Based on this fundamental theorem for balanced signed graphs, vertices of a balanced signed graph can be labeled in a way so that its adjacency matrix is well structured. Using this special structure, we find exactly all eigenvalues and their associated eigenvectors of the adjacency matrix A of a given balanced signed graph. We will present eigenpairs (λ, x) of adjacency matrices of three types of balanced signed graphs: (1) graphs that are complete; (2) graphs with t vertices in X or in Y that are not adjacent; and (3) graphs that are bipartite.

A Geometric Formulation for Balancing Chemical Equations, Jer-Chin Chuang, Georgia College and State University

Abstract: It has long been known that balancing chemical reactions can be formulated using linear algebra. Here, we provide a reformulation via convex geometry that is visually appealing especially regarding questions of existence and uniqueness of balancings.

Mathematical Explanation of Ecosystem Homogenization, Adrian Coles, University of North Carolina Wilmington

Abstract: In recent years, ecologists have begun to refine the mathematical study of complex networks of interactions

between species within an ecosystem. In particular, Network Environs Analysis (NEA) has made use of linear algebra to formalize analysis of the relative importance of direct and indirect connections between species. One of the many indicators used to quantify such description is homogenization, which is a measure of the propensity of a network to distribute material throughout all species along all connections. We examine a matrix-theoretic formulation of the homogenization indicator and describe how linear algebraic tools can be refined to determine which species and paths may exert strongest influence on the behavior of an ecosystem.

Using Markov Theory to Find the Expected Diameter of Random Graphs, Cynthia Cook, Catawba College, Patrick Bahls, UNCA, Mark McClure, UNCA

Abstract: We will discuss particular random trees constructed through a process called Use It or Lose It. This process gives rise to infinitely many nonisomorphic trees, which we will classify into ten states. We will prove the different structures these particular trees can form and their transitions from one state to the next. By finding the transition probabilities of each tree, we are able to use Markov Theory to approximate the probability of being in a given state at time t. Knowing these probabilities and the probability that each state will increase the diameter allows us to find an approximation for the expected diameter at time t.

Unreal Irrationals: Turing Halts Cantor, Brian Crissey, North Greenville University

Abstract: Rational and repeating real numbers are denumerable. Predictable irrationals (procedural numbers) are denumerable and disjoint from the rationals. Cantor's production of a procedural number not in any list of real numbers is of no consequence. Turing's proof of the insolubility of the Halting Problem prevents unpredictable irrationals from being ordered, which prevents their being real, if they exist at all. Thus the cardinality of the reals is the same as that of the integers. Transfinite mathematics is discredited and may be relegated to history. Much rewriting of mathematical texts lies ahead.

Intergrating the Three Stooges into Trigonometry, Robert Davidson, East Tennessee State University, Robert Gardner, East Tennessee State University

Abstract: Our favorite class to teach is trigonometry. This subject matter is all around us in everything we see and do from NASCAR (linear and angular speed) to the Three Stooges (Larry, Curly, and Moe). One way in which we illustrate this is to show a clip from a Three Stooges film. In one scene, a board is in a vertical position against a wall. It tips over, and falls on Moes head. The class usually gets a kick out of this and it keeps them awake. We then discuss the fact that such motion involves a circular path. This simple scene sets up many aspects of trigonometry from arc length to the unit circle. We will demonstrate how to develop various trigonometry lesson plans from this one Three Stooges scene (we will show the clip).

All Math Software is Not Created Equal: Whats the Difference?, Erica Dean, Hawkes Learning Systems

Abstract: The need for and use of technology has become increasingly prevalent in Mathematics courses. But with all the software options available, it can be difficult to determine the differences from one system to another. Hawkes Learning Systems (HLS) is a unique program that stands out from the rest. Students learn more effectively and efficiently through interactive tutorials, unlimited practice, mastery-based homework assignments, and error-specific feedback provided by artificial intelligence. From having the lowest cost and lifetime access to not requiring the internet to do homework and an easy-to-use interface, it is the most student-friendly product available. Not only is it different from other software systems, it has also been proven through controlled studies to be more effective in helping students learn and retain mathematics skills. This presentation will show the many benefits of Hawkes Learning Systems for both students and instructors and will highlight case studies proving that it truly works in helping students excel in Math. Curious about these differences that HLS has to offer? Come to discover how HLS is the perfect solution for student success!

Exploring the Bootstrap Mean Exposure Time in Professional Bull Riding, Erica L. Deahl, Presbyterian College

Abstract: Resampling is a computationally intensive form of modern data analysis. This paper explores the bootstrap technique of resampling as a way to investigate the distribution of mean exposure to injury time in the extreme sport of professional bull riding.

Total Efficient Domination and Circulant Graphs, Joe DeMaio, Kennesaw State University

Abstract: A set $S \subseteq V$ is a dominating set of a graph $G = (V, E)$ if each vertex in V is either in S or is adjacent to a vertex in S. A vertex is said to dominate itself and all its neighbors. A set $S \subseteq V$ is a *total dominating set* of a graph $G = (V, E)$ if each vertex in V is adjacent to a vertex in S. In total domination a vertex no longer dominates itself. These two types of domination can be thought of as closed (domination) and open (total domination) neighborhoods of vertices in the set S. An independent set $S \subseteq V$ is an *efficient dominating set* of a graph $G = (V, E)$ if each vertex

in $V - S$ is adjacent to exactly one vertex in S . A set $S \subseteq V$ is a *total, efficient dominating set* (also known as an *efficient open dominating set*) of a graph $G = (V, E)$ if each vertex in V is adjacent to exactly one vertex in S. In 2002 Gavlas and Schultz completely classified all cycle graphs that admit a total, efficient dominating set. This paper extends their result to circulant graphs.

A Graph Theoretic Summation of the Cubes of the First n Integers, Joe DeMaio, Kennesaw State University, Andy Lightcap, Georgia State University

Abstract: This paper provides a combinatorial proof for the sum of the cubes of the first n integers. A combinatorial proof for the sum of the first n integers is used as a basis for the proof here. We use a complete bipartite graph construction and build the edges step-by-step to show the final result.

Logarithmic concavity of polynomials, Robin Devitt-Ryder, UNC Asheville

Abstract:

A sequence of number $a_1, a_2, \ldots$ is said to be logarithmically concave if ${a_i}^2 \geq a_{i-1} \cdot a_{i+1}$. Now consider a monic polynomial multiplied by a conjugate root. Using simple inequalities, we can generate this polynomial so that every coefficient is logarithmically concave.

Teaching Geometry From a Historical Perspective, Meg Dillon, Southern Polytechnic State University

Abstract: It took more than two thousand years and the best efforts of the ablest mathematicians to sort out the controversy surrounding Euclid's Fifth Postulate. The results of those efforts included the discovery of non-Euclidean geometries and a revolution in the way people thought about space. This story can provide the outline for an undergraduate geometry course that assumes little background but takes students a long way towards understanding how modern mathematics evolved from ancient times to the present.

Teaching a Hybrid (Classroom + Online) Calculus Class, Laurie P. Dishman, Cumberland University

Abstract: In the summer of 2008, Cumberland University (CU) implemented a plan to change all traditional Monday/Wednesday/Friday classes into hybrid classes, whereby the classes would meet face-to-face on Mondays and Fridays with Wednesday classes delivered online via Blackboard Vista. Calculus I is a four credit hour course at CU, traditionally meeting four days a week, including Wednesdays. With the amount of material required in a first semester of calculus, online Wednesdays necessitated delivery of new material online. Based on two fall semesters of teaching Calculus I with one-quarter of the delivery online, information and data will be presented outlining the successes/failures, improvements in pedagogical practice, and opportunities for further development.

Use of Technology in Problem Solving; Student Presentations of Group Projects, Stephen Doty, Georgia Perimeter College, Kader Conde, Georgia Perimeter College, Lekha Pate, Georgia Perimeter College, Aamir Bey, Georgia Perimeter College, Courtney Lemon, Georgia Perimeter College

Abstract: In this presentation, students from Calculus and Differential Equations classes will present their group projects. The Calculus students apply Newton's Law of Cooling and Heating to create a mathematical model for investigating a crime scene. During the presentation the students become crime scene investigators using their mathematical skills and technology to demonstrate and solve the problem at hand. The Differential Equations students use Mathematics to solve and interpret a differential equation governing the motion of a Mass-Spring mechanical system. In the process, the students show how technology can be used to perform the ponderous calculations and explore some properties of each system.

Using Origami to Teach Proof Techniques, Patrick Dukes, Winthrop University, Joe Rusinko, Winthrop University

Abstract: Recently, all origami constructions were axiomatized by Huzita and Hatori. Using these axioms, we construct puzzles, whose solutions model various proof techniques. These puzzles build a connection between abstract reasoning and concrete manipulation. Induction, construction, contradiction and proof by cases will be explored at a level appropriate for an introductory geometry class.

Approximating Nearly Singular Integrals in Introductory Calculus Courses, Chris Duncan, Lander University

Abstract: In many applications, solution techniques require the approximation of a nearly singular integral in which the integrand has very large derivatives. Special methods are often used to achieve good accuracy. One such method is appropriate for first year calculus students since it only involves the trapezoid rule in conjunction with an inverse substitution. In this talk, we will consider examples of this method that could be used in an introductory calculus course. We will also explore why the method is so effective.

A Probabilistic Approach to Finding Irreducible Polynomials, Jeffrey Ehme, Spelman College
Abstract: Polynomials that cannot be factored into simpler polynomials are used to construct fields and play a role in error correcting codes and cryptography. In this presentation, we will demonstrate a probabilistic method for constructing irreducible polynomials over large finite fields and explain why the method works.

Comparing Online Systems, Amy H Erickson, Georgia Gwinnett College
Abstract: Students of the millenial generation expect that college courses will have an online component that seamlessly meshes with the in-class piece. In mathematics, these online systems can be used for homework submission, student practice, and material delivery. What features should an instructor look for to maximize instructional benefit, and what pitfalls should one be aware of? A quick comparison of several common systems will be included.

DGM-FD: A Finite Difference Scheme Based on the Discontinuous Gakerkin Method, Anne Fernando, Norfolk State University
Abstract: In this paper we formulate a numerical method that has high-order convergence, with strong accuracy for numerical wave numbers, and is adaptive to non-uniform grids. Such a method is developed based on the Discontinuous Galerkin Method (DGM) applied to the hyperbolic equation, resulting in finite difference type schemes applicable to non-uniform grids, which are proposed. The schemes will be referred to as DGM-FD schemes. These schemes inherit naturally some features of the DGM, such as high-order approximations, applicability to non-uniform grids and super-accuracy for wave propagations. Stability of the schemes with boundary closures is investigated and validated and are demonstrated by numerical examples including the linearized acoustic waves. For non-linear equations, proposed flux finite difference formula requires no explicit upwind and downwind split of the flux. This is in contrast to existing upwind finite difference schemes in the literature. This flux scheme will be applied to the solution of non-linear Burger's equation and the flat-plate boundary layer problem. Content Area: Numerical Analysis

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Understanding How the Hailstone Falls Using a New Coding Process, Richard Freedman, Wake Forest University
Abstract: The Collatz Conjecture, also known as the 3x+1 problem among other names, has puzzled mathematicians since its introduction by Lothar Collatz around 1937. It seems to have an interesting property in which the discrete dynamical systems orbits, called Hailstone Sequences, using any positive integer as an initial value will eventually reach the sequence 1, 4, 2 which is a 3-cycle for the discrete dynamical system. We have found interesting relationships that allow us to devise a new coding process that we have called set positions. They are three-tuples that span the set of integers crossed with the set of all rational numbers in the interval $[0, 1)$ such that their denominators are powers of two. Using set positions, we can quickly determine distances between two integers in a Hailstone Sequence as well as generate sets of initial values such that all initial values in a set are confirmed for the Collatz Conjecture if just one initial value in the set is confirmed. The latter property may be used to create a new discrete dynamical system with an associated conjecture that has a logically equivalent, yet smaller, solution space than the one for the Collatz Conjecture. We will introduce the coding process through a discovery approach as well as introduce a more generalized version of set positions that will allow us to generalize the discrete dynamical system and its Hailstone Sequences and expand the Collatz Conjecture to consider the generalized Hailstone Sequences.

Unexpected Connections: from Factorization Theory to Ecosystem Analysis, Michael Freeze, UNC Wilmington
Abstract: Unexpected insights often arise at intersections, both between disciplines and between subdisciplines. We discuss the use of the graph pebbling problem as a bridge between related problems in zero-sum theory from additive combinatorics and network environs analysis from theoretical ecology.

Evolving Discriminators and other Algebraic Terms: Genetic Programming as a Mathematical Tool, Robert French, Austin Peay State University
Abstract: Genetic Programming is a search tool for finding logically structured solutions to well-defined problems in computer science, engineering, and mathematics. Recently, Genetic Programming has been applied to problems in Universal Algebras, and has produced results not obtainable via previous techniques. In 2008, Lee Spector and others at Hampshire College used Genetic Programming to produce several different algebraic terms of theoretical interest. Many of these terms had previously been proven to exist, though no method was known for constructing them. The audience will be introduced to Genetic Programming as a problem solving tool. Then we will define Universal and Finite Algebras, and show how the problem of finding algebraic terms of interest can be formulated as a minimization problem. We will end by summarizing Spectors work and discussing the potential of Genetic Programming as a search tool for more general mathematical problems.

The Singular Value Decomposition: A Project for an Undergraduate Linear Algebra Class, Edward

Fuselier, High Point University
Abstract: The singular value decomposition (SVD) is one of the most important ideas in applied linear algebra, yet for many undergraduate curricula it is left out altogether. It could be argued that an in-depth study of the SVD may not be appropriate for a first linear algebra course. However, non-math majors who typically take only one undergraduate linear algebra course, such as those majoring in engineering and the sciences, would probably benefit greatly from learning about the method. Further, early exposure to the powerful applications of the SVD could increase students' appreciation of linear algebra. In this talk we will briefly review what the SVD is and its importance, and discuss a project created for my undergraduate linear algebra class. The purpose of this project is to expose my students to the singular value decomposition and to give them an idea of how it can be used.

Patterns and Integer Valued Polynomials, Jenny Fuselier, High Point University
Abstract: In second semester calculus, students learn how to find Taylor series expansions for basic functions. They look for patterns in successive derivatives and use these patterns to generate coefficients. For example, when considering $f(x) = \sin(x)$ about $x = \pi/4$, a pattern of signs $++--++--$ arises, and $(-1)^{\frac{n(n-1)}{2}}$ is included in the expansion to achieve these signs. Students (and teachers!) may wonder how one determines the polynomial $\frac{n(n-1)}{2}$ as the right choice. Is there a way other than trial and error? In this talk, we explore what patterns of $+$'s and $-$'s are generated by integer valued polynomials and see how to build the "right" polynomial for a predetermined pattern.

Can You Hear the Species of a Frog? An Analysis of Tree Frog Calls, Melissa Gaisser, Elon University
Abstract: There are hundreds of different species of frogs, each of them with a distinct vocal call. This research focuses on determining the frequencies that are dominant in various tree frog calls. This is accomplished through the use of Fourier Analysis, and more specifically, Fourier Transforms. After using four identified frog calls, two from one species and two from another, these methods were applied to ten identified calls from Sri Lanka, as well as two unidentified calls from the country, in an attempt to match the unidentified calls to the calls of one of the identified species of frog.

Cyclic and Bicyclic Decompositions of the Complete Graph into the 4-Cycle with a Pendant Edge, Robert Gardner, East Tennessee State University, Daniel Cantrell, Gary Coker
Abstract: We denote the graph consisting of a 4-cycle with a pendant edge as H (sometimes called a *kite* graph). This talk centers on decompositions of the complete graph into copies of graph H, but mentions other related decompositions. Automorphisms of such decompositions are addressed for (1) cyclic automorphisms (consisting of a single cycle), and (2) bicyclic automorphisms (consisting of two disjoint cycles). All terms will be defined and illustrated with examples. Also, a bit of history of graph decompositions will be discussed, going back to the mid-1800s and the "nonlinear" history of Steiner triple systems.

Ranking Systems: Purpose, Derivation, Implementation, and Evaluation, Benjamin Goldman, Wake Forest University
Abstract: This talk explores why ranking systems exist and how they can be used in real world situations. We derive two new ranking algorithms and test them on various situations including the 2008 NCAA FBS Football Season. Then we discuss how these algorithms can be adjusted to other real-world applications and how to optimize these ranking algorithms' effectiveness.

Personalized Ranking Algorithms, Benjamin Goldman, Wake Forest University
Abstract: This talk discusses the positives and negatives of college ranking algorithms and proposes a method for improving some existing algorithms. We will also mention how a basic set of assumptions could allow matrix ranking algorithms to personalize these rankings.

North Carolina NAEP: Improving Mathematics Content and Methods Courses, Tracy Goodson-Espy, Appalachian State University
Abstract: North Carolina NAEP: Improving Mathematics Content and Methods Courses is a National Science Foundation supported project (2008-2010) that has created a set of instructional modules concerning the National Assessment of Educational Progress (NAEP) to improve instruction in mathematics content and methods courses for preservice elementary and middle school teachers. There are three sets of modules, one directed at content and methods courses at the elementary level, a second prepared for the middle school level, and a third aimed at community college undergraduate mathematics courses frequented by preservice teachers (i.e. College Algebra). These modules are also appropriate for use in graduate mathematics education courses. The purpose for the materials is to help preservice and in-service teachers: 1) improve their mathematical content knowledge; 2) improve their understanding of how to use effective methods to teach mathematics to children; 3) become aware of the purposes for, and uses of, NAEP; and 4) learn how to use NAEP data to improve their mathematics teaching. The presentation will: 1) explain

the purposes for the NC NAEP modules; 2) make the modules available for use to the audience; and 3) announce a May 2010 workshop (stipend available) to be held at ASU to assist faculty in learning how to use the modules in their own classroom settings. The NC NAEP project team consists of Dr. Tracy Goodson-Espy, Dr. Kathleen Lynch-Davis, Dr. Tracie Salinas, and Dr. Katie Mawhinney (Appalachian State University), Dr. David Pugalee and Dr. Victor Cifarelli (University of North Carolina at Charlotte), Dr. Shelby Morge (University of North Carolina at Wilmington), Ms. Sharilyn Owens (Wilkes Community College), and Ms. Paula Savich (Mayland Community College).

Math and Marriage - Don't Call a Lawyer Yet, Ron Gould, Emory University
Abstract: Beginning with Philip Hall's famed "Marriage" Theorem in 1935, the study of marriages (or matchings) has seen significant development, both theoretical and algorithmic. Taking a graph theoretic point of view, we will consider a number of "marriage" questions including:

1. When can a set of k marriages be found?
2. When we can find a set of k marriages, are there ways to optimize the pairings? Here we consider the famed stable marriage theorem.
3. What ways are there to generalize the idea of marriage? The roommate problem and multi-matchings will be considered.
4. What can we say about these generalizations? Is there an optimum form of marriage?

On the Location of Zeros of Polynomials, Narendra Govil, Auburn University, Auburn, Alabama
Abstract: Let $p(z) = \sum_{\nu=0}^{n} a_\nu z^\nu$ be a polynomial of degree n. Then the problem of finding the smallest region containing all the zeros of a polynomial has been of great interest, and there is always a need of better and better results because of its applications in many areas, such as signal processing, communication theory and control theory. The first result in this subject is due to Gauss, which was improved by Cauchy, who proved Let $p(z) = z^n + \sum_{j=0}^{n-1} a_j z^j$, be a complex polynomial, then all the zeros of p(z) lie in the disc

$$\{z : |z| < \eta\} \subset \{z : |z| < 1 + A\}, \tag{1}$$

where $A = \max_{0 \le j \le n-1} |a_j|$, and η is the unique positive root of the real-coefficient polynomial

$$Q(x) = x^n - |a_{n-1}|x^{n-1} - |a_{n-2}|x^{n-2} - \cdots - |a_1|x - |a_0|. \tag{2}$$

The above result of Cauchy has been sharpened by many people, including Joyal, Labelle, and Rahman [Canadian Math. Bull., 1967], Datt and Govil [Jour. Approx. Theory, 1978], Zilovic, Roytman, Combettes, and Swamy [IEEE Trans. Circuits Syst., 1992], and Sun and Hsieh [IEEE Trans. Circuits Syst., 1996]. In this talk we will present some generalizations and refinements of the above Theorem.

The Degree Distance vs. the Wiener Index, Daniel Gray, Georgia Southern University, Hua Wang, Georgia Southern University
Abstract: The degree distance of a graph G is defined as $D'(G) = \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n}(d_i + d_j)L_{i,j}$, where d_i and d_j are the degrees of vertices $v_i, v_j \in V(G)$, $L_{i,j}$ is the distance between them. The Wiener index is defined as $W(G) = \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} L_{i,j}$. Both indices were raised in chemical research, their mathematical properties have been studied vigorously in the past two decades. An elegant result is known regarding their correlations, that $D'(T) = 4W(T) - n(n-1)$ for a tree T with n vertices. In this note we consider this question for other graphs that have frequent appearance in the study of these indices. In particular, we develop a formula regarding their correlation, with an error term that is presented with explicit formula as well as sharp bounds for cycles, unicyclic graphs, and cacti with given parameters. The extremal structures that maximize or minimize this error term are also identified.

Magic Squares of Fixed Line Sum, William Griffiths IV, Southern Polytechnic State University
Abstract: A magic square is an nxn matrix with non-negative integer entries in which the sum of each row and column is fixed. Enumerating these objects has been an ongoing quest for more than 40 years. For magic squares of fixed line sum, we have only answered the first few cases. Trivially, magic squares of line sum 1 are permutations. The number of magic squares of line sum 2 has been known for some time, but we shall present a simple, combinatorial proof using a new method. This method is then extended to enumerate magic squares of line sum 3, as well as progress on the case of line sum 4. This talk will be accessible to undergraduates.

Suspension Profiles, Charles Groetsch, The Citadel
Abstract: The standard model of a uniform roadbed suspended from an essentially weightless cable constrains the suspending cable to conform to a parabolic shape. But what if the roadbed is not uniformly loaded? We characterize the shape of the suspension cable in this case and show that the catenary is a special case. Additional properties of such "suspension profiles" are discussed and the work of a seventeenth century Jesuit savant makes a cameo appearance.

Generalized Fibonacci Sequence mod n and its Period Function, Chuya Guo, Agnes Scott College, Alan Koch, Agnes Scott College
Abstract: We study the generalized Fibonacci sequence mod n for some positive integer n. Such sequences are periodic and we let $k(n)$ denote the period. The inverse problem is: given a positive integer m, does there exist an n with $k(n) = m$? The answer to this question is affirmative in the case where m is square-free.

Ramanujan Congruences for Partition Related Eta-quotients, Hudson Harper, University of South Carolina
Abstract: In a 1919 paper, Ramanujan proved his three eponymous congruences for the integer partition function using identities of q-series. Since then, combinatorial identities, properties of Eisenstein series, and other methods have been employed to prove these results. In 1981, Serre proved there exists a finite list of lacunary powers of the eta function. From these lacunary functions, Ramanujan's congruences can be proven in a new way. In this talk I will prove how congruences, similar to Ramanujan's, of general partition functions may be proven using the lacunarity of specific eta-quotients. A background in algebraic number theory or modular forms will not be necessary for the audience. All relevant terms and methods will be introduced.

The Q Perception, Queen W. Harris, Georgia Perimeter College
Abstract: Participants will see an amazing technique used in integration when u-substitution might be a method of choice. This innovative method saves students time and leaves teachers excited about grading homework! WOW!

Equilibrium of Shortest Path Load in Ring Networks, Jason Hedetniemi, Furman University
Abstract: Given an undirected network, we consider a network congestion game where each vertex (considered an agent) in the network needs to pass a message to every other vertex in the network. As these agents pass messages along edges of the network, congestion occurs, slowing communication and forcing agents to find alternate routes in passing information in future iterations. We investigate whether this game over time reaches an equilibrium with regard to edge load for ring networks. We also consider the changes that occur to this load equilibrium upon the introduction of new edges.

Integral Calculus in a One-Semester Calculus Course, Michel Helfgott, East Tennessee State University
Abstract: The Symbiosis project at ETSU (2006-2010), funded by the Howard Hughes Medical Institute, is a three-semester integrated sequence of biology, mathematics, and statistics for freshman-sophomore students. The first semester has a strong statistical component, while the second semester is mostly calculus and biological topics with links to calculus. The third semester is oriented toward bioinformatics, including analysis of microarray data, and other mathematical and statistical topics. I will explain how we approach the challenge of teaching the essentials of integral calculus through a combination of technology, relevant applications to biology, and standard mathematical techniques.

Mathematical Principles of Military Combat and Counter-Insurgency, Luis Hercilla-Heredia, UNC Greensboro
Abstract: Abstract: This research involves the use of mathematical techniques to derive theoretical criteria for the outcome of military combat and counter-insurgency combat. The mathematical techniques used include Dynamical Systems, Theory of Linearized Stability, and Non-Linear Differential Analysis. Generalized Mathematical models are constructed depicting various scenarios of military combat involving a regular army and guerrilla forces. In particular this work is more realistic than previous existing models and analyses. For each of the military models, explicit operational outcomes are calculated and analyzed for exploitable advantages. The research also shows mathematically the validity of some essential principles of combat derived in the past and used at present.

Binet's Formula Mod p, Curtis Herink, Mercer University
Abstract: Binet's formula gives a closed-form representation of the Fibonacci numbers $(1, 1, 2, 3, 5, 8, \ldots)$, where $F_n = F_{n-1} + F_{n-2}$. If we use the same recurrence to define a sequence of members of the finite field with p elements, the result is the sequence of Fibonacci numbers mod p, which is necessarily cyclic. It is again possible to give a closed-form representation of the terms, which is very similar to the usual Binet's formula unless $p = 5$. We use this formula together with standard results from number theory and the theory of finite fields to draw conclusions about the cycle length for the Fibonacci numbers mod p.

Analysis of Pawpaw Leaf Characteristics: An investigation of possible hybridization with Asimina triloba and Asimina parviflora in South Carolina, Olivia Hightower, Presbyterian College
Abstract: Physical characteristic data of pawpaw leaves was collected during Summer 2009 in the midlands of South Carolina. The purpose of this study is to determine whether pawpaw species is related to three physical characteristics of the leaves: leaf length, leaf length to widest, and leaf width. Three statistical approaches are employed: analysis of variance, a nonparametric equivalent, and bootstrapping.

The "Magicness" of Powers of Some Magic Squares, Rebecca Hillman, University of South Carolina Sumter, Charles Cook, University of South Carolina Sumter, Michael Bacon, University of South Carolina Sumter
Abstract: Powers of matrices representing a variety of classical magic squares are computed and conditions that guarantee their magic properties are explored.

The Gap Number of the T Tetromino, Robert Hochberg, East Carolina University
Abstract: We prove in this paper that the gap number of the T tetromino is finite. In particular, every rectangle having both sides at least 12 can be tiled with T tetrominos and at most 20 1x1 monominos. On the other hand, rectangles of width 11 can require arbitrarily many monominos in a tiling by T tetrominos and monominos.

A Collaborative Learning Approach to Precalculus and College Algebra, Sarah Holliday, Southern Polytechnic State University, Jennifer Vandenbussche, Southern Polytechnic State University
Abstract: Research has shown that students who engage in a hybrid lecture-workshop class outperform their peers who receive instruction only in a lecture environment. There have also been studies indicating that students' attitudes toward mathematics are improved by a cooperative learning environment (Springer, Stan, Donovan 1997). Since most STEM majors at SPSU require at least three semesters of mathematics beyond Pre-Calculus, maintaining the students' interest in mathematics is necessary for retaining them in their STEM fields. We offer hybrid sections of College Algebra and Pre-Calculus. In this talk, we will discuss strategies employed and successes achieved using these techniques.

Knots vs Graphs: An Epic Tale of Survival!, Hugh Howards, Wake Forest University
Abstract: One reason that both knots and graphs are exciting mathematical objects is their accessibility. It is not hard to pose open questions understandable to bright high school students in ether field. We reprove a surprisingly simple and elegant theorem by John Conway and Cameron Gordon about the dramatic struggle between knots and graphs. It has led to countless papers, including many by undergraduates. It also gives us a springboard into several of the author's recent results as well as some of those open questions previously mentioned. No experience with knot or graphs is necessary for this talk.

Gian-Carlo Rota in some history of Umbral Calculus, Katherine Humphreys, FAU
Abstract: In the early 1960's Gian Carlo Rota defines a functional L which he believes gives a more natural definition of the Bell numbers demonstrating rigorously an example of Umbral Calculus: $B_n = L(u^n)$. *Umbral* means *shadow* in Latin. In the Umbral Calculus from Blissard of 1864, a sequence of numbers $a_0, a_1, a_2, \ldots$ would be represented by a sequence $a^0, a^1, a^2, \ldots$ in order to use notation of the form e^{ax} to represent the series $\sum a_i \frac{x^i}{i!}$, or the notation $(a+x)^n$ to represent a polynomial $\sum \binom{n}{i} a_i x^{n-i}$. Rota then learns about polynomial sequences of binomial type which have the property that $b_n(x+y) = \sum_{k=0}^{n} \binom{n}{k} b_k(x)\, b_{n-k}(y)$ and he sets off to make Umbral Calculus rigorous! Along the way, Finite Operator Calculus, a theory of operators on polynomials is expanded and polynomials are shown to count combinatorial objects. In 1994, Rota turns back to the original thought of a functional and gives "Classical" Umbral Calculus a rebirth.

Classifying the Vertices of a Digraph using Markov Chain Theory, Keshav Jagannathan, Coastal Carolina University
Abstract: This presentation focusses on linking two fields of mathematics. Vertices of a digraph are classified using Markov Chains. A few preliminary results using two different approaches are presented.

Splicing Graceful Labelings of Caterpillars, Michael James, Georgia College & State University
Abstract: Work has been done on calculating the number of graceful labelings of paths, but what about slightly more complex graphs? The next most simple class of trees is caterpillars—more specifically, r-regular caterpillars, where each vertex in the caterpillar's spine has r-leaves attached to it. In this paper we will obtain a lower bound on the number of graceful labelings of these types of graphs. We will show how to combine two such graphs to generate larger and larger gracefully labeled graphs which we can then count by employing an inductive proof.

The 15 Puzzle, Kelsey Johnson, Elon University
Abstract: Sam Loyd's 15 Puzzle will be examined to attempt to find a solution to his original puzzle: can you switch

the positions of two adjacent blocks while returning all other blocks to their original position? It will be proved why this is impossible set up of the board, and alterations will be made to the puzzle to make it possible to solve. Similar arguments will also be generalized about other size boards.

Queueing Model for "Congestive" Systems, Mike Johnson, Meredith College
Abstract: What do wireless networks and interstate highways have in common? Both systems have the interesting property that actual service time per request increases in response to offered load. This is distinctly different from the familiar experience of total system time increasing due to increased waiting time in a queue: On a packed highway, for example, cars simply cannot move as quickly as they can on an open road. In wireless networks, two requesters trying to broadcast at the same time effectively jam each others' signals, necessitating re-broadcasts. I will show that complex "congestive" systems such as these can be effectively modeled as a single queueing system with unknown bandwidth. A nonlinear regression then yields the effective bandwidth of the congested system as a function of offered load, as a fit to observed total system times.

Harvesting the Fruit: a Panel Discussion of Undergraduate Researchers, Corey Jones, UNC Asheville, Erin Luther, UNC Asheville, Cindy Cook, Catawba College
Abstract: As summer undergraduate research programs vary dramatically in their methods and structures, students taking part in such programs have dramatically varying experiences. This panel will allow several recent student participants in regional undergraduate research programs the chance to describe the ups and downs of their summer experiences.

Substructures of Endomorphism Near-rings, Corey Jones, University of North Carolina, Asheville
Abstract: For a group G, the endomorphism near-ring $E(G)$ is a natural algebraic structure generated by the set of endomorphisms of G. We define certain sub near-rings of $E(G)$ that correspond to subgroups of G, and using these we demonstrate several results linking the ideal structure of $E(G)$ to the subgroup structure of G.

How to implement Mathematical Induction in the Classroom, Leandro Junes, University of South Carolina Sumter
Abstract: In this talk I will discuss an approach to teaching mathematical induction to undergrad students. It will principally focus on the meaning of induction and its importance in mathematics. I will also talk about fallacies and paradoxes that are relevant to this topic.

Math and Fabric Art, Samuel Kaplan, UNC Asheville, Ida Bostian, UNC Asheville
Abstract: Hands-on sewing projects strengthen the understanding of geometric and topological concepts. A joint drama and math department course for freshmen teaches students sewing skills and covers topics of an elementary topology course where the assignments are all fabric art projects.

Teaching Differential Equations Inquiry-Style, Karen Keene, North Carolina State University
Abstract: In this short course, Dr. Karen Keene will present some of the material in an innovative first semester differential equations course. The course is inquiry-oriented, in that the students work on context based tasks to learn the conceptual underpinnings of finding solutions and structuring solutions to differential equations. Then they reinvent the solution methods for first order and linear systems of differential equations. Emphasis is on qualitative analysis of solutions. Those attending will work through some of the tasks that are used in the materials and with the Java applets that the course uses. Experience with Differential Equations is not required. These materials are new and were developed by Dr. Chris Rasmussen of San Diego State University and colleagues. They have been used in approximately 20 universities in the United States and Korea. Last year, they were used at Elon University, North Carolina.

Role of Bases and Wavelets in Stocastic Processes, Sujin Kim, Savannah State University
Abstract: The fractional Brownian motion has been used in interpolating, generating images, modeling hydrological phenomena, analyzing network traffics, generating random landscapes, classifying textures, modeling of errors in communication channels, $1/f$ noise in oscillators, current noise in metal films, semiconductor devices, and financial mathematics. Study of wavelets has motivated in data processing, signal processing, changing finger prints into digital data files, and subdivision algorithms for graphics. Wavelets have a certain form of self-similarity which makes the theory suited to analyze the fractional Brownian motion to study its statistical self-similarity since they lead to a multi-resolution analysis of the underlying signal. Wavelets-based methods have been used to analyze the fractional Brownian motion. What I have been trying to develop is framework for constructing wavelet representations of the fractional Brownian motion because both the fractional Brownian motion and wavelets are of great interest in applications.

Investigation of the Independence Assumption in Capture-Recapture Methods in Epidemiology, Heather

King, Georgia Southern University, Patricia Humphrey, Georgia Southern University
Abstract: In this paper, we will quantify the effects of violating an important (and often ignored) assumption in the application of capture-recapture methods in epidemiological studies. Capture-recapture methods have traditionally been used to estimate the abundance of some animal species. These methods have been adapted for use in human population size estimation. Although there exist a set of assumptions that should be reasonably satisfied before employing capture-recapture methods in human population size estimation, we choose to focus on one: independence among data sources. This paper is a study and interpretation of the effects of departures from independence in two-list and three-list capture-recapture applications on the well-known Chapman estimator. The Chapman estimator has been used in the literature extensively for two-list systems. We propose another estimator for three lists that is based on the Chapman estimator. After quantifying the effects of departures from independence on the Chapman estimator in two lists, we will examine the effects of departures from independence among the three lists. The results from two-list and three-list systems will then be reported, interpreted, and compared. Finally, the performance of both estimators will be compared to the estimate derived from log linear modeling, a considerably more complex method that tolerates dependency among data sources.

Graph Theory and Neural Networks, Jeff Knisley, East Tennessee State University, Debra Knisley, East Tennessee State University
Abstract: A predictive model uses data to estimate the probability distribution of a model outcome. Often these models involve data mining and machine learning, and often the predictive ability of these models can be enhanced through the use of graph theory. In this talk, we introduce and explore two predictive models in computational and molecular biology that combine graph theory with neural networks. The talk will be accessible to anyone with a background in calculus and some familiarity with graph theory.

Some Interesting Properties of 7-core Partitions, Louis Kolitsch, UT Martin
Abstract: By dissecting the generating function for 7-core partitions, it can be shown that the number of 7-core partitions of certain values of k can be expressed in terms of the number of 7-core partitions for other values. For example, $a(13n + 11) = 7a(5n + 3)$ provided n is not congruent to 12(mod 13) or 4(mod 5) where $a(k)$ is the number of 7-core partitions of k.

Mathematical Culture Shock, Trent Kull, Winthrop University
Abstract: Sudden immersion in the world of mathematics can lead to a "culture shock" of sorts for the undergraduate student. The symbols, vocabulary, language, and logic associated with a formal study of subjects such as calculus, analysis, and linear algebra may overwhelm and demotivate aspiring mathematicians. We will look at several instances where this can occur, and discuss ways to enhance student and instructor success in these situations.

Proving the Existence of Positive Solutions to Various Singular Boundary Value Problems, Curtis Kunkel, University of Tennessee at Martin
Abstract: This talk will focus on the study of singular boundary value problems, focusing mainly on a second order ordinary differential equation of the form, $u''(t) + f(t, u(t)) = 0$, for $t \in (0, 1)$ with $u'(0) = u(1) = 0$. We assume that $f(t, x)$ is continuous on $[0, 1] \times R$ and that f has a singularity at $x = 0$. An overview of the proofs required in attaining a positive solution by means of a lower and upper solutions method, application of the Brouwer fixed point theorem, and perturbation methods to approximate regular problems will be illustrated. In addition to the second order example given above, a general overview of the current state of research in this area will also be presented, along with references to the journal articles from which the talk was based. This talk is intended for undergraduates having only knowledge of an introductory differential equations course and perhaps an intro to Real analysis course.

Clicking Away in Introductory Statistics, Aprillya Lanz, Virginia Military Institute
Abstract: The classroom response systems have become a popular tool to use in the classroom. Many studies have shown that classroom response systems, commonly known as *"clickers"*, increase students participation and engagement in lectures. This talk will present and discuss the implementation of clickers in some mathematics courses at Virginia Military Institute, especially the Introductory Statistics course. Because of VMI's unique academic environment, it is a common obstacle across the campus to maintain student's attention in class, making VMI an ideal place to implement clickers in the classroom. The technology was used to foster a transition from a passive to an interactive learning environment in mathematics courses. This talk will discuss how the clickers are used, comparison of test scores, and student responses.

History of Mathematics at VMI, Aprillya Lanz, Virginia Military Institute
Abstract: Virginia Military Institute is a four-year undergraduate college that carries a lot of history. It was founded as the first state military college in 1839. During the early years of VMI, there were many significant contributions

made by mathematicians at VMI. This includes the first Superintendent. This talk will present the timeline of mathematics faculty at VMI and their involvement in the academic growth of VMI.

Optimal Anchoring and Motion Control of a Wave Energy Converter, Jeff Lawson, Western Carolina University, Murugan Vinayagam, Western Carolina University

Abstract: A Wave Energy Converter (WEC) is a device that generates electricity from the periodic motion of ocean surface waves. One type of WEC floats, but must be anchored to the seabed. In this study, we seek to optimize the cost of anchoring a WEC by varying the thickness of the cable. We will optimize to determine the thickness of the cable and the trajectory of the cable in a flat seabed, two anchors in two-dimensions; an inclined seabed, two anchors in two-dimensions; and a flat seabed, three anchors in three-dimensions. We will also look at the dynamics of a moored WEC using variational calculus.

On the Extremal Problem of Polya, Tuan Le, Fairmont High School

Abstract: The notion of transfinite diameter of planar sets was introduced by M. Fekete around 1920s. This concept plays an important role in the classical complex analysis and is related to other well-known concepts such as the logarithmic capacity and Chebyshev polynomials. The transfinite diameter of a compact set is the limit of n-diameters. For each $n \geq 3$, the n-diameter $d_n(E)$ of E is given by

$$d_n(E) = max \prod_{1 \leq i < j \leq n} |z_i - z_j|^{\frac{2}{n(n-1)}} \tag{3}$$

The following is the extremal problem of G. Polya: among all n-tuples $E = \{z_1, z_2, \cdots, z_n\}$ with $|z_i| \leq 1$, find one with the largest n-diameter. The solution of this problem, attributed to Polya, is the following

$$d_n(E) \leq n^{\frac{1}{n-1}} \tag{4}$$

and the equality holds for n-tuples of equally spaced points on the boundary of D. While investigating the transfinite diameter of sets of constant width, Prof. Zair Ibragimov was led to the following weaker version of Polyas problem: among all n-tuples $E = \{z_1, z_2, \cdots, z_n\}$ with $|z_i - z_j| \leq 2$, find one with the largest n-diameter. In this paper, I will present my solution of Ibragimovs problem for the case $n = 5$ and approach for $n = 7$. I will also discuss why other cases can not be proved using the same method as for $n = 5$.

The G-Translativity of Abel-Type Transformations, Mulatu Lemma, Savannah State University

Abstract: Suppose $0 < t_n < 1$ and $lim_{n\to\infty} t_n = 1$ then the Abel-Type matrix, denoted by $A_{\alpha,t}$, is the matrix defined by

$$a_{nk} = \binom{k+\alpha}{k} t_n^k (1-t_n)^{\alpha+1}, \alpha > -1. \tag{5}$$

Recently the author proved that the Abel-Type matrix $A_{\alpha,t}$ is ℓ-translative. In this paper, we investigate the G-translativity of these fascinating transformations.

Optimal Play In A Solitaire Game With Switches, Thomas Lewis, Furman University, Kyle Tenke, Furman University

Abstract: We consider a solitaire game consisting of a row of switches whose operation is governed by a strict set of rules. We consider the problem of determining the smallest number of moves in which such a row of n switches, which are all on, may be turned off. This problem, for the cases $n = 1, \ldots 10$, is from *Problem Solving Through Recreational Mathematics*, by Bonnie Averbach and Orin Chein. Our analysis of the general case involves the triangular numbers.

Modeling the Spread of Alliaria Petiolata across Different Landscape Distributions, Michael Lomuscio III, Western Carolina University

Abstract: Invasive plant species are believed to be the second greatest threat to biodiversity within the plant community. Among these invasives is the noxious weed Alliaria petiolata, otherwise known by its more common name: garlic mustard. Because garlic mustard is such an aggressive and entrenching invasive species, modeling its spread across landscapes and being able to predict where it will travel is an invaluable tool in the battle to protect landscapes and their biodiversity. We model the spread of garlic mustard using a stochastically driven simulation in order to determine landscape characteristics that drive or dampen its spread.

Non-perturbation Structure of Unsteady Plane: Shock Waves in a Viscous Heat-conducting Gas, Shan Manickam, Western Carolina University

Abstract: An non-perturbation model for an unsteady plane shock wave in a viscous heat-conducting gas is derived and an exact solution of this is obtained with the Prandtl number of three quarters. This solution agrees with most steady state solutions in the literature, with appropriate modification for the unsteady nature of the flow.

Which Chessboards have a Closed Knight's Tour within the Rectangular Prism?, Bindia Mathew, Kennesaw State University, Joe DeMaio, Kennesaw State University
Abstract: A closed knight's tour of a chessboard uses legal moves of the knight to visit every square exactly once and return to its starting position. In 1991 Schwenk completely classified the rectangular chessboards that admit a closed knight's tour. In honor of the upcoming 20th anniversary of the publication of Schwenk's result, this talk extends the result by classifying the rectangular prisms that admit a closed knight's tour.

Women and Mathematics in the Time of Euler, Betty Mayfield, Hood College
Abstract: In the past couple of years, we have celebrated Everything Euler - his life, his work, his legacy. This talk, which grew out of a summer research project with undergraduate students, examines some female contemporaries of Euler, some famous, some not so famous. We will also look at mathematics that was written both by and for women in the time of Euler.

Developing an Introductory Scientific Computing Course for Mathematics Majors, Erin McNelis, Western Carolina University
Abstract: Are you having a hard time finding a course and/or text that mixes the right portions of algorithm development, programming, computational mathematics, and problem solving? This session will discuss the ongoing modification of an introductory course in scientific computing designed to familiarize mathematics majors with a variety of mathematical software packages (numerical, symbolic, graphical, and system dynamics) in the context of mathematical modeling, simulation, and mathematical problem solving. Software used has included MATLAB, Octave, Maple, Mathematica, Vensim, Excel, C, and NetLogo. As the result of the course, students also become proficient users of LaTeX, a typesetting system for scientific documents.

Galois Groups of Quartic Polynomials, Kate Melhuish, Western Carolina University
Abstract: We will discuss the problem of determining the Galois group of polynomials of fourth degree (quartic polynomials) from its coefficients. In addition we will discuss irreducibility criteria for quartic polynomials. We will apply these criteria to find the Galois group of special quartic polynomials in a more elementary manner.

Agent-Based Simulations of Acquired Immunity for Malaria Endemic Populations, Mary Minor, Elon University
Abstract: Mathematical models can be used to predict how a disease spreads through a population. The use of a model allows for a better understanding of how specific factors will accelerate or reduce the spread of a disease. Malaria is a serious disease affecting 40% of the world's population, and killing over 1 million people each year. Creating a model of the spread of malaria through a population can aid in the control of this devastating disease. Through this research an agent-based simulation has been created that can model the spread of malaria in a population that has acquired immunity. Acquired immunity is gained through repeated exposure to malaria and can either prevent a person from contracting malaria or allow them to only have a milder form of the disease. The agent-based simulation models the individual interaction of members of the different populations involved in the spread of malaria and keeps track of the changes in the populations as a result of these interactions.

Effects of Linear and Exponential Increases of Radiative Forcing on Temperature, Andrew Moss, Clemson University
Abstract: In this talk, the climate model from "Simple Climate Modeling" (Tung, 2006) is used to compare temperature changes resulting from linear and exponential radiative forcing. This model takes into account feedback from a change in temperature. The model's response to a cap on radiative forcing is also explored.

Factoring Polynomials of Type $(x-a_1)(x-a_2)\cdots(x-a_n)\pm 1$, Stephen Nanney, Western Carolina University
Abstract: We will consider polynomials of degree n with integer coefficients of type $(x-a_1)(x-a_2)\cdots(x-a_n)\pm 1$ such that $a_i \neq a_j$ for $i \neq j$ $(i,j=1,2,\ldots,n)$. Our goal is to determine the coefficients of these polynomials for which they can be factored as a product of two polynomials with integer coefficients.

A Distortion Theorem for Univalent Functions Defined using the Salagean Differential Operator, Ben Ntatin, Austin Peay University
Abstract: We give a distortion theorem for a subclass of functions that are univalent in the unit disk, and defined using the Salagean differential operator. The result generalizes and unifies similar well known results for several

subclasses of univalent functions defined on the unit disk, of the form $f(z) = z + \sum_{n-2}^{\infty} a_n z^n$, normalized such that $f(0) = 0$, and $f'(0) = 1$. In particular, the result generalizes known results on the subclass of Bazilevic functions.

Cycle Space of the Closed Orbit of a Semi-simple Lie Group Acting on a Flag Manifold, Ben Ntatin, Austin Peay University
Abstract: Abstract: Let $Z = G/Q$ be a flag manifold of a complex semi simple Lie group G, and $G0$ a real form of G. Both $G0$ and K, the complexification of the maximal subgroup of $G0$, act on Z with finitely many orbits, and as such, at least one open orbit. All the other lower dimensional orbits lie in the boundary of this open orbit, and the smallest orbit is unique and closed. The open orbits have been studied extensively. It is our aim in this talk to focus on the unique closed orbit and use the Matsiki duality to characterize the cycle space associated to this closed orbit.

Heegaard Diagrams, Karoline Null, University of Tennessee Martin
Abstract: A Heegaard diagram gives both a splitting for a 3-manifold and a group presentation. How is the 3-manifold related to the group presentation? In this brief talk I will spend the majority of the time explaining how a Heegaard diagram determines these two objects, and then state my result and a few important points in the proof, time permitting.

Mathematical Models of Malaria, Sarah Oberst, Davidson College
Abstract: Malaria is an infectious disease that causes approximately 10 million deaths annually, primarily among children in sub-Saharan Africa. The disease is transmitted by mosquitoes, and is estimated to slow economic growth in afflicted countries by 1.3% per year. This paper develops a discrete deterministic model for the transmission of the disease in human and mosquito populations. We then explore a Markov Chain version of the model, and compare the results. Finally, both models are used to explore the impact of various interventions which may lower the death rate from the disease.

Building a Labyrinth in the Back Yard - Geometrical Challenges, Brian O'Connor, Tennessee Tech University
Abstract: A labyrinth is often confused with a maze, but differs from it in that a labyrinth usually has a single, non-branching path that leads to the center. It is often used for prayer or meditation. A famous labyrinth is in France, constructed sometime about the year 1220 in the floor of the Cathedral at Chartres. This presentation will discuss the geometrical challenges encountered in attempting to replicate the Chartres labyrinth in my back yard using concrete pavers.

Analysis of a Regenerative Stirling Engine, Jack Pace, Southern Polytechnic State University
Abstract: A Stirling engine is an external-combustion, closed-cycle heat engine in which air is the working fluid, and is of interest as a replacement for standard petroleum-based engines. Stirling engines are capable of very high efficiency, provided they have an efficient regenerator, which is a device that absorbs heat energy during part of the cycle, and stores it for re-use during a later part of the cycle. This paper presents several ways of modeling a Stirling engine's dynamics and thermodynamics. Mathematical analysis of the regenerator is the most difficult part. The resulting D.E. system is solved numerically, and the computer program draws a moving diagram of the engine running, and also graphs the fundamental variables of the motion as they change with time. Actual small models of this type of engine will also be shown.

A 2008 Student-run Exit Poll and Clustering, Jason Parsley, Wake Forest University, Annalaissa Johnson, Wake Forest University
Abstract: In 2008, a group of first-year Wake Forest students conducted an exit poll within our home county [Forsyth]. We successfully predicted the races for president, senate, governor, & local bonds, all posted within an hour of polls closing. This talk will describe the methods & results of our exit poll. Time allowing, we discuss a clustering of the 100+ precincts in the county & how it helps our understanding. See www.wfu.edu/ parslerj/exitpoll/

Observations on a Lecture by Robert Moses, David Peifer, UNC Asheville
Abstract: Robert Moses gave the keynote lecture at the Asheville Math Submit, held at UNCA about two years ago. When I first heard he was coming I was intrigued that a civil rights activist from the sixties would be giving a talk sponsored by the Math Department. He had been an early member of the Student Nonviolent Coordinating Committee (SNCC) and had helped to organize voter registration programs in the deep south. I did not know what he had to do with mathematics. By the time I had learned more about him, and his work as an educator, my understanding of mathematics education in America had changed. I'll give a short introduction on Robert Moses and his work with the Algebra Project. This foundation is working to improve the mathematics skills of students in low income and minority communities across the country. Robert Moses' lecture that night was evidence that he is not only a great orator but also a great teacher. I will discuss his lecture and a few of the lessons that I learned that evening.

Hidden Linearity, Convexity, and Separability in Nonlinear Programming, Elmor Peterson, Systems Science Consulting

Abstract: Geometric programming (GP), including both the original prototype algebraic case (AGP) and its various non-algebraic generalizations (GGP), has increased greatly in importance while evolving over the past 50 years. The true essence of AGP will be illustrated and clarified in an extremely novel way, using only introductory single-variable differential calculus on two simple concrete examples – the optimal sizing of a wire, and the optimal transport of gravel across a river. The speaker (one of three originators and principal developers of GP) will also describe the industrial problems that stimulated the discovery and subsequent development of AGP, as well as some of the political difficulties of implementing new mathematical methodology in industry, business, and government. His lecture notes (including references) will be made available to attendees who wish to use AGP to motivate a study of elementary multi-variable differential calculus and/or introductory linear algebra for students who have completed only a study of the optimization of the elementary functions normally taught in Differential Calculus I. If time permits, the speaker will also describe somewhat more advanced topics, such as the mathematical duality between AGP and Shannons Information Theory, as well as relatively new applications of GGP – to the iterative numerical solution of large-scale systems of linear equations and/or linear inequalities (including those resulting from both large-scale Markov chains and large-scale linear optimization problems).

Methodology of Teaching Between a Military and Collegiate Environment, Mark Pierce, Macon State College

Abstract: As a non-traditional, first-time collegiate professor, having come from a military and industrial background, there are unique differences in the teaching methodology used in the military/industry and that found in a traditional academic environment. The talk will focus on comparing and contrasting these different teaching methodologies employed by the military, primarily, as well as those found in traditional academia. Additionally, a brief discussion will include the adjustments that had to be made between the two environments, the successes as well as valuable lessons learned.

Examining Life's Big Questions in Contemporary Math (?!), Jeffrey Powell, Samford University

Abstract: What is truth? What does it mean to be human? How do we determine what is fair and just? These are the types of questions students are typically encouraged to wrestle with in many humanities courses, but they rarely make appearances in science and mathematics courses where the focus is often on technical insight and proficiency. In this talk, I will discuss my approach to incorporating some big questions into one of my contemporary math courses (Math 110). This experiment is part of a Teagle Foundation grant awarded to one of my colleagues to frame teaching and research in the sciences and mathematics using the big questions of meaning and value.

Introduction to LaTeX, Nell Rayburn, Austin Peay State University

Abstract: Designed for beginners to LaTeX, this hands-on short course is designed to teach participants how to create documents and typeset mathematical expressions. We will also discuss issues involved in installation of a LaTeX system on a personal computer. The emphasis will be on using software implementations which are free, although the TeX and LaTeX syntax that we will learn is standard across platforms. A bibliography of reference materials will be provided. At the end of the course, participants should be comfortable typesetting something like:

$$s = \sqrt{\frac{1}{n}\sum_{i=1}^{\infty} p_i (x_i - \overline{x})^2}$$

Teaching the Computation of Variance, Xavier Retnam, Anderson University, Charles Rains, Anderson University

Abstract: In the lab experiments, the numbers are measured accurate to a fixed digits of accuracy. When teaching statistics to students from Physics and Chemistry, it is important to stress the use of the alternative formula to compute the variance. In this talk we will quantify the error in using the definition of variance to compute the variance while rounding off the measured values to fixed significant digits.

Toric Models for Generating Biological Sequences, Rebecca Rodger, Samford University

Abstract: This talk concerns *toric models*. Let A be a non-negative integer $d \times m$ matrix, such that all column sums of the matrix are equal. The *toric model* of A is defined to be $f : \mathbf{R}^d \to \mathbf{R}^m$, where $f(\theta) = (p_1, p_2, \ldots, p_m)$, and for each j, $\theta^{a_j} = \theta_1^{a_{1j}} \cdots \theta_d^{a_{dj}}$, a monomial, and $p_j = \frac{\theta^{a_j}}{\sum_k \theta^{a_k}}$. Note that all the monomials θ^{a_j} have the same degree. To interpret this *toric model*, let Σ be an alphabet of size m. Then $f(\theta)$ represents the probabilities of

obtaining the letters of Σ. For example, this model can be applied to DNA sequences, which consist of words from the alphabet $\Sigma = \{A, C, G, T\}$, where each letter represents the four nitrogen bases: Adenine (A), Cytosine (C), Guanine (G), and Thymine (T). We assume that an observed sequence of letters from Σ was generated independently using the probabilities in $f(\theta)$. Let u_j = the number of times the j^{th} letter of Σ occurs. A key problem is to estimate the probabilities of the model and to find the parameters θ that best represent the given data using the method of maximum likelihood. Various methods will be presented for solving these maximum likelihood problems, which involve Lagrange multipliers and linear algebra. This talk will also cover other applications of *toric models*. Two typical applications are to *independence models* and *Markov chains*.

Fermat's Integration, Kyle Rollins, Coastal Carolina University
Abstract: In this presentation we will investigate Pierre Fermat's solution to the integral of x^n from 0 to a. Fermat's solution handled all rational values of n except -1. Emphasis will be placed on the similarities and differences between his treatment and a modern treatment of the problem. A theme of the presentation is calculus before Newton, and in keeping with this, reference will be made to other calculus results from as early as Archimedes.

Modeling of the Kidney Transplant Waiting List, Natalie Ross, Elon University
Abstract: The kidney transplant waiting list continues to grow due to the failure of donor kidneys to counteract the number of patients who are added. A Markov chain can be used to model changes in the population between four states: healthy, waiting list, transplant, and death. Current data has been used to create a transition matrix that contains the probability of moving among the states. This matrix can be multiplied by an initial population matrix to determine the population distribution over a one year time step. Without a birth rate, the entire population enters the death state. Assuming that the birth rate is equal to the death rate, those who enter the death state will return to the healthy population. This allows for the population distribution to converge. Three stipulations, waiting one year after a transplant to reenter the waiting list, waiting one year after eligibility to enter the waiting list, and not allowing for a patient to receive more than one transplant, are applied to the transition matrix to determine if they will result in better outcomes than the current system. None of the researched stipulations benefit the population.

Isomorphism Classes of Wiring Diagrams, Joe Rusinko, Winthrop University, Patrick Dukes, Winthrop University
Abstract: Wiring diagrams appear in many mathematical disciplines. In applications, results involving wiring diagrams depend not on the diagram itself but on an isomorphism class of diagrams. We will demonstrate a new technique for calculating isomorphism classes of wiring diagrams, and discuss the implications of these calculations have on understanding totally positive matrices.

A Mathematical Model of Stealing without Perfect Information, Jan Rychtar, University of North Carolina Greensboro
Abstract: Kleptoparasitism, the stealing of food items or other resources by one animal from another is a well studied phenomenon. Previous models of kleptoparasitism assume that both the current holder/owner as well the potential thief of the resource know the same information about it. Our model breaks the symmetry by allowing only the holder/owner to have the full knowledge. We study how the asymmetry affects the evolution of stealing and the co-evolution of related protecting behavior. We show that stealing is favored over not-stealing under more natural parameters in our asymmetrical model than in corresponding symmetrical models. This quite surprising result could mean that too much knowledge hurts (the thief). In fact, our result is a consequence of the ability of holders to assess their property and then not protecting extensively the resources of a small value (i.e. knowledge still hurts, only this time the owner). Yet, the most important feature is that even in our model, the potential thieves know something, namely that the owners know. Hence, at least to some individuals, knowledge can be beneficial after all.

Solving Initial Value Problems using Boundary Value Technique, Ramanjit Sahi, Austin Peay State University
Abstract: Boundary value techniques based on second derivative Adams-type methods (SDAMs) are applied on initial value problems. The methods are constructed through a continuous approximation of the SDAM and then are simultaneously applied to generate all approximations on the entire interval. The order and the linear stability properties of the methods are discussed. Results of numerical experiments are compared with those of existing methods in the literature.

Colonel Blotto's Combinatorial Decisions, Toby Sanders, Georgia Southern University, Hua Wang, Georgia Southern University
Abstract: We consider variations of a game called Colonel Blotto, originally from Borel in 1921. We consider optimal strategies for different versions of the game. In the original game there are two players, each beginning with a specified

number of armies. Now we have a specified number of bases in which each player distributes his or her armies amongst the bases. Neither player can see where the opponent is placing his or her armies, and after the armies are placed, the player with more armies at some base will win that base, and the player which loses the base, also loses his or her armies at that base. The object of the game is to win the most bases, but sometimes a player would not only want to win as many bases as possible, but at the same time lose as few armies as possible. In search for the results, we were able to represent the expected number of bases won, lost, tied, and expected number of armies lost as a summation of numbers of partitions, and showed which partitions optimized a winning strategy. It was found that an equal distribution of ones armies amongst the bases would produce the largest value for the expected number of bases won, however when factoring in wanting to lose as few armies a possible the results were somewhat different.

Catch Me If You Can: Geographically Profiling Serial Burglars, Whitney Sanders, Wofford College, Corey Gelbaugh, Wofford College, Mitchell Worley, Wofford College
Abstract: Predicting future strike locations of serial criminals has been a subject of intense research in both the mathematical and criminological communities. As part of the MCM Mathematical Contest in Modeling, we developed a multi-scheme approach to aid local police agencies in predicting future attacks of serial burglars. Our model utilizes an assortment of existing and novel modeling techniques grounded in graph theory, set theory, Bayesian methods, and more traditional statistical approaches. The variety of approaches allows us to develop a robust prediction of future strike locations based on a diverse set of factors including the locations of past break-ins by the serial burglar, locations of past serial burglars' anchor points, and retrospective mapping of burglary hotspots within the region. Strengths of each technique are fully utilized as we correlate the predicted potential strike zones generated by the multiple methods. We conclude by critically analyzing our approaches, determining for which situations our techniques are applicable, and suggesting how to use our methods to best curb serial crime within a district.

The Structure of Mathematics as a Self-Similar Syntactic Fractal, Damon Scott, Francis Marion University
Abstract: Mathematicians already are aware intuitively that folding an if-clause into a statement, introducing an assumption into a lecture, and adding an axiom into a branch of mathematics are basically the same thing at different scales. This intuitive notion is formalized into a single new operator where they are the same thing. The general procedure is then repeated for all the other operators of first-order logic. In this way is created a system where the logic governing statements, lectures, and branches of mathematics is all the same, the only difference being one of scale.

ArcLength and Newton's Earth Radii, Andrew Simoson, King College
Abstract: This talk is meant to be a fun illustration of the use of arclength in a calculus class. In particular, in the *Principia*, Newton estimates the difference Δr in earth's equatorial and polar radii to be $\Delta r = 17.1$ miles. He also gives two old measurements: the arclength along 1° at London as 69.35 miles and the arclength along 1° at Paris as 69.10 miles. With the assumption of an elliptical earth profile, by way of a computer algebra system, Δr based on these measurements, is 128 miles! Newton's prediction of a flattened earth clashed with the reigning viewpoint on the continent that the earth was bulging at the poles. In 1736, the French launched twin expeditions to the equator and the arctic to settle this controversy. Using their new measurements along with a CAS gives close agreement with Newton's guess, (although the actual value for Δr is 13.3 miles).

Using Miller Rabin to Test for Prime Numbers, Toya Skeete, Spelman College
Abstract: The wide spread use of public key cryptography has created a high demand for quickly finding large prime numbers. In this presentation, we discuss the Miller-Rabin test for prime numbers, explain why it works, give examples, and show an extension of this test.

Journal Writing in the Mathematics Classroom , Kelli Slaten, University of North Carolina Wilmington, Yulia Coburn, University of North Carolina Wilmington
Abstract: The presenters, a beginning mathematics education professor and a beginning secondary mathematics teacher, will discuss our experiences with incorporating journal writing into our mathematics instruction. The benefits of student journal writing in mathematics are two-fold. One, students gain valuable experience in learning to communicate their knowledge of and beliefs about mathematics. Two, beginning instructors are provided with valuable information concerning their students' mathematical knowledge and beliefs. Excerpts from students' journals will be shared.

Equiangular Tight Frames and Fourth Root Seidel Matrices, James Solazzo, Coastal Carolina University, David Duncan, Coastal Carolina University, Thomas Hoffman, Coastal Carolina University
Abstract: In this talk we will explore the construction of complex equiangular tight frames (ETFs). In particular, we examine the grammian associated with an ETF whose off-diagonal entries consist entirely of fourth roots of

unity. These ETFs are classified, and we also provide some computational techniques which give rise to previously undiscovered ETFs.

Teaching Calculus Uniformly, James Solazzo, Coastal Carolina University
Abstract: In this talk we will discuss teaching muliple sections of calculus 1 uniformly. In addition, we will present data which suggests that students taught under the uniform system perform better in classes which require calculus 1 as prerequisite.

Ramsey Numbers and Ramsey Saturation of Bistars, Timothy Spencer, UNC Ashville
Abstract: The *Ramsey number* of a graph G, denoted $r(G)$, is the number of vertices in the smallest complete graph K such that any arbitrary edge two-coloring is guaranteed to contain at least 1 monochromatic copy of G. If there exists a graph of the form $G + e, e \notin G$ such that $r(G + e) = r(G)$, the graph is called *Ramsey unsaturated*, and *Ramsey saturated* otherwise. We will discuss some proof methods and results concerning Ramsey numbers of *bistars*, the development of new lower and upper limits for $r(G)$, and the Ramsey saturation of *bistars*.

Using Spherical Trigonometry to Develop Proof Making Skills in a Geometry for Teachers Course, Cynthia Stenger, UNA
Abstract: This talk describes my approach to an undergraduate course in Geometry for Prospective Teachers. It is a challenge to engage students in writing arguments or 'proofs'. The challenge heightens as high school curriculum continues to de-emphasize methods of proof and proof writing. The course begins with an investigation of axioms on the sphere which leads to some results in spherical trigonometry. Since students are unfamiliar with properties of the sphere, a discovery approach can be used to develop theorems concerning, for example, parallel lines or the sum of the angles of a spherical triangle. As students work with spherical models, tables and even calculus, they find results contrary to their intuitions, presumably from the plane. In this way, students are given the opportunity to develop and write arguments that are based on their current work, as opposed to their previous knowledge of geometry.

Four Kissing Circles, David Stone, Georgia Southern University, John Hawkins, Georgia Southern University
Abstract: Problems involving tangency conditions on circles date back to Apollonius. Descartes' Theorem for four mutually tangent circles was rediscovered in 1936 by the chemist Sir Frederick Soddy, who memorialized his result poetically as "The Kiss Precise" (also the title of a 1969 Monthly article on the result). Recently, in the Problems Section of the Journal of the School, Science ad Mathematics Association, Korbin posed the problem: given two circles with curvature 14 and 15, find two other circles with integer curvature so that each circle is tangent to the other three. We show how to find two infinite sequences of solutions and discuss their interesting geometry.

Successful Grant Writing, Tina Straley, Executive Director MAA
Abstract: Attendees should come with grant ideas written out in a 1-2 page prospectus. For the first hour, I will give them guidance on what makes a good proposal, and then in the second part, they will share their ideas and critique each others' prospectuses in a panel format.

Writing in History, Sharon Sullivan, Catawba College
Abstract: In some History of Math courses, a wide diversity of areas of math, such as probability, calculus, number theory, and geometry, are often discussed. How can we engage the student, through writing, to take into consideration this rich nature of the course? Various writing assignments, both those that worked and not worked, will be discussed.

Reality Math, Dot Sulock, University of N Carolina at Asheville
Abstract: Reality Math is a radical new approach to the general education mathematics course required for students majoring in liberal arts fields such as foreign languages, art, drama, history, literature, language, and philosophy at the college level. The approach can be trickled down to high school, middle school, and even elementary school. Instead of studying math topics which are not of interest to these students, students work on modules about real-world subjects which are of interest to them. In these modules, mathematics is used to clarify the issues. Doing the math helps understand the subjects, but doing the math also increases the numeracy of the students. Many of these students are handicapped by their avoidance of numbers and math in their daily lives. Reality Math strengthens the abilities of these mathematically-deprived students to use numbers to help themselves in many arenas, from money management to health and nutrition. Reality Math helps these students gain confidence in their ability to reason analytically, to read and understand tables, graphs, and to think using numbers, even very large numbers. They learn to overcome their confusion about measurement units from electricity to metric. The content of "Reality Math" is current and Internet-based. Reality Math modules can be done independently or cooperatively by students. Each module is 8-10 pages long and contains 20-30 questions unfolding naturally within the module. Examples of Reality Math modules are Ecological Footprint, Credit Cards, Exercise and Nutrition Labels, World Oil, etc. Dealing with real-world problems in

some depth strengthens reading skills, problem-solving skills, analytical thinking skills, and teamwork skills if working cooperatively, in addition to mathematical skills.

Paper Clip and Pipe Cleaner Geometry, Richard Summers, Reinhardt College
Abstract: Finite geometries can be taught using paper clips for the points and pipe cleaners for the lines. A set of axioms is first provided for the student, and he/she is challenged to create a model from the axioms. A list of theorems is provided and the student manipulates the pipe cleaners and paper clips to help him/her think about the possibilities for proof within a very simple axiomatic system. The approach can also be used to nicely illustrate the idea of topological equivalence.

Using Low Cost Classroom Activities to Teach Sampling Techniques, Richard Summers, Reinhardt College
Abstract: Sampling techniques need to be emphasized early in a beginning statistics class. An easy and fun way to help students learn sampling techniques is to use the class itself as a population and sample some cahracteristic of the class members using different sampling techniques. Sample statistics from each sample can then be compared to the population parameter. This teaching method can emphasize the inherent differences among the various sampling techniques, such as random sampling, stratified sampling, cluster sampling and systematic sampling and provides an opportunity to discuss the relative merits of each technique to the class.

Projects Ideas Involving Linear Algebra and MATLAB, David Szurley, Francis Marion University
Abstract: In the Spring 2009 semester, the author assigned four projects within a linear algebra course. Each project was designed to accomplish to two objectives: illustrate an application of linear algebra and introduce the students to MATLAB. In this talk, each project is described in detail. The experiences of the class as a whole and ideas for future projects will be presented.

Risk Factors for Students Success in Calculus, M. Hanif Talukder, Albany State University
Abstract: The success rate for first year calculus is around 50% through the North America. All mathematical and engineering major and several physical sciences majors require all or part of calculus sequence. Calculus is a gateway to all majors. There is a positive correlation between students who struggle in their calculus class and those who ultimately change their majors drop out from the school. The goal of this study is to find the risk factors for the student success in calculus. Statistical analysis was performed to analyze the data which is collected from calculus students in the Albany State University.

Optimal Control of Walking and Efficient Methods for Multi-Domain Simulations, Kristen Thomas, Clemson University
Abstract: This project was completed at the Cleveland Clinic's Lerner Research Center, under the supervision of Dr. van den Bogert. The goal was to implement new software packages as aids in finding optimal walking simulations. Several small optimization problems were tested before attempting the optimal walking scenario. IPOPT, a software package for solving large-scale optimization problems, was used as the aid in the creation of a MATLAB program that used mathematical equations to create a simulation for the optimal walking pattern. This optimization was based on minimizing fatigue or muscle expenditure. Through multiple tests and comparisons it was discovered that IPOT was more robust and efficient than SNOPT, the software package that was currently being used. This discovery will allow Dr. van den Bogert and other biomechanics to use this MATLAB program to create simulations that will assist in the treatment of patient aliments, such as drop foot or cerebral palsy, and in the analysis of optimal running and other movements. With more research and understanding, this program can be used in many ways to predict, analyze, and solve various medical problems.

How Big is a Big Game? Finding the Best Weights to Predict the March, Colin Thomson, Davidson College
Abstract: One can imagine without knowing a lot about college basketball that how a teams does towards the end of the season will be a better indicator of how well the team does in the tournament compared to the beginning of the season. Most sports ranking algorithms give equal weight to each game. However, exactly how valuable a game at a particular point in the season is to a team's performance in the tournament is not readily apparent. I set out to try and find approximately how how much of an influence games at varying points in the season related to the team's performance in the March Madness tournament. If the patterns of appropriate weights for each game was consistent from year to year, it could greatly improve methods of ranking teams to predict the outcome of the tournament.

Hindman's Finite Sum Theorem, Anh Tran, Georgia Southern University
Abstract: Hindman's Finite Sum Theorem states that whenever the natural numbers are colored with finitely many colors, one of the color classes contains an infinite sequence with the property that any sum of finitely many distinct elements of the sequence is again of the same color. The original combinatorial proof of 1974 was of tremendous

complexity. We present a noncombinatorial proof due to Galvin & Glazer based on the topological and algebraic structure of the space of ultrafilters over the natural numbers.

Clustering with Cluto, Mark Trawick, Davidson College, Jennings Boley, Davidson College
Abstract: Cluto is a freely available computer program capable of clustering low and high dimensional datasets using several different algorithms. I will explain a few of the algorithms, demonstrate some of Cluto's features through clustering on datasets built in to Cluto, discuss how Cluto can be applied to sports ranking and other clustering problems, and point out some troubleshooting issues that may arise.

Longest Paths in Graphs, Tzvetalin Vassilev, Nipissing University, Minko Markov, University of Sofia
Abstract:

1 Introduction

We consider undirected graphs without multiple edges or self-loops. A path in a graph is a sequence of vertices and edges such that every two consecutive edges share a vertex and no vertex is repeated within the sequence. We investigate the problem of computing the longest path in a graph. There are two versions of this problem, unweighted and weighted. In case the graph has no edge weights the length of a path is the number of edges in it. If there are edge weights the length of a path is the sum of the weights of its edges. Our results are constructive, that is, our algorithms output a longest path, not just the length of a longest path.

2 Background

Both the weighted and unweighted versions of the problem are $\mathcal{NP}$-complete. Polynomial time approximation algorithms within a multiplicative constant do not exist, unless $\mathcal{P} = \mathcal{NP}$. The best approximation algorithm has an approximation ratio which is asymptotically linear. The problem is fixed parameter tractable. Given certain restrictions on the graph, there exists an algorithm that is sub-exponential in the parameter.
Given these negative results, it is interesting to know whether this problem is tractable in polynomial time for certain restricted graph classes. In the 60's of the last century Dijkstra developed a linear time algorithm for the longest path in edge weighted trees. Since then, there has been no significant results on other graph classes until the first decade of this century. Then several researchers started developing algorithms solving efficiently the longest path problem for graph classes that admit representation in terms of generalized trees.
In 2007, Uehara and Uno proposed polynomial time algorithms for two graph classes: block graphs and cactus graphs. Block graphs are connected graphs whose blocks are cliques. The algorithm for longest path in block graphs runs in $O(n + m)$ time, where n is the number of vertices in the graph, and m is the number of edges of the graph. This algorithm is optimal in terms of the running time. Cactus graphs are connected graphs whose blocks are cycles or single edges. Their algorithm for cactus graphs runs in $O(n^2)$ time.
In 2008, Takahara, Teramoto and Uehara gave $O(n^5)$ time and $O(n^2)$ space algorithm for the longest path problem in Ptolemaic graphs. The algorithm is based on dynamic programming and uses the so-called laminar structure of the graph, a tree-like structure of cliques, some of which intersect along smaller cliques, not necessarily along a single vertex as in block graphs. There are several definitions of Ptolemaic graphs found in the literature that are equivalent. The two main ones are: (i) for every induced subgraph of size 4, the distances satisfy the Ptolemy inequality, and (ii) the Ptolemaic graphs are the intersection of the distance-hereditary graphs and the chordal graphs.
In 2009, Ioannidou, Mertzios and Nikolopolous, following upon the ideas of Uehara and Uno proposed an $O(n^4)$ time algorithm for the longest path problem in interval graphs. The algorithm is based on dynamic programming. Interval graph is a graph whose vertex set corresponds bijectively to a set of intervals on the real line and there is an edge between two vertices in the graph if and only if the corresponding intervals intersect. If the intersection is restricted to proper intersection, the graph class resulting from this restriction is called proper interval graphs.

3 New Developments

In 2009, Markov and Manev proposed a linear time and therefore optimal algorithm for the longest path problem on cactus graphs. The algorithm is based on computing labels in a rooted cacti from the leaves towards the root. The label of each vertex has two components: the length of the longest path in the subcactus rooted at this vertex, and the length of the longest path in the subcactus starting at this vertex.
Besides settling the problem on cactus graphs, this approach has important implications. It generalizes to other graph classes. In 2010, Markov and Vassilev proposed a linear time algorithm for 2-trees. 2-trees are graphs that are

constructed recursively from a single edge, by adding at each step a vertex and connecting it to both vertices of an already existing edge. The general approach is the same here: compute labels in a rooted 2-trees, working from the leaves towards the root. The labels have more than two components, reflecting the greater variety of ways in which the longest paths in a 2-tree can be structured. The approach developed in solving the problem on 2-trees can be applied to partial 2-trees and in particular to maximal outerplanar graphs.
In 2010, Markov and Vassilev proposed an $O(n^3)$ time algorithm for the longest path problem in distance-hereditary graphs. Distance-hereditary graphs are graphs in which every induced subgraph inherits the distance function from the original graph. This definition is not particularly geared towards algorithmic treatment. However, in 1986, Bandelt and Mulder gave an equivalent definition of this graph class, which serves as a basis of our algorithm. Distance-hereditary graphs can be constructed from a single edge through the application of two operations: adding a pendant vertex and splitting a vertex. The splitting can be performed in two different ways: with or without adjacency between the two copies of the vertex being split. Our algorithm computes sequence of operations that leads to the given graph and then computes and maintains the longest path in the graph, along with its construction from a single edge. One important consequence of this algorithm is that it improves the solution for Ptolemaic graphs by a quadratic factor.

Model-based Pre-processing in Protein Mass Spectrometry, John Wagaman, Western Carolina University
Abstract: The discovery of proteomic information through the use of mass spectrometry (MS) has been an active area of research in the diagnosis and prognosis of many types of cancer. This process involves feature selection through peak detection but is often complicated by many forms of non-biological bias, and the need to extract biologically relevant peak information from MS data has resulted in the development of statistical techniques to aid in mass spectra pre-processing. Baseline estimation and normalization are important pre-processing steps that are performed simultaneously using a mixture model and nonparametric function estimation to estimate the baseline and peak heights through the expectation-maximization (EM) algorithm and a penalized likelihood approach. The model-based pre-processing approach provides inputs into subsequent mass spectral classification procedures and performs well in the presence of raw, unnormalized data, with few subjective inputs.

Ascending Subgraph Decompositions of Digraphs, Brian Wagner, The University of Tennessee at Martin
Abstract: A digraph D with $\binom{n+1}{2}$ arcs has an ascending subgraph decomposition (ASD) if there exists a partition of the arc set of D into n sets of arcs of size $1, 2, 3, \ldots, n$ such that the digraphs $D_1, D_2, \ldots, D_n$ induced by the arc sets in the partition have the property that for all $i = 1, 2, 3, \ldots, n-1$, D_i is isomorphic to a subgraph of D_{i+1}. We will look at a technique that can be used to prove that several classes of digraphs have ASDs.

The Fast Food Diet Problem, Rebecca Waldrip, Furman University
Abstract: According to a report by the USDA, approximately half of the money Americans spent on food in 2004 was used to purchase food consumed outside the home. At the same time that a growing percentage of Americans have made dining out a part of their daily routine, many individuals have become increasingly concerned with nutritional diets. In today's climate of economic hardship, growing concern for nutrition, and a desire for the convenience of restaurant-prepared meals, individuals often seek to obtain the most nutritional benefit possible from the restaurant foods on which they spend their hard-earned money. The problem of developing a single day's diet that reaches this goal is a variation of the Stigler diet problem and can be solved using basic integer programming methods. We will discuss this problem and its solution in this talk.

Discovering Identities Using Simple Urn Models, Dennis Walsh, Middle Tennessee State University
Abstract: We offer several simple urn models as templates for teaching and learning interesting mathematics. Using only basic algebra, arithmetic, and probability, we readily uncover a multitude of interesting mathematical identities. Along the way, we view simple models for some discrete probability distributions, discover a quick route to sum the reciprocals of all binomial coefficients on an infinite diagonal of Pascal's triangle, and gaze at some pathological random quantities.

Trees in Phylogeny and Biochemistry, Hua Wang, Georgia Southern University, Laszlo Szekely, University of South Carolina, Taoyang Wu, University of London
Abstract: For trees, we present an interesting semi-regular property, which emerged from the study of the extremal questions regarding trees and several different topological indices from different backgrounds such as phylogeny and biochemistry. We shall see that this semi-regular property plays an important role in characterizing the extremal structures and potentially leads to a unified solution for various extremal problems.

Making Connections between Math Courses: Motivating Students Learn More Mathematics, Pinghua Wang, Georgia Highlands College
Abstract: In this presentation, I like to share a teaching example, in which we will see the intersection of traditional

instructions and technology strategies. We will see how to help students make discoveries through hands-on experience, how to motivate students to think independently and make connections between math courses.

Foundations of Mathematics Undergraduate Constructed TeXBook, Jacob Watson, University of North Carolina Asheville, Timothy Sawicki, University of North Carolina Asheville, Kristina Bender, University of North Carolina Asheville

Abstract: The topics covered in a foundations of mathematics course are often challenging for any individual introduced to the complex world of mathematical proofs and theorems. In order to assist with the daunting task of understanding these concepts, the students of our fall 2009 course compiled their own version of a foundations text book while completing the course. Our primary goal was to provide potential aid for upcoming students by approaching these concepts from the perspective of their peers. Throughout the process we discovered that not only was completing the project a fulfilling experience, but that throughout the writing process our understanding of the material expanded dramatically. This talk will outline our experiences during the construction process.

Clustering Presidential Election Data over Time, Chuck Wessell, North Carolina State University

Abstract: The current fixation on red and blue states in American politics masks the fact that states change their "color" over time. By clustering states based on their voting behavior from 1912 through 2008 we can capture some of these subtleties. A method will be developed, and maps that avoid using red and blue will be presented.

A Mathematical Introduction to Shor's Quantum Factoring Algorithm, J. Caleb Wherry, Austin Peay State University

Abstract: RSA has long been one of the most widely used public key encryption algorithms to secure information. The privacy provided by this algorithm comes from the fact that no classical computing algorithm is known which can factor large numbers in polynomial time. Known classical algorithms take exponential time when faced with the factoring problem. In 1994, Peter Shor of Bell Labs (now at MIT) developed a quantum algorithm that can factor large numbers exponentially faster than classical algorithms by using a quantum computer. This task is accomplished by reducing the factoring problem to a period finding problem and making use of the quantum entanglement and quantum superposition properties of elementary particles to factor such numbers. The use of quantum logic gates and the quantum Fourier transform (QFT) yield the factorization of the said large numbers in polynomial time when the entanglement and superposition properties of quantum bits (qubits) are exploited. Although this algorithm resides in the BQP ("Bounded-error Quantum Polynomial Time") complexity class, it poses a major threat to RSA encryption because it can factor large numbers exponentially faster than classical algorithms. The audience will be introduced to the topic of quantum computation with a focus on obtaining a mathematical understanding of Shor's quantum factoring algorithm. The information will be presented in such a fashion that no prior knowledge of quantum mechanics will be necessary.

Reorganizing for Better Inference, Cathy Whitlock, UNC-Asheville

Abstract: Inference is one of the most important topics we teach in Introductory Statistics classes, but it is also one of the most difficult concepts for students to grasp. Could we improve inferential comprehension and retention by a simple rearrangement of the typical Introductory Statistics curriculum? I will present ideas for better organizing an Intro. Stats course in order to help students tackle these ideas earlier, spend more time on them, and better connect inference to other topics in the course.

Volatility of High Frequency Financial Data, Zhijian Wu, The University of Alabama

Abstract: Measuring and modeling financial volatility are key steps for derivative pricing and risk management. In this talk, by generalizing the Ito's isometry, we study the convergence speed of the realized volatilities. As an example, we apply our results to analyze the high-frequency data of the Bank of America's stock prices.

A New MCDM Method Based on Fuzzy Dempster Theory, Ying Xiao, China Univ of Political Science and Law

Abstract: Multi-criterion decision-making plays a very important role in minimizing cost and maximizing profit. In this talk, a new decision-making method based on Fuzzy Dempster is presented. To avoid complicated fuzzy arithmetic operations, a new group of BPA functions are created, which is based on the fuzzy number distribution of the linguistic variables. With the new BPAs and the Demspter combination rules, all the criterion data are combined to generate the final scores for the alternatives, which can be used to draw a final decision by using the pignistic probability transformation. The proposed method is simple and easy to apply. An example is provided to illustrate the efficiency of the proposed method.

Young Tableaux and Sequences , Laurie Zack, High Point University

Abstract: Young diagrams and Young tableaux have been studied over the past 100 years. They were first applied to the study of representations of the symmetric group but have since been used to study different classical groups as well as graph theory, combinatorics, and even physics. This talk will present a simple application of using Young Tableaux to find the longest increasing subsequence as well as the longest decreasing subsequence of any particular sequence.

On (2,3)-agreeable Box Societies, Thierry Zell, Lenoir-Rhyne University, Michael Abrahams, Vassar College, Meg Lippincott, Vassar College

Abstract: In a recent article, D. E. Berg, S. Norine, F. E. Su, R. Thomas, and P. Wollan introduced a notion of geometric approval voting, involving convex sets. They proved lower bounds on the agreement proportion in societies they termed (k, m)-agreeable: where every subset of m voters contains at least k voters who can agree on a common platform. The first non-trivial case left open by their work is the case of (2,3)-agreeable arrangement of d-dimensional boxes, for which we give a lower bound of $1/(2d)$. All three authors gratefully acknowledge the support of the 2008 Undergraduate Research Summer Institute at Vassar College, when these results were obtained.

A Graph Theoretical Approach to Scramble Squares, Mali Zhang, Davidson College

Abstract: To solve the scramble squares puzzle, which consists nine square pieces, one needs to put the nine pieces into a 3×3 grid so that the pictures on adjacent pieces match. This puzzle is one of the NP-complete problems, which means as the size of the puzzle grows, it becomes significantly harder to solve. In this research, I took a graph theoretical approach to a 2×2 scramble square puzzle. With the newly developed theorem for finding a solution graph for a 2×2 puzzle, we are now able to solve the puzzle, or to spot a lack of solution in a puzzle, more efficiently.

Numerical Experiments on a Variation of Root Finding Algorithm through Chebyshev Expansion, Yilian Zhang, University of South Carolina Aiken

Abstract: It is known that "black box" rooting finding algorithm can be derived by expanding function $f(x)$ as a Chebyshev polynomial series, then finding the zeros of the truncated Chebyshev series. In this paper, we show a variant of the above method and discuss the effects of multiple roots.
