Presentation Abstracts
MAA-SE 2013
Winthrop University, Rock Hill, SC

ALT.1 Eleanor Abernethy University of Tennessee

Minute Papers

Minute papers are a tool I use to keep my thumb on the pulse of my classes. I pose a question at the end of each class meeting that should take a minute or less to answer and that is their 'exit ticket' for the day. I use this to take attendance, check for understanding, gain feedback on the pace of the class, and an opportunity for students to communicate questions, concerns or comments. I've found this to be a great tool to get to know my students and give them some ownership of their class as well.

GME1.1 Tonya Adkins Johnson & Wales University - Charlotte

Flipping the Classroom - A Math Instructor's Perspective

Serving the varying academic needs of all students in a college classroom can be a daunting task. "Flipping the classroom," by employing technological methods for content delivery, can allow for more class time to be dedicated to developing students' higher-order thinking skills and problem-solving. The concept of the "flipped classroom" will be explained, and the experiences of a college math instructor will be shared.

UGC.3 Liliana Alvarez Austin Peay State University

Ramanjit K. Sahi

Mathematical Words in the Form of Knots

This research project studies Markov chains and their mathematical applications. It focuses on the ability to construct mathematical knots from n-length words. Thereafter, we will demonstrate how these knots were created with the usage of graph theory. With the medium of Markov chains, we will see that the connection of literature was possible in knot theory.

❋ MSF.1 Cole Arendt University of North Carolina at Chapel Hill

Wayne Tarrant, Wingate University

A New Perspective on Risk Measures

The banking-fueled economic tragedy of 2008-2009 is still fresh in the minds of many Americans. The problems inherent in not handling risk properly reached the level of global catastrophe, so it is reasonable to work towards understanding risk better for the future. The Basel Committee on Banking Supervision requires the use of risk measures such as the Value at Risk (VaR) and Tail-Conditional Expectation (TCE) to determine a bank's risk profile. However, both measures can be shown to have shortcomings in the information that they provide to regulators and investors. We present a rudimentary background of risk and risk measure calculations before exploring the weaknesses of these statistics. Then we will progress to specific cases that show how quite different risk profiles have identical values for these measures. This is done first with an approach introduced by Guégan and Tarrant (2012), calculating risk measures for geometric objects that represent investment distributions. Then we will progress to many types of naturally occurring probability distribution functions (pdfs) such as the Normal and Pareto, differentiating between them by using various measures. As is done in our paper, we will use this evidence to recommend that a combination of several risk measures be used to give a more accurate representation of the risk contained on banking balance sheets.

UGA.4 Ashley AsKew Appalachian State University

Symmetries of n-tone pitch systems

We will discuss how musical properties of the traditional twelve-fold pitch system of octave division can be studied algebraically. For example, the circle of fifths can be viewed as the integers modulo twelve when the group is generated by seven. Then we discuss how these properties can be generalized to n-tone pitch systems and for which values of n such generalizations are possible.

❁ CLH.5 Leigh Atkinson UNC-Asheville

The Day the Scientific Revolution Began

Everyone will probably agree that the Scientific Revolution began no later than 1543, when Copernicus's great book was published. There is little agreement otherwise; one historian placed the start time at 1277. We provide a little background, and suggest that the SR must have begun somewhere in the interval 1494--1539, these being the dates of publication of two significant math books. This talk will be accessible to absolutely everyone and will perhaps provide some interesting background material which can be worked into a variety of math classes.

❁RES1.4 Chad Awtrey Elon University

Trevor Edwards

Counting dihedral p-adic fields

The p-adic numbers are foundational to much of 21st century number theory, and are connected to applications in both physics and cryptography. Recently, interest has been shown in cataloging arithmetic invariants associated to finite extensions of the p-adic numbers. In this talk, we will discuss an approach for completely determining the number of prime degree extensions of the p-adic numbers whose normal closures have dihedral Galois group.

UGH.4 Robbie Bacon University of South Carolina Salkehatchie

Ibrahima Seck

Rock Paper Scissors Lizard Spock

The classical Rock-Paper-Scissors game is revisited. We use payoff matrix and expected value to analyze the winning strategy of this game. We also examine several of its variations, like Rock-Paper-Scissors-Well and Rock-Paper-Scissors-Lizard-Spock. Other potential additional weapons are also discussed.

❁ RES1.5 Paul L. Baker Catawba College

Identity posed by Mohammed Almasalmeh of Al Buraimy Unimersity, Oman

Interesting Trig Identity

$(\sin A)^2 = (\sin B)^2 + (\sin C)^2 - 2\sin B \sin C \cos A$ is not a misstatement of the Law of Cosines, but is indeed an identity. Different approaches to proving the identity will be considered, including some unexpected connections with other identities.

❁ CLH.2 Julie Barnes Western Carolina University

Pringles, Icing, and Multivariable Calculus: A hands-on way to explore calculus on a saddle surface

In this talk, we discuss a classroom activity that can be used to help students gain a better understanding of partial derivatives, gradients, critical points, and Lagrange Multipliers. The activity combines work on a two dimensional contour plot for a saddle surface while simultaneously making connections to a Pringles potato chip. We use decorator's icing to draw various vectors and paths on the potato chip corresponding directly to actual sketches on the contour plot. We also do the algebraic calculations and compare those results to both the sketches on the contour maps and the icing curves on the chip.

❁ PRO2.1 Brian Beasley Presbyterian College

David Stone, Georgia Southern University

The Pedagogical and Research Value of Problems Sections

This talk will present a summary of the results of a survey conducted with the editors of problems sections in various mathematical journals and with several mathematicians who have been active throughout their careers as posers and solvers of problems. In addition to sharing their insight about the objectives of problems sections and the applications of such problems, both in the classroom and in mathematical research, the talk will provide their views on the general role of problem solving in the mathematical enterprise. The presentation will conclude with examples of some of the all-time favorite problems of the survey participants.

UGF.1 Daniel Bernstein Davidson College

A Strictly Increasing Function with Derivative Zero Almost Everywhere

In my talk, I will walk through a simple construction of De Rham's Function. This is a fractal curve which arises as a cumulative distribution function for a natural probability question. We will show that this curve has seemingly incompatible properties of having derivative zero almost everywhere while being strictly increasing.

UGH.3 Jim Bertagnolli Auburn University Montgomery

From 'Final 3' to 'Final n': Popular Card Trick Explained and Generalized for Any Size Deck

While the origins of the "Final 3" card trick are unknown, the trick itself is quite popular, with one (out of several) online tutorials gaining over 1.7 million views on YouTube. We explore the mathematical foundations of the trick as well as derive a generalized formula which will allow us to perform the trick with any size deck.

❁ GME1.5 Jeffrey Beyerl Furman University

Wikiversity in teaching: an attempted online supplement to traditional education

Wikiversity is a sister project of Wikipedia whose purpose is education rather than encyclopedia. This semester in a finite math class I have been working to develop a model to use a Wikiversity as a supplement to a traditionally taught course. In this talk I will give some background on Wikiversity, describe the approach I have been using, and and present the successes and failures that I have experienced.

ALT.5 Erin Bodine Rhodes College

Assessing Scientific Writing in a Mathematical Modeling Course

In an effort to develop mathematics majors at Rhodes College to scientific writing early in their college career, we developed a mathematical modeling course with a heavy focus on scientific writing. Student in the course work in teams developing and studying mathematical models and learn to write descriptions of their model, methods of analysis, and results. This talk will go over the structure of the course and discuss the issued involved in grading written work and group work. Sample rubrics for grading will be presented.

❁ ALT.4 Emily Braley Duke University

Jack Bookman, Duke University

Self-assessment and reflection through writing

Students frequently ask one another “How did you do on that test?” Typical responses to this question give no information about the test, the student's performance, or the student's preparation. Commonly a response includes a score or list of mistakes. We've designed student writing assignments aimed at meaningful reflection on in class exams. These assignments require students to communicate their understanding of the types of questions being asked on assessments (i.e. conceptual questions, skill testing questions) and describe what in their preparation helped them or hindered them in answering questions. The purpose of this study (piloted this semester) is to identify whether students recognize conceptual questions, and determine whether reflection on exam preparation can influence students' future preparation.

UGG.1 Joshua Brandl Samford University

On Constructing Binary Polynomials to Represent Perceptrons

In developing artificial intelligence, computer scientists and mathematicians aimed for a way to mirror the function of neurons. Researchers found a way to accomplish this with binary Perceptrons, which are linear threshold functions with binary inputs and outputs. While investigating the mathematical properties of binary Perceptrons, it is useful to consider them as binary polynomials with integer coefficients. This presentation will explore how to construct binary polynomials in order to create threshold functions for Perceptrons. Particularly, the presentation will focus on a matrix method for identifying the coefficients needed for a binary polynomial to achieve a desired set of outputs. In a one input Perceptron the coefficients are easily obtained by inverting a certain 2-by-2 matrix. For n inputs, the coefficients are obtained by inverting the 2^n-by-2^n matrix which is the nth tensor power of the 2-by-2 matrix. The impact of this method is that a binary polynomial can be easily found through a simple algorithm, and thus binary Perceptrons can be formed for any desired output.

❁ PRO2.2 James Brawner Armstrong Atlantic University

Using a Journal Problem to Explore Tetrahedra in a Multivariable Calculus Class

When I teach multivariable calculus, I often give students a collection of bonus problems to work on throughout the semester. I have found that there are a number of students, not always the strongest students in the class, whom these bonus problems engage in ways that other assignments do not. In this talk, I describe a problem from the Pi Mu Epsilon Journal about tetrahedra that was particularly well suited to the tools we were using in the class. The problem was to determine whether a tetrahedron with all four faces of equal area was necessarily regular. If so, students were asked to provide a proof; if not, to give a counter-example, and to characterize all such counter-examples.

❁ INQ.4 Ryan Brown Georgia College

An IBL algebraic geometry course for undergraduates

In this talk we examine an inquiry based learning model for teaching an undergraduate course in algebraic geometry using the book {\em Algebraic Geometry: A Problem Solving Approach}. The course is suitable for both mathematics majors who intend to pursue graduate study and future secondary school teachers. We discuss the specifics of how the course was run and include a description of a typical class day. We also address how problems were assigned to students, how students were motivated to present solutions to selected problems, and how student work was assessed. We conclude with remarks on course revisions for Fall 2013.

UGG.3 Megan Bryant Clemson University

Carl Mummert (Clemson University), Roger Garcia (Kean University), James Figler, and Yudhishthir Singh

How many mates can a latin square have?

We study the number of mates that a latin square may possess as a function of the size of the square. We performed an exhaustive computer search of all squares of sizes 7 and 8, giving the exact value for the maximum number of mates for squares of these sizes. The squares of size 8 with the maximum number of mates are exactly the Cayley tables of Z3 = Z2 ×Z2 ×Z2 ,
and each such square has 70, 272 · 8! mates. We obtain a combinatorial proof that, for every k ≥ 2, the square obtained from a Cayley table of Zk has a mate. This research was partially supported by NSF grants OCI-1005117 and EPS-0918949.

UGB.1 Abdoulie Ceesay Methodist University

Shivappa Palled

The Second Derivative Test and Its Applications

The second derivative test determines the nature of a critical point of a function. That is whether the critical point is a local minimum, local maximum, a saddle point or none of these. Generally, for a function of n variables, it is determined by the algebraic sign of a certain quadratic form, which in turn is determined by eigenvalues of the Hessian matrix. The general second derivative test states that:
Suppose f(x) is a function of x that is twice differentiable at a stationary point x0.
1. If f”(x)> 0, then f(x) has a relative minimum at x0 .
2. If f”(x)< 0, then f(x) has a relative maximum at x0.
The extremum test gives slightly more general conditions under which a function with is a maximum or minimum. If is a two-dimensional function that has a relative extremum at a point (x0, y0) and has continuous partial derivatives at this point, then fx (x0,y0) = 0 and fy (x0, y0) = 0. The second partial derivatives test classifies the point as a local maximum or relative minimum. Defining the second derivative test discriminant as

fxx fyy - fxy fyx

fxx fyy - f2xy

Then,
1. If D > 0 and fxx (x0, y0) > 0, the point is a relative minimum.
2. If D >0 and fxx (x0, y0) < 0, the point is a relative maximum.
3. If D < 0, the point is a saddle point.
4. If D = 0, higher order tests must be used.
Thus, in this paper the focus will be on the second derivative test applied to functions of 1, 2, 3….n variables. This test can be applied to a variety of functions ranging from quadratic to multivariable functions that are used in Physics, Computer Science and Chemistry. Additionally, the second derivatives form the bases in many symbolic computational work and advanced computational techniques in fluid dynamics.

UGH.6 Moses Chandiga Methodist University

Shivappa Palled

Famous Bridges and Mathematics: Is there a connection between Mathematics and Bridges?

Bridging the gap between disjoint places has taken up an ingenious turn in recent years. In the historical world, obstacles have been bypassed by various bridges whether complex or simplistic in construction is not the question as long as they serve their purposes. We have always tended to ignore the questions that lead to the understanding of their constructions. In other words, perception precedes mathematical reasoning like we only notice the magnificence of bridges, stop and wonder how such innovative structures were built. If we look at the history of bridges, with the advancement of

technology their constructions have become more complex. Thus mathematics plays a vital role in the construction of modern complex bridges. A bridge construction specification relies immensely on the mathematical concepts of geometry, functions and distance measurements. Mathematical computations are done on cable elongations, arches, lengths, widths, heights, distances, frictions and forces like tensions, compressions, strain and stress forces. With this, we can infer that mathematics is a language that is often encrypted into our structural forms. The dialogue between structural strength, structural magnificence and mathematical logic is imperishable. We can therefore say that understanding these structures requires a great deal mathematical reasoning. Our objective is to look at some of the most famous bridges and discuss the mathematics behind their constructions. Had bridges not been introduced imagine how the world would have been.

❁ RES3.5 Tieling Chen University of South Carolina Aiken

The place shift problem – a generalization of the problem of 3n + 1

In the binary number system the computations for the problem of 3n + 1 is a sequence of shift operations on binary expressions. If n is even there are at least one ending 0 in its binary expression. Dividing n by 2 is equivalent to crossing the ending 0 and shift the binary expression to the right by one place. The process repeats until all the ending 0's are gone and the remaining part of the expression shifts to the rightmost place. If n is odd the product of n and 3 is the product of the binary expression of n and the binary number 11, which can be obtained by shifting the binary expression of n to the left by one place and then adding the original binary expression of n. Adding 1 to the product is equivalent to adding the 1's complement to the rightmost bit of the binary expression of the product, which changes the rightmost bit to 0 and carries 1 to its left place. The Collatz conjecture states that for any positive integer n, the process would end at 1.

The above process can be generalized to the following place shift problem with an arbitrary base. Given a positive integer n, convert n into the expression in a given base. If the expression has ending 0's, shift the expression to the right by eliminating the ending 0's. If the expression has no ending 0's, multiply the expression with the number 11 in the given base. The multiplication can be performed by shifting the expression to the right by one place and then adding the original expression. Then the complement of the rightmost digit is added to make a 0 in the rightmost place, which also results in a carry to its left place. This step can be implemented by eliminating the rightmost digit to shift the expression to the right by one place and then incrementing the result by 1. The above process can be repeated and the place shift problem is whether the repeated process finally ends at 1.

When the base is 2 the place shift problem becomes the problem of 3n + 1. The Collatz conjecture has been verified for n up to the magnitude level of the 18th power of 10 by computer. The problem of 3n + 1 is not specific now because in many bases the place shift problem has a similar impact. Computer checking shows that for n up to the magnitude level of the 11th power of 10, the process of the place shift problem reaches 1 in the bases of 5, 7, and 8. Computer checking also shows that for the bases such as 3, 4, 6, 9 and 10, the place shift problem has a negative answer. In base 100, the place shift problem has a positive answer for n up to the 11th power of 10. In fact there are much more bases giving positive answers for n up to 10 million than bases giving negative answers, among the bases 2 through 100.

❁ RES2.5 Jeffrey Clark Elon University

Derivative Sign Patterns

We will examine the patterns of signs of infinitely differentiable real functions, showing that only four possible patterns are possible if the domain is the set of real numbers while all patterns are possible if the domain is an open interval.

UGF.6 T. Conrad Clevenger LaGrange College

Steven A. Porrello

Numerical Solutions to Ordinary Differential Equations

Useful differential equations may not have closed-form solutions. Consequently, it is useful to have numerical techniques that approximate those solutions. Iterative differential equation solvers are presented and compared.

UGH.5 Kayla S. Cline LaGrange College

Modeling the Tacoma Narrows Bridge

Have you ever wondered how to model the swaying effect of the Tacoma Narrows bridge? In this presentation, a differential equation model of the Tacoma Narrows bridge is presented. Then, a computer simulation using that model is displayed which demonstrates the collapse of the bridge.

❁ INQ.5 Jill Cochran Berry College

Zane Cochran (undergraduate student)

The Development of Digital Manipulatives on Multiple Platforms for Enhanced Student Explorations

Online manipulatives can facilitate learning opportunities for students to have a "hands-on" experience without being bound by physical limitations. However, many of the currently available online manipulatives are geared toward K-12 students and are limited to select computing platforms, often excluding mobile devices. This presentation will focus on a simple method using Processing to develop digital activities that are applicable to college level students and are accessible to beginning programmers. Examples will highlight topics such as number systems and proportional reasoning. The application of this method is appropriate for many courses where student discovery is emphasized even though the examples in the presentation are designed for math teacher preparation courses.

UGA.6 Ethan Colazzi Coastal Carolina University

Andrew Incognito

Approximating Pi

In this talk we will examine methods used in three different millennia to approximate the value of pi. First, we will discuss the method of the ancient Egyptian rope stretchers, Then, the method of inscribing polygons used by Archimedes and finally Newton's approximation using his binomial theorem.

❁ CLH.3 Ray E. Collings Georgia Perimeter College

Project Infinity

Our use of infinity in the mathematics classrooms of freshmen and sophomores is sometimes confusing and frustrating to our students. A 1-year STEM mini-grant is underway at GPC-Clarkston to improve instruction involving infinity in such applications as asymptotes, limits, Riemann sums, and series representations of functions. Activities and preliminary results in precalculus, calculus 1, and calculus 2 will be shared.

❁ ALT.3 Charles Collins University of Tennessee

Web 2.0 for Math Learning

Discussion and demonstration of ways to use Web 2.0 tools like wikis and discussion boards for facilitating and assessing learning in a math classroom.

UGE.6 Christopher A. Corriere Southern Polytechnic State University

An Application of the Binomial Thorem in Computer Science

Using enumerated bit flags to represent primitive Boolean values allows a computer programmer to leverage the binomial theorem in the process of constructing an object oriented model. This talk weighs the advantages and disadvantages of using this model with respect to software performance, maintainability, and insights it may provide to any data being collected.

GT3.6 James Diffenderfer Georgia Southern University

On Infinite Families of Ramanujan Type Congruences for Restricted Compositions

Drawing inspiration from Ramanujan's partition congruences (e.g. $p(5n+4) \equiv 0 \pmod 5$), infinite families of congruences are presented for compositions with parts congruent to $a \pmod b$ then proved using generating functions and the advantageous application of field extensions.

❁ IYS.4 Lothar A. Dohse UNC Asheville

Why is the U.S. Congess Deadlocked? A Game Theory Primer

After a brief description of the assumptions underlying game theoretical models, the speaker will apply the ideas of Game Theory to the stand-off in the U.S. congress. By developing pay-off matrices, using basic Linear Algebra, and interpreting the resulting equilibria, the question "Why is Congress Deadlocked?" will be addressed. Please be forewarned, the speaker does not plan to offer any resolution as to unlocking the congressional gridlock.

UGF.4 Jeffrey Dzugan Samford University

Arc Length as a Function of Sag for Catenary Curves

In this project, I studied catenary curves. Specifically, I analyzed the functional relationship of the sag and arc length of catenary curves, where the sag is the vertical distance between the minimum and endpoint of the curve. Consider a curve created by hanging a cable between two supports of equal height. Let l be the arc length of the curve from the minimum to the endpoint and let d be the horizontal distance between the same two points. I found functions f and g so that $l/d = f(d/a)$ and $s/d = g(d/a)$ where a is a certain physical parameter, f is a ``hyperbolic sinc" function, and g is defined similarly using the hyperbolic cosine. Furthermore, let F be the function whose graph is determined parametrically by $x = g(t)$, $y = f(t)$. Then $l/d = F(s/d)$. Also, I showed that asymptotically $g(t) = f(t)$, and thus it is possible, using Taylor polynomials, to approximate F with a piecewise function using a quadratic and $y = x$. I will also discuss the analysis of the case of uneven support heights.

UGD.3 Nick Dzugan Samford University

Wide-Diameter, Hypercubes, and Network Design

There are multitudes of ways to define a "good" network. However, there are certain generally accepted principles for the design of efficient and reliable networks. In this talk, after briefly discussing these principles, we'll take a look at a particular regular graph called a hypercube which satisfies many of these design principles, and we'll look at a measure known as the wide diameter which attempts to provide a measure of the reliability and efficiency of a network. Essentially, the wide diameter of a network combines connectivity and diameter as it measures the longest optimal path required in a multipath system joining any two vertices. After defining and illustrating this measure, we will link it to the network design principles and demonstrate a method for calculating the wide diameter of the hypercube.

❁ PRO1.2 Steven Edwards Southern Polytechnic State University

Fibonacci Fallout

Problems involving the Fibonacci and Lucas numbers, especially those from the Fibonacci Quarterly, have been a source for much interesting mathematics. I will focus on some interesting problems and how I have used them in the classroom, and for my students' and my own research.

UGC.1 Evan Elmore Samford University

Bruce Atkinson

On Simplex Methods in Linear Programming that Guarantee Termination of the Algorithm

Since linear programming is primarily an applied form of mathematics, the notation is typically designed to facilitate the process of working a specific problem rather than proving the theory behind that process. As a result, proving the most basic theorems of linear programming is a cumbersome activity. In this paper we develop a modified version of matrix-based notation for linear programming problems. After putting the problem in matrix form, we use basic linear algebra to manipulate the matrices and optimize the objective function. We focus on the simplex method of solving linear programming problems. One of the problems with the simplex method is cycling, but we prove, with relative ease, that the perturbation method must terminate to demonstrate the accessibility of our notation.

❁ RES3.3 Jon Ernstberger LaGrange College

A. D. Perkins, Mississippi State University (perkins@cse.msstate.edu)

A Metaheuristic Search Technique for Graceful Labels of Graphs

Computational techniques have been presented that will identify a graceful labeling for a given graph provided one exists, thereby confirming that the graph is indeed graceful. Supported by the necessary theory to guarantee a solution, these routines primarily rely upon constrained iterative methods and are often quite computationally expensive. A number of other methods for graceful labelings have been proposed, including those employing deterministic backtracking and tabu search, among others. Here, a genetic algorithm-inspired, metaheuristic search technique to attempt to ascertain graceful labels, via a modified objective functional, that operates on simple graphs is presented. This broad-spectrum method will be discussed and compared to previous techniques.

GT3.4 Ricky E. Farr University of North Carolina at Greensboro

Dr. Sebastian Pauli

Zeros of the Derivatives of the Riemann Zeta Function on the Left Half Plane

We present the zeros of the derivatives, $\zeta^{(k)}(\sigma+it)$, of the Riemann zeta function for $k \le 28$ with $-10 < \sigma < \frac{1}{2}$ and $-10 < t < 10$. Our computations show an interesting behavior of the zeros of $\zeta^{(k)}$, namely they seem to lie on curves which are extensions of certain chains of zeros of $\zeta^{(k)}$ that were observed on the right half plane.

UGH.2 Lucy Findley High Point University

Modifying The NFL's Quarterback Passer Rating

The NFL's Quarterback Passer Rating has long been recognized as one of the most prevalent and widely used statistics in sports. After its inception in 1973, the rating has been used to determine the effectiveness of a quarterback's performance, though it has been widely criticized for its shortcomings. In 2011, ESPN released a Total Quarterback Rating that attempted to rectify the inadequacies of the NFL's Quarterback Passer Rating. However, the Total Quarterback Rating utilizes subjective statistics that are not available to the average fan. We will offer background on current quarterback ratings, identify their weaknesses, and propose some minor modifications and additions that we hope will improve the effectiveness of the statistic. Taking into account positive per-game statistics including touchdowns, passing yards, rushing yards, and rushing touchdowns balanced with negative statistics including sacks and interceptions, we will use a point allowance system to determine the quality of a quarterback. We will also attempt to normalize the statistic to avoid extreme changes from year to year.

❋ RES3.1 Rigoberto Florez The Citadel

Eva Czabarka (University of South Carolina), and Leandro Junes (California University, California, PA)

Using Hosoya's Triangle to Count Some Dyck Paths

The Hosoya's triangle is an arrangement of numbers where each entry is a product of two Fibonacci numbers. A Dyck word is a word in the letters X and Y with as many X's as Y's, and with the property that no initial segment of the string has more Y's than X's. A pyramid of height n is a sub-word of the form X^nY^n (n-X's and n-Y's). Each Dyck word gives rise to a path. A sub-path is a pyramid if the corresponding sub-word is a pyramid.
In this talk we discuss how to use the rows of the Hosoya's triangle to count maximal pyramids in some types of Dyck paths.

UGG.4 Anne French Austin Peay State University

John Nicholson

The Mathematics of Bayesian Learning Models and Text Classification

Just as a cryptographer would analyze a block of code for its concealed meaning, a mathematician or statistician can analyze a seemingly average text or document for its hidden connotations. Taking the idea a step further, a computer scientist can develop computer programs which employ mathematical concepts for quick, precise data analyzation. There is a vast amount of data available on earth, most of which has been untouched. Furthermore, there are endless possibilities for growth and learning if new methods of data investigation are developed and deployed on available data. This presentation lays out the process of classifying and finding hidden meaning in texts based on the words, phrases, and information they hold by means of computer programming utilizing Bayesian Learning and hidden Markov models.

MSF.2 Heather Gaddy Wake Forest University

Cole Arendt (UNC Chapel Hill), and Wayne Tarrant (Wingate University)

Measuring Risk in Various Markets

In the wake of the 2008 Financial Crisis, many Americans across the country had the great misfortune to see what assets they had drop substantially in value, their savings dwindle until there was nothing left, and their purchasing power diminish as the price for goods and commodities increased. In the following months, economists attributed the economic downturn primarily to numerous banks across the country issuing risky subprime mortgages to recipients who generally did not have the means to bear such a financial obligation. In response to the Financial Crisis, many analysts and economists have begun to investigate how an economic system's improper handling of risk can impact the overall well-being of the system. Expounding on the research of Dr. Tarrant and Mr. Cole Arendt regarding how risk measures such as Value at Risk (VaR) and Tail-Conditional Expectation (TCE) should be used in conjunction to measure risk in the

banking sector, the focus of this research will center on applying the VaR and the TCE to measure risk in other markets, particularly the foodstuffs, metals, and currency market. Conclusions are then drawn about the varying successes and detractions of these measures.

UGD.1 Jonah Galeota-Sprung Davidson College

Joshua Chester, Linnea Edlin, Bradley Isom, Andrew Lantz, Alexander Moore, Virginia Perkins, E. Tucker Whitesides, Laurie J. Heyer, and Jeffrey L. Poet

Counting LOGs and GIGs

This project defines a class of graph objects coined "Limited Outdegree Grid Digraphs", or LOGs for short, and begins investigating their combinatorial properties. An LOG is an nxn grid-graph with a maximum outdegree of one. If the vertices in a LOG can be labeled with the integers 1, 2, … n^2 such that each arc is in the direction of greatest increase from that vertex, we call the graph a Greatest Increase Grid (GIG) digraph. So far our investigations have yielded two successful methods for enumerating all possible 3x3 LOGs, a method to enumerate all possible 3x3 GIGs, and two distinct procedures for determining if a given LOG digraph is a GIG digraph.

❁ MPE.2 Jerome Goddard II Auburn University Montgomery

R. Shivaji, University of North Carolina Greensboro

Diffusive logistic equation with negative density dependent emigration on the boundary

We examine the structure of positive steady state solutions for a diffusive population model with logistic growth and negative density dependent emigration on the boundary. In particular, this class of nonlinear boundary conditions depends on both the population density and the diffusion coefficient. In this presentation, we will discuss results obtained in the one-dimensional case.

❁ RES2.3 Adam Graham-Squire High Point University

Optimal Strategy in Mat-Rix-Toe

The game Mat-Rix-Toe is played in the same manner as Tic-Tac-Toe, with a matrix as the board and zeroes and ones instead of Xs and Os. If the matrix is invertible, the ones win; if non-invertible, the zeroes win. In this talk, we discuss the optimal strategy for each player, as well as who will win in the 2x2, 3x3, and 4x4 cases. Mat-Rix-Toe was originally taught as part of a project for undergraduate Linear Algebra students, and this talk focusses on the research behind the game.

❁ RES3.6 John Harris Furman University

Maria Barrell, Charldon Dennis, and Kristina Pardo (Undergraduates)

Ranking College Football Teams

The purpose of this research is to identify an algorithm based upon team statistics that ranks FBS college football teams more accurately than the BCS rankings system. Ranking methods used included the Massey, Keener, and Colley, as well as variations on these. The rankings were based off of the following statistics: points scored, total yards, passing yards, possession time, and more. For the years 2009-2011, the Massey Method based solely on points scored (Massey Points) had the highest prediction percentage for bowl game outcomes. This method was later modified with a Similar Teams method, which looks through each bowl teams regular season schedule, finds the team most similar to their bowl game opponent. Other ranking systems were developed over the course of the research period, but none were as successful. Continuation of this project will be focused on finding a new method that trumps the modified Massey, or continuing to modify the Massey to improve results.

UGA.2 Meredith Harris Clemson University

Laura Bradford (Bard College); Brant Jones (James Madison University), Alex Komarinski (Arizona State University), Carly Matson (University of Virginia), and Edwin O'Shea (James Madison University)

A New Proof of the Lecture Hall Theorem

Euler proved a bijection between integer partitions with distinct parts and integer partitions with odd parts. The lecture hall partitions can be thought of as a way to arrange the levels of seats in a lecture hall so every student may see the speaker. Bousquet-Mélou and Eriksson provided a proof of a bijection between these lecture hall partitions and integer partitions of "small" odd parts that generalizes Euler's celebrated result. This presentation provides a new Coxeter-free bijection using abacus diagrams and bounded partitions.

❁ IYS.5 Queen Harris Georgia Perimeter College

How much does a five pound bag of potatoes weigh?

Did you ever wonder if the five pound bag of potatoes that you purchase is actually five pounds? Samples were obtained from four major grocery stores. We will test the null hypothesis that the median weight of N samples of five pound bags of potatoes is five pounds, using Wilcoxon Signed Rank Test.

GME1.2 Janine M. Haugh UNC-Asheville

Improving Learning Outcomes with Backward Course Design

When planning math courses, many of us write our syllabi using some variation of this method: (1) choose a textbook, (2) choose enough sections from the book to fill the semester, and (3) plot them on a calendar with some assignments and tests evenly dispersed throughout. Even when the method of instruction or evaluation undergoes a change (e.g. lecture, IBL, flipped classroom), the topics and order may not. This approach isn't wrong, but it also isn't our only option.
I recently attended a workshop on backward course design, and have since used it to redesign both my Calculus II and Introduction to Mathematical Models classes with great success. In this talk I will discuss what I mean by "backward course design" and how it has improved my students' learning.

❁ CLH.6 Curtis Herink Mercer University

Tennebaum's New(?) Proof that the Square Root of 2 is Irrational

Stanley Tennenbaum was a twentieth-century American mathematician who made a number of contributions to set theory and mathematical logic. We will present an interesting geometric proof of the irrationality of the square root of 2 that has been ascribed to him. After rephrasing the proof algebraically, we will compare it with a proof given by Dedekind in "Stetigkeit und irrationale Zahlen" ("Continuity and Irrational Numbers") that the square root of any non-square positive integer is irrational, published around 1872.

UGE.4 Daniel Heslop Savannah State University

Implementation of 3D Visualization of a Brain Tumor

The primary purpose of this project lies on the 3-D visualization of sequential under-resolved planar images, in particular, including medically abnormal cell structures. It thus contributes to medical engineering for better recognizing less informed planar images, such as the Magnetic Resonance Imaging (MRI), a medical imaging technique used in radiology. A series of head MRI scans of a brain with tumor are imported into MATLAB as matrices. The distance from a fixed point on each matrix to a boundary point of the tumor is measured along the boundary point's corresponding angle. Using the numerical interpolation theories, boundary points on each layer in the polar coordinate systems are connected. In order to proper implement a real 3-D shape of the tumor, various procedures, such as boundary decomposition, scaling, recovering top & bottom caps, decision of patch types, etc. are achieved in an efficient manner.
By manipulating the obtained surface functions, the rate of growth of the tumor in volume or surface or growth direction can be discussed as future work.

GT3.5 Joshua Hiller Western Carolina University

On a Relationship Between a Generalization of Pascal's Matrices and Arbitrary Square Matrices Over the Complex Numbers

Over the last 25 years mathematicians have explored many of the fascinating properties and applications associated with Pascal's matrices. Our work builds on this momentum, showing that some of these properties can be generalized to any square matrix. We begin by defining a class of matrices called Pascalian which is a generalization of Pascal's matrices (and which retain some of the most interesting properties of Pascal's matrices). We then define the n-similar relationship and show that every square matrix over the complex numbers is n-similar to some Pascalian matrix. We also use this property to find matrix powers and inverses.

GME2.6 Jennifer Hontz Meredith College

An NSF S-STEMS Scholarship Program at Meredith College

Supported by a grant from the National Science Foundation, the Paschal Scholarship Program at Meredith College provides support for STEM majors. Paschal scholars not only receive a scholarship, but participate in a learning community. A mentoring program prepares students for careers in industry, government and education, as well as assists students in exploring options for graduate studies. For freshmen and sophomores, the emphasis of the mentoring program has been on academic success and achievement. Freshmen participate in a First Year Experience (FYE) course dedicated to Paschal Scholars. In addition to mentoring, Paschal scholars will have the opportunity to attend a speakers program, in

which outside speakers address topics of interest for women in science, technology, engineering and mathematics. The Paschal Scholarship Program is named for Rosa Catherine Paschal, the first person to earn a mathematics degree from Meredith College. As the principal investigator of the NSF grant that supports the Paschal program, I will speak about successes and lessons learned.

GT2.3 Shujiao Huang Georgia Southern University

Broderick O. Oluyede

A new class of exponentiated generalized Dagum Distributions

A new class of distributions called the exponentiated Kumaraswamy-Dagum-Weibull family of distributions is developed. The family or class of distributions includes several sub models, namely the exponentiated Kumaraswamy-Dagum (EKD), exponentiated Dagum-Weibull (EDW), exponentiated Dagum (ED), Dagum-Weibull (DW), exponentiated Kumaraswamy exponentiated Dagum (EKED) and Dagum distributions. Statistical properties including series representation of the probability density function, hazard and reverse hazard functions, moments and entropy measures for this class of distributions and the sub models are presented.

UGA.3 Noah Hughes Appalachian State University

Bill Cook

Permutations and Weyl Groups

Lie theory (the theory of Lie algebras and Lie groups) is important to many branches of mathematics and mathematical physics. Finite dimensional simple Lie algebras (over the complex numbers) are among the most important and best understood examples of Lie algebras. A simple Lie algebra's structure is determined by its "root system" (a collection of generalized eigenvalues associated with certain elements of the algebra). These root systems have beautiful geometric structures and are highly symmetric. The symmetry groups of these root systems are known as "Weyl groups".

In this talk we will describe the Weyl groups associated with simple algebras of type B_n (special orthogonal algebras $\mathfrak{so}(2n+1)$). In particular, we will present a set of permutations which generate the representation of the Weyl group corresponding to the so-called "minuscule" representation.

Claude Mitschi and Michael F. Singer developed a technique which constructs differential equations whose symmetry groups (i.e. differential Galois groups) are simple Lie groups if their corresponding Lie algebras possesses a minuscule representation whose permutation representation has a "strictly transitive set of permutation conjugacy classes". Using our generators we are able to show that such a set exists for simple Lie algebras of type B_n when $n = 2,3,5,7$ (thus Mitschi and Singer's construction applies). In addition, we can show that no such set exists for when $n = 4,6,8,9,10,11$.

UGA.5 John Hull Georgia State University

Polynomials Over Finite Fields

Introduction: Polynomial functions over finite fields are important in computer science and electrical engineering in that they present a mathematical representation of digital circuits. The validity of circuit designs can be tested abstractly using polynomial representations of circuits instead of physical testing the circuits post-construction. Toward this end, we aim to find necessary and sufficient conditions for polynomial functions with coefficients in a field of characteristic p, when restricted to a subfield, to map from the restricted domain to a different subfield of the original field. This problem is of particular interest in the aforementioned context when p = 2 due to the relationship between fields of characteristic 2 and binary structures.

Method: For univariate polynomials, relationships between powers of the indeterminate and the behavior of indeterminate's evaluation at elements of the restricted domain was examined to determine patterns that could be used to verify a mapping's image through the equation-of-coefficients method. This relationship was examined in the general case of the characteristic prime and powers of that prime.

Results: A method satisfying the above requirements is presented for all primes and all positive powers of those primes through the discovery of a permutation on a particular set related to the largest degree of a polynomial with coefficients in the original field of characteristic p but evaluated at the subfield of restriction. This permutation is cyclic and permutes the coefficients of the restricted polynomial in such a way that the requirements of the restricted polynomial mapping to the target subfield are met if and only if an equation-of-coefficients system is satisfied. For cases of a prime p, an algorithm for construction of an n-by-n matrix representing this permutation, where n is the order of the subfield of restriction, is presented.

Conclusion: Our findings demonstrate that it is possible to greatly reduce the computational expense of the problem outlined above. Further research should aim to outline the behavior of the aforementioned permutation with respect to specific primes and solve the above problem for multivariate cases.

❁ IYS.1 Patricia Humphrey Georgia Southern University

Lotteries through time and Space

The earliest recorded evidence of lotteries dates to the Chinese Han dynasty (c. 200 B.C.). They are believed to have helped finance the Great Wall of China. Progressing to medieval times, the Genoese Lottery (originally in the form of betting on the next members of the Great Council, who were drawn by chance), and morphed into a lottery involving numbers when the government figured out it could raise money (especially by having more frequent drawings). Modern lotteries support education in the U.S. and throughout the world from Spain to England to Thailand. We'll learn some interesting probability and combinatorics results due to lotteries, and how the probabilities of winning vary around the world.

GT3.3 Iuliia Inozemtseva Georgia Southern University

S. A. Shogolev and I. I. Mechnikov (Odessa National University, Ukraine)

Generalized periodic solutions of linear systems of differential equations with slowly varying parameters

We consider the problem of finding the periodic solutions of linear systems of differential equations. We investigate the periodic solutions by representing them in the form of trigonometric Fourier series with real frequency. This method produces an infinite system of linear algebraic equations. This leads to consideration of a problem of finding the approximation to the periodic solution of that system in the form of finite sums. The matrix of that system has an interesting ribbon structure.

We set a next problem: to show enough conditions of existence of particular solution of the system that is presented as Fourier series with slowly varying coefficients and frequency. The process of integration of infinite systems of linear differential equations with slowly varying coefficients takes considerable difficulty. Use one of the well-known methods of solving these systems - the truncation method.

There will be illustrated several methods of analyzing the nature and behavior of the eigenvalues of given matrix. Moreover, it will be explained the importance of reducing the matrix to a diagonal form and used the method of successive approximations to find the slowly varying solution of the system, taking as an initial slowly varying approximation the solution of the diagonal system.

Finally, there will be given several interesting and considerable difficult examples of orders 3x3 and 5x5.

UGE.5 Rahul Isaac Furman University

Jack Farnsworth, and Stella Watson

The Firefighter Problem - A Continuous Approach

The Firefighter problem is a mathematical problem situated in the field of graph theory. Consider a symmetric graph of any shape. Imagine a node on the graph is set on fire. At each time step, the fire spreads to all adjacent nodes. Imagine also a firefighter that can move along the grid in a continuous path at a fixed rate relative to the fire. The firefighter can travel to and insulate any nodes that are not already on fire. The basic goal of the problem is to contain the fire. We attempt to discover the most efficient algorithm and the critical rate below which the fire cannot be contained. Though this problem can occur on any kind of graph, we have only considered a regular square graph. We found that the most efficient method of containing the fire was simply first approaching it and then staying as close as possible. We worked largely on the continuous analog of the problem, mapping the firefighter's path as a recursive function. By writing this function as a transformation matrix, we were able to use matrix analysis to obtain a non-recursive function. Here we discovered that as the rate ranges from less than three to greater than three, the eigenvalues of the matrix range from purely real and greater than 1 to either 0 or less than one (at rate 3) to less than 1 or imaginary. Thus the critical rate was found to be three times the rate of the fire.

UGB.3 Kev Johnson Auburn University Montgomery

Daniel McElveen, and Katelyn Sanders

Diffusive logistic equation with nonlinear boundary conditions and Sigma-shaped bifurcation curves

Even though population models with diffusion have been the subject of research since the 1960's, still little is known about their varied dynamics. In this talk, we will study the structure of positive steady state solutions to a logistic population model with diffusion and grazing, i.e. a form of natural predation. Of interest, we consider a relatively new

direction: a population that satisfies a certain nonlinear boundary condition. We obtain one-dimensional results via the Quadrature Method and numerical computations using the software package Mathematica.®

UGC.5 Vanda Johnson Savannah State University

Juhi Brahmbhatt

On finding the optimal trail up a mountain with the energy expenditure cost function

We often confront to the question that "Is there a best trail to climb higher mountain?" Concerning on the energy expenditure, Alberto E. Minetti states that when the slope of the route is about fifteen degrees, the energy required to gain a certain altitude is minimized. This research introduces the general method to calculate the total energy costs from a fixed point to the summit on a topographic map. Such procedure is achieved with the image processing tools. And we examine the Minetti's theory with the help of other analysis from biomechanical literature and compare the result with the existing park trails.

GT1.3 Marvin Jones University of South Carolina

Dr Jeremy Rouse (Wake Forest University)

Solutions of the cubic Fermat equation in quadratic fields

We give necessary and sufficient conditions on a squarefree integer d for there to be non-trivial solutions to $x^{3} + y^{3} = z^{3}$ in $\Q(\sqrt{d})$, conditional on the Birch and Swinnerton-Dyer conjecture. These conditions are similar to those obtained by J. Tunnell in his solution to the congruent number problem.

UGF.2 Elizabeth A. Juelfs Austin Peay State University

Self-Starting Improved Euler for Solving the Heat Equation

In this presentation, we derive the Continuous Improved Euler's Method. We then apply the method to solve the Heat Equation using the Method of Lines.

UGB.5 Philip Kearse University of South Carolina Salkehatchie

Proof (Almost) Without Words: Conic Sections

The traditional definition of a conic section is a curve obtained as the intersection of a cone with a plane. Another equivalent definition is that a conic section consists of those points whose distances to some point, called a focus, and some line, called a directrix, are in a fixed ratio, called the eccentricity. In this talk I will use Dandelin spheres, both literally and figuraly, to show that this two definitions are equivalent.

❁ RES2.2 Ken Keating Kennesaw State University

Joshua Du

Trinity Matrices: Properties and Applications

A trinity matrix is a special kind of rotating square matrix satisfying $A = A^T = A^{-1}$. The application of these kinds of matrices in modeling and solving supersonic multiple jets is critical. An introduction to trinity matrices will be given, including their properties, construction, and some applications.

UGE.2 Alyse Keim Elon University

Todd Lee, and Crista Arangala

Agent-based modeling of malaria transmission: investigating the Ross-Macdonald model

Even in this era of modern medicine, Malaria- a fatal blood and liver disease-continues to run rampant throughout the world. With over half a million deaths last year, better understanding the patterns and behaviors of the disease is crucial to the development of prevention methods that will stifle the epidemic. Through mathematical modeling, specifically agent-based modeling (ABM), we can gain an accurate insight to the dynamics of the diseased populations. This talk will explore an ABM that effectively models realistic malaria transmission while incorporating the parameters and assumptions established by the Ross-MacDonald model. Comparing the outcome of the simulation to the Ross-MacDonald prediction, we can better study how factual parameters from real life epidemics translate to the differential equations modeling them. Furthermore, by comparing the two models, we can devise a more accurate set of mathematical equations for epidemic modeling and, ultimately, better combat the implications of such widespread disease.

UGB.4 Kevin Kern Coastal Carolina University

Einstein Notation for Tensor Calculus

Einstein notation is also known as index notation or indicial notation. Albert Einstein, who was famous for saying "Whatever your difficulties in mathematics, I can assure you, mine are far greater," was its inventor and used this notation to develop the General Theory of Relativity. The mathematical formalism Einstein notation provides a simple and elegant framework for developing tensor calculus. But we need not be engineers nor physicists to appreciate its beauty, simplicity, and power. This presentation provides a brief introduction to Einstein notation in Euclidean 3--space and concludes with a six line proof of the triple vector product $\vec{u}\times(\vec{v}\times\vec{w})=(\vec{u}\cdot\vec{w})\vec{v}-(\vec{u}\cdot\vec{v})\vec{w}$.

❁ PRO2.3 Ben Klein Davidson College

Remembrance of Problems Past

We will consider the ways in which solving and proposing problems can and should be considered as creditable professional activity for college faculty. We will discuss at least two specific problems that will be require nothing more than first year calculus to appreciate.

❁ CLH.1 Vicky Klima Appalachian State University

Undergraduates, Sudoku, and Groebner Bases

In this talk we will present a classroom project in which undergraduate students are introduced to concepts related to Groebner Bases as they work to solve systems of linear equations derived from the rules of Sudoku. These concepts include the definition of a Groebner Basis, Buchberger's Algorithm for computing such bases, and applications of these bases to counting problems. We will present the content of the project as well as discuss its successes and challenges.

UGG.2 Joshua Klingel Georgia Southern University

Hua Wang

Tilings and combinatorial identities – more proofs that count

It is well known that classic integer sequences such as the Fibonacci numbers enumerate various combinatorial objects such as tilings of a 1 by n board with squares and dominoes. The establishment of such relations generates many interesting combinatorial proofs of identities, as nicely presented in Proofs that Really Count by Benjamin and Quinn. We will start off by showing, through bijections between the classic tilings, some identities of Fibonacci numbers that appeared to be open for combinatorial proofs. Then the known combinatorial identities will be generalized to new sequence through the consideration of tilings with dotted tiles and/or 1 by k tiles in general. This is joint work with my mentor Hua Wang.

UGG.6 Kristen Knight Austin Peay State University

Ayman Alzaatreh

Applications to Generalized Distributions

Due to a variety of incoming data, new distributions are being derived to model the diverse data which well-known distributions are unable to model. Various applications and methods for these generalizations will be discussed. One specific new distribution, the gamma-half normal distribution, is proposed and studied. Various structural properties of the gamma-half normal distribution are derived. The shape of the distribution may be both unimodal and bimodal. Results for moments, limit behavior, mean deviations and Shannon's entropy are provided. In order to estimate the model parameters, the method of maximum likelihood estimation is proposed. Three real-life data sets are used to illustrate the applicability of the gamma- half normal distribution.

❁ IYS.6 Jeff Knisley East Tennessee State University

Exploring Ecological Systems with Statistical Models; and Vice Versa

Relatively simple mathematical and statistical models have proven to be very useful as tools for exploring complex ecological systems. Conversely, there are simple to understand ecological systems that have proven to be very useful in exploring difficult mathematical and statistical concepts. This presentation focuses on the use of statistical concepts such as bootstrapping, statistical distributions, and the Poisson distribution as tools for exploring migratory systems; and vice versa. That is, not only do the models reveal important information about the ecological systems, but also, the migratory systems reveal important aspects of the statistical concepts being used, such as, for example, why bootstrapping requires sampling with replacement. Indeed, the focus of the talk will be on using accessible migratory models as a means of better understanding the mathematics and statistics applied to them.

❁ GME1.6 Charlotte Knotts-Zides Wofford College

Teaching Calculus to Students who have already seen Calculus

The math department at Wofford College decided to resequence the topics in Calculus I and II to address the concern that an increased number of students in our classes have already had calculus in high school. This gave us an opportunity to create a calculus class where derivatives and integrals are introduced almost simultaneously. For example, shortly after we discuss the product rule for a derivative, we introduce integration by parts as its partner for antiderivatives. The result is a course that is refreshingly new to students who had calculus in high school and that demonstrates applications of both derivatives and antiderivatives even to students who only take one semester of calculus. In this talk, I'll discuss our new sequence of topics in Calculus I and II and talk about its impact on our students.

UGB.2 Dodji Kuwonu Austin Peay State University

Solving a parabolic PDE using the Laplace transform throught the method of lines(MOL)

In this paper, we transform a parabolic Partial Differential Equation(PDE) into a system of Ordinary Differential Equation(ODE) via the method of lines. The resulting system of ODE is then solved using the Laplace transform. The results obtained using this approach is compared with existing methods in the literature.

❁ PRO1.3 Wei-Kai Lai University of South Carolina Salkehatchie

Independent Study with Problem Solving Approach

At the University of South Carolina Salkehatchie, besides Independent Study, the highest level Math course offered is Calculus I. With students having only limited background knowledge, we found that the problem sections from mathematical journals become ideal material for students when picking a topic and concentration for their study. In this talk I will discuss how we design an independent study from these problems.

❁ MPE.6 Suzanne Lenhart U of Tennessee and NIMBioS

Beyond the MPE year

Activities on the Mathematics of Planet Earth (MPE) are being showcased this year in research and education sessions. Looking ahead to 2014-2015, there will be six NSF sponsored workshops continuing the MPE theme with research and education components; the initiative and leadership of these workshops are coming through Fred Roberts at DIMACS, Rutgers University. Information about these workshops will be given. Some research related to the MPE at the National Institute for Mathematics and its Applications will be presented.

RES3.4 Rao Li University of South Carolina Aiken

On the Upper Bound for the Number of Spanning Trees of a Connected Graph

Using matrix–tree theorem and the established bounds for the largest and the second largest Laplacian eigenvalues of a graph, we obtain a new upper bound for the number of spanning trees of a connected graph. We also characterize the extremal graphs achieving the upper bound.

GME2.1 Robin Lovgren Belmont University

Improving Student Evaluations in a Freshman Level Gen. Ed. Math Course – One Example

It is often a challenge to motivate students in a freshman-level general education math course and even more difficult to get them to "enjoy" the course such that they give positive feedback in their evaluations. Several ideas taken from various teaching seminars and workshops were implemented over the course of one semester in order to improve evaluations and student learning: the results were positive. This presentation examines the various techniques that were used and their results.

❁ INQ.1,2 W. Ted Mahavier Lamar University

Resources for University-level IBL Instruction

From a perspective driven by 25 years of IBL teaching, we will discuss the nuts and bolts of teaching your first university-level IBL course. Beginning with a time-tested strategy for implementing such a course, we will discuss the classroom culture, structure and grading. We will address resources available to anyone wishing to try an IBL course including materials, articles, books, workshops and mentoring.

GT1.5 Sara Malec Georgia State University

On the Intersection Algebra of Principal Ideals

Given two ideals in a Noetherian ring, the intersection algebra is an object that captures some information on the relationships between those two ideals. When the ring is a UFD and the ideals are principal, we use a connection to semigroup rings to describe some properties of the intersection algebra, including an algorithm that produces its generating set.

❁ INQ.6 John Mayer University of Alabama at Birmingham

Hexagon Numbers: An Open-Ended Problem

An equiangular hexagon is a six-sided convex polygon all of whose internal angles are equal. Imagine that you have an unlimited supply of congruent equilateral triangles. A number of these triangles can be placed with edges adjoining (fully, not overlapping) so as to form an equiangular hexagon. The first two hexagon numbers are six and ten. Call a positive integer n a hexagon number provided that with n of your congruent equilateral triangles, you can build an equiangular hexagon. What are the hexagon numbers? We will show how, using manipulatives (pattern blocks), this problem, and others that flow from it, can be introduced to students, working individually or in collaborative groups, in grades 5-16. There are multiple entry- and exit-levels for this problem. Such problems help students understand what mathematics actually is, as a study in its own right as opposed to (merely) a tool. (Hexagon numbers are not to be confused with hexagonal numbers: The nth hexagonal number is the number of points on a regular hexagon with n regularly spaced points on a side, including the vertices.)

❁ MPE.3 Erin McNelis Western Carolina University

Meaningful Modeling: Connecting Computational Science, Student Interests, and the Mathematics of Planet Earth 2013

Drawing a broader audience from the sciences, our Introduction to Scientific Computing course is an ideal setting for introducing students to mathematical modeling, computational science, and interdisciplinary applications of mathematics. This semester, our course has adopted the theme of the Mathematics of Planet Earth to help raise awareness of the role mathematics plays in understanding and potentially solving problems facing our generation and generations to come. The course introduces students to a variety of models (discrete, continuous, stochastic, systems-based, individual-based, statistical, etc.) and this year the examples and applied homework projects have been developed to highlight environmental mathematics applications such as population dynamics, epidemiology and ecological succession models, natural resource modeling, and optimal land use problems. As the semester progresses, students will develop and carry out long-term projects investigating a question or theme that interests them and provides meaningful connections to their disciplines (mathematics, mathematics education, computer science, chemistry, or engineering). This presentation will identify the challenges, successes, and failures experienced in this special themed course to date and will share examples of associated environmental mathematics applications and projects, and student selected topics for long-term course projects.

BEG.2 Razvan Alexandru Mezei Lander University

George A. Anastassiou, University of Memphis

Reverse Lp Fractional Integral Inequalities

We present reverse fractional integral inequalities, in the Lp norm, for left and right Riemann-Liouville, generalized Riemann-Liouville, Hadamard, Erdelyi-Kober and multivariate Riemann-Liouville fractional integrals. Then we derive reverse Lp fractional inequalities regarding the left Riemann-Liouville, the left and right Caputo and the left and right Canavati type fractional derivatives.

GT1.1 Christopher Miglino Albany State University

Renu Angira (Graduate Student), Li Feng (Faculty Mentor)

The Orbit Structure of the Power Sequence in Z_{100}

Let $n>0$ and $Z_{100} = [0],[1],\ n[99]$ be the commutative ring of all congruence classes modulo . In this paper, we study the orbit of the sequence of positive powers

$\{[k],[k]^2,[k]^3,\ n[k]^n,\ n\}$,

for each $k \in Z_{100}$. We characterize if an orbit is a fixed point orbit, a periodic orbit, or an eventually periodic orbit. We study the group structures in the orbits and the relationships between the orbit structures. It is interesting that there are

group structures among non-units. For example, we prove that for every even integer $0<k<50$, if $k \notin \{10, 20, 30, 40\}$, then either the orbits $\{[k], [k]^2, [k]^3, \text{n}[k]^n, \text{n}\}$, or

$\{[50+k], [50+k]^2, [50+k]^3, \text{n}[50+k]^n, \text{n}\}$

is a periodic orbit and thus is a cyclic group (with identity $[76]); *another orbit will be eventually periodic. Moreover,* [k]^{n} =[50+k]^{n}$ for every $n \geq 2$, thus the two orbits becomes one after the first power.

GT2.6 Christopher Miglino Western Carolina University

The Stability and Chaos of the Games We Play: Monopoly and Beyond!!

We will describe the space of infinite sequences generated by common games including Rock, Paper, Scissors and Monopoly. After a brief introduction to Ergodic Theory including the formal definitions of ergodicity and entropy, we will discuss some easily observable properties of these games which allow us to classify them as ergodic or not. We will also show how entropy is calculated. We will then introduce some new games that we have created and analyze these games using properties of ergodicity. Our results may surprise you!

❁ MSF.4 Andrew J. Miller Belmont University

Credit Cards: A Simple(?) Application of Difference Equations

Since 2009, credit card companies have been required to report two things to customers on each monthly payment: how long it would take to pay off the balance with the minimum payment and how much the customer would need to pay each month to pay off the balance in three years. This problem is frequently discussed in mathematics classes at many levels. Less frequently discussed is the situation when a consumer has balances at two different interest rates (say, purchases at one rate and a cash advance at another). We will look at modeling all of these problems using difference equations. Unfortunately, the formulas get unwieldy fairly quickly, so we will also advocate for other appropriate tools for the general student.

UGD.5 Sarah Minion Clayton State University

Elliot Krop, Pritul Patel, and Christopher Raridan

On the Edge-Balanced Index Sets of Complete Odd Bipartite Graphs

We determine the edge-balanced index sets for all complete bipartite graphs with parts of odd cardinality.

❁ MPE.1 William Garrett Mitchener College of Charleston

Simulating the Evolution of Regulatory Networks

The Utrecht Machine (UM) is a discrete abstraction of a biochemical gene regulatory network (GRN). Virtual organisms based on the UM can perform any computation, given sufficient resources. Such simulations combine ideas from molecular genetics, artificial life, and evolutionary dynamics to form a platform for studying how GRNs evolve to solve problems. I'll discuss the modeling process, explaining why I designed the UM the way I did, which biological details are included and which are left out. I'll discuss a case study in which selective breeding discovers agents that solve a data encoding problem, and its roots in a question about the evolution of linguistics.

❁ RES1.3 Jemal Mohammed-Awel Valdosta State University

Ruijun Zhao, Minnesota State University, Mankato, Mankato, MN

A Mathematical Model Studying Mosquito-stage Transmission-blocking Vaccines

Two compartmental deterministic models are developed in order to understand how transmission-blocking vaccines affect malaria transmission. One is a basic model and the other is an extension which incorporates transmission-blocking vaccines. The basic model is rigorously analyzed to gain insights into its dynamical features. The model consists of seven compartments representing the human and vector dynamics. When the disease-induced mortality rate is large, it is shown that, a backward bifurcation occurs where a stable disease free equilibrium coexists with a stable endemic equilibrium. Moreover, we set conditions under which the disease free equilibrium is globally stable if the basic reproduction number, R_0, is less than R_c, a critical value to avoid the backward bifurcation. Also, we show that the extended model has a locally-asymptotically disease free equilibrium whenever the basic reproduction number (R_tbv) is less than unity. Theoretical analysis of the extended model shows that transmission-blocking vaccine can reduce the basic reproduction number, i.e R_tbv ≤ R_0. Since a reduction in the basic reproduction number implies reduction in disease burden, the model suggests that transmission-blocking vaccines have a positive impact on reducing the disease burden.

GT3.2 Quinn A. Morris The University of North Carolina at Greensboro

Dr. Stephen B. Robinson (Wake Forest University)

A Landesman-Lazer Condition for the Boundary Value Problem $-u'' = au^+ - bu^- + g(u)$ with Periodic Boundary Conditions.

In this paper we prove existence results for the boundary value problem

$$\begin{cases} -u'' = au^+ - bu^- + g(u) \\ u(0) = u(2\pi) \\ u'(0) = u'(2\pi) \end{cases}$$

where $(a,b) \in \mathbb{R}^2$, $u^+(x) = \max\{u(x), 0\}$, $u^-(x) = \max\{-u(x), 0\}$, and $g : \mathbb{R} \to \mathbb{R}$ is a bounded, continuous function. We consider both the resonance and nonresonance cases relative to the Fu\u{c}\'{i}k Spectrum. For the resonance case we assume a generalized Landesman-Lazer condition that depends upon the average values of g at $\pm\infty$. Our theorems generalize the earlier results Rumbos by removing certain restrictions on (a,b). Our proofs are also different in that they rely heavily on a variational characterization of the Fu\u{c}\'{i}k Spectrum given Castro.

UGF.3 Jacob Mullins Samford University

Interpolation Of Data Using the Fast Fourier Transform

Fourier transforms have become incredibly useful in chemical instrumentation to create spectrums of data. Although this process works well, it can be time-costly on a computer. In order to highly reduce the amount of time to create a spectrum, the Fast Fourier Transform (FFT) can be exploited. In this analysis, a regular partition of size N is taken over a certain interval, say $[0, 2\pi]$. G_N is the space of functions defined on the partition. We start with a set of data which amounts to a function f in this space; often, such data is obtained by sampling a function defined on the entire interval. The Fourier transform (i.e. the spectrum) of the data is the set of coefficients that allow you to write $f(x) = \sum c_n e^{inx}$; if f is real valued, this expresses it as a trigonometric polynomial. There is a certain polynomial, with coefficients determined by f so that c_n is the polynomial evaluated at ω^{-n}, ω being the primitive Nth root of unity. A fast polynomial evaluation algorithm (Horner's method) can be applied resulting in the FFT. The presentation will show examples, using \emph{Mathematica} of this method applied to various data sets.

UGE.1 Matthew Neal Winthrop University

Whitney Taylor

A multi-scale model of polyp growth

Edward Giovannucci proposes that variation in insulin levels influence colonic carcinogenesis. To study these proposed effects, we develop a multi-scale model of polyp growth. We develop a system of linear ordinary differential equations to model the human colon on an intracellular level. We focus on the insulin-dependent and independent signaling pathways and how they influence programmed cell death and growth. We consider the dynamics of all colorectal crypts using a compartmental approach, accounting for stem cells, transit cells and differentiated cells. With this model in place, we determine how changes in insulin levels affect mutated cell growth.

To model insulin's effect on the intercellular level, we develop a predator-prey system of reaction-diffusion equations in which neoplastic tissue competes with cancerous tissue over available insulin in the colon. We use reaction-diffusion equations to model the growth of polyps, a precursor to carcinomas and tumors. Presentation will include development of the model and nondimensionilization of equations. We will discuss performance of both models in our results.

UGD.2 Michael Ngo Clayton State University

Ellliot Krop, Thuhong Nguyen, Petra President, and Marcus Bartlett

Small Pattern Gallai Ramsey Numbers

The minimum order of any complete graph so that for any coloring of the edges by k colors it is impossible to avoid a monochromatic or rainbow triangles is known as the smallest Gallai-Ramsey number. For any graph H with edges colored from the above set of k colors, if we consider the condition of excluding H in the above definition, we produce a pattern Gallai-Ramsey number. In this talk, we consider this problem when H is a two-colored cycle with one color repeating three times and discuss the solution in terms of k.

❁ ALT.2 Ben Ntatin Austin Peay State University

Practical formative assessment strategies suitable for a hybrid business calculus course.

Formative assessment is a process used by teachers and students during instruction that provides feedback to adjust ongoing teaching and learning to improve students' achievement of intended instructional outcomes. Formative Assessment provides layers of organization and pre-planning guidance to reach instructional goals for student learning outcomes. In contrast, students often feel they are doing all right in a class, and then they have a graded assessment and find out otherwise. We provide a an assessment strategy that balances formative and summative assessment strategies for maximum impact. This strategy has been applied successfully in a business calculus course to assess; course content Knowledge and Skills, learner attitudes, Values, self-awareness, and learner reactions to instruction.

UGC.6 Aaron Ostrander Berry College

Dr. Chris White (University of Glasgow)

Combinatorial Aspects of Quantum Chromodynamics

We begin this talk with a discussion of how certain particle physics processes are represented diagrammatically. We apply combinatorics and algebra to these diagrams to define matrices that are useful in physics computations. We discuss methods utilizing directed graphs and posets that have been applied to the study of these matrices. We also discuss some conjectures about these matrices that are motivated by physics, and we present some of the proofs of the initial cases of these conjectures.

UGD.4 Pritul Patel Clayton State University

Elliot Krop, Sarah Minion, and Christopher Raridan

The Edge-Balanced Index Sets of $K_{13,7}$

Let G be a graph with vertex set $V(G)$ and edge set $E(G)$, and f be a binary labeling using 0 and 1 of $E(G)$ so that the absolute difference in the number of edges labeled 1 and 0 is no more than one--we call such a labeling edge-friendly. We examine the edge-balanced index set of a particular complete bipartite graph, $K_{13,7}$.

UGG.5 Robert Pickus Coastal Carolina University

Lindsey Bell, John Marcis, and Nicholas Pritchard

An Analysis of Vehicular Collisions in the Myrtle Beach Area

Myrtle Beach is a popular travel destination that attracts visitors from many states and countries. These visitors impact the area in many economic, environmental, and socio-cultural ways. One major way that visitors interact with and impact the Myrtle Beach community istransportation. For tourists, navigating Myrtle Beach roads may be a challenge because of general unfamiliarity with roads and intersections, changing traffic patterns, traffic congestion, and many visual distractions.

The purpose of this study is to examine traffic collision data for Myrtle Beach between 2001 and 2010. This study proceeds in the following manner. The first section addresses the unique nature of the data set. This section not only provides a detailed analysis of each traffic accident occurring in Horry County but also provides summary statistics for these data. The summary statistics provide general observations as well as some specific findings. The second section identifies 95 intersections in the Myrtle Beach area that are frequented by both tourists and locals. The third section develops a statistical model designed to investigate the accident patterns for the intersections that tend to have the highest frequency of accidents. The number of collisions at these intersections is modeled using the following three methodologies: (1) least squares regression; (2) a negative binomial generalized linear model; and (3) quantile regression techniques.

ALT.6 Katherine Pinzon Georgia Gwinnett College

Using POGIL in a Calculus Classroom

This talk will discuss Process Oriented Guided Inquiry Learning (POGIL). I will give a description of what POGIL is and how it works. It will include some sample activities used in the class, as well as discuss some details about the implementation in my classroom.

IYS.3 Nicholas Pritchard Coastal Carolina University

Jacqueline Leake (undergraduate student)

The Advantage of the Coin Toss for the New Overtime System in the National Football League

In 1974, the National Football League (NFL) instituted a sudden death overtime to hopefully reduce the amount of ties during the regular and post seasons. Since then, overtime in the NFL has been a highly debated topic. Empirical evidence has shown that the coin toss winner has a significant advantage since the first team to score wins the game. In fact, from 1994 – 2009, 59.4% of teams who won the coin toss at the beginning of overtime went on to win the game. In addition to empirical evidence, Michael Jones (2004) modeled sudden death overtime in the NFL using absorbing state Markov chains and found theoretical results similar to the empirical results. In 2010, the NFL instituted a new overtime system to be implemented only during the playoffs beginning in 2011. Under this new system, both teams get to attempt at least one offensive series unless a touchdown is scored by the team with the ball first. This new system was fully implemented into the regular season in 2012. Since it has only been in effect for one complete regular season, it is difficult to see from data if the new overtime system reduces the advantage of the coin toss winner. This talk will examine a model for the probability of winning in overtime under the new NFL system after winning the coin toss using the law of total probability and absorbing state Markov chains.

GT1.2 Ashley Rand University of Tennessee, Knoxville

Non-Unique Factorizations of Polynomials

The Fundamental Theorem of Arithmetic tells us that any positive integer can be uniquely factored as a product of positive prime numbers. This gives us a nice structure to teach College Algebra students, but it is much more interesting when we have non-unique factorization. In this talk, we explore polynomial subrings where we have non-unique factorizations. Specifically, we determine when all of the factorizations of these polynomials will include at least one reducible element.

❋ RES3.2 Christopher Raridan Clayton State University

Christian Barrientos

Mean Labelings of Outerplanar Graphs

Mean labelings were introduced in 2003 in the context of additive vertex labelings. In this case, nonnegative integers are assigned to the vertices of a graph in such a way that all edge weights are different, where the weight of an edge is defined as the average of the labels on its end vertices rounded up to the next integer. In this presentation, we explore mean labelings of outerplanar graphs.

GT2.2 Natalie Rose Rich Wake Forest University

Knots and Links in the Complete Directed Graph on Six Vertices

We define the complete directed graph J6 to be the set of six vertices with the property that every pair of distinct vertices is connected by exactly one pair of edges such that each of the two edges e and e' connecting the same two vertices has a direction assigned to it such that the initial point of e is the terminal point of e' and the initial point of e' is the terminal point of e. We define a triangle in J6 to be a set of three vertices and three edges connecting them such that for every two of the three consecutive edges that form the triangle, the initial point of one edge is the terminal point of the other edge. We say that two disjoint triangles form a nontrivial link if they are impossible to pull apart or if one (or both) of the triangles contains a nontrivial knot. This presentation features results that were obtained through efforts to prove that J6 is intrinsically linked (that is, J6 contains a nontrivial link no matter how we position it in space).

GME2.4 Josie Ryan Lander University

A Look at University Preparedness of Incoming Freshmen

An interactive look at preparedness of incoming university students as compared to university expectations. Where are our students excelling? Where do they need improvement? A look at the book I am writing based on talks I have given to parents of home school and regular high school students about university expectations in mathematics and beyond. How do you answer the question “Should my child take Calculus in high school?” What needs are we seeing? Is there a real increase in helplessness, a decrease in knowledge, or simply generational perception? If you had the opportunity, what would you tell parents of elementary, middle, and high school students?

GME2.2 Dohyoung Ryang University of North Carolina at Greensboro

Does gender affect mathematics teaching efficacy?

A mathematics teacher's efficacy is a strong influence to the person's actual mathematics instructional behaviors. It is a classical theme if gender is a factor to mathematics learning. Gender might be a factor to mathematics teaching efficacy (so theoretically actual ability to teach mathematics). This talk discusses the gender difference on prospective teachers' efficacy beliefs in teaching mathematics.

❁ MPE.4 Jan Rychtar University of North Carolina Greensboro

The effect of the cost on the fighting behavior

One of the most fundamental games applied to biology is the so called Hawk-Dove game. It is a simple model of a conflict situation which can potentially result in a fight between individuals. A nice consequence of this model is a prediction that costly fight should not really happen that often in the nature. In this talk we present a more realistic variant of the (sequential) Hawk-Dove game where the individuals can vary the investments they put in the potential conflict. The bigger the individual's investment, the bigger the chances of winning and also the bigger the cost. We model the investment versus cost relationship by several different kind of functions and study the optimal investment levels. We conclude that under most circumstance, the individuals will actually avoid direct fights (either do not attempt the fight at all, or invest 0 and give up once they see the other is ready to fight). The only occasion when the fights may occur according to our model is the scenario when the gain from the fight is significantly more than the cost of the maximal investment in the fight.

❁ RES1.1 Ramanjit Sahi Austin Peay State University

Samuel Jator

A higher order method for boundary layer to problems in Engineering

Third order boundary value problems have gained a lot of attention in the literature due to their applications in the field of engineering and science. Many of these boundary value problems (BVPs) cannot be solved analytically, hence, new numerical techniques have been proposed for solving some of these BVPs. In this presentation, we will solve the Blasius equation that has its origin in the theory of laminar boundary layer using a new higher order method of order 8. The results produced using this new method are compared with the well known Adams method of order 8. We will perform numerical experiments to check the efficiency of these methods.

❁ MPE.5 Rene A. Salinas Appalachian State University

Modeling the Spread and Control of Pseudo-rabies Virus in Feral Hogs in Great Smoky Mountains National Park

For over two decades, the Park Service has been removing feral hogs from Great Smoky Mountains National Park (GSMNP) in a attempt to control the population. In 2005, the first seropositive cases of pseudo-rabies virus (PRV) were recorded in harvested individuals. We developed an individual-based model (IBM) for the feral hog population in Great Smoky Mountains National Park (GSMNP) and surrounding regions to test theories on the spread of pseudo-rabies virus (PRV) in GSMNP. Because there is limited understanding of the spread of the disease in feral populations, an IBM is well suited to test both modes and effectiveness of transmission. Another advantage of the IBM approach is the ability to model the efficiency of control methods (harvesting) for mitigating disease spread. IBMs can be used to compare changes in location, time, and effort to determine optimal control strategies. In this presentation I will describe the disease components of the model and present preliminary results on the effectiveness of the current harvesting strategy on the population density of hogs and the spread of PRV.

Results suggest that although the year-to-year variation in fall hard mast is a natural population regulator, harvesting has had a impact on the population. This work is part of a NIMBioS Working Group that includes: Bill Stiver, Joseph Corn, Suzanne Lenhart, Chuck Collins, Marguerite Madden, Eric Carr, Brandon Schmidt, Ellen Kasari, Kurt VerCauteren, Agricola Odoi, Hamish McCallum, and Graham Hickling.

❁ RES2.1 Damon Scott Francis Marion University

Newly Structured Programming

We perform a change of phrase structure to structured programming and create a new language called Newly Structured Programming. Nest-levels fall dramatically when algorithms are written in the Newly Structured system. Code written in the new language mostly flows and only minimally nests, and the look-and-feel of the newly structured code is called fluvious.

UGH.1 Joseph Scott Georgia College

Dr. Darin Mohr

Implicitly Defined Baseball Statistics

In Major League Baseball, the batting champion is given to the player with the highest batting average. The Cy Young Award winner is given to the top pitcher and is determined by a combination of statistics including earned run average (ERA). These statistics do not consider the strength of the opposition. We develop two implicitly defined statistics that determine the value of a batter and the value of a pitcher based on the relative skill of the opposing pitcher and batter respectively. This statistic relates a player's performance with the skill of the opposition and allows us to identify the best hitter and pitcher of a specific season.

GT2.5 Valeriia Sherina Georgia Southern University

Disclosure Risk of the Hybrid Method of the microdata protection

The purpose of Statistical Disclosure Limitation (SDL) is to protect statistical data in such a way that dissemination and analysis of this data can be made without giving away confidential information that can be linked to specific individuals, businesses, or entities. The application of SDL techniques involves balancing two competing objectives: the minimization of disclosure risk and the maximization of data utility for the legitimate data user. In this research we study the disclosure risk of the hybrid method of microdata protection that consists of clustering the records first and then synthesizing them independently for each cluster.

UGA.1 Christopher Shill Elon University

Chad Awtrey

Galois 2-adic Fields of Degree 12.

An important problem in computational number theory is to clasify all nite extensions of the p-adic numbers by computing important invariants which dene each extension. Current research has focused on computing Galois groups of these extensions up to degree 11. Consequently for this talk, we will focus on degree 12 extensions. We will begin with a brief overview of p-adic numbers and will conclude by discussing a method for calculating Galois groups of Galois extensions of the 2-adic numbers.

❁ PRO1.4 Andrew Simoson King College

From Newton to Nim: inviting journal problems to class

We give two examples of classroom incorporation of lists of problems from various journals.
We chronicle how introducing a *Math Horizon*'s nim-like problem into a number theory course led to a student MAA poster and a student publication; and how an examination of Newton's *Prinicipia* in both a History of Math Class and a Vector Calculus course resulted in new entries for the problem sections of the *CMJ* and the *Math Magazine*.

GT1.4 Nicholas Sizemore Western Carolina University

Group Covers: Covering and Partition Numbers

A group cover is a collection of proper subgroups whose union is the group. One can also consider a partition, which is a group cover consisting of subgroups with trivial intersection. Of interest in this talk will be the covering number, which is the minimal number of subgroups necessary to form a cover, and the partition number, which is the minimal number of subgroups necessary to form a partition.
The key question will be, "When is the covering number strictly less than the partition number?", which will motivate some interesting results. In particular, the dihedral groups are turn out to be quite interesting, and we can completely classify the relationship between the covering and partition number of these groups.

INQ.3 Cornelius Stallman Georgia Regents University Augusta

Can you teach calculus using the Moore Method and still cover the material?

During the past ten years I have used a modified Moore Method approach in teaching calculus.
The benefits of a Moore Method course are known to many who experienced such a course in graduate school or in an upper level undergraduate course. Calculus presents a special challenge to the would-be Moore Method practitioner. How will you cover the material? Is it possible? Does it matter? What does “covering the material” mean?
I hope to address these questions as well as shed some light on how Moore Method/IBL practices can address some of the recent concerns about the state of undergraduate education expressed in for example Academically Adrift and Our Underachieving Colleges.

❁MSF.3 Richard Stephens Columbus State University

Estimating the Rate of Interest For An Ordinary Annuity Certain

Classic textbooks on the Mathematical Theory of Interest such offer simple approximations of the interest rate i for an ordinary annuity certain with n terms when the present value or the future value is known. These approximations are not very accurate. In fact, when the present value is fixed, the approximation of i approaches 2i as n becomes very large and even though the future value can not be a fixed value for all n, the approximation of i approaches zero as n becomes very large. This paper discusses old and new estimates for each case.

❁ PRO1.5 Richard Stephens Columbus State University

Problems, Solutions, Students and Other anecdotes

The problem sections of the MAA journals are rich sources mathematics that may lead to faculty research papers, class projects or program recognition. We shall present examples of the value found in these problems by faculty and students Columbus State University.

❁PRO1.1 David Stone Georgia Southern University

Brian Beasley, Presbyterian College

Solve This! Mathematics Problems as Challenges

Many mathematicians have viewed problem solving as the most important aspect of our discipline. The problems sections in today's mathematics periodicals are a continuation of a longstanding practice in which mathematicians have challenged other mathematicians. Fibonacci, the Italian algebraists and Newton are classic examples. More recently, Erdos challenged audiences, offering monetary prizes. All MAA journals, and many others, have problems sections in which specific problems are posed and the "best" solutions published.
We'll review the history and provide many examples and observations.

UGE.3 Hannah Swan Winthrop University

Agent-Based Fabric Modeling Using Differential Equations

Using the drape of a circular sheet over a point from its center, we compare meshes that mimic woven fabric structure to one based on the shape of the pattern piece: an arc mesh. We use agent-based modeling software to simulate fabric drape by modifying existing linear differential equations of mass spring systems. We decompose the forces of gravity and Hooke's law into directional components, forming a new nonlinear system of the force in each direction. There are then three differential equations for each mass point, resulting in a system of hundreds of equations for each mesh. Euler's numerical method is coded into the model to solve the system and calculate the new position of each mass point at every time step. Observing the super-elasticity problem, the tendency of springs to stretch farther than fabric, we apply constraints to spring length. We analyze the effect of resolution and bending springs, additional springs connected to every other mass point, on the accuracy and computational time of each simulation. To identify the best mesh geometry, we compare the drape coefficient, a standard measurement for textiles, to an actual fabric drape.

GME2.3 M. Hanif Talukder Elizabeth City State University

Analyzing the Effects of Predictors on Student Performance in the Historically Black College and University in the Calculus

Calculus is fundamental course for STEM program. Failure in calculus sequence is one of the reason student leave STEM program during their academic years. This paper focuses on the academic level of STEM students entering in HBCU in the Calculus sequence. The quantitative method consisted of various statistical analysis was performed to identify the important factors on performance in calculus sequence.
Keywords:-Regression analysis, ANOVA, odds

MSF.5 Wayne Tarrant Wingate University

Does the adoption of a flat tax lead to greater income inequality?

Progressive income taxes had been the norm for about 150 years, with the exception of a few British protectorates. Starting in Estonia in 1994, several formerly communist countries decided to adopt a flat tax. There was near unanimity among political theorists that this policy change would lead to greater income disparity, shifting a heavier burden on the poor and allowing the rich to benefit. This theory has gone mostly untested, as very few have looked at actual statistical data.

In this talk I will introduce the Gini coefficient as a measure of income inequality. I will then show results from several statistical tests on this data, and we will attempt to answer the question that is the title of this lecture. Then we will see new questions concerning the flat tax that can and should be studied.

UGF.5 Jordan Taylor — Austin Peay State University

Robert French

Extended Backwards Differentiation using Trig Basis for oscillatory problems

In this presentation, we derive an Extended Backward Differentiation Formula with trignometric basis functions. The method is implemented on oscillatory problems and the results obtained are compared with existing methods in the literature.

UGC.2 Lain Tomlinson — Cumberland University

Chris Fuller, and Sarah Pierce

Making Musical Serialism From Mass Spectrometry and Nuclear Magnetic Resonance

Using mathematic principles, music was generated from applications such as mass spectrometry and nuclear magnetic resonance (NMR). Research was conducted on different methods such as sound formulas, frequency formulas, and Fourier series that could be used on mass spectrometry and NMR data. The data that was used was obtained from the Spectral Database for Organic Compounds (SDBS) and included caffeine, adenine, and 2,4,5-trifluoro-1,3 phenylenediamine. Using the recorded data and the formulas, tones were produced with MATLAB. The music, serialism, is tones produced from data sets. The results were atonal at this time, but further research will hopefully yield results that are more melodic.

GT3.1 Anh Tran — Georgia Southern University

Yan Wu

Adaptive control of Lorenz system to non-trivial equilibrium points

The complex Lorenz system is a simplified nonlinear dynamical system, which is derived from the Navier-Stokes equations that govern a closed thermal convection loop. The Lorenz system is chaotic for large Rayleigh number. In this chaotic regime, we implement a linear state feedback controller to stabilize the state trajectory at its original non-trivial equilibrium. The state variable for feedback is easily measurable. The system is proved to be globally asymptotically stable with a low feedback gain. The stability bound is improved over the previous result. We present numerical simulations to demonstrate the stability, transient and steady state responses, and the performance of the state feedback controller.

GT1.6 Will Trott — Georgia Southern University

The Default of Contraction and Regularity

The category CONV, with convergence spaces as objects and continuous maps as morphisms, is generalized by the category CAP, in which convergence-approach spaces are objects and contractions are morphisms. This presentation will focus on introducing these two categories as well as introducing a recent generalization of a theorem of Wolk.

❁ CLH.4 John Wagaman — Western Carolina University

Statistics and Service Learning in the Campus Garden: A Preliminary Report

We have several courses at our university which serve as introductory courses in statistics for many students; among these are a service course in applied statistics and a graduate course in experimental design. In Fall 2012, we started our involvement with the Campus Kitchen Garden, a student-run facility and organization under the Center for Service Learning at WCU. In this talk, we will describe our continued work with this organization through our statistics classes in assisting the garden to grow food for the local food bank.

❁ RES1.2 Brian Wagner — UT Martin

Ascending Subgraph Decompositions in Oriented Complete Balanced Tripartite Graphs

A digraph D with $\binom{n+1}{2}+k$ arcs ($0 \le k \le n$) has an ascending subgraph decomposition (ASD) if there exists a partition of the arc set of D into n sets of size $1,2,3,\ldots,n-1,n+k$ such that the digraphs $D_1, D_2, \ldots, D_{n-1}, D_n$ induced

by the n sets of arcs 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 outline the proof that all orientations of complete balanced tripartite graphs have ASDs.

UGB.6 Stella Watson Furman University

Rahul Isaac, and Jack Farnsworth

The Geometry of the Narayana Numbers

This presentation examines the fractal nature of the object created by reducing the Narayana numbers modulo 2 and embedding them in the first quadrant. This object, the Narayana fractal, closely resembles Sierpinski's gasket. Its Hausdorff dimension is $\log 3 / \log 2$, and its limit converges to Sierpinski's gasket unioned with the point $(1,1)$.

UGC.4 Christian Weigandt High Point University

Alex Palmer

Artificial Neural Networks: My computer can do WHAT?!

Artificial Neural Networks are mathematical models that are used heavily in regression and classification tasks. Unlike other forms of machine learning, artificial neural networks do not require feature engineering, i.e. they learn which features are important and which ones are not. In our talk, we will discuss the back-propagation learning algorithm, methods for increasing the speed of learning, and ways to avoid over-fitting. We will demo our web application which uses a neural network trained on the MNIST data set to classify handwritten digits. We will also discuss the history of as well as recent advances in the use of artificial neural networks.

BEG.1 Mary Wilkerson Coastal Carolina University

Dynamics of mated quadratics through tile subdivision

"Mating" is an operation that topologically glues the domains of a polynomial pair in order to obtain a new map on the resulting quotient space. The dynamics of the mated map are then dependent on the two polynomials and the manner in which their domains were glued. In this talk, I will address using Hubbard trees and finite subdivision rules as tools to examine certain quadratics and their matings. These tools will allow us to translate discrete parameter information on a map into information on how the map behaves topologically.

❁ GME2.5 Allison Wolf Georgia Perimeter College

Ashraful Chowdhury, Patricia Jayne

Concurrent skill review in College Algebra - Does It Help?

College Algebra students often have significant pre-requisite skill gaps that can interfere with successful completion of the course. We have attempted to remedy this deficiency by creating online pencast reviews, complete with review assignments, for students to complete as a pre-requisite for gaining access to the online homework. Come learn about the effects on retention rates, pass rates, and classroom dynamics.

RES2.4 Leina Wu Queens University of Charlotte

Tsun-zee Mai (University of Alabama)

Search for the Optimal Omega of the Successive Over Relaxation Method in Multi-layer Grid Refinement Theme

The successive over-relaxation (SOR) method has been widely used as an iterative method to solve large sparse linear system. When solving a partial differential equation over a rectangular domain with Dirichlet boundary conditions, the multi-layer grid refinement method can be used to generate the linear system, with higher efficiency than uniform grid theme. In this paper, we will study the SOR method in the multi-layer grid refinement scheme. A heuristic estimation for the optimal parameter of the SOR method is given and numerical experiments are carried out to verify the estimation in this scheme.

GT2.4 Tiantian Yang Georgia Southern University

Broderick O. Oluyede

Statistical Properties of Beta and Kumaraswamy Generalized Lindley Distributions

In this paper, new classes of generalized Lindley distribution called the beta-generalized Lindley and Kumaraswamy (Kum) generalized Lindley distributions as well as related sub-distributions are presented. Expansion of the density of Kum generalized Lindley distribution is obtained. The properties of these distributions, including the hazard function,

reverse hazard function, monotonicity property, shapes, moments, coefficient of variation, and coefficient of skewness are derived and studied. The method of maximum likelihood is used to estimate the parameters of these new classes of distributions. Finally, real data examples are discussed to illustrate the applicability of the models.

❁ IYS.2 Carl Yerger Davidson College

Paul Britton '12, Davidson College

Boxing in Basketball: What factors affect the outcome in a college basketball game?

In the last two decades, basketball coaches have increasingly relied on statistical analysis to determine teaching points for their teams. Davidson College men's basketball coach Bob McKillop divides each game into ten "rounds", with a round ending at each media timeout and at halftime, and gives his team several "round" goals for every game. Two particular goals are winning both rounds five and ten, and winning several rounds overall. How does winning more rounds affect the probability of winning the game? What other factors (such as field goal percentage, home-court advantage) are most descriptive in winning a game? Can looking at the rsults of multiple rounds give more information than just looking at the results of one round at a time? Come and learn some new updates from last year's suggested by reviewers of the paper.

GT2.1 Shuai Yuan Georgia Southern University

Huiqing Liu (Hubei University)

On the spectral moment of quasi-unicyclic graphs

A connected graph G = (V, E) is called a quasi-unicyclic graph, if there exists $u0 \in V(G)$ such that $G - u0$ is a unicyclic graph. Denote $Q(n, d0) = \{G : G$ is a quasi-unicyclic graph of order n with $G - u0$ being a unicyclic graph and $dG(u0) = d0\}$. Let A(G) be the adjacency matrix of a graph G, and let $\lambda1(G), \lambda2(G), \ldots, \lambda n(G)$ be the eigenvalues in non-increasing order of A(G). The number of the sum of all of the λi (i=1,2,...n) square is called the k-th spectral moment of G, denoted by Sk (G). Let $S(G) = (S0(G), S1(G), \ldots, Sn-1(G))$ be the sequence of spectral moments of G. For two graphs G1 , G2 , we have $G1 \prec S G2$ if for some k ($k = 1, 2, \ldots, n - 1$), we have $Si(G1) = Si(G2)$ ($i = 0, 1, \ldots, k - 1$) and $Sk(G1) < Sk(G2)$. In this paper, we determine the last and the second last quasi-unicyclic graph, in an S-order, in the set Q(n, d0), respectively.

❁ GME1.4 Laurie Zack High Point University

A First Year Seminar on Cryptography

This talk presents an overview of a freshman seminar on cryptography created at High Point University that required no mathematical background. The students went through the history of cryptography as well as learned the mathematical ideas behind the current high computing coding and were able to encrypt and decrypt using the RSA algorithm.

❁ GME1.3 Steven Zides Wofford College

Liberal Arts Mathematics: "One and Three Chairs"

The Conceptual Art movement of the 1960's/1970's characterized itself by elevating "Platonic Ideas" to paramount importance, while downplaying material manifestation as nothing more than ephemeral modes of sensory stimulation. In other words, for the conceptual artist, the mental experience was lasting while the medium itself was only temporary. One classic example of conceptual art was Joseph Kosuth's "One and Three Chairs", a celebration of "chairness" through physical, photographic and semantic representations. Here Kosuth's ingenious gestalt elevates something as simple as a chair into an intellectual puzzle that sparks the imagination. The success of Kosuth's work raises the question; could a similar pedagogical structure be used as an effective model for a typical Liberal Arts Mathematics Course?

With this question in mind, I have been tinkering with an introductory mathematics course that emphasizes its "One and Three Chairness" through a balance of problem solving, artistic representation, and literary example. As such, instead of introducing concepts like "number" or "proof" with a single monolithic resource (such as a $100 textbook), we engage such mathematical concepts through the visual arts (paintings, sculptures, films) and literary fictions (short stories, novels, plays, poems). Although my students still work through the traditional analytical exercises, a significant portion of the course is designed to broaden their experience by observing how the mathematical concepts are incorporated into the other humanistic modes of thought.

In this talk, I will outline the structure of the class, required texts, suggested audio-visual resources, and several types of possible assessment. Emphasis will be placed on specific examples and time will be set aside at the end for questions.