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http://sections.maa.org/southeastern/maase/conference2015/

Abstracts for all Talks

CP1.1	*Mathematicians or Poets... Yes.*	
Josie Ryan	Lander University	Sean Barnette, Lander University
A discussion of the creation and implementation of a course given to honors students- designed to teach them that math, history, philosophy, theology, poetry, law and other areas of study have not historically been as isolated from one another as they are now. We want to show math students that writing and self expression are important and show humane students that the concepts and thought processes inherent in mathematics are not alien to their interests. The course looks at the works and interests of Augustine, Descartes, Khayyam, Leibniz, and others.		

CP1.2	*Unrealistic Word Problems, and Other Stupid Math Jokes, or: Take my Dept Chair...Please*	
Leigh Atkinson	UNC Asheville	
On exams and in lectures, humor can be used to emphasize what is important, to make what is important memorable, to lighten the mood of a classroom, and to make mathematics seem more human than Vulcan. The presenter has tried for 25 years to be funny in class, with what success the audience for this talk will be able to judge; he will present examples of what has seemed to work, on the board and on exams, along with some thoughts on the limitations of humor as an aid to math education.		

CP1.3	*Finding Math in Ormskirk?*	
Douglas Daniel	Presbyterian College	
As part of the general education curriculum at Presbyterian College many of our students use short term study abroad opportunities to fulfil requirements. For many years, I wished to be part of these study trips. Without many math majors I wondered how I might accomplish this. Many, if not most, math study abroad trips seem to primarily cover the historical aspects of math, but I wanted something a bit more. In this talk, I will discuss how the program was developed, how I attracted students and how I taught a course that attracted math majors and non-majors alike that went beyond the usually math history trip. I will also present some of the comments of the students assessing the course and their experiences, as well.		

CP1.4	*Probability and strategy in the context of games of chance and popular culture*	
Stacey Ernstberger	LaGrange College	
At LaGrange College, opportunities are given to develop month-long atypical courses in non-major-related topics. In this context, a class was developed which deals with the probabilities and strategies in classic game shows, casino games, and in other forms of entertainment. This talk is a discussion of the applications and structure of this entertainment-based mathematics course for non-mathematics majors.		

CP2.1	*Ideal free distributions in structured habitats*	
Rychtar	UNCG	
The important biological problem of how groups of animals allocate themselves between different habitats has been modeled extensively in the past. Such habitat selection models have usually involved infinite well-mixed populations. In particular, the ideal free distribution (IFD) model is well-developed. Here we generalize (and solve) a habitat selection game for a finite structured population. We show that habitat selection in such a structured population can have multiple stable distributions (in contrast to the equivalent IFD model that is practically unique). We also define and study a ``predator dilution game'' where unlike in the habitat selection game, individuals prefer to aggregate (to avoid being caught by predators due to the dilution effect) and show that this model has a unique solution when movement is unrestricted.		

CP2.2	*Improved full-Newton-step interior-point methods for LO and LCP*	
Mustafa Ozen	Georgia Southern University	
An improved version of an infeasible full Newton-step interior-point method for linear optimization(LO) is considered. In the earlier version, each iteration consisted of one infeasibility step and a few centering steps while in this version each iteration consists of only an infeasibility step. This improvement has been achieved by a much tighter estimate of the proximity measure after an infeasibility step. However, the best iteration bounds known for these types of methods are still achieved. Next, a preliminary work on generalizations of the improved method to linear complementarity problems is considered.		

CP2.3	*Incorporating Cancer Stem Cells into a Hormone Therapy Model for Breast Cancer*	
Zachary Abernathy	Winthrop University	
Despite improvements in cancer therapy and treatments, tumor recurrence is a common event in cancer patients. One explanation of recurrence is that cancer therapy focuses on treatment of tumor cells and does not eradicate cancer stem cells (CSCs). CSCs are postulated to behave similarly to normal stem cells in that their role is to maintain homeostasis. That is, when the population of tumor cells is reduced or depleted by treatment, CSCs will repopulate the tumor, causing recurrence. In this talk, we shall consider a hormone therapy model for estrogen-receptive breast cancer in which the behaviors of tumor cells and CSCs are separately considered. A stability analysis will reveal conditions on the effectiveness of a receptor-blocking drug that determine whether treatment fails, cures the cancer completely, or reduces the final tumor size.		

<table>
<tr><td>CP2.4</td><td colspan="2">Using Item Response Theory (IRT) Model to evaluate the Military traumatic brain injuries (TBI) and post-traumatic stress disorder (PTSD)</td></tr>
<tr><td>Cuixian Chen</td><td>University of North Carolina Wilmington</td><td>Yishi Wang, University of North Carolina Wilmington
Antonio Puente, University of North Carolina Wilmington</td></tr>
<tr><td colspan="3">Brain health of military service members and aging veterans has been considered as a signature issue (The Congressional Budget Office, 2012). During the wars of Iraq and Afghanistan, there are an increasing number of military service members who were injured by improvised explosive devices such as mortar fire and rocket-propelled grenades. As a result, there is a surge of traumatic brain injuries (TBI) and post-traumatic stress disorder (PTSD) (Friedl, 2014). Therefore it is extremely important and urgent to develop a neuropsychological battery to provide an accurate, efficient and quick assessment of trauma-related diagnose for this military population. In our preliminary study, we will apply the Item Response Theory (IRT) Model to the existing military dataset to evaluate the TBI/PTSD. One of the key components of this study is to calibrate test items to access TBI / PTSD. It aims to decrease patients’ burden and increase measurement precision.</td></tr>
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<table>
<tr><td>CP2.5</td><td colspan="2">A lunatic trick for the moon's cycle</td></tr>
<tr><td>Andrew Simoson</td><td>King University</td><td></td></tr>
<tr><td colspan="3">What is the natural period for the moon? Since the 5th century {\sc bc}, man has known that every $n = 19$ years, the moon almost repeats itself. We show that 19 is the {\em second} best integer choice for n. Our answer involves a little trigonometry, the standard deviation, the Farey series, and Kepler's laws of motion.</td></tr>
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<table>
<tr><td>CP3.1</td><td colspan="2">Spherical Turkeys and Vibrating Balloons</td></tr>
<tr><td>Russel Herman</td><td>UNC Wilmington</td><td>None</td></tr>
<tr><td colspan="3">We describe interesting examples that can be simulated using solutions of linear partial differential equations. How long should one cook a turkey? What happens when a spherical balloon is set into motion by an impulse? These simple examples highlight long known methods for solving standard partial differential equations in higher dimensions.</td></tr>
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<table>
<tr><td>CP3.2</td><td colspan="2">Convolution and Nonhomogeneous Equations</td></tr>
<tr><td>Curtis Herink</td><td>Mercer University</td><td></td></tr>
<tr><td colspan="3">Let f_n denote the n-th Fibonacci number. we begin with the observation that a particular solution of the nonhomogeneous linear difference equation x_n = x_{n-1} + x_{n-2} + f_n is the convolution of the sequence of Fibonacci numbers with itself. This motivates an exploration of when convolution can be used to give particular solutions of nonhomogeneous linear diffference equations. Then, because there is an analogy between difference equations and differential equation, we ask the same thing about nonhomogeneous differential equations.</td></tr>
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CP3.3	*Stability and bifurcation results for positive solutions for classes of semilinear elliptic boundary value problems with nonlinear boundary conditions*	
Jerome Goddard II	Auburn University Montgomery	R. Shivaji, University of North Carolina Greensboro
In this talk, we will investigate the stability properties of positive steady state solutions of semilinear initial-boundary value problems with nonlinear boundary conditions. In particular, we will employ a Principle of Linearized Stability for this class of problems to prove sufficient conditions for stability and instability of positive steady state solutions. These results shed some light on the combined effects of the reaction term and the boundary nonlinearity on stability properties. If time permits, we will also provide complete bifurcation curves in the case of dimension one.		

CP3.4	*Spacewalks and amusement rides: Illustrations of symmetry, geometric phase and holonomy*	
Jeff Lawson	Western Carolina University	Matt Rave, Western Carolina University
Geometric phase in a dynamical system can be visualized as the interplay between two competing frequencies in a closed orbit which go in and out of "synch". In a simple mechanical system with rotational symmetry the computation of geometric phase is distilled down to integrating a one-form obtained from a single conservation law. This emphasizes that geometric phase can be computed with only a minimum of dynamic information. Through examples whose configuration spaces are tori, we illustrate that in many instances geometric phase can be computed through kinematics alone, using a single constraint. We conclude by showing that the requisite one-form can be interpreted as the holonomy of a connection on the torus.		

CP4.1	*Listening Closely to Abstract Algebra*	
Vicky Klima	Appalachian State University	
This talk explores the importance of symmetry in music theory giving several examples of how connections to music theory can be used to illuminate basic concepts taught in an introductory abstract algebra course. We will use the cyclic group with 12 elements as our musical model and study key structure through isomorphisms, chord structure through Cayley diagrams, and twelve-tone rows through coset constructions.		

CP4.2	*Veronese Embeddings of Quadrangles in Characteristic 2*	
Ogul Arslan	Coastal Carolina University	Peter Sin, University of Florida
Over an algebraically closed field of characteristic 2, we show that a certain projection of P9 to P8 induces an isomorphism of algebraic varieties from the quadratic Veronese embedding of P3 to the standard embedding of the orthogonal Grassmanian of lines of a quadric in P4.		

CP4.3	*Number of points completely determining an algebraic plane curve*	
Jeremiah Bartz	Francis Marion University	
Lines, parabolas, ellipses, and hyperbolas are well-known examples of algebraic plane curves. A line is completely determined by two distinct points. A parabola is completely determined by three points in general position. In this talk, we will explore the relationship of how many points in general position completely determine a particular algebraic plane curve including when the curve is a hyperbola or an ellipse.		

CP4.4	*Groups, Loops, and a Construction of Baer*	
Lee Raney	University of North Alabama	
In a construction known as the "Baer Trick," a uniquely 2-divisible group $(G,\cdot)$ is modified to induce a commutative loop $(G,+)$. It is known that if $(G,\cdot)$ has nilpotence class at most 2, then $(G,+)$ is an abelian group. We discuss recent results, and we will provide at least a conjecture involving the structure of the nonassociative loop $(G,+)$ when $(G,\cdot)$ has nilpotence class exactly 3.		

CP4.5	*Bernoulli, Euler, and Induction Formulas*	
David Turner	Faulkner University	
Students are often introduced to mathematical induction with expressions such as 1+2+...+n=n(n+1)/2. Homework problems consist of proving such relationships by induction and sometimes also require the student to conjecture a formula for the sum before providing the induction proof. This talk will consider sums of the type where the general term is a polynomial or alternating polynomial. Formula generators for each type will be obtained.		

CP5.1	*On Colored Packing Densities*	
Matthew R. Just	Georgia Southern University	
Pattern packing concerns finding optimal permutations that contain the maximum number of a given pattern. Much work has been done on the study of packing layered patterns, and it has been shown that the packing density of a layered pattern is achieved by a layered permutation. We explore the consequences of colored permutations and patterns on packing densities. Through examining the novel concept of "colored blocks'' within a pattern or permutation, we present analogous results on pattern packing in colored permutations.		

CP5.2	*Weighted trees and labeling*	
Demet Yalman	Georgia Southern University	Mustafa Ozen, Georgia Southern University
In 1975, John Leech brought forward a problem about finding positive integer-weighted trees with n vertices such that weighted distances between vertices are exactly the consecutive positive integers starting from 1 . This question is motivated from Electrical Engineering and later became interesting to computer scientists and mathematicians in addition to engineers. In this talk, we are going to give an introduction to Leech Tree. Then we examine variations of such "leech type" tree labeling questions including the Modular Leech Tree, near leech labeling and in particular, the leaf-Leech tree. Observations regarding their structures will be presented, analogous to those established for the original Leech trees. This is based on joint work with Mustafa Ozen and Hua Wang.		

CP5.3	*Enigma: An Analysis and Maplet Simulator*	
Rick Klima	Appalachian State University	
The Enigma was an electromechanical cryptographic machine used by Germany during World War II, the cryptanalysis of which by the Allies is the basis for the recent Hollywood blockbuster The Imitation Game. In this talk, I will give an overview of the variable components of an Enigma, and demonstrate a simulator for the machine written as a Maplet, which is like a Java applet but uses (and requires) the mathematical software package and symbolic manipulator Maple. I will also give a brief analysis of the security of an Enigma, by using elementary combinatorics to show the number of possible configurations of the variable components of the machine.		

CP5.4	*Categorical Combinatorics: Combining the Concrete and the Conceptual*	
Dr. Tien Chih	Newberry College	
The traditional view of Combinatorics is that of a collection of seemingly disparate problems. While much good mathematics has been done to solve these problems, not as much has been done to build an over arching theory for Combinatorics. Thus, even problems within the same branch of Combinatorics (e.g. Graph Theory or Enumerative Combinatorics) are often viewed “discretely”, and not part of a greater theory. In other branches of Mathematics, the use of Category Theory, and the perspective that it presents, did a lot to tie together the various concepts and problems of those fields. Thus mathematicians in those areas do much more work developing a richer theory, and solutions to the problems of those areas follow as a result. It is natural to believe then that bringing such an approach to Combinatorics would expose both the connections between different branches of Combinatorics, as well as the solutions to some long standing problems. In this talk, we give a survey of some of the ways that Category Theory may be applied to Combinatorics.		

CP5.5	*What Must Go Down Will First Go Up: The Rises and Falls of Permutations*	
William Griffiths	Kennesaw State University	Daniel Karasek, Kennesaw State University, Student (Undergraduate at time of research, currently graduate)
Permutation statistics are an interesting and accessible area of combinatorics. Two such statistics, the numbers of descents and inversions of a permutation, describe in some sense how many elements are larger than those to their right, descents looking only at the next entry while inversions to the end of the permutation. We have generalized this concept in a previous year, by allowing a 'drop sequence' to control how far each entry of a permutation checks those following it. New progress and questions accessible to undergraduates have arisen recently, including finally allowing an increase in the 'drop sequence.'		

CP6.1	*Using Cognitive Wrappers in a Remedial Mathematics Classroom*	
Lisa Carnell	High Point University	
Based on the work of Dr. Jose Bowen, cognitive wrappers focus on strengthening the metacognitive skills of students. In this talk I will a) describe the concept of cognitive wrappers, b) show examples of cognitive wrappers, c) describe how I used cognitive wrappers in a remedial mathematics classroom, and d) explain the potential benefits I believe students could gain from using cognitive wrappers.		

CP6.2	*Creating a More Inquiry Based Linear Algebra Class*	
Laurie Zack	High Point University	
Linear Algebra has traditionally been taught at High Point University in the standard lecture style format. In the Summer of 2014, I spent time working on creating a more hybridized course, using part flipped model techniques, part lecture style techniques, and part inquiry based/Moore Method techniques. This resulted in a course using these various methods to help promote student learning and engagement in not just the standard topics in Linear Algebra, but allowing for further exploration into other applications. This talk focuses on the course design, layout, activities, student responses, and instructor perspective to the course.		

CP6.3	*Extended College Algebra: A Redesign of College Algebra*	
James Matthew Dawson	Charleston Southern University	
College Algebra is often a struggle for students. Particularly for students that come into the course with a weak math background. Those students need extra attention, but the course often moves too quickly for them. Here at Charleston Southern University, we addressed that problem by redesigning and splitting our College Algebra offerings. We now run a 3 hour College Algebra and a 4 hour Extended College Algebra. I will discuss what changes we made in the redesign, how the Extended College Algebra course compares to the standard, and how the changes have affected student outcomes.		

CP6.4	*The iPad as a Teaching Tool*	
Denise Dawson	Charleston Southern University	
Integrating technology in the classroom can improve student learning, from actively engaging students, to having examples of real world connections at hand. I will discuss how I am currently using my iPad to supplement my lectures in College Algebra, Calculus, and Linear Algebra. I will review the apps I use regularly and some future plans to improve student engagement in class.		

CP6.5	*Enabling Success in a General Education Mathematics Class*	
Gregory Goeckel	Presbyterian College	
This talk will cover the teaching techniques and technologies that I have used to flip my mathematics classroom. I will share my discoveries, insights, and its impact on my students grades.		

CP6.6	*Creating a Meaningful Undergraduate Research Project*	
Brandon Samples	Georgia College & State University	
Our majors participate in a year-long research project under the direction of a faculty member, which leads to a written report and a presentation at our annual capstone day. Aligning with our two mathematics major tracks, students choose to present research in the areas of pure and applied mathematics or mathematics education. Creating a challenging project suitable for the undergraduate background takes some careful planning on the part of the faculty mentor. In this talk, we will discuss some strategies for creating meaningful undergraduate research projects in either track as well as provide some examples of past projects.		

CP7.1	*Rationally 4-periodic biquotients*	
Jason DeVito	UTM	
A simply connected manifold M^n is called rationally 4-periodic if there is an element $e \in H^4(M;\square)$ with the property that cupping with e, $\cup e : H^k \to H^{k+4} issurjectiveif$ 0\leq k < n-4 and injective if $0 < k \leq n-4$. A biquotient is any manifold obtained as the quotient of a homogeneous space by a free isometric action. We classify all compact simply connected biquotients with rationally 4-periodic cohomology ring. In particular we show there are only finitely many examples in each dimension.		

CP7.2	*Introducing Galois theory in an introductory linear algebra course*	
Chad Awtrey	Elon University	
The goal of this talk is to describe a computational and inquiry-based activity the speaker has used to introduce linear algebra students to the symmetries of roots of polynomials with rational coefficients. Included are discussions of the following: motivating examples, detailed aspects of the activity, implementation suggestions for Mathematica, and undergraduate research projects the speaker has mentored related to the topic.		

CP7.3	*Limits of Golden Constructions*	
Timothy E. Goldberg	Lenoir-Rhyne University	Leigha K. Myers, Lenoir-Rhyne University
A golden rectangle can be characterized by the fact that if you remove a square from one end, the remaining rectangle is similar to the original one. By iterating this process of removing a square, one obtains an infinite sequence of shrinking golden rectangles which converges to a point. One can construct other sequences of rectangles by starting from arbitrary, not necessarily golden, rectangles. In this presentation, we will demonstrate how to analyze the end behavior of these sequences using some tools from linear algebra. This presentation should be accessible to any students with a basic knowledge of matrices, vectors, and limits.		

CP7.4	*Completing the Card Game SET: To (points at) Infinity and Beyond*	
Douglas Burkholder	Lenoir-Rhyne University	
The card game SET is a wonderful “hands-on” example of finite affine geometry. This is useful for helping students understand points, lines, planes, hyperplanes and Euclid’s Fifth Postulate in a finite geometry setting. Here we show a simple method for extending this to finite projective geometry by adding 40 additional cards to the deck. Although these new cards represent points at infinity, the modified game can be played without treating these new cards as special. In the geometry of the completed set of SET cards, Euclid’s Fifth Postulate is now replaced with “no parallels.” We also show a simple method for extending the SET game to model finite affine and finite projective geometries of order p for every prime p.		

CP7.5	*Origami, Math, and Engineering*	
Alan Russell	Elon University	
This talk shares the progress of a National Science Foundation grant entitled “Externally-triggered Origami of Responsive Polymer Sheets". As the mathematics and origami consultant for the project, I will discuss how the design theory has grown mathematically in service of engineering. Video examples will be shown as well as several mathematical insights into the nature of our folding process.		

CP8.1	*On the convergence and stability of Semi-Lagrangian methods for time-dependent partial differential equations*	
Daniel Guo	University of North Carolina Wilmington	
Semi-Lagrangian methods were proposed to compute the numerical solutions of time-dependent partial differential equations. Those methods were based on Lagrangian trajectory or the integration from the departure points to the arrival points (regular nodes). The departure points were traced back from the arrival points along the trajectory of the path. The convergence and stability were investigated.		

CP8.2	*Electric Car Numbers*	
Rudy Beharrysingh	UNC-Asheville	
The latest advent of electric cars lends itself well to interesting classroom applications from liberal studies math to calculus. Topics such as range, charge time, costs to operate, energy consumption and emissions will be compared. The demands and infrastructure for this form of transportation will be examined and the calculus of the electric motor will be explored.		

CP8.3	*Controlled Random Walks and Postural Stability Regions*	
Erin McNelis	Western Carolina University	Martin Tanaka, Department of Engineering, Western Carolina University Andrew Tanaka, Department of Mathematics & Computer Science, Western Carolina University
Human postural stability is a major concern in injury prevention as human posture by nature is inherently unstable. Despite this, human postural sway demonstrates two regions of stability. For the past twenty years, researchers have believed that these regions exist as the result of both non-feedback dynamics as well as feedback loop controls. This research, a collaboration between engineering and mathematics faculty and a computer science student, was conducted to determine if applying a simple controller to a random walk alone would demonstrate two regions of stability. This talk will present the results of MATLAB simulations of random walks with varying levels of control, their associated stability regions, and our conclusions.		

CP8.4	*The Mathematics of Enemy-Protector*	
Adam Graham-Squire	High Point University	
Enemy-Protector is a noncompetitive camp game. It is played as follows: in a group of people, each player chooses one player to be their enemy and a different player as their protector. When the game starts, all players try to keep their protector between themselves and their enemy, and chaos ensues. We will describe some of the various behaviors that can occur in the game, as well as some preliminary efforts at modeling those behaviors. These efforts lead to numerous potential areas of recreational mathematics research related to Enemy-Protector. In particular, the mathematics of Enemy-Protector is a fruitful area for undergraduate research, since the topic is very easy to grasp, yet has many possibilities for interesting research projects.		

CP8.5	*Migration, Deportation and the U.S. Population, a classic Linear Algebra Problem*	
Lothar A. Dohse	UNC Asheville	
In the present century industrial nations like the The United States and Germany process millions of immigrants each year. Understanding the effect of migration on the population structure of a country is essential part of good planning. The author will present a matrix modeling approach that can be used to analyze the present population trends. The resulting mathematical models may explain why a country like the U.S. ends up having 11 million undocumented residents.		

CP9.1	*Illustrating the Gibbs Phenomenon*	
Iason Rusodimos	Georgia Perimeter College	Barrett Walls Georgia Perimeter College
Students in lower level calculus courses study Taylor series but rarely are exposed to other ways of expressing functions as infinite series. This talk is aimed at giving ways teachers can present an introduction to Fourier series to Calculus students. More precisely it is about the convergence of a Fourier series which leads to the Gibbs phenomenon.		

CP9.2	*Some Average Calculus*	
Chuck Groetsch	The Citadel	
Some problems arising from questions involving functional averages posed in various undergraduate analysis classes are discussed. The context includes ordinary average values of continuous functions and a generalized average suggested by mechanics of non-uniform bars. The analysis of the problems relies on a number of fundamental concepts in calculus.		

CP9.3	*Attracting Students to Mathematical Biology: Three Simple Models Using Elementary Calculus*	
Charles Rains	Anderson University	
Attracting Students to Mathematical Biology Three Simple Models Using Elementary Calculus Mathematical biology is flourishing as an interdisciplinary field of study. Ecology, cancer metastasis and treatment, pharmacokinetics, and epidemiology are just some of the areas of biology under intense study today by scientists cross-trained in both advanced mathematics and biology. Most incoming college students, however, see mathematics and biology as completely unrelated and have no idea of the mutually fertile interplay between the two disciplines. Early introduction into the students' mathematical curriculum of topics with a biological flavor might serve as a stimulus to those who possess both a mathematical and biological bent. Three examples of such topics that have been used successfully have been "The Mathematics of Coughing", "Gompertz Model of Tumor Growth", and "Drug Concentration in a Patient".		

CP9.4	*Roots of polynomials with Fibonacci number coefficients*	
ron taylor	Berry College	Eric McDowell, Berry College Jill Cochran, Berry College
In this presentation we construct sequences of polynomials and Laurent polynomials whose coefficients are Fibonacci numbers. These sequences have properties similar to the classical Fibonacci numbers and arise from considering powers of the golden ratio φ. We show that each sequence has a subsequence whose roots converge to values related to φ.		

CP9.5	*Teaching Calculus II with No-Cost-to-Students Course Materials*	
Lake Ritter	Kennesaw State University	
Textbooks and required course materials can easily add $650 to $1100 per academic year to the already rising costs of tuition and fees in many public colleges and universities. Increasingly students forego purchasing required materials. Lacking the course text can be a crippling disadvantage to a student in an already challenging course such as college Calculus. This talk is a preliminary presentation of a project using exclusively open access texts and tools in a Calculus II course at (the new) Kennesaw State University. I will discuss some of the available open access materials, and present the combined and customized e-text we have provided for the students in our pilot classes. The program to be presented is supported by the Affordable Learning Georgia initiative.		

CP9.6	*Analyzing graphs in calculus using limit windows and Wikki Stix*

	representations	
Julie Barnes	Western Carolina University	

In this talk we introduce two easy to run, hands-on, group activities used to help students better understand graphical calculus concepts. The first activity has students evaluating limits from given graphs. Students often have trouble focusing on the correct portion of the graph when asked to evaluate a limit. By using notecards and limit windows, students are able to demonstrate that they understand the notion of limit. In the second activity, students use Wikki Stix to graph functions that meet various conditions on the first and second derivative. By also graphing the derivative and second derivative on the same axes but in different colors, students are able to further explore the relationships between a function and its derivatives. For each activity, we will discuss the logistics of running the activity and the expected student outcomes.

CP10.1	*On the Sweepwidth of Orthogonal Polygons*	
Dr. Tzvetalin S. Vassilev	Nipissing University	Dr. J. Mark Keil, University of Saskatchewan

We consider decontaminating the interior of a simple polygon in the plane by sweeping it with planar curves. This problem has attracted recent attention. It is the continuous two-dimensional analogue of the classical graph search games. It is also a generalization of some well-studied problems in computational geometry such as polygon searchability and elastic ringwidth, and is naturally related to a large class of problems known as art gallery problems. Practical applications include automated surveilance, scene discovery/recognition, etc.

Sweepwidth of a polygon is defined as the minimum over all decontamination sweeps of the maximum total length of the sweeping curves at any time during the sweep. Thus it represents a measure of efficiency of the decontaminating process. The problem of determining the sweepwidth of given polygon has interesting geometric and algorithmic aspects.

In their recent work, Karaivanov et al. showed that every decontamination sweep can be transformed into a canonical one that uses only either line segments with endpoints on the polygon boundary or pairs of line segments with one endpoint on the boundary each and shared endpoint in the interior of the polygon. This result helped them prove a number of properties of the sweepwidth. Second significant result from that work is an NP -hardness proof for the sweepwidth of orthogonal polygons by reduction from Partition. Further, they show polynomial time solvability of the problem for two specific classes of orthogonal polygons: comb polygons and a subclass of flag polygons.

Our work extends those results towards efficient algorithms on larger classes of orthogonal polygons. We show that one can determine the sweepwidth of a staircase polygon and a pyramid polygon in linear time with respect to the number of vertices of the polygon. Using similar ideas, we give a linear time $2\sin\frac{3\pi}{8}$ -approximation algorithm for the problem on histogram polygons. To obtain these results, we prove additional properties of the optimal sweeps for these classes of polygons.

CP10.2	*Ascending Subgraph Decompositions of Oriented Complete*

	Balanced Bipartite Graphs	
Brian Wagner	UT Martin	
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 any orientation of a complete balanced bipartite graph has an ASD.		

CP10.3	*Generalized Ramsey Theorems for r-Uniform Hypergraphs*	
Mark Budden	Western Carolina University	Josh Hiller (University of Florida) Aaron Rapp (Western Carolina University)
Classical Ramsey theory for graphs contains several theorems that are based on constructive methods. Namely, one begins with an optimal coloring of the edges of some complete graph (whose existence is guaranteed by some known Ramsey number) and constructs an optimal coloring of a larger complete graph using multiple copies of the initial graph. In this talk, we will focus on proving analogues of some constructive theorems in Ramsey theory in the setting of r-uniform hypergraphs.		

CP10.4	*On the Hamiltonian Number of a Planar Graph*	
Thomas M. Lewis	Furman University	
The Hamiltonian number of a connected graph is the length of a shortest, closed spanning walk in the graph. We will show how a simple modification of a result of Grinberg can shed some light on the Hamiltonian number of a planar graph.		

CP10.5	*The number of possible baseball line scores with a 6-3 final score*	
Brian M. O'Connor	Tennessee Tech University	
A line score in baseball is a two-line chart that displays each team's run totals by inning. An example of a line score is: STL CARDINALS 0 0 1 2 0 0 0 0 0 3 SF GIANTS 0 0 2 0 0 0 0 1 3 6 We will investigate how many distinct line scores there are for a given final score, for both nine-inning games and extra inning games. There will be door prizes!		

CP11.1	*Problems made to ignite undergraduate research*	
George Cazacu	Georgia College	
This work is exploring ideas about creating and perfecting a classroom environment that facilitates undergraduate research. It presents a collection of mathematical problems and examples that are meant to attract and challenge students' mathematical thinking.		

CP11.2	*Preparing Undergraduates for Industrial Careers*	
Kristen Abernathy	Winthrop University	
We have heard for some time that many industries seek to hire math majors, but how do we ensure our students are ready for such careers? The Preparation for Industrial Careers in the Mathematical Sciences (PIC Math) program offers faculty the opportunity to teach a course where students work on current problems from the industry. In this talk, I'll discuss my experience in offering a research course in which students work on current problems from the video game industry. I'll focus on the lessons learned from partnering with an industry to develop undergraduate research problems and share advice for faculty interested in starting such a course at their own institution.		

CP11.3	*Building Capacity for a Research Rich Curriculum in Mathematics at Georgia College*	
Darin Mohr	Georgia College	Ryan Brown, Georgia College Marcela Chiorescu, Georgia College
The Department of Mathematics has recently revised its curriculum to make undergraduate research a prominent feature of the major. We require all undergraduate students to complete a year-long research project, submit a written report, and give a presentation at our department's annual capstone day. Before we could implement a robust research experience, we first had to build institutional capacity to support our students and faculty to ensure its sustainability. This presentation will describe the roadmap we developed, the lessons we learned and an outline of our plans moving forward as we implement the next phase of our curriculum building.		

CP11.4	*Do Inquiry-Based Methods Work with Developmental Math?*	
J. Donato Fortin	Johnson & Wales University - Charlotte	
Faculty are increasingly encountering topics that they can "no longer teach" to students in Developmental Mathematics. Topics include percentages, the point-slope formula, quadratic equations, and interpreting graphs. Failing with traditional approaches, the presenter has experimented the past years with problem- and inquiry-based approaches. The presenter has attempted problem-guided learning (PGL), inquiry-based learning (IBL), and, more recently, process oriented guided inquiry learning (POGIL). The early report is that POGIL is favored by developmental students, but other methods are useful. The presenter will share his experiences with inquiry methods and will report on student perspectives.		

CP11.5	*Developing Qualified Teaching Assistants for the Math Emporium*	
Kathy Cousins-Cooper	North Carolina A&T State University	Katrina Staley, North Carolina A&T State University
The Math Emporium method is an instructional method that requires students to work problems during class time using an online instructional delivery system. The idea behind this method is that students learn math by doing math. An important aspect of the Math Emporium method is that it allows for increased interaction between instructors and students. Therefore, training on how to work in the emporium is important. This talk focuses on developing qualified teaching assistants to work in the Math Emporium.		

CP11.6	*How to Create User-Friendly, Flowing Syntax for the Mathematics You Teach and Study*	
Damon Scott	Francis Marion University	
Mathematicians generally adopt as syntax whatever was handed them by tradition, together with carefully choosing names for objects or operators they create themselves. Such syntax tends to be nested, with various syntactic elements nesting inside other elements. But in a wide variety of circumstances one may have syntax fall into structures where the elements flow one after another, as in a string structure. Such flowing syntactic systems are much more pliant and user-friendly than nested systems. We present two techniques for making syntax flow: “Finding the Function Space” and “The Russian Doll Maneuver”. As time permits, the superiority of flowing structures over nested structures will also be presented.		

CP12.1	*Another Approach to the Truncated Pentagonal Theorem*	
Louis W. Kolitsch	The University of Tennessee at Martin	
Recently, in three separate papers, Andrews and Merca, Yee, and Kolitsch and Burnette proved some results concerning the Truncated Pentagonal Number Theorem. In this talk a family of generating functions that keeps track of the number of different parts in a partition will be discussed. This family of generating functions can be used to get the earlier results on the Truncated Pentagonal Number Theorem as well as several other results.		

CP12.2	*Augmented Happy Functions*	
Breeanne Baker Swart	The Citadel	Kristin Beck -- Saint Mary's College of California Susan Crook -- Loras College Christina Eubanks-Turner -- Loyola Marymount University H. G. Grundman -- Bryn Mawr College May Mei -- Denison University Laurie Zack -- High Point University
Let S be a function which maps a positive integer to the sum of the squares of its digits. A positive integer a is considered happy if for some positive integer k, $S^k(a)=1$. An augmented happy function, $S_{[c]}$, maps a positive integer to the sum of the squares of its digits and a non-negative integer c. A positive integer a is a \emph{fixed point} if $S_{[c]}(a)=a$. In this talk, we will discuss augmented happy functions and some properties of their fixed points.		

CP12.3	*Card Shuffles, Symmetric Groups, and Landau's Function*	
Brian Beasley	Presbyterian College	
Viewing a given shuffle of a deck of cards as a permutation, we know from group theory that repeatedly applying this same shuffle will eventually return the deck to its original order. But how many steps will that take? What type of shuffle will require the greatest number of applications before restoring the original deck? What is the probability that a shuffle chosen at random will achieve this maximum order? This talk will answer those questions in the specific case of a standard 52-card deck. In addition, it will describe the history of the general case, starting with Edmund Landau's work in 1903 on the maximal order of an element in the symmetric group on n objects and highlighting recent progress in refining his results.		

CP12.4	*GCD Properties of the Hosoya Polynomial Triangle.*	
Antara Mukherjee	The Citadel	Rigoberto Florez (The Citadel), Robinson Higuita (Universidad de Antioquia, Medellin, Colombia)
In this talk we discuss the generalized Fibonacci polynomials which is a second order recurrence relation. The Hosoya triangle is a triangular arrangement of numbers similar to Pascal's triangle where the entries are products of Fibonacci numbers; we generalize this triangle to Hosoya polynomial triangle (entries are generalized Fibonacci polynomials). We show that some algebraic and geometric properties that occur in the Pascal triangle also hold in this new triangle. For instance, we prove the Hoggatt-Hensell identity and Gould or GCD property in the Hosoya polynomial triangle. In addition we explore the GCD properties in other geometric shapes that appear in the Hosoya polynomial triangle. We also discuss particular examples of Hosoya polynomial triangles and their properties. In particular we use Chebyshev polynomials, Morgan-Voyce polynomials, Jacobsthal polynomias and many more to construct these examples of Hosoya polynomial triangles and explore algebraic properties in those triangles as well.		

DDL.1	*An Online, General Education Math/Finances/Spreadsheet Course v. 3.x*	
Jon Ernstberger	LaGrange College	

As part of the general education requirement for all students, LaGrange College regularly runs a mathematics-based finances course. Taught using spreadsheets, this course is an ideal online offering. Having been offered online each semester for the past two years and in its second significant revision, the course has drastically improved. This presentation will relate instructor responsibility, pedagogical changes to the course over all iterations, evidences of impacts on student learning, and difficulties that have naturally arisen.

DDL.2	*Using Mathematica as the primary technology in the calculus sequence and in linear algebra*	
Karen A. Yokley	Elon University	Crista Arangala Elon University

Although calculators are often used as the primary technology in calculus courses, typical graphing calculators do not have the sophistication of mathematical software nor are calculators used in academic research or industry. Teaching calculus and linear algebra in a computer lab requires an alteration of approach to content but can motivate abstract comprehension. This presentation will focus on topic-based classroom assignments and labs in Wolfram Mathematica created in order to foster student engagement, guide individual exploration, and increase the depth of conceptual understanding. Project ideas for further exploration that could lend itself to undergraduate research will also be discussed.

DDL.3	*Statistically Significant Attempts at Students' Understanding*	
Rodica Cazacu	Georgia College	George Cazacu, Georgia College

While teaching the introductory statistics course, even though most of our students are not mathematics majors, we try to emphasize why they need statistics at a level higher than just manipulating data. During the years we were teaching statistics courses we tried different approaches on the subject and while some did not give the expected results, some became valuable tools for learning, exploring, and assessing students' understanding. This presentation will show how some of these methods were implemented in the online statistics courses that we developed recently and how we use them as assessment tools along with other more dedicated online instruments.

DDL.4	*Reflections on the Implementation of the Mathematics Emporium as a Model for Teaching First Year Algebra and Trigonometry Courses*	
Nicholas Luke	North Carolina A&T State University	
In the fall semester of 2012, the Department of Mathematics at North Carolina A&T State University began to teach its lower level algebra and trigonometry sequence employing the Math Emporium model of instruction. In the Math Emporium, students learn mathematical concepts by completing interactive computer-based modules in lieu of a traditional lecture. The Math Emporium model of instructional delivery includes methods to encourage and require students' participation in the classroom such as self-paced instruction, peer tutoring, and immediate feedback. This presentation will examine the experiences in the development and implementation of the Math Emporium. Perceived benefits and pitfalls of the Math Emporium will be shared. Effects of the implementation of the Math Emporium in regards to the classroom environment and students' performance in these classes will also be presented.		

DS.1	*An introduction to the p-adic absolute value*	
Ellen Eischen	University of North Carolina at Chapel Hill	
Everyone encounters the usual absolute value while growing up. In this talk, we introduce a different absolute value, the p-adic absolute value, which measures divisibility by a prime number p. We will introduce its basic properties and then discuss some surprising consequences in geometry. The talk will include some facts that those who have studied algebra, number theory, or topology will appreciate, but to understand most of the talk, students will just need a general curiosity about math		

DS.2	*Knots, and how to use cloud computing to tabulate them*	
Jason Parsley	Wake Forest University	
In this interactive talk we will introduce the mathematical theory of knots. Suppose we wanted to begin making a table of all the possible knots and links. Topologists have been attempting this for over a century. We will discuss the history of these efforts, including the errors made along the way. Finally, we will close by discussing the COLD (Census Of Link Diagrams) project, which uses distributed computing to tabulate all possible diagrams of links. [COLD is a joint project of the speaker along with Jason Cantarella (UGA), Harrison Chapman (UGA), and Matt Mastin (WFU).]		

GS1.1	*A Glimpse into the World of Geometric Modeling*	
Yuliya Babenko	Kennesaw State University	
Mathematicians, computer scientists, scientists, and engineers all work with curves and surfaces, which arise from a finite amount of data points. Different goals and different tools available in the fields lead to different approaches to the same subject, which often lead to new methods and discoveries. For instance, how do mathematicians typically represent curves and surfaces? On the other hand, how do computer scientists naturally represent curves and surfaces? Or, how do scientists need to represent curves and surfaces? What about engineers? In this talk we will introduce some basic ideas (interpolation and approximation) as well as sophisticated tools of geometric modeling (Bezier curves and B-splines), and discuss their theoretical advantages /disadvanatges as well as powerful algorithms.		

GS2.1	*The Tropical Mathematics of Evolution*	
Joseph Rusinko	Winthrop University	
We explore tropical mathematics (arithmetic without the unnecessary burden of subtraction) and its applications to evolutionary biology. Hedgehog's gone rogue and the ghosts of student research past, present and future will be highlighted.		

GS2.2	*MAA 100/MAASE 93*	
Virginia Watson	Kennesaw State University	
The MAA turns 100 this year and the Southeastern Section turns 93. Come celebrate the milestones in the history of the Southeastern Section from its beginnings in 1922 to the current day.		

GS3.1	*The Lion and the Path*	
Linda Braddy	MAA	
TBA		

GT.1	*Applications of Holder's Inequality to a Fibonacci Problem*	
Rachel Graves	The Citadel	
In this talk, I will explain how I applied Holder's inequality, which is a well-known inequality in functional Analysis, to solve an open problem that was published in the May 2014 edition of the Fibonacci Quarterly. I will also give a brief history of Fibonacci and Fibonacci numbers.		

GT.2	*Application of the Reduced Basis Method to the Forward Problem of Hyperspectral Diffuse Optical Tomography*	
Rachel Grotheer	Clemson University	
Diffuse Optical Tomography (DOT), which uses a low-energy light source in the visible to near infrared range, has become a popular alternative in medical imaging to traditional imaging techniques such as x-ray or computed tomography (CT), because it is non-ionizing and cost effective. In recent years, researchers have sought to apply hyperspectral imaging, the use of hundreds of optical wavelengths in the imaging process, to DOT in order to improve the resolution of the image by adding new information. We develop a reduced basis method approach to solve the forward problem in hyperspectral DOT (hyDOT). The forward problem in hyDOT is to determine the measurements on the boundary of the medium, given a light source on the boundary and the values of the optical parameters, such as the absorption and scattering coefficients. Our work on the forward problem is motivated by the image reconstruction problem in hyDOT which is computationally expensive because any inversion algorithm requires solving the forward problem hundreds if not thousands of times. Recently, the Reduced Basis Method (RBM) has been proposed for parameter dependent PDEs with significant success in developing faster algorithms particularly for models involving parameter dependent elliptic PDEs. The RBM involves finding an initial finite element approximation of a parameterized form of the PDE, from which a set of basis functions is derived. A linear combination of these basis functions then forms a reduced basis approximation of the solution. We show how the RBM greatly improves the computational burden of the forward problem and thus, improves the efficiency of the inverse problem.		

GT.3	*Reverse mathematics and marriage problems*	
Noah A. Hughes	Appalachian State University	
The program of reverse mathematics deals with calibrating the logical strength of mathematical theorems. We analyze several theorems regarding marriage problems via the techniques of reverse mathematics. A marriage problem M consists of a set of boys B, a set of girls G and a relation R, a subset of $B \times G$, where $(b,g) \in R$ means ``boy b knows girl g.'' A solution of the marriage problem is an injection f mapping B into G, such that for every b in B, $(b, f(b))$ is in R. Using the standard anthropocentric terminology, we see that f assigns a unique spouse to each boy from among his acquaintances. In this talk, we will discuss the program of reverse mathematics, review past results regarding marriage problems, share recently completed work concerning the necessary and sufficient conditions for a marriage problem to have a unique solution, as well as show how each of these theorems fit within the framework of reverse mathematics.		

GT.4	*Ideal Factorizatins*	
Ashley Lawson	Tennessee Technological University	
This talk will discuss indivisible ideals and indivisible ideal factorization properties. A ideal I is indivisible ideal of R if $I = JK$ where *J,K* are ideals of R then either $J = R$ or $K = R$ and a ring R said to satisfies the indivisible ideal factorization property (or IIF) if nonzero every ideal of R can be written as a product of indivisible ideals. In particular, every Noetherian domain satisfies IIF		

HOM.1	*Anything Besides Zero?*	
Paul L Baker	Catawba College	
The Khmer (Cambodian) Empire lasted more than a thousand years. The Khmers were the first recorded users of the number zero in 683 A.D. (605 Saka). We will consider a number of possible factors why no other mathematical advancements originated within the Khmer Empire.		

HOM.2	*Finding Zero*	
Dr. John Zerger	Catawba College	Dr. Paul Baker, faculty member at Catawba College
This session will review the recently published book "Finding Zero" by Amir D. Aczel. The research behind the book has created a definitive work on the origin of the number zero.		

HOM.3	*Islamic Complex of Mathematics, Architecture and Art*	
AbdelNaser Al-Hasan	Newberry College	
In this short talk, my aim is to review some important results of the ongoing research on the connections of mathematics, architecture and art in the Islamic heritage. One important result is the complex geometrical tiling patterns called “girih” that was widely used to decorate Islamic mosques and buildings. These patterns were discovered in 1973 by the British mathematical physicist Roger Penrose. In 1984, they were found in metal alloys called quasi-crystals that seemed to break the geometric rules of atomic packing. Did Muslim mathematicians understood such complex mathematical concept 500 years prior to its discovery by the Western world?		

HOM.4	*Ibn Al-Haytham and Wilson's Theorem*	
Nathaniel Collier	Newberry College	

Abu Ali Al-Hasan ibn Al-Hasan ibn Al-Haytham, frequently referred to as Ibn Al-Haytham, known variously in Renaissance Europe as Alhazen, latinized from his first name, and The Physicist, not only introduced the world to the first understanding of scientific experimentation, but also, as part of the Golden Age of Islamic scholars, furthered our mathematical knowledge with his study of systems of congruences. Nevertheless, the western world has only recently rediscovered his work and its profound importance for the development of mathematical and scientific thought.
It is the aim of this study to establish, briefly, the connection between the Chinese Remainder Theorem and Wilson's Theorem in al-Haytham's work, to attribute Wilson's Theorem properly to al-Haytham, and ultimately to explore the necessity of his work in the development of number theory.

PST.1	*A Seminar on Preparing Graduate Students to Teach College Mathematics*	
Sarah Schott	Duke University	

Preparing graduate students to teach undergraduates is an ongoing process. For graduate students in the Mathematics department at Duke University, this process begins even before their studies commence and continues well after they've taught their first class. A major component of this training is Math 771, a required seminar for all first year graduate students. This semester-long seminar involves two 75 minute meetings each week and covers a myriad of topics and situations that instructors may face in the classroom. Topics include lesson planning, overview of the content in calculus courses, writing effective tests, and grading. Graduate students are matched with current instructors in order to observe teaching practices, and prepare and present lectures to their peers. I will discuss in more detail the content and organization of this course.

PST.2	*A framework for a graduate student teacher mentoring program*	
Emily Braley	Duke University	

In the Mathematics Department at Duke, preparation of graduate student teachers is considered an ongoing process that starts when a first year graduate student arrives and ends when a graduate student leaves Duke to pursue their career. Graduate students begin their involvement in the program before the start of their first semester at Duke by attending meetings in a teacher-training week. First year graduate students attend a teacher-training course in their first semester, observe classes, practice teaching, and work as TA's. Once graduate students are ready to teach their own classes, they work closely with a course coordinator who provides guidance, feedback, and direction throughout the graduate student's first teaching experience. I will discuss the structure of the program and how it continues to provide guidance and feedback after a graduate student's first year.

PST.3	*Teaching Preparation for Graduate Students at NCSU*	
Brenda Burns-Williams	North Carolina State University	

All graduate students who will have teaching duties in the mathematics department at NCSU are required to take 2 introduction to teaching workshops during their first year. I will discuss the professional development opportunities that we provide to them during these workshops.

PST.4	*Graduate Student Teaching Training at Clemson*	
Meredith Burr	Clemson University	
The Department of Mathematical Sciences at Clemson University has recently begun formal TA training for its graduate students. I will discuss our previous and current efforts in providing TA training, as well as the expectations and outcomes so far of the current TA professional development course.		

PST.5	*A Community of Practice for Preparting Graduate Students to Teach Undergraduate Mathematics*	
Jack Bookman	Duke University	
Most college teachers have very little preparation for teaching, often just a few hours of "training" in the week before classes begin. The purpose of this talk is to describe a project, funded by the National Science Foundation to create an infrastructure, housed and supported by the MAA, to enhance the mathematics community's ability to provide high quality, teaching-related PD to graduate students. Project activities will include the creation of a community of practice and an online resource library to help mathematics departments start and strengthen programs to prepare graduate students to teach undergraduate mathematics.		

PUB.1	*Mastery Learning: Anytime, Anywhere*	
Jennifer Kolb	Hawkes Learning	
Hawkes Learning believes in offering affordable and accessible materials. Their comprehensive learning system is built and based on the principle of mastery learning to ensure that each student develops a solid foundation and deep understanding of the curriculum. This competency-based approach adapts to each student's individual needs and has a proven track record of increasing student success. Learn about the new tablet-friendly platform that requires no installation or plug-ins. All attendees will be entered to win a $50 Amazon.com giftcard!		

RME.1	*A demonstration of a lesson in a randomization-based curriculum*	
Tonya Adkins	Johnson & Wales University - Charlotte	
For this topic, I would be happy to do a special session. If it doesn't fit, then a contributed talk will do. Thank you. In this session, the presenter will share a sample lesson from a randomization-based statistcs curriculum, which was learned at an MAA-PREP course in June 2014 presented by Nathan Tintle, et. al. The demonstration is intended to spark an interest in using randomization investigations, to encourage others to attend the same PREP workshop this summer, and to widen the faculty community implementing this pedagogy.		

RME.2	*Inquiry-Based Learning on the Way to Calculus*	
John C. Mayer	University of Alabama at Birmingham	William O. Bond, Alabama School of Fine Arts, Birmingham, AL
Studies that we did at UAB in 2010, 2011, and 2013 point, in different ways, to the potential for IBL class meetings in pre-calculus courses to improve the chances of students to perform satisfactorily in Calculus I. The studies in 2010-11 were quasi-experimental studies of incorporating IBL/Group Learning sessions in Basic Algebra (a remedial course), reported at the Conferences on Research in Undergraduate Mathematics Education the subsequent years. The 2010-11 studies led to a change in how we teach Basic Algebra from 2012 onward. The 2013 study was a statistical study of success of students in Calculus I in the period 2006-2012 based upon the first mathematics course taken at UAB. The 2013 study pin-pointed where we could get the most ``bang for the buck'' in subsequent student success in Calculus, if we made an appropriate change in instruction. Of course, the study does not imply what type of change is appropriate. I will outline a two-pronged approach (one quasi-experimental, one statistical) to help resolve this issue.		

RME.3	*Measuring the Conceptual Teaching in Undergraduate Mathematics*	
Jim Gleason	The University of Alabama	
Many state and national organizations that focus on mathematics teaching and learning, including the MAA, have put forth recommendations regarding teaching mathematics for conceptual understanding. To date, there are few valid and reliable instruments designed to measure the extent to which a classroom matches up with these recommendations for the purposes of evaluation and/or research. In this talk, we will give an overview of the observation protocols currently available in this area and introduce the Mathematics Classroom Observation Protocol for Practices (MCOP^2).		

RME.4	*The Reflexive Step: How Students Understand Verified Trigonometric Identities*	
Ben Wescoatt	Valdosta State University	
This study explored college students' actions and conceptual understanding while verifying trigonometric identities. During semi-structured clinical interview in which students verified identities, many students concluded their written verification with a reflexive equality, i.e., sin(x)=sin(x). A possible meaning held by the students for this reflexive step will be discussed.		

UT1.1	*Sums of Fibonacci Numbers*	
Nicole Fox	Georgia Southern University	

Sums of Fibonacci numbers
By Nicole Fox
Georgia Southern University
Abstract
There are well known results for the sum of the first n Fibonacci numbers, for the sum of the first n Fibonacci numbers with even subscripts, and for the sum of the first n Fibonacci numbers with odd subscripts.
For instance, F1 + F2 + F3 + F4 + ...+ Fn = Fn +2 −1
and F2 + F4 + F6 + F8 + ...+ F2n = F2n +1 −1.
We investigate similar sums with subscripts from an arithmetic progression.
For example, F0 + F3 + F6 + F9 + ...+ F3n = 1/2 (F3n +2 −1),
and F1 + F4 + F7 + F10 + ...+ F3n +1 = F3n +3 .
We also investigate similar sums involving Lucas numbers. For instance,
Lk
k= 0
nΣ
= Ln +2. −1,
€
L4 i+2
i= 0
nΣ
= F4 n +4 and (−1)iL2i+1
i= 0
nΣ
= (−1)n F2n +2.

The ultimate goal would be to know the value of sums such as
Fai+b
i= 0
nΣ
and (−1)iFai+b
i= 0
nΣ
.

UT1.2	*Counting Roots and Galois Groups*	
Nicole Soltz	Elon University	Dr. Chad Awtrey - Mathematics Department at Elon University

Let $f(x)$ be an irreducible polynomial over a field F with roots a, b, and c (in some algebraic closure), and let $K = F(a)$ be the extension obtained by adjoining one root of f to F. We present two methods for determining the Galois group of $f(x)$. One involves answering the question: is $(a-b)(a-c)(b-c) \in F$? The other involves answering the question: how many roots of f are in K ? We end by discussing an application to computing Galois groups of degree 15 polynomials defined over an extension of the p-adic numbers.

UT1.3	*The Path Between the Points: Interpolation and Splines*	
Jeffrey Fisher	Lenoir-Rhyne University	
This paper examines polynomial interpolation and spline interpolation using mathematics and SAGE. Using graphs and code from SAGE, functions are compared to ascertain the optimal interpolation function. Polynomial interpolations are discussed as a base for understanding interpolation through a proof and examples. Splines are introduced to formulate an accurate and smooth function for interpolating points on a plane. Finally, the applicability of splines to fonts is examined by using a letter drawn with a spline function.		

UT1.4	*Augmented Happy Functions of Variable Power*	
Marcus Harbol	The Citadel	Dr. Breeanne Swart
The presentation investigates Augmented Happy Functions of Variable Power, defined as $T_{[c,q]}\left(\sum_{i=0}^{n} a_i 10^i\right) = \sum_{i=0}^{n} a_i^q + c$, $0 \le a_i \le 9$ with $c, q \in \backslash\mathrm{mathds}Z^{+}$. This function takes the digits of a positive integer, raises each digit to the power q, sums the results, and adds a constant, c, to the sum. In particular, the iterative properties of this function are investigated for a range of values of c and q.		

UT1.5	*The Hilbert series of polynomials invariant under a circle action*	
Emily Cowie	Rhodes College	
Let G be a subgroup of $GL_n(\square)$ isomorphic to the circle S^1, then S_1 permutes the polynomials in the ring $\square[x_1, \ldots, x_n]$. Under this group action, there is an invariant polynomial ring, the set of polynomials that are mapped to themselves under the actions. It can be quite simple to produce a polynomial that is invariant under this group action, and knowing all of the invariants provides a lot of information about the action; however, it can be computationally challenging to "count" the number of invariants of each degree. One technique is to compute the Hilbert series, the power series whose nth coefficient is the dimension of invariants of degree n. This talk will discuss computations of the Hilbert series for arbitrary weights $a_1, \ldots, a_n$, as well as the computation of the first few Laurent coefficients of this series at $t = 1$.		

UT2.1	*A New Method for Musical Encryption*	
Olivia Vanarthos	Appalachian State University	
In this talk, I will begin by giving a brief introduction to encryption and a survey of historical methods that use music to encrypt information. I will then present and demonstrate a new method for encryption that utilizes notes within a scale to cause musically-encrypted information to have a more pleasing and unique sound.		

UT2.2	*How To Protect Gotham City Using Voronoi Diagrams*	
Damien Wright	Coastal Carolina University	
Imagine Gotham City in which Batman and Robin parted ways and decided to fight crime separately. We can use Voronoi Diagrams to partition the city in a way that will create distinct regions in which Batman and Robin will be responsible for protecting. If we assume that Batman has more times the ability to protect Gotham than Robin(AKA Nightwing) does, we can use Weighted Voronoi Diagrams to partition the city.		

UT2.3	*Distance-Two Domination on Grid Graphs*	
Dante Durrman	Furman University	Jerez Chen, Furman University
A distance-two dominating set is a set of vertices in a graph such that every vertex not in the set is within distance two of at least one member of the set. We investigate the problem of finding a maximum minimal distance-2 dominating set on a grid graph. Our method uses tilings of an associated gameboard.		

UT2.4	*Derivative Sign Patterns for Infinitely Differentiable Functions in Three Dimensions*	
Madeline Edwards	Elon University	
A derivative sign pattern is a sequence of positive and negative signs that represent the signs of a function and its derivatives over its domain. Special cases of the function's domain in one-dimensional analysis include the real numbers, where there are four possible sign patterns, and the unit interval, with infinitely many possible sign patterns. In the first case, a function that is infinitely differentiable will have a sign pattern that can be determined from the original function and the first derivative. Prof. Kenneth Schilling expanded from the one-dimensional case to the two-dimensional case for the entire plane. His specific cases included the positive real numbers, the positive real numbers restricted with the unit interval, and the first quadrant. Building on Schilling's Derivative Sign Pattern Theorem (DSP), the expansion to the three-dimensional case is analyzed. The specific case of interest in three-dimensions is ordered triples of real numbers. From Schilling's research of matrix possibilities in two-dimensions, analysis of what is possible in three-dimensions can be constructed. In the three-dimensional case, there is interesting geometry among the derivative sign patterns. From combinatorics of all possible cases of two dimensional possibilities into three dimensions, there are only eight possible DSP's in three dimensions; a total of 16 DSP's with their negations. Each possible DSP in three dimensions can be represented by $\pm e^{\pm x \pm y \pm z}$ where the only difference between any given DSP is the positive and negative coefficients.		

UT2.5	*Creating and Extending Fibonacci-Type Formulas by Counting Tiles*	
Langston Williams	Lenoir-Rhyne University	
This research focuses on counting the number of ways $1 \times m$ blocks can tile an $m \times n$ size board. The case where $m = 2$ is special in that it can be used to generate the Fibonacci sequence. The case where $m > 2$ can be used to generate Fibonacci-like sequences. By changing the way in which we decide to count these tilings we can produce a wide variety of Fibonacci and Fibonacci-like formulas.		

UT2.6	*Matroids 4 Macaulay2*	
Ben May	High Point University	
The purpose of this research project was to study matroids in order to create a package for them in Macaulay2. Macaulay2 is a software system designed to aid mathematical research in algebraic geometry and commutative algebra. My work focused on approaching Matroids from a Linear Algebra perspective. The package's first function allows users to input a set of vectors and receive the associated matroid as output. Continued growth and implementation of a Matroid package for Macaulay2 should facilitate further research on Matroids.		

UT3.1	*Various Properties of the Fibonacci Number Sequence*	
Moriah Gibson	Georgia College and State University	
The Fibonacci number sequence is famous for its connection to the Golden Ratio and its appearance within natural objects. However, there do exist Fibonacci-like sequences that share the same recursive definition as the Fibonacci sequence without possessing its same connection to the Golden Ratio. We will explain a method for constructing such Fibonacci-like sequences, and then examine the relationship between the Golden Ratio and the Fibonacci number sequence through the appearance of Fibonacci numbers within a sunflower.		

UT3.2	*A Geometric Approach to Voting Theory*	
Lee Fisher	Appalachian State University	Dr.Vicky Klima was guiding professor.
In this poster we highlight the connection between the way a voter's ranking of the candidates is scored, or weighted, and the outcome of an election, emphasizing that the selection of a weight system may strongly influence the outcome of an election. This observation is important from a practical standpoint in considering the objectivity of voting procedures. We then introduce and use geometric tools to analyze a new system that, while based on the idea of position weighted voting, does not require the vote counter to choose particular values for the weights.		

UT3.3	*4x4 to 2x2*	
Sierra Doherty	Coastal Carolina University	
Searching on the internet, it is easy to find algorithms for solving the 4x4 Rubik's Cube. The purpose of this talk is to demonstrate a way to solve the 4x4 Rubik's Cube, developed by the author, and compare it with a more well-known method. This new method may provide an easier solution to an otherwise complicated puzzle.		

UT3.4	*Disney in a Day: TDTSP applied to theme parks*	
Danny Rivers	Furman University	Rahul Isaac, Furman University

In the Traveling Salesman Problem (TSP), one seeks the shortest way to visit a number of given number of locations. We investigate a more complicated variant of the TSP, the Time-Dependent TSP (TDTSP), in which node or edge weights (travel or visit times) vary over time in a known fashion. In particular, we used Disney theme park attractions as our locations and tried to find a way to minimize the time required to visit each ride once (which maximizes your time to see them again). We created a genetic algorithm to find good solutions to the time-dependent problem, and tested multiple heuristics within this framework.

UT3.5	*Degree 6 Polynomials and Their Solvability by Radicals*	
Peter Jakes	Elon University	Robin French, Elon University Dr. Chad Awtrey, Elon University Dr. Alan Russell, Elon University

For about 500 years, formulas have existed to find exact solutions to quadratic, cubic and quartic polynomials. However, it was proven later that not all solutions to quintic polynomials can be found exactly, or solved by radicals. As a result, a method was created in the 20th century using a property of each function called its Galois group in order to determine which degree five polynomials could be solved exactly and which could not. This project expands upon this discovery by exploring degree six polynomials. By using computer software, the Galois group of a degree six polynomial can be determined by only using two resolvent polynomials, improving upon prior methods. From this information, it can then be determined whether or not the polynomial is solvable by radicals. Further research can explore higher degree polynomials as well as reducible polynomials, as the current method is only viable for irreducible polynomials.

UT3.6	*The optimum turning angle after aircraft engine failure at a low altitude*	
Xinyue Dai	Sewanee: the University of the south	Dr. Catherine Cavagnaro, Math and Cs department, Sewanee: the university of the south

Engine failure in a single aircraft at a low altitude right after takeoff demands immediate reaction. The FAA recommend procedure pilot to land straight ahead, but it not work effectively when the failure altitude is 300-1000 feet. The purpose of this study is evaluate the possibility and feasibility of turning back after engine failure during the takeoff phase of flight in a single engine aircraft by building analytical model with Mathematica. Then, matching the result to the analytical result done by Rogers at 1994 . By examining the influence of engine failure altitude, wind direction and velocity, and bank angle on the required runway length of single aircraft, the model shows that the optimum flight turning angle is 45° bank angle at constant velocity during the turn.

UT4.1	*The classification of SU(2)^2 biquotients of compact, simply-connected rank 3 Lie groups.*	
Robert DeYeso III	University of Tennessee at Martin	Dr. Jason DeVito - coauthor

A biquotient is any manifold which is diffeomorphic to the quotient of a homogeneous space G/H by an effectively free isometric action. We provide a classification of $SU(2)^2$ biquotients of compact, simply-connected rank 3 Lie groups. We show most of these biquotients are distinct up to diffeomorphism by computing their respective cohomology rings and first few Pontryagin classes.

UT4.2	*Drawing numbers and listening to patterns*	
Zo (Loren) Haynes	Georgia Southern University	

We present an interesting study of the patterns of number series. Using Triangular numbers as an example, we study their patterns through basic approaches analogous to that in digital topology. While employing elementary number theory to justify these patterns, we also make a connection to math music by interpreting the patterns in terms of notes.

UT4.3	*A new algorithm for Galois groups of quintic polynomials*	
Robin French	Elon University	Dr. Chad Awtrey, Assistant Professor of Mathematics, Elon University

Finding solutions of polynomial equations is a central problem in mathematics. Of particular importance is the ability to solve a polynomial``by radicals''; i.e., using only the coefficients of the polynomial, the four basic arithmetic operations (addition, subtraction, multiplication, division), and roots (square roots, cube roots, etc.). For example, the existence of the quadratic formula shows that all quadratic polynomials are solvable by radicals. In addition, degree three polynomials and degree four polynomials are also solvable by radicals, which was shown in the 16th century. However, the same is not true for all degree five polynomials. Therefore, we are left with the following question: how do we determine which degree five polynomials are solvable by radicals? To answer this question, we study an important object that is associated to every polynomial. This object, named after 19th century mathematician Evariste Galois, is known as the polynomial's Galois group. The characteristics of the Galois group encode arithmetic information regarding its corresponding polynomial, including whether or not the polynomial is solvable by radicals. In this talk, we will discuss a new algorithm for determining the Galois group of a degree five polynomial.

UT4.4	*Constructions in Design Theory*	
Leah Foster	LaGrange College	

A Steiner Triple System is defined as a set T of 3-element subsets, called triples, whose elements come from a set S in which each pair of elements in S occurs in exactly one triple in T. I will be discussing two different constructions of Steiner Triple Systems, the 2n+1 and 2n+7 Constructions. In addition to presenting the constructions, I will also prove the 2n+1 construction.

UT4.5	*A closed form for the sums of squares of consecutive Lucas numbers*	
Kaige Lindberg	The Citadel	
In this talk I will be talking about how I found the closed form for a finite sum of the square of two consecutive Lucas numbers. I will discuss the identities and techniques I used. I will additionally talk about the potential generalizations of this result to generalized Fibonacci numbers. The summation was an open problem in the Fibonacci Quarterly.		

UT4.6	*Extending J. Chernik's Construction of Carmichael Numbers*	
Tyler A. Woolley	Wofford	N/A
A Carmichael number is an integer n such that $a^n \equiv a \pmod{n}$ for all integers a. In this talk, we construct Carmichael numbers based on J. Chernik's work in which he noted that there exists a Carmichael number of the form $(6k+1)(12k+1)(18k+1)$ when each factor is prime. We take a similar construction of primes to those above and show that our newly constructed products satisfy Korselt's Criterion when they are extended indefinetly, which implies that the products are Carmichael numbers.		

UT5.1	*Monochromatic-bichromatic Ramsey numbers for some small cycles*	
Michael Ngo	Clayton State University	Elliot Krop
We call 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 triangle, a Mixed 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 \emph{Mixed Pattern Ramsey number}, denoted $M_k(H)$. We determine this function in terms of k for all colored 4-cycles. We also find bounds for $M_k(H)$ when H is a monochromatic odd cycle. We state several open questions.		

UT5.2	*Snakes on the Plane*	
Jerez Chen	Furman University	Dante Durrman, Furman University
A depletion of a graph is a permutation of its vertex set such that each vertex in the list (except for the first) can find a neighbor in the list to its left. A depletion models the spread of a disease through a system of nodes and edges. A snake is a special type of maximal outerplanar graph. In this talk, we will enumerate the number of depletions of a snake graph.		

UT5.3	*Graph coloring, art gallery, and applications*	
Yunwei Zhang	Georgia Southern University	
In this talk we survey results and tools in the application of graph coloring on the well known art gallery problem. We will explore the basic approaches such as triangulation and how to deal with "ears" in a structure. The slightly different Right-Angled Art Gallery problem will also be visited as an application of the aforementioned work. We also mention potential applications to other related questions.		

<table>
<tr><td>UT5.4</td><td colspan="2">Using Wavelets for Image Noise Removal</td></tr>
<tr><td>Maria Peter</td><td>Coastal Carolina University</td><td>Victor Harris (Undergraduate Students & Partner)</td></tr>
<tr><td colspan="3">We see images every day and sometimes they look distorted. Often times now, image sharing sites have many filters to “enhance” photos in various ways. So, we decided to engage in a project to create a program to test several different ways to remove noise from the images. Using this program, we were able to separate images’ red, blue, and green channels and to test how denoising one impacts the image as a whole. The program was written in C# and allowed us to combine Mathematics with Computer Science. What we will be presenting is just a small part of a much larger ongoing research project.</td></tr>
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<tr><td>UT5.5</td><td colspan="2">Machine Learning Techniques for Detecting Humans in Images</td></tr>
<tr><td>Troy Kling</td><td>UNCW</td><td>Dr. Yishi Wang, UNCW</td></tr>
<tr><td colspan="3">Statistical machine learning techniques play a very significant role in computer vision and pattern recognition. In this presentation, techniques for feature extraction from images, including local n-ary patterns and histograms of oriented gradients, are discussed. Dimensionality reduction techniques, such as principal component analysis and Fisher's linear discriminant analysis, are also introduced. Finally, support vector machines are reviewed as a popular approach for classification. These aforementioned techniques will be applied to a large scale problem involving detecting the presence of humans in images. The strengths of the feature extraction and dimensionality reduction methods will be discussed.</td></tr>
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<table>
<tr><td>UT6.1</td><td colspan="2">Introduction to the Wave Equation: Derivations and Illustrations</td></tr>
<tr><td>Amber Holmes</td><td>LaGrange College</td><td></td></tr>
<tr><td colspan="3">The derivation of the equation governing the vibrating string yields the one-dimensional homogeneous wave equation. Once the solution is derived, the partial differential equation is used to further discuss the normal modes of a vibrating string when initial spatial positions are altered.</td></tr>
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<tr><td>UT6.2</td><td colspan="2">Ecological models with U-shaped density dependent dispersal</td></tr>
<tr><td>Jordan Price</td><td>Auburn University Montgomery</td><td>Jordan Berry, Auburn University Montgomery</td></tr>
<tr><td colspan="3">Dispersal of an animal population is considered to be density dependent when dispersal decisions are made based on the presence of conspecifics. Recently, several ecologists have noted density dependent dispersal in multiple species of animals from insects to birds to bears. In fact, the relationship between population density and dispersal has been shown (empirically) to be U-shaped. In this talk, we will model the effects of U-shaped density dependent dispersal on the patch-level dynamics of a population using one of the most versatile theoretical population frameworks, the reaction diffusion population model. In particular, we will explore the dynamics of a diffusive logistic population model on a one-dimensional domain with nonlinear boundary conditions modeling U-shaped density dependent dispersal via study of the model’s positive steady state solutions. We obtain results through use of the quadrature method and Mathematica computations and will briefly explore their biological implications.</td></tr>
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UT6.3	*Linear Sums of Binomial Coefficients*	
Soowhan Yoon	Mercer University	
The Fibonacci sequence and Pascal's triangle are closely tied together because of the connection between the recursive property of the Fibonacci sequence and the combinatorial property of Pascal's triangle. Noticing the flexibility of Binet's formula that allows one to extend the sequence into a continuous function and extending the definition of the binomial coefficients to the complex numbers, one can make remarkable observations about the nature of the linear sums of binomial coefficients.		

UT6.4	*Modeling of financial flow over time through recursive network construction*	
Kayla Hagerty	Georgia Southern University	Jing Sun, Georgia Southern University
The study of financial flows between different financial institutions has long been an interesting and important topic. In particular, the development of the U.S. economy in terms of both domestic and international trades, investments, donations, etc., form a complex system of financial flows whose stability and future direction have been controversial subjects of debate for a long time. In this talk we present a model based on flow network, which incorporates the change of flow over time, to provide an effective tool for such a study.		

UT6.5	*The Cobb-Douglas Production Function: Analysis and Application of the Model*	
John Saeger	Coastal Carolina University	
Production Functions take factors of production and relate them to the output of production processes and are a fundamental concept associated with supply side economics. In mathematical terms, a production function is used to represent the limit of output obtainable from all possible sets of inputs or to specify minimum requirements necessary to produce a desired output. Analysis of production functions allows for the calculation of concepts such as the change in ratio of capital to labor over time and the value of long run economic equilibrium.		

UT6.6	*Tracking Robots using Elementary Tactics from Computer Vision*	
William Lewis	Furman University	Chase Fiedler, Furman University
We employ some simple methods from computer vision in order to create an indoor global positioning system for small scale autonomous vehicles.		

WS.1	*Fifty Years of Geometric Programming*	
Elmor Peterson	Systems Science Research and Consulting	

WS.2	*Teaching Numerical Analysis using the free software SAGE MATH*	
Razvan Mezei	Lenoir-Rhyne University	
In recent years, Python has gained a lot of popularity as being one of the easiest programming language to learn, and many universities are using it in their introductory programming courses. SageMath is a free open source Mathematical software that uses a Python-based syntax. In this workshop we will present how one can integrate it in teaching undergraduate Numerical Analysis courses. In particular, we will make use of the web-based version of SAGE Math, called SAGE Cell Server. This can be accessed from almost any computer or mobile device connected to the Internet, making it very convenient for in-class use, or at home. Other options of using SageMath are: the Sage Cloud, and the Sage Virtual Machine. We will demonstrate:- how one can use existing Sage library functions to quickly introduce the students to Numerical Analysis topics, and then,- how to implement specific algorithms to create our own functions and demonstrate understanding of the Numerical Analysis concepts.		

WS.3	*Graduate Student Career Development Workshop*	
Sarah Frick	Furman University	