Mathematical Association of America
MD-DC-VA Section, November 5-6, 2010
George Mason University
Abstracts

Invited Addresses

FRIDAY WORKSHOP
David Neel, Seattle University
Borges, Novels, and Maths! Oh My!
4:00 pm, Innovation 208
Too many undergraduates end up believing, permanently or just for far too long, that mathematics has little to say to or hear from other ways of knowing. One way to combat this would be to incorporate more mathematics across this curriculum, but what of the complementary approach: incorporating the study of other fields into the study of mathematics. We will begin with some specific examples and readings that have been used in a linked pair of courses, Math 107: Mathematical Reasoning for Humanities Majors and English 120: Introduction to Literature, but ample time will be provided for discussion of additional appropriate literary possibilities, for ways to better connect a stand-alone course, and especially for other possibly beneficial pairs of linked courses.

BANQUET ADDRESS
Betty Mayfield, Hood College
Women and Mathematics in the Time of Euler
8:00 pm, Johnson Center, 3rd floor
The life and work of Leonhard Euler have been widely celebrated, especially in the years surrounding his 300th birthday in 2007. During that summer, former Hood professor Kimber Tysdal and I supervised a group of students in an undergraduate research project. We discovered some interesting and unusual things about the intersections of the seemingly disparate topics of women, mathematics, and Euler.

SATURDAY INVITED ADDRESSES
Chris Danforth, University of Vermont
Chaos and the Mathematics of Prediction: from Hurricanes to Climate Change
9:20 am, Innovation 131
For centuries, scientists have developed increasingly sophisticated mathematical models in an attempt to uncover the rules by which the physical world evolves. Their ultimate goal is not only to understand the nature of the systems they observe, but to predict how they will behave in the future. In this talk, we use simple examples to demonstrate the difficulties and recent advances in prediction of various physical phenomena including the path of Hurricane Katrina, next week's weather, and the global mean temperature in 2100.

David Neel, Seattle University
The Many Masks of Matroids
2:00 pm, , Innovation 103
They lurk, they wait, peeking from behind the familiar. Matroids are combinatorial objects related to graph theory, to linear algebra, to ordered sets, and yet they remain subtle and surprising despite the intuitions we bring from those fields. We will introduce these accessible-yet-challenging objects and a few of the ways to think about them.

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Contributed Papers by Author

Mohammad AlQudah, Virginia Union University
Best Approximation and Lipschitz Constant in Generalized Haar Spaces of Tensor Product Type of the Same Dimension
11:10 am, Innovation 131
We show the characterization of best approximation and present a formula for the local Lipschitz constant for uniform approximation of f on a finite discrete set from n-dimensional generalized Haar subspace of a tensor product type.

Elizabeth Arnold, James Madison University
How do YOU solve Sudoku? A Group-Theoretic Approach to Human Solving Strategies
8:50 am, Innovation 133
Computers can solve Sudoku puzzles quickly and efficiently using a brute force, depth first search algorithm. Humans, on the other hand, use more complicated logical strategies to solve a Sudoku puzzle. In this talk, we codify these human solving strategies using the idea of a "packet" or "not-clue". We introduce functions on sets of packets called solving symmetries. Solving symmetries are functions which manipulate a Sudoku puzzle while maintaining the same solutions as the original puzzle. We show that these solving symmetries form an algebraic group which acts on the set of Sudoku puzzles.

William Barfield, BAE Systems, Inc.
Using Regression Equations to Determine Cost Estimating Relationships for Software Development
11:35 am, Innovation 131
The writing and testing of large-scale software is expensive and involves many substantial costs in addition to the development of the basic software itself. A reliable method to estimate these costs is to employ Cost Estimating Relationships (CERs) applied to the various activities involved in the software development and delivery process. CERs are regression equations typically based on normalized actual costs of prior analogous software development. The Federal Aviation Administration is responsible for management of our National Airspace System, which requires massive amounts of software development and maintenance. We show the methodology, regression results and statistical accuracy of new CERs available for the FAA to use in estimating costs for nine work breakdown structure elements of software development. This is an excellent example of using applied statistics in business, industry, and government.

Olivia Berrier, Hollins University
The MAPLE Version of the Euclidean Discus Toss
3:25 pm, Innovation 132
This talk presents MAPLE programs which model the tables produced by the students in the Euclidean Discus Toss. The student version of this program takes two natural numbers as input and does all of the calculations required in the Euclidean Discus Toss. The teacher versions of this program allow instructors to quickly create problems and answer keys to use in the Euclidean Discus Toss that have the appropriate number of iterations for the size of their classes.

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Ezra Brown, Virginia Tech
A Tale of Two Integrals: Why Ellipses Are Not Elliptic Curves (Part I)
11:35 am, Innovation 132
Circles and ellipses aren't really all that different: each resembles the other when viewed from the proper angle. The integrals for calculating their arc-lengths, however, are really quite different. This talk is about the consequences of this difference, including a hint at why ellipses and elliptic curves really are different.

Dimplekumar N. Chalishajar, Virginia Military Institue
Controllability of Semilinear Impulsive Neutral Functional Differential Equations with Infinite Delay
11:10 am, Innovation 133
In this paper, we examine sufficient condition for controllability of first order impulsive partial neutral functional differential equations. Here we do not assume that the system generates a compact semigroup, so method is applicable to a wide class of impulsive partial neutral functional differential equations in Banach spaces. Also we claim that phase space for infinite delay with impulse, considered by different authors, are not correct.

Hongwei Chen, Christopher Newport University
A Unified Method to Sum Infinite Series
8:50 am, Innovation ???
A number of formulas are presented for summing a variety of infinite series in terms of definite integrals. Several new explicit summations, including some recently Monthly posed problems, are obtained by these methods. This talk will provide a nice example of, "New Wine in Old Bottles."

Bryan Faulkner, Ferrum College
Calculus I: A Paired Topics Approach
10:45 am, Innovation 132
Why should we teach differentiation techniques before integration techniques? We are currently teaching derivative and integration rules in pairs. For example, the chain rule and the method of substitution are covered in the same week. We will discuss the benefits and drawbacks of this course design.

Raymond Fletcher, Virginia State University
Perfect Pentagons and Hexagons
10:45 am, Innovation 131
Let P be a set of points labeled with the Z(mod n), and for each k in Z(mod n) let W(k) denote the set of lines {(x,y) : x+y = k}. If for each k, the lines in W(k) are concurrent, then we call P a perfect n-gon. Let X(k) denote the point of concurrence of the lines W(k). Then {X(k) : k in Z(mod n)} is called the set of perspective points of P. The combined set of vertices and perspective points of a perfect polygon lie on a cubic curve C which we call the cubic envelope of P. If C is irreducible, we can define an algebra on the nonsingular points of C by setting x*y = the third point besides x,y on the line (x,y) and on the curve C. We call P closed if its vertices and perspective points form a subalgebra of (C,*). The completion C(P) of P, consists of the vertices of P, all the lines joining vertices of P and all the intersection points of these

lines. A derivative of a perfect n-gon P is a perfect n-gon all of whose vertices lie in C(P). We determine the isomorphism classes of closed perfect polygons and then discuss derivatives of perfect hexagons and closed derivatives of closed perfect pentagons.

Greg Hartman, Virginia Military Institute
A New Paradigm in Collaborative Textbook Writing
3:25 pm, Innovation 133
In this talk we will discuss the current author/publisher/student textbook paradigm and present an alternative. With software such as LaTeX and affordable online based print-on-demand services, faculty can work together to present their students with inexpensive, yet high quality, textbooks and course books that can be tailored to fit specific needs. We will introduce the APEX (Affordable Print and Electronic teXtbook) Project, a consortium of authors who collaborate to produce open textbooks.

Brian Heinold, Mount St. Mary's University
Patterns and Number Theory
8:50 am, Innovation 132
Last semester, my honors student Jackie Kearney and I investigated plots of {(x,y): f(x,y) ≡0 (mod n)} for various functions and various values of n. Interesting patterns appear along with some nice connections with number theory.

Malynda Jennings & Bobby Moore, Students, Virginia State University
The Distinguishing Chromatic Number of a Graph
3:00 pm, Innovation 133
An *r*- labeling of the vertices of a graph $f : V(G) \to \{1, 2, 3, \ldots, r\}$ is said to be *r*-distinguishing if no non-trivial automorphism of the graph preserves the labeling. The distinguishing number of a graph *G*, *D*(*G*), is the minimum number *r* such that *G* has an *r*-distinguishing labeling. Furthermore, if the labeling is proper, then the distinguishing number becomes the distinguishing chromatic number of *G*, $\chi_D(G)$. In this talk, we will explore the distinguishing number and the distinguishing chromatic numbers of different classes of graphs.

Kurt Ludwick, Salisbury University
Mathematics & Music - A Course for the Liberal Arts Audience
3:25 pm, Innovation 134
In this talk, I will discuss a course I recently created at Salisbury University, entitled "Music and Mathematics," which is a course designed specifically for non-science majors. While there is no traditional textbook for this course, we loosely follow the first several chapters of Leon Harkleroad's expository text, "The Math Behind the Music." Through exploring musical ideas including intervals and chords, alternate tunings of the octave, and variations on musical themes, students with limited mathematical backgrounds are exposed to concepts ranging from exponents and logarithms to combinatorics and group theory. In this talk, I will discuss observations and strategies learned from the first few offerings of this course, and I will provide examples of handouts and assignments which I've developed for the course.

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Shadiyah Mangru, Student, George Mason University

Investigations in Linear Algebra and Combinatorics related to Biclique Decompositions of Graphs

11:35 am, Innovation 134

We formulate five new propositions related to the Graham-Pollak Theorem. The first four illuminate properties of both biclique edge covers of the edge set of K_n, and nullspace basis vectors of a matrix representation of such covers. These four propositions motivate the recursively-defined sparse null space basis we present, as proposition five, for a particular subset of matrices of interest in Algebraic Graph Theory.

Terry Quinn, Middle Tennessee State University, and Sanjay Rai, Montgomery College, Germantown

A Variation in Making Sense of Variation of Parameters

11:35 am, Innovation 133

The method of variation of parameters can be found in most undergraduate textbooks on differential equations. The crux of the matter is looking for solutions of the non-homogeneous equation of the form $y = u_1y_1 + u_2y_2$, a sum of function products using solutions to the homogeneous equation y_1 and y_2 . Why though, might varying parameters be a feasible approach in the first place? An insight is needed, even for a good "guess". We provide a variation to the standard textbook approach, intended to help students find their way toward a key insight: "Aha!, let's try … ."

Dohyoung Ryang, University of North Carolina at Greensboro

The MTEBI for Korean Secondary Teacher Candidates

10:45 am, Innovation 134

The Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) was developed by Enochs, Smith, and Huinker (2000), and has been widely used in the study of efficacy beliefs for elementary teacher candidates in the United States. Teacher efficacy is influenced by the context of academic settings and culture (Lin, Gorrell, & Taylor, 2002). It is necessary to test the accuracy of the MTEBI when the instrument is used in a non-western culture and/or for non-elementary teachers. This paper investigated the validity and reliability of the MTEBI for Korean secondary teacher candidates.

Bonita Saunders, National Institute of Standards and Technology

The NIST Digital Library of Mathematical Functions: A New Resource for Mathematical and Physical Scientists

10:45 am, Innovation 133

This past April the National Institute of Standards
and Technology (NIST) released the NIST Digital Library of Mathematical Functions (DLMF) and its companion, the NIST Handbook of Mathematical Functions. These publications replace the well-known NBS Handbook of Mathematical Functions edited by Abramowitz and Stegun. I will talk briefly about the twelve year project, but focus on how one accesses and uses the various features of the NIST DLMF.

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Martha Siegel, Towson University
CUPM: Curriculum Guide to the Major in Mathematical Sciences (Discussion–Parts I & II)
3:00 pm, Innovation 136
CUPM is planning a new curriculum guide to the major in the mathematical sciences to be published by 2015. Our discussion will focus on issues that are important to the development of the major, models that work well at transition points, that encourage majors, that integrate undergraduate research, etc. Come and share ideas about what you think is essential.

Deirdre L Smeltzer and Owen D Byer, Eastern Mennonite University
Applications of Circular and Spherical Inversions
8:50 am, Innovation 134
Most mathematicians are likely familiar with inversion of a plane with respect to a circle. An inversion "erases" the distinction between lines and circles, often demonstrating that apparently unrelated geometric properties are actually equivalent. In this talk we generalize this concept to inversion of 3-space with respect to a sphere and describe the resulting properties. We consider geometric problems in 2-space that have natural generalizations to 3-space, and present some examples of results from solid geometry that can be proven using inversion with respect to a sphere.

Michael Smith, Hollins University
The Euclidean Discus Toss
3:00 pm, Innovation 132
This talk presents two classroom activities that model Euclid's Algorithm with Frisbees. Students line up in a single file line, and the student in the front of the line is given two Frisbees with the natural numbers "a" and "b" written on them. The first activity is set up so the last student catches a Frisbee with gcd(a,b) written on it, and the second activity is set up so the first student catches Frisbees which encode the coefficients y and z such that ya+zb=gcd(a,b).

Wendy Hageman Smith, Longwood University
How is a mathematics teacher like Bartholomew Cubbins?
11:10 am, Innovation 134
At most undergraduate college and university math departments we teach at least three or four distinct populations of students. Some of these populations show up in the same courses, but most also get one or more of their own courses. We have courses for liberal arts majors, for elementary education majors, for secondary education majors, for non-education math majors, for business students, and for students
majoring in physical or information sciences. Each of these populations has characteristic strengths and weaknesses, and distinctive expectations. This places on the college instructor an obligation to be able to put on different math-teacher "hats" as needed to serve each student population effectively. I have found that those “hats” can be as different as a baseball cap and a balaclava.

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David Taylor, Roanoke College

The Harmonic Series and Biconvergence: One Step Forward, Two Steps Back

11:10 am, Innovation 132

Recent interest in the harmonic series has spawned double-, triple-, and multi-harmonic series, in addition to variants of q-series. Drawing upon the harmonic series and its counterpart, the alternating harmonic series, we have forged a wonderful series using the positive real line as a basis for adding and subtracting elements of the harmonic series. The number of terms used in each step is given by powers of a fixed base $x \geq 1$. In this talk, we construct a formal illustration of the biconvergence of these series, define what it means to sum a non-integer number of parts, and prove some very interesting results regarding our series.

Eve Torrence, Randolph-Macon College

The Art of Stellation

3:00 pm, Innovation 134

We will discuss how the stellation process is used to create uniform polyhedra and how artists have incorporated stellation in artworks from the Renaissance to modern times.