College of Science and Mathematics

Department of Mathematics

Fourth Annual Kennesaw Mountain Undergraduate Mathematics Conference Program and Abstracts [1]

October 10–11, 2014

[1]Funding for the Kennesaw Mountain Undergraduate Mathematics Conference is provided by NSF grant DMS-0846477 through the MAA Regional Undergraduate Mathematics Conferences program (http://www.maa.org/RUMC). Additional support was provided by the Center for Excellence in Teaching and Learning and the Department of Mathematics at KSU.

Welcome

Welcome to the fourth annual Kennesaw Mountain Undergraduate Mathematics Conference!

We are thrilled that this year KMUMC attracted approximately 170 participants from 26 universities in 8 states!

We hope you will enjoy the talks, activities, food, great weather, and the beautiful Kennesaw State University campus and come back next year!

We would also appreciate any feedback and any suggestions you have. Please fill out the feedback form included in your registration materials or send comments to Dr. Yuliya Babenko (ybabenko@kennesaw.edu).

Sincerely,
KMUMC Organizers

Accessing KSU WiFi Network

1. Select "`KSUGuest`" from the list of available wireless networks.
2. Enter "`kennesaw`" as security key.
3. Open a web browser.
4. Login with your email address.
5. You are now connected to the WiFi network.

Note: Guests have limited bandwidth, will only be able to access the Network between 6am and midnight, and are restricted to Internet connectivity through a web browser.

Location of Talks

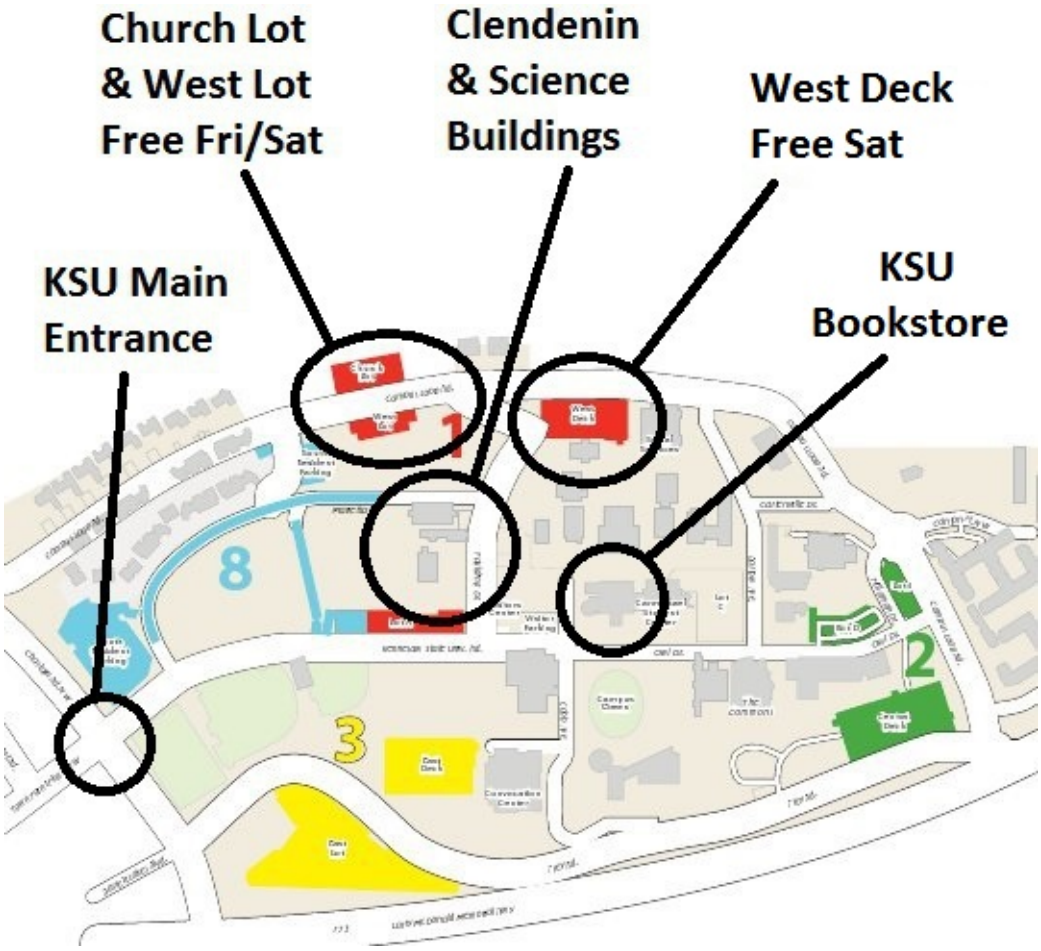
The conference will take place in the Clendenin, Science, and Science Lab Buildings, abbreviated CL, SC, and SL, respectively. See the campus map in your registration packet for directions. Registration and all breaks will be in the Clendenin and Science Lab Building Atriums (CL 1000 and SL 1001).

KSU Campus Bookstore

The KSU Campus Bookstore is located about 200 yards from the main entrance to the Science building (see parking map on the next page). Its posted hours of operation during the conference are:

- Friday 7:30am – 5:00pm
- Saturday 10:00am – 5:00pm
- Sunday closed

Campus Parking Map



On Friday, all visitors can park for free in the Church Lot or West Lot Parking (see map above). **The Visitor Parking Lot is not free on Friday.** Saturday parking is free anywhere. We have been asked to use the West Deck, if possible. All these lots are conveniently close to the Science and Clendenin Buildings.

Please take notice, open parking excludes dedicated parking spaces, service vehicle spaces, loading/unloading spaces, handicap spaces, fire lanes, and police spaces.

Friday, October 10, 2014

2:00	Registration Opens (CL 1000 Atrium)
2:00–4:00	Menger Sponge Folding Activity (CL 1000 and SL 1001 Atriums)
4:00–4:00	Math Scavenger Hunt
5:00–5:10	Opening Remarks (SC 109)
5:10–6:00	Plenary Lecture 1: **Carolyn Yackel** (SC 109) *Fractal Art for Public Consumption*
6:00–7:00	Movie: *Hunting the Hidden Dimension* (CL 1009) pizza and soda provided

Saturday, October 11, 2014

8:00–8:30	Registration (CL 1000 Atrium) and Breakfast (SL 1001 Atrium)			
	Contributed Talks			
Judges & Moderators:	**Algebra/Discrete** (CL 1010) DeMaio & Adhikari	**Analysis/Applied** (CL 1009) Ellermeyer & Bowie	**Pedagogical** (CL 1008) Glassmeyer & Raney	**Pedagogical** (CL 1007) Babenko
8:30–8:45	**M. Beaver, A. Edwards** *Investigating Cardano's Irreducible Case*	**A. Croicu** *Control of HIV Infection of CD4+T Cells*	**C. Walkey** *Why Do I Have to Take This Class? A Study of How Mathematics Content Courses Affect Pre-Service Teacher's Beliefs*	**R. Taylor** (8:30–8:55) *Implementations of Active Learning in the Mathematics Classroom*
8:50–9:05	**D. Branscomb** *Metric Distances Between Cayley Tables*	**N. Rovetto** *How Derivatives Help Us Make Business Decisions*	**Jerkins, Stenger, Stovall** *An Instructional Design Using Computer Programming to Teach Abstraction and Generalization*	**F. Su** (9:00–9:25) *Thinking about Mathematics and Meaning*
9:10–9:25	**J. Eubanks** *Not Your Standard Chess Game*	**K. Mulkey, S. FeSenntao** *Modeling Traffic at an Intersection*	**K. Goldsmith** *Investigating the Effectiveness of Peer-Led Supplemental Instruction*	
9:30–9:45	**B. Johnson** *Counting Lattice Paths with Calculus*	**R. Spencer-Strong** *Calibrating a Trinomial Maple Model to Compute the Current Call Values of Call Options*	**V. Watson, T. Rudchenko** *Problem Solving and Ethical Leadership in a Mathematics Summer Camp*	**Discussion**
9:50–10:00	Coffee Break (SL 1001 Atrium)			
10:00–11:00	Plenary Lecture 2: **Francis Su** (SC 109) *Voting in Agreeable Societies*			
11:00–12:00	Career Panel (SC 109) **Sudheer Chava** (Georgia Tech Scheller College of Business) **Joseph Dolan** (North Highland Worldwide Consulting) **Tom Freeman** (GE) **Kathy Grubbs** (Lockheed Martin) **John Jacobson** (Moxie) **Louise Lawson** (Kennesaw State University)			
12:00–12:45	Lunch (SL 1001 Atrium)			
12:45–1:45	Plenary Lecture 3: **Tim Chartier** (SC 109) *Putting a Spring in Yoda's Step*			

1:45–2:15	Poster Session (CL 1000 Atrium) Judges: Bailey, Bartz, Ehme, Johnson, Keating, Yu **S. Ahmed** *Exact geometry and dimension of bivariate splines* **E. Ander** *Alcoholism — A Mathematical Model with Media Awareness Programs* **N. Davis** *Could you complete A Survey Correctly?* **A. Francis** *Comparing the bounds on the dimension of trivariate spline spaces* **G. Ildefonso** *Cancer Lineages and Radiotherapy* **C. Kaempf** *In Search of an Optimal Physical Sorting Algorithm* **S. King** *Introduction to Mathematical Modeling of Ebola Outbreaks* **D. Rosales** *Modeling traffic at an intersection* **J. Vastola** *On the Use of Integral Transforms to Evaluate Sums Analytically*			
2:15–2:30	Coffee Break (SL 1001 Atrium)			
2:30–3:30	Plenary Lecture 4: **Tim and Tanya Chartier** (SC 109) *"Mime-Matics"*			
	Contributed Talks			
Judges & Moderators:	**Algebra/Discrete** (CL 1010) Sharma & Cazacu	**Analysis/Applied** (CL 1009) Laval & Stupiansky	**Probability/Applied** (CL 1008) Espinoza & Derado	**Pedagogical** (CL 1007) Kimitei
3:30–3:45	**J. Bartz** *Factoring Multivariate Polynomials*	**J. Dangar** *Functions of Matrices*	**J. Derado** *Point Reward System: A Method of Assessment that Accommodates a Diversity of Student Abilities and Interests and Enhances Learning*	**S. Molitoris Miller** (3:30–3:55) *To Define or Not to Define? : An Alternate Route to Teaching Mathematical Concepts*
3:50–4:05	**B. Borror, A. Morris** *The Strong Symmetric Genus Spectrum of Abelian Groups*	**A. Contractor** *On a convergence / divergence problem from integral calculus*	**F. Espinoza** *Spatial and Temporal Image Correlation Analysis of Orai1 and STIM1 during Depletion and Replenishment of Endoplasmic Reticulum Calcium Stores in Immune Cells*	**W. Sanchez** (4:00–4:25) *Open-ended Assessment*
4:10–4:25	**A. Ladha** *Calculating and Optimization of Every Possibility of a Derivation of the N-Queens Problem*	**C. Jones** *Approximations of π*	**K. Doroudi** *Determining the Randomness of Random Number Generators*	**A. Johnson, M. Bowie** (4:30–4:55) *GeoGebra: More than just a geometry tool*
4:30–4:45	**J. Carr** *Exploring Algebraic Relationships Between Quasigroups and the Sudoku Property*	**D. DiMatteo** *Dimension of trivariate C^1 splines on double pyramid cells*	**S. Yoon** *Probability Distribution of Probabilities*	**M. Garner, D. Glassmeyer** (5:00–5:25) *Collaborative Learning in the University Mathematics Classroom*
4:50–5:05	**G. Cazacu** *Why you should win the battle with INTUITION*	**M. Muallem** *Interpolation of Quadratic Functions By Linear Splines*	**L. Allen** *Characterization of Unconfinable Hexagonal Cells*	
5:10–5:25		**V. Harris, M. Peters** *Using Wavelet for Image Processing*		
5:30–6:00	Concluding Remarks and Awards Ceremony (SC 109)			

Biographies of Invited Speakers

Tim Chartier: Tim Chartier is an Associate Professor of mathematics at Davidson College. His ability to communicate math both in and beyond the classroom were recognized with the Henry L. Alder Award for Distinguished Teaching by a Beginning College or University Mathematics Faculty Member from the Mathematical Association of America. His research and scholarship were recognized with an Alfred P. Sloan Research Fellowship. Tim serves on the Editorial Board for Math Horizons, a mathematics magazine of the Mathematical Association of America. He also serves as chair of the Advisory Council for the Museum of Mathematics. Tim has been a resource for a variety of media inquiries which includes fielding mathematical questions for the Sports Science program on ESPN.

Francis Su: Francis Edward Su is the Benediktsson-Karwa Professor of Mathematics at Harvey Mudd College. He received his B.S. in Mathematics from the University of Texas at Austin and his Ph.D. from Harvard University. He is President-Elect of the Mathematical Association of America. His research is in geometric combinatorics and applications to the social sciences, and he has co-authored numerous papers with undergraduates. He also has a passion for teaching and popularizing mathematics. From the Mathematical Association of America, he received the 2001 Hasse Prize for expository writing, and the 2004 Alder Award and the 2013 Haimo Award for distinguished teaching. He authors the popular Math Fun Facts website and iPhone app. His hobbies include songwriting, gardening, photography, and theology. Just like mathematics, these are modes of creative expression that divinely blend structure and freedom, truth and beauty, reflection and action.

Carolyn Yackel: Carolyn Yackel was educated at the University of Chicago (B.S.) and at the University of Michigan (M.S., Ph.D.), where she trained as a commutative algebraist. She's now an associate professor at Mercer University, where she studies the implications of mathematics for fiber arts and vice versa — an emerging field usually referred to as math and fiber arts. This subject brings her much joy as it marries her two loves. She enjoys working both alone and with her major collaborator, Sarah Marie Belcastro, with whom she recently edited their second book, Crafting by Concepts.

Career Panelists

1. **Sudheer Chava**
   Professor of Finance
   Director, Quantitative and Computational Finance (QCF) Program
   Georgia Tech Scheller College of Business

2. **Joseph Dolan**
   Data Analyst
   North Highland Worldwide Consulting

3. **Tom Freeman**
   Sales Director – Engineered Solutions – North America
   GE

4. **Kathy Grubbs**
   Systems Engineer – Reliability Engineering
   Lockheed Martin

5. **John Jacobson**
   Senior Analyst
   Moxie

6. **Louise Lawson**
   Professor of Statistics
   Kennesaw State University

Plenary Talks

1. Title: *Putting a Spring in Yoda's Step*
Speaker: **Tim Chartier**
Institution: Davidson College
Email: tichartier@davidson.edu
Abstract: When the character Yoda first appeared on the silver screen, his movements were due to the efforts of famed muppeteer Frank Oz. In Star Wars Episode II: Attack of the Clones, Yoda returned to the movies but this time the character was not a puppet but a digital image within a computer. This talk will discuss the role, or more aptly the force, of mathematics behind a few aspects of movie special effects. Armed with differential equations, animators can create a believable flow to Yoda's robe or a convincing digital stunt person.

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2. Title: *"Mime-matics"*
Speaker: **Tim and Tanya Chartier**
Institution: Davidson College
Email: tichartier@davidson.edu
Abstract: Mime-matics is a fun and informative show that explores mathematical ideas through the art of mime. The Chartiers have performed the show across the U.S. for audiences ranging from school children to college math professors, from accomplished mimes to self-described math geeks. Whether creating an illusion of an invisible wall, wearing a mask covered with geometric shapes or pulling on an invisible rope, the Chartiers delve into mathematical concepts such as estimation, tiling, and infinity. Through Mime-matics, audiences encounter math through the entertaining style of performing artists who have performed in local, national and international settings.

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3. Title: *Voting in Agreeable Societies*
Speaker: **Francis Su**
Institution: Harvey Mudd College
Email: su@math.hmc.edu
Abstract: When does a majority exist? How does the geometry of the political spectrum influence the outcome? What does mathematics have to say about how people behave? When mathematical objects have a social interpretation, the associated results have social applications. We will show how math can be used to model people's preferences and classical results about convex sets can be used in the analysis of voting in "agreeable" societies. This talk also features research with undergraduates.

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4. Title: *Fractal Art for Public Consumption*
Speaker: **Carolyn Yackel**
Institution: Mercer University
Email: yackel_ca@mercer.edu
Abstract: This talk will focus on specific fractal art projects, including the Menger Sponge. Fractal dimension, dissections of the Menger Sponge, and other mathematical intricacies will be explored. From an artistic standpoint, we consider how to best present the mathematics to a public audience.

Contributed Talks & Posters

1. Title: *Exact geometry and dimension of bivariate splines* (poster)
Speaker: **Zeba Ahmed**
Institution: Towson University
Email: zahmed2@students.towson.edu
Abstract: The well-studied and still poorly understood spline spaces over the so-called Morgan-Scott partition of a triangle provides an insight into a complicated matter of how exact geometry of a partition affects the dimension of corresponding polynomial splines. For the Morgan-Scott split, it is the lines that are not in the partition that affect the dimension. We construct a "Morgan-Scott" partition of a pentagon that has the same property, and investigate the dimension of the associated splines.

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2. Title: *Characterization of Unconfinable Hexagonal Cells*
Speaker: **Larry Allen, Katherine Borst, Brittany Claiborne,** and **Katherine Pilewski**
Institution: Towson University
Email: lallen13@students.towson.edu
Abstract: We address an open question posed by Alfeld, Piper, and Schumaker in 1987 and again by Alfeld in 2000 regarding the characterization of unconfinable cells. For cells with 6 interior edges, we obtain a geometric characterization of confinability in terms of cross-ratios. This characterization allows us to show that a hexagonal cell in which the diagonals intersect at the interior vertex is unconfinable if and only if the lines containing opposite edges and the diagonal through the remaining points are either parallel or are concurrent.

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3. Title: *Alcoholism — A Mathematical Model with Media Awareness Programs* (poster)
Speaker: **Erik Ander** and **Zeynep Teymuroglu**
Institution: Rollins College
Email: eander@rollins.edu
Abstract: In this paper, we address the role of media awareness on the spread and persistence of a drinking behavior in a community. Our model integrates a media awareness component into a modified version of an SIR drinking model. Here, the number of problem drinkers that exist in the community depends on the effectiveness of media awareness programs and peer pressure without the possibility of direct relapses. Our model mimics the dynamics of media awareness programs such that the density of awareness increases as the percentage of problem drinkers increase in the population. However maintaining continuous support for media awareness is not possible. The peer influence is modeled as a factor to encourage drinking among the susceptible population as well as to cause relapses among recovered individuals. A threshold value, R_0, is proposed for the drinking-free equilibrium. Numerical simulations are presented to study the stability conditions in the case that alcoholism culture is established in the community.

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4. Title: *Factoring Multivariate Polynomials*
Speaker: **Jeremiah Bartz**
Institution: Francis Marion University
Email: jbartz@fmarion.edu
Abstract: Factorization of polynomials is one of the fundamental topics in classical polynomial algebra. Although the theory is well-developed for the univariate case, factorization becomes much more difficult for multivariate polynomials. In this talk, we discuss general methods to factor multivariate polynomials and explore deeper results for a specific subset of homogeneous multivariate polynomials.

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5. Title: *Investigating Cardano's Irreducible Case*
Speaker: **Michael Beaver, Alex Edwards,** and **Jessica Stovall**
Institution: University of North Alabama
Email: jbeaver1@una.edu, aedwards1@una.edu
Abstract: Solving cubic equations is a historically rich problem in mathematics. Unlike with quadratic equations, cubic equations do not have a "cubic formula." However, over the years many techniques have been presented that successfully find the solutions of cubic equations. Our research investigates one of these techniques known as Cardano's Method. This method provides an algebraic technique for solving the general cubic equation. Since its initial inception, this technique has suffered a significant drawback. In some instances, the application of Cardano's Method results in what Cardano termed the "irreducible case." The irreducible case occurs when a complex number is needed in order to complete the process. We are investigating the relationship among the

coefficients of the general cubic equation and the irreducible case. We have determined that these relationships fall into one of three categories: always reducible, always irreducible, or conditionally irreducible. Through our research, we have discovered which relationships fall into each of the aforementioned categories. We are now attempting to formulate a general algorithm to easily determine whether or not a given cubic equation will produce Cardano's irreducible case.

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6. TITLE: *The Strong Symmetric Genus Spectrum of Abelian Groups*
SPEAKER: **Breanna Borror** and **Allison Morris**
INSTITUTION: Towson University
EMAIL: bborro1@students.towson.edu, amorri21@students.towson.edu
ABSTRACT: The strong symmetric genus of a group G, is the minimum genus of any compact surface on which G acts preserving orientation. We investigate the set of positive integers which occur as the strong symmetric genus of a finite abelian group. This is called the strong symmetric genus spectrum. We prove that there are an infinite number of gaps in the strong symmetric genus spectrum of finite abelian groups. We also determine an upper bound for the size of a finite abelian group that can act on a surface of a particular genus and then find the genus of abelian groups in particular families. These formulas produce a lower bound for the density of the strong symmetric genus spectrum.

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7. TITLE: *Metric Distances Between Cayley Tables*
SPEAKER: **Daniel Branscomb**
INSTITUTION: University of North Alabama
EMAIL: dbranscomb@una.edu
ABSTRACT: We will use prior research to help put a metric between Cayley tables of finite cyclic groups. After discussing specific examples of lower orders and observing patterns to create a representation of the metric, we will examine an algorithm developed through C++ to simulate examples of higher order and show the representation holds.

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8. TITLE: *Exploring Algebraic Relationships Between Quasigroups and the Sudoku Property*
SPEAKER: **John Carr**
INSTITUTION: University of North Alabama
EMAIL: jacarr1@una.edu
ABSTRACT: Sudoku puzzles are 9×9 arrays divided into nine 3×3 subarrays. A completed Sudoku puzzle will have every entry filled with a digit from 1 through 9 in such a way that each digit appears exactly once in each row and in each column, and in each block. Prior research has shown that the Cayley table of any group can be constructed in such a way that the table takes on the Sudoku property (removing the 9×9 restriction). Since groups are generalized by quasigroups, one can ask if the same construction that worked in the group setting will also work in the quasigroup setting. We are currently investigating this question along with investigating the algebraic relationships between quasigroups and the sudoku property.

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9. TITLE: *Why you should win the battle with INTUITION*
SPEAKER: **George Cazacu**
INSTITUTION: Georgia College & State University
EMAIL: george.cazacu@gcsu.edu
ABSTRACT: This presentation includes a collection of examples of mathematical contexts in which relying on intuition, even though very tempting, is not a good policy. The talk is targeted at a general audience and is intended to both entertain and challenge the mathematical component in the mind of undergraduate students.

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10. TITLE: *On a convergence/divergence problem from integral calculus*
SPEAKER: **Aziz Contractor** and **Elliot Krop**
INSTITUTION: Clayton State University
EMAIL: acontractor@student.clayton.edu
ABSTRACT: This summer, in my second semester calculus class, we studied the convergence and divergence of infinite series. Motivated by results on the divergence of

$$\sum_{n=1}^{\infty} \frac{1}{n}, \quad \sum_{n=1}^{\infty} \frac{1}{n\log(n)}, \quad \text{and} \quad \sum_{n=1}^{\infty} \frac{1}{n\log(n)\log(\log(n))}$$

I considered the "ultimate" case in which we continue the above pattern until the number of logarithms in the denominator is as large as possible, before the value becomes zero. This led to an exploration of more advanced tests. In this talk I will show my solution to the problem by means of Ermakov's test, which I will prove. I will also discuss future directions for exploration inspired by this problem.

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11. TITLE: *Control of HIV Infection of CD4+T Cells*
SPEAKER: **Ana-Maria Croicu**
INSTITUTION: Kennesaw State University
EMAIL: acroicu@kennesaw.edu
ABSTRACT: We will present some results of the control of HIV Infection of CD4+T cells by applying the classical control theory. The mathematical model under consideration is characterized by a system of nonlinear differential equations with unknown functions: the concentration of susceptible CD4+T cells, CD4+T cells infected by the HIV viruses and free HIV virus particles in the blood. Our goal is to minimize the CD4+T cells infected by the HIV viruses.

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12. TITLE: *Functions of Matrices*
SPEAKER: **Jared Dangar, Christina Jones,** and **Joshua Du**
INSTITUTION: Kennesaw State University
EMAIL: jdangar3@students.kennesaw.edu, cjone280@students.kennesaw.edu
ABSTRACT: Finding the properties of matrices and their functions is critical for the advancement of engineering and mathematics as a whole. As a different approach, we will look at diagonalizable matrices and their properties to find quick and efficient results to matrix functions. We will begin with elementary functions of a single matrix to find basic properties to act as building blocks for more complicated functions of two or more matrices under certain cases. Once these functions are discovered, calculus of matrices functions will be explored.

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13. TITLE: *Could you complete A Survey Correctly?* (poster)
SPEAKER: **Nicole Davis**
INSTITUTION: Kennesaw State University
EMAIL: ndavis52@students.kennesaw.edu
ABSTRACT: In the initial statistical research study, I wanted to look at what methods people use to communicate with other as individuals/groups when using their cell phones. Specifically, I wanted to look at internet (email and social media), texting, talking, and video chatting usage. However, something interesting came up when analyzing the data. Many people answered the part looking at methods of communication incorrectly, rendering the information useless for my intended question.

I subsequently inferred that there could be very interesting information among these hidden errors. I turned my attention to a new question and instead analyzed variables related to answering the questions correctly: i.e. reading the directions.

If the results are consistent with my hypotheses, future researchers will be able to design more directed studies. It will also will help with retrieval of more accurate and complete information which may be hidden among seemingly useless data.

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14. TITLE: *Point Reward System: A Method of Assessment that Accommodates a Diversity of Student Abilities and Interests and Enhances Learning*
SPEAKER: **Josip Derado**
INSTITUTION: Kennesaw State University
EMAIL: jderado@kennesaw.edu
ABSTRACT: A prevalent problem that we are presently facing in teaching college mathematics is a large diversity in students' abilities and their interest in mathematics. In this paper we present the Point Reward System (PRS), a new method of assessment which resolves this problem and enhances learning. The PRS is easy to implement and it does not require additional resources. We compare PRS to the traditional teaching method which prevails at the universities and colleges today. The data show that PRS has significantly lower WFD rates than the traditional teaching method. PRS is also more successful in keeping students engaged in course throughout the semester and it has more impact on students' learning.

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15. TITLE: *Dimension of trivariate C^1 splines on double pyramid cells*
SPEAKER: **Devan DiMatteo, Julien Colvin,** and **Tatyana Sorokina**
INSTITUTION: Towson University
EMAIL: ddimat2@students.towson.edu
ABSTRACT: We consider trivariate C^1 splines on cells with $n+2$ boundary vertices, n of which are coplanar with the interior vertex. The remaining two boundary vertices are either collinear with the interior vertex or not. We compute the exact dimension in most cases and provide tight upper and lower bounds in the remaining few cases. We also prove which configurations form a free module. We use tools from both algebraic geometry and Bernstein-Bèzier methods.

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16. TITLE: *Determining the Randomness of Random Number Generators*
SPEAKER: **Kaveh Doroudi**
INSTITUTION: Dalton State College
EMAIL: kdoroudi@daltonstate.edu
ABSTRACT: As Coveyou said in 1969, "random number generation is too important to be left to chance". Given the importance of the issue, researchers should always be able to verify that the RNG they use in a given simulation is of a high quality. This talk will survey the basics of randomness and Pseudo-Random Number Generators (PRNG). Then we will discuss the details of some PRNG and introduce the beginning of the author's summer research project.

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17. TITLE: *Spatial and Temporal Image Correlation Analysis of Orai1 and STIM1 during Depletion and Replenishment of Endoplasmic Reticulum Calcium Stores in Immune Cells*
SPEAKER: **Flor A. Espinoza**
INSTITUTION: Kennesaw State University
EMAIL: fespino1@kennesaw.edu
ABSTRACT: Changes in calcium concentrations are required for many physiological processes such as proliferation and secretion. STIM1 and Orai1 have been identified as the main molecular components to replenish depleted calcium in the endoplasmic reticulum through the activation of calcium release-activated calcium channels. In this study, using image correlation spectroscopy we quantify the spatial and temporal changes of Orai1 and Orai1-STIM1 complexes during this signaling process.

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18. TITLE: *Not Your Standard Chess Game*
SPEAKER: **James Eubanks**
INSTITUTION: Kennesaw State University
EMAIL: james.eubanks21@gmail.com
ABSTRACT: Chess began as a military game and has evolved into a strategy game which has been played in parks across the world and competitively for at least the last 150 years. This presentation introduces the idea of a Bouncing Bishop, and provides insight on the independence of Bishop and Bouncing Bishop armies various $m \times n$ chess boards.

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19. TITLE: *Comparing the bounds on the dimension of trivariate spline spaces* (poster)
SPEAKER: **Andrew Francis**
INSTITUTION: Towson University
EMAIL: afranc10@students.towson.edu
ABSTRACT: Consider the vector space of a piecewise polynomial function defined on a three-dimension polyhedral, a spline space. MourrainVillamizar and AlfeldSchumacher developed bounds on the dimension of trivariate spline spaces using two different methods. MourrainVillamizar used a homological approach while AlfeldSchumacher developed their bounds using approximation theory. There have been no previous comparisons of these two bounds. In this project I have compared the two bounds for a particular family of partitions.

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20. TITLE: *Collaborative Learning in the University Mathematics Classroom*
SPEAKER: **Mary Garner** and **David Glassmeyer**
INSTITUTION: Kennesaw State University
EMAIL: dglassme@kennesaw.edu

ABSTRACT: In this presentation we share two activities used to provide students opportunities to learn mathematics in a collaborative nature. We then overview strategies for implementing these activities and open up the floor for the audience to contribute to the discussion.

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21. TITLE: *Investigating the Effectiveness of Peer-Led Supplemental Instruction*
SPEAKER: **Katie Goldsmith**
INSTITUTION: University of North Alabama
EMAIL: kgoldsmith@una.edu
ABSTRACT: The University of North Alabama's math department has collected data from the Fellow's program since it began in the fall semester of 2013. Their Fellow's Program allows undergraduate students majoring in any areas of STEM- science, technology, engineering, or math- to attend and participate in gatekeeper math classes and offer those students supplemental instruction once a week. Supplemental instruction is a learning support model comprised of peer-assisted study sessions and at UNA is led by those students in their Fellow Program. Research suggests supplemental instruction increases student retention of material and his or her performance in a class. My goal is to further the research that says supplemental instruction increases student learning built on data from analysis of data collected in spring 2014 and this fall.

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22. TITLE: *Using Wavelet for Image Processing*
SPEAKER: **Victor Harris** and **Maria Peters**
INSTITUTION: Coastal Carolina University
EMAIL: vharris@coastal.edu, malelekin@coastal.edu
ABSTRACT: We see images every day and sometimes they look distorted. Often times now, with image sharing sites and they have many filters to "enhance" photos in various ways. So, we decided to engage on a project to create a program to test several different things. With this we were able to separate images red, blue, and green channels 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 research project that will be ongoing.

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23. TITLE: *Cancer Lineages and Radiotherapy* (poster)
SPEAKER: **Geena Ildefonso**
INSTITUTION: University of Central Florida
EMAIL: Geena.Ildefonso@ucf.edu
ABSTRACT: The traditional view of cancer states that the unregulated division and growth of cells is the cause of tumor formation and growth. In recent years, studies have shown that only small subpopulations of tumor cells are responsible for the relentless growth of tumors. These cells are called cancer stem cells (CSC) and this new point of view is known as the CSC hypothesis. Here, we propose to investigate the use of radiotherapy in cancer treatment of heterogeneous tumors containing stem and non-stem cells. A feature of our approach is that we incorporate feedback processes that regulate cell behavior. In addition, we account for radiation-induced reprogramming of differentiated cells into stem cells, which has been observed experimentally. We develop a mathematical model of the cell dynamics using differential equations and the linear-quadratic model to estimate the survival of cells to radiation exposure. To simulate spatial effects, we also plan to use the Cellular-Potts model in which individual cells are represented as a collection of pixels and the dynamics are governed through a probabilistic algorithm that is based on an energy that also takes into account adhesion, motility, and cell stiffness. To parameterize the models, we will use data from brain tumors provided by the laboratory of F. Pajonk (UCLA). The goal is to develop tumor-specific therapy schedules and dosages to optimize response of tumors to radiation treatment. This is an important step towards developing individualized therapy protocols where therapy is designed to optimize response for patient-specific tumor cells.

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24. TITLE: *An Instructional Design Using Computer Programming to Teach Abstraction and Generalization*
SPEAKER: **James A. Jerkins, Cynthia L. Stenger,** and **Jessica Stovall**
INSTITUTION: University of North Alabama
EMAIL: jajerkins@una.edu, clstenger@una.edu, jstovall@una.edu
ABSTRACT: As colleagues in a Mathematics/Computer Science department, we found that many of our undergraduates were not able to participate successfully in the full range of STEM course offerings. In response to this need, we developed a strategy for explicit instruction in mathematical reasoning and computational thinking. Our instructional design is grounded in a theory of mathematical learning that uses computer programming to

induce students to build the mental frameworks needed for a wide range of advanced math concepts. In our inquiry-based learning approach, students explore conceptual underpinnings through a series of strategically designed mini programs. As they form conjectures and explore them, they are taught to write general expressions and develop convincing arguments concerning the conjectures. Rather than teach a series of steps to solve a particular problem, we use programming to push students to build mental frameworks that are associated with the problem being explored. In many instances, students have no prior experience with programming and are taught to program in the context of the problem being explored.

We have tested our Instructional Design in professional development for high school math teachers and regional specialists, with students in high school math classrooms, in middle school math classrooms, and in our math and CS undergraduate classes. We were awarded a 3 year USDE Math/Science Partnership grant through the Alabama State Department of Education in 2013. We will share details of our Instructional Design and results from classroom implementations.

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25. TITLE: *GeoGebra: More than just a geometry tool*
SPEAKER: **Ashley Johnson** and **Miranda Bowie**
INSTITUTION: University of North Alabama
EMAIL: ajohnson18@una.edu, mbowie@una.edu
ABSTRACT: In this talk, we will provide an introduction to the (free) program GeoGebra and explore how it can be used to facilitate exploratory learning and aid in visualization. Contrary to how it sounds, GeoGebra has many uses outside of the geometry classroom. We will show a handful of applets in areas including trigonometry, calculus and, of course, geometry.

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26. TITLE: *Counting Lattice Paths with Calculus*
SPEAKER: **Brooke Johnson**
INSTITUTION: Valdosta State University
EMAIL: Johnsonbrooke22@yahoo.com
ABSTRACT: In this presentation, we provide an alternative proof to a nontrivial combinatorial problem. We will employ some basic continuous methods to what seems on the surface, to be a purely discrete problem. Time permitting, we will indicate how the methods used may lead to more general results, as well as point related ideas of possible research interest.

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27. TITLE: *Approximations of π*
SPEAKER: **Christina Jones, Jared Danger,** and **Joshua Du**
INSTITUTION: Kennesaw State University
EMAIL: cjone280@students.kennesaw.edu, jdangar3@students.kennesaw.edu
ABSTRACT: Using Taylor Series of arctangent and trigonometric formulas, it is possible to write equations that can be used to approximate π to an nth degree. To get the most accurate approximations, the smallest angles are the most desirable. By using trigonometric formulas such as the half angle formulas and triple angle formulas the sines and cosines of smaller angles can be found, and therefore the tangents of these angles can be found. After the tangent of an angle is found, a formula to approximate π at that angle can be found. This talk will focus on finding the tangent of different small angles and examining the accuracy of their π approximations.

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28. TITLE: *In Search of an Optimal Physical Sorting Algorithm* (poster)
SPEAKER: **Carly Kaempf** and **Jeff Allotta**
INSTITUTION: Dalton State College
EMAIL: ckaempf@daltonstate.edu
ABSTRACT: The goal of this research was to determine an optimal sorting algorithm for humans. Test volunteers were asked to sort a list of twenty-four names alphabetically using a number of different algorithms. The algorithms used were computer sorting algorithms modified for a human to use. The data showed that bucket sort and insertion sort were the fastest and merge sort had the fewest errors.

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29. TITLE: *Introduction to Mathematical Modeling of Ebola Outbreaks* (poster)
SPEAKER: **Samuel King** and **Ana-Maria Croicu**
INSTITUTION: Kennesaw State University
EMAIL: sking111@kennesaw.students.edu

ABSTRACT: S-E-I-R and S-I-R are mathematical models used to simulate epidemics, and in particular Ebola outbreaks. Both models compartmentalize populations into three basic categories: susceptible, infected and recovered individuals. These models are derived using systems of ordinary differential equations. Simulations of current Ebola outbreaks in West Africa are analyzed using these models.

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30. TITLE: *Calculating and Optimization of Every Possibility of a Derivation of the N-Queens Problem*
SPEAKER: **Abrahim Ladha** and **Patricia Brown**
INSTITUTION: Armstrong State University
EMAIL: ibayibay1@gmail.com
ABSTRACT: In this project, we study a game derived from the classic n-queens problem. In the original statement of this problem, a player tried to place n queens on an n by n chessboard so that no queen could attack another. In this derivation, we relax the conditions of attack as follows: If the number of queens attacking a non occupied square modulo $2 \equiv 0$, a new queen can be placed in that square, however if the number of queens modulo $2 \equiv 1$, the square is forbidden. Now, not only does the position of the queens matter, but also the order of placement. Some solutions will "lock" the board with less than n^2 queens placed on the board, with every non occupied square unable to host an additional queen. Our goal is to determine the relationship between locked solutions, complete solutions and n. We can form decision trees to determine every single possibility, but the unique thing is that due to symmetry, some solutions are completely identical. By changing traditional tree notation, to one where branches are given the possibility to recombine, we get a much smaller and more visually understandable diagram. As n increases, the time it takes for a computer to fully solve a board for that n increases exponentially. Further work will be done to convert the tree diagram system with combining branches to something a computer can calculate more effectively than a traditional tree diagram.

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31. TITLE: *To Define or Not to Define? : An Alternate Route to Teaching Mathematical Concepts*
SPEAKER: **Susanna Molitoris Miller**
INSTITUTION: Kennesaw State University
EMAIL: smolitor@kennesaw.edu
ABSTRACT: Many instructors and text books begin introducing a new mathematical structure or concept by providing students with a definition. However, many theories of learning suggest alternative ideas about how students learn concepts and when they would be ready to work with a mathematical definition. This talk will address a few research-based theories regarding how students learn concepts and the implications of these theories for teaching mathematics.

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32. TITLE: *Interpolation of Quadratic Functions By Linear Splines*
SPEAKER: **Maice Muallem**
INSTITUTION: Kennesaw State University
EMAIL: mmuallem@kennesaw.edu
ABSTRACT: We consider quadratic functions $Q(x, y) = Ax^2 + By^2 + Cxy$ defined on polygonal subset Ω of $\mathbb{R}^2$.

The goal of this part of the project was to find a linear spline function $L(Q)$ that interpolates f and minimizes the L_2-error of approximation of f by $L(Q)$.

Due to the natural connection between linear splines and triangulations of the domain, we first find optimal shape of the local triangle. Using rotation and translation of the optimal triangle, we then build a triangulation of the whole domain optimal for the given quadratic function. We conclude by giving a scheme on how to use these estimates to obtain error estimate for arbitrary function $f \in C^2(\Omega)$.

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33. TITLE: *Modeling Traffic at an Intersection*
SPEAKER: **Kaleigh Mulkey** and **Saniita FaSenntao**
INSTITUTION: Kennesaw State University
EMAIL: kmulkey@students.kennesaw.edu, sfasennt@students.kennesaw.edu
ABSTRACT: The main purpose of this project is to build a mathematical model for traffic at a busy intersection. We use elements of Queueing Theory to build our model: the vehicles that drive up to the intersection follow a Poisson distribution and we call it the "arrival process (λ)" and the stop light at the intersection is considered the "server."

We collected traffic data on the number of vehicles arriving to the intersection, the duration of green and red lights, and the number of vehicles going through the intersection during a green light. We built a SAS macro code to simulate traffic based on parameters derived from the data.

In our program we compute the number of vehicles in the queue every time a vehicle arrives and leaves the intersection, the service time, and the total time the vehicle spends in the queue, or the sojourn time. We describe the probability distribution of the queue length in the long run and analyze its dependence on λ and the durations of the green and red light. Using regression, we build a model for the dependence of the average queue length and the average service time on λ and the durations of the green and red light.

Based on the regression results we propose traffic models that achieve optimal queue lengths and sojourn times.

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34. TITLE: *Modeling Traffic at an Intersection* (poster)
SPEAKER: **Dennys Rosales**
INSTITUTION: Kennesaw State University
EMAIL: drosale1@students.kennesaw.edu
ABSTRACT: Modeling the traffic at the intersection of Chastain Road and I-75N near Kennesaw, Georgia. Vehicles arrive according to a Poisson process and "service" time (time it takes a vehicle to go through the green light) is considered constant. With green light and red light returning at fixed intervals of time, the service time has a general distribution whose average we derive through simulations. Other variables that are derived from simulations are average amount of vehicles in the system, average sojourn time, and how many vehicles were serviced. All these simulations are a product of Maple. We will collect data from traffic and compare the simulation results to the actual traffic measurements. Eventually we will attempt to see if there are any ways in which we can optimize the traffic at the intersection without any major changes, such as adding another lane.

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35. TITLE: *How Derivatives Help Us Make Business Decisions*
SPEAKER: **Natalie Rovetto**
INSTITUTION: Kennesaw State University
EMAIL: nrovetto@students.kennesaw.edu
ABSTRACT: In this presentation, the applications of calculus in business are considered. Examples of total revenue, marginal revenue, average revenue, price elasticity of demand, discrete future and present value, and optimization are shown. In addition, real world examples using calculus within supply chain management are also looked at.

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36. TITLE: *Open-ended Assessment*
SPEAKER: **Wendy Sanchez**
INSTITUTION: Kennesaw State University
EMAIL: wsanchez@kennesaw.edu
ABSTRACT: In this session, we will consider ways of opening traditional questions to reveal more about student thinking. We will see examples of open-ended questions. We will also see student work and use a rubric to score a few student responses.

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37. TITLE: *Calibrating a Trinomial Maple Model to Compute the Current Call Values of Call Options*
SPEAKER: **Rebecca Spencer-Strong**
INSTITUTION: Towson University
EMAIL: rspenc6@students.towson.edu
ABSTRACT: A model was constructed using Maple and knowledge of mathematical finance. A Maple procedure was designed to perform calculations on a given list of stock prices, an expiration date, a list of quoted strike prices and their corresponding call prices, and an interest rate. We used the concept of European Call Options, and considered a trinomial model, similar to the idea of a binomial model, where the stock prices, instead, have three possibilities of change within each step of the model.

The procedure calculates initial call prices by performing backwards induction with an optimal value for a free variable. The optimal value of the free variable was determined in a separate procedure that compared the calculated call prices of several values to the quoted call prices. This optimal value determination resulted in calculated initial call prices that were the closest to the quoted call prices that our model could estimate. The model worked best with a particular window range of strike price values that were chosen with respect to symmetry.

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38. Title: *Thinking about Mathematics and Meaning*
Speaker: **Francis Su**
Institution: Harvey Mudd College
Email: su@math.hmc.edu
Abstract: It is a uniquely human endeavor to reflect on the things of this world and the relationships between them, and to seek meaning in the patterns we encounter. In mathematics, we not only reflect on but we create things and relationships between them by endowing them with meaning. So we can teach effective thinking by helping people deeply engage the meaning of every idea they encounter, in mathematics and in life.

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39. Title: *Implementations of Active Learning in the Mathematics Classroom*
Speaker: **Ron Taylor**
Institution: Berry College
Email: rtaylor@berry.edu
Abstract: In this presentation we discuss the guiding principles of active learning, particularly in mathematics, and discuss some different pedagogical methods. Further, we provide some empirical and anecdotal evidence of the benefits of these methods.

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40. Title: *On the Use of Integral Transforms to Evaluate Sums Analytically* (poster)
Speaker: **John Vastola**
Institution: University of Central Florida
Email: johnvastola@knights.ucf.edu
Abstract: Evaluating sums analytically is a problem that is easy to pose and to give approximate solutions to, but is difficult to exactly solve in general. Many of the results that are known are byproducts of Fourier analysis, which requires guessing that a given series corresponds to a particular function; for obvious reasons, this is undesirable. A method of evaluating sums using integral transforms is proposed which can reproduce many results obtained using other techniques. In particular, representing polynomials as Laplace transform gives some nontrivial exact results.

Some applications of the method are demonstrated, and extensions of the method using integral representations of frequently appearing functions are suggested. One useful representation of the gamma function is supplied, and used to provide both well-known and more obscure results. Interestingly, the application of this integral representation to evaluating sums suggests the introduction of a novel integral transform, which itself can be used to evaluate sums. Some of the transform's properties are given, and its usefulness in other areas (like solving differential equations) is touched upon.

Some physical problems involving the partition functions of statistical mechanics, and some infinite sums appearing in quantum mechanics, are considered.

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41. Title: *Why Do I Have to Take This Class? A Study of How Mathematics Content Courses Affect Pre-Service Teacher's Beliefs*
Speaker: **Caitlin Walkey**
Institution: Kennesaw State University
Email: cwalkey@students.kennesaw.edu
Abstract: Students from Universities across the country may beg the question, "Why is it important for me to take multiple mathematics content courses?". At the end of the Spring 2014 semester, Dr. Susanna Molitoris Miller and I distributed Likert Scale surveys about beliefs and personal self-efficacy across the four mathematics content courses required for pre-service teachers at Kennesaw State University. From these surveys, we found that there were significant differences between the first and final class of the set. After completing the analysis, we concluded that it takes four mathematics content courses to make an impact on pre-service teachers' beliefs and personal self-efficacy.

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42. Title: *Problem Solving and Ethical Leadership in a Mathematics Summer Camp*
Speaker: **Virginia Watson, Tatiana Rudchenko, Josip Derado** and **Ken Keating**
Institution: Kennesaw State University
Email: vwatson@kennesaw.edu, trudche1@kennesaw.edu
Abstract: The third annual KSU Math Circle Summer Camp was held this year with the support of an AMS Epsilon Grant and a generous donation from Lockheed Martin. Thirty students attended the two-week, non-residential camp in June. The focus is on mathematical problem solving but this year two afternoon sessions

involved an ethics and leadership component led by the Siegel Institute for Leadership, Ethics and Character. We will discuss some of the mathematical problems and the ethics and leadership problems that students worked with.

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43. TITLE: *Probability Distribution of Probabilities*
SPEAKER: **Soowhan Yoon**
INSTITUTION: Mercer University
EMAIL: 10916858@live.mercer.edu
ABSTRACT: We use probability distributions to measure the likelihood of the outcomes in many different phenomena. It is so useful in many applications that we study statistics not only in mathematics but also in sciences, engineering and businesses though the degree may vary. In whichever field, one cannot speak of statistics without speaking of the concept of probability. Though it is so familiar to us, grasping where the probability of all begins seems so distant to us. Consider the following curious question:

> *Suppose at a beach were sand particles only consisting of blacks or whites. A man, being blindfolded, picks up a particle and observes that it is black. Then, he puts it back in to the beach. What is the probability of picking up another black for the second pick?*

Many of us are used to the process of obtaining the probability distribution using either the equally-likely principle or the empirical process, but in the case of the given problem, none of those methods seems to be the reasonable choice. It turns out, if we use the concept of computing the conditional probability with some additional assumptions, the answer to the given question above, $\frac{2}{3}$, can be obtained. In the presentation, we will talk about how one can obtain the answer along with my personal account of arriving at such observation.

Friday, October 10, 2014

2:00	Registration Opens (CL 1000 Atrium)
2:00–4:00	Menger Sponge Folding Activity (CL 1000 and SL 1001 Atriums)
4:00–4:00	Math Scavenger Hunt
5:00–5:10	Opening Remarks (SC 109)
5:10–6:00	Plenary Lecture 1: **Carolyn Yackel** (SC 109) *Fractal Art for Public Consumption*
6:00–7:00	Movie: *Hunting the Hidden Dimension* (CL 1009) pizza and soda provided

Saturday, October 11, 2014

8:00–8:30	Registration (CL 1000 Atrium) and Breakfast (SL 1001 Atrium)			
	Contributed Talks			
Judges & Moderators:	**Algebra/Discrete** (CL 1010) DeMaio & Adhikari	**Analysis/Applied** (CL 1009) Ellermeyer & Bowie	**Pedagogical** (CL 1008) Glassmeyer & Raney	**Pedagogical** (CL 1007) Babenko
8:30–8:45	M. Beaver, A. Edwards	A. Croicu	C. Walkey	R. Taylor (8:30–8:55)
8:50–9:05	D. Branscomb	N. Rovetto	Jerkins, Stenger, Stovall	F. Su (9:00–9:25)
9:10–9:25	J. Eubanks	K. Mulkey, S. FeSenntao	K. Goldsmith	
9:30–9:45	B. Johnson	R. Spencer-Strong	V. Watson, T. Rudchenko	Discussion
9:50–10:00	Coffee Break (SL 1001 Atrium)			
10:00–11:00	Plenary Lecture 2: **Francis Su** (SC 109) *Voting in Agreeable Societies*			
11:00–12:00	Career Panel (SC 109) Sudheer Chava, Joseph Dolan, Tom Freeman, Kathy Grubbs, John Jacobson, Louise Lawson			
12:00–12:45	Lunch (SL 1001 Atrium)			
12:45–1:45	Plenary Lecture 3: **Tim Chartier** (SC 109) *Putting a Spring in Yoda's Step*			
1:45–2:15	Poster Session (CL 1000 Atrium) Judges: Bailey, Bartz, Ehme, Johnson, Keating, Yu Presenters: S. Ahmed, E. Ander, N. Davis, A. Francis, G. Ildefonso, C. Kaempf, S. King, D. Rosales, J. Vastola			
2:15–2:30	Coffee Break (SL 1001 Atrium)			
2:30–3:30	Plenary Lecture 4: **Tim and Tanya Chartier** (SC 109) *"Mime-Matics"*			
	Contributed Talks			
Judges & Moderators:	**Algebra/Discrete** (CL 1010) Sharma & Cazacu	**Analysis/Applied** (CL 1009) Laval & Stupiansky	**Probability/Applied** (CL 1008) Espinoza & Derado	**Pedagogical** (CL 1007) Kimitei
3:30–3:45	J. Bartz	J. Dangar	J. Derado	S. Molitoris Miller (3:30–3:55)
3:50–4:05	B. Borror, A. Morris	A. Contractor	F. Espinoza	W. Sanchez (4:00–4:25)
4:10–4:25	A. Ladha	C. Jones	K. Doroudi	A. Johnson, M. Bowie (4:30–4:55)
4:30–4:45	J. Carr	D. DiMatteo	S. Yoon	M. Garner, D. Glassmeyer (5:00–5:25)
4:50–5:05	G. Cazacu	M. Muallem	L. Allen	
5:10–5:25		V. Harris, M. Peters		
5:30–6:00	Concluding Remarks and Awards Ceremony (SC 109)			