Mathematical Association of America
MD-DC-VA Section, November 4 & 5, 2011
Christopher Newport Univeristy
Abstracts

Invited Addresses

FRIDAY WORKSHOP

Robin Blankenship, Morehead State University
Undergraduate Investigations in Graph Theory and Knot Theory
4:00 pm, Board Room, David Student Union

Come prepared to work collaboratively on explorations of my former research students; no prior knowledge of graph theory and knot theory required! We will begin by constructing graphs from Sudoku puzzles and Chessboards, and then attempt to create book embeddings of these graphs. Next we will move pebbles around these graphs, in an attempt to find minimal pebbling numbers for them. Finally, we will make puzzles out of hextiles, asking various combinatorial questions about creating hextile knot mosaics. These hands-on activities will serve as background for my talk on Saturday, where you may take on leadership roles in the brief moments I allow the general audience to explore the topics prior to revealing the conclusions obtained by my undergraduates!

BANQUET ADDRESS

Marjorie Senechal, Smith College
Quasicrystals: a Mathematical Goldmine
8:00 pm, Ballroom David Student Union

The Nobel Foundation awarded its chemistry prize this year to materials scientist Dan Shechtman "for the discovery of quasicrystals." I will explain what quasicrystals are (and are not), and why mathematicians should thank him too.

SATURDAY INVITED ADDRESSES

Ezra "Bud" Brown, Virginia Tech
The Many Names of (7,3,1) and the Unity of Discrete Mathematics
9:20 am, 1022 Forbes Hall

In the world of discrete mathematics, we encounter a bewildering variety of topics with no apparent connection between them. There are block designs in combinatorics, finite projective planes in geometry, round-robin tournaments and map colorings in graph theory, (0, 1)- matrices in linear algebra, quadratic residues in number theory, error-correcting codes on the internet, and the torus at the doughnut shop.

But appearances are deceptive, and this talk is about the (7,3,1) design, a single object with many names that connects all of these topics. Along the way, we'll learn how Leonhard Euler was once spectacularly wrong, how P. J. Heawood was almost completely right, and what happened when Richard Hamming got mad at a computer.

Robin Blankenship, Morehead State University
Exhilaration and Consternation: Adventures in Conducting Undergraduate Research
2:00 pm, 1022 Forbes Hall

One day you are sitting in your office, chipping away at your responsibilities: preparing for class, grading papers, producing paperwork for committees, planning your next academic adventure into research, creating workshops for teachers, or whatever it is that you do to find and maintain your niche. There comes a knock at your door. "I need a research adviser to help me;" she says, "Are you willing?" Ah, the excitement, and...the fear. Being an adviser for research is as different from working on your dissertation as being a teacher is different from being a student. I will relate my personal story of entering this endeavor: the trials and tribulations, the excitement and revelations, as I carry you through the results my students have produced over the past few years. Come explore topics in graph theory and knot theory with me!

Contributed Papers by Author

Chiru Bhattacharya, Randolph -Macom College
Which groups have reversible PTAs?
8:50 am, 2015 Forbes Hall
Motivated by our previous work on classifying all perfect ternary arrays of energy 4 and thereby explaining the construction of all (16, 6, 2) Hadamard difference sets, we set out to classify all PTA(9)s. The problem is computationally much more difficult and even restricting ourselves to reversible PTA(9)s requires the use of computational algebra software. We present the results of our search for all reversible PTA(9)s and give examples of finite groups in which they are found.

James Blowers, US Army CASCOM (retired)
There is No Simple Group of Order __
3:00 pm, 2015 Forbes Hall
A problem appeared on an online mathematics help service: Show that there is no simple group of order 760. Although all simple groups have been found, solving simplicity questions for low orders like this one provides a good exercise in group theory concepts. This presentation will demonstrate that and show how new concepts, such as Sylowpass numbers and Mersenne groups, can arise from the study of simplicity questions.

David Clark, Randolph-Macon College
Guesses, Metrics and Basketball
3:00 pm, 2012 Forbes Hall
Imagine that you compete in an NCAA basketball tournament bracket pool with some buddies, and that you end up with the most points in your pool -- except that you are tied with one other person. One common way to break this tie requires that each player, when entering their bracket picks, must also guess the final score of the championship game (without, of course, any knowledge of which teams will compete in that game). Whichever player guesses closer to the actual score wins the tiebreaker, and thus the pool. But what should "closer" mean here? In other words, how do we determine which is the better guess? And what if the two guesses are equally good (or bad)? In this talk we'll explore a notion of "distance" that can help us decide, with some possible applications to gambling and voting.

Jerome Dancis, University of Maryland
Algebra Avoidance in High School Math and Science
3:25 pm, 2015 Forbes Hall
“We found ... a deliberate avoidance of symbolic manipulation in algebra ... .” in High School Math Textbooks. [By Guershon Harel and W. Stephen Wilson, “The State of High School [Math] Textbooks”, AMS Notices, 2011]. National Research Council (NRC) released its Framework for K-12 Science Education, in July 2011. In his review, “Education to Raise Technology Consumers instead of Technology Creators”, Ze'ev Wurman wrote: “[The NRC science framework] only expects students by grade 12 to be competent in "recognizing," "expressing," and "using simple … mathematical expressions … to see if they make sense," but not in actually solving science problems using mathematics. ... . But there is nothing about actually being able to model a system by its equations, or solve it using mathematical techniques.” About 40 states have signed onto this almost Algebra-free science framework. Maryland is one of 20 lead states.

George DeRise, Thomas Nelson Community College (retired)
The Shape of Inner Space
8:50 am, 2012 Forbes Hall
The six hidden dimensions of string theory provide an intellectual orgy for the mathematician- including topology, differential geometry, group theory and much more-in addition to all the physics! Can a great geometer present these esoteric concepts in a popular book? I will attempt to explain just one of these concepts.

Raymond Fletcher III, Virginia State University
Perfect Hexagons, Elementary Triangles and the Center of a Cubic Curve
11:10 am, 2012 Forbes Hall
Let P be a set of n points in the plane labeled with the integers mod n. If for each k the lines {(a,b) : a+b = k} are concurrent, then we call P a perfect polygon. We call the concurrence points perspective points of P. The vertices and perspective points of a perfect polygon lie on a cubic curve C. If C is irreducible then an algebra (C,*) can be defined on C by setting a*b = the third point on (a,b) and on C. We show that there are 6 colineations of the plane which restrict to automorphisms of (C,*). These collineations form a group G isomorphic to S6. Each member of G of order 2 fixes all the points on a certain line. There are 3 such lines and they concur at a point Z which we call the center of C. If f is a member of G of order 3 and x is any point in the plane, then the points {x,f(x),f(f(x))} form an elementary triangle. We will discuss properties of the center Z and elementary triangles, most notably that two nonincident elementary triangles form a perfect hexagon. If P is a perfect hexagon then V(P) denotes the figure consisting of all vertices of P as well as all lines joining these points and all intersection points of these lines. The Theory of elementary triangles is used to explain the occurence in V(P) of a multitude of perfect hexagons.

Kira Hamman, Penn State Mont Alto
Blogging for Quantitative Literacy
10:45 am, 2058 Forbes Hall
What do quantitative literacy, reading comprehension, writing across the curriculum, civic engagement, and a lively classroom have in common? A blog! Since the introduction of a class blog, the class I will discuss has become better at all of the above. Coincidence? I think not. I will discuss how my class uses the blog, some other math classes using blogs, and how you could use one, too.

Gregory Hartman, Virginia Military Institute
Writing a Collaborative, Open Source Calculus Book
11:00 am, 3012 Forbes Hall
The current publishing paradigm produces quality textbooks with significant shortcomings. The open textbook movement seeks to address some of these shortcomings by offering flexible, low-cost alternatives. This talk will describe some of the motivation behind the open textbook movement and the opportunity to get involved in writing an open calculus text supported by a grant from the VMI. Feedback from the audience will be greatly appreciated.

Brian Heinold, Mount St. Mary's University
Iterating the Complex Logarithm
10:45 am, 3012 Forbes Hall
Iterating the log function in the complex plane produces some interesting results. In particular, we look at some compositions involving the log function. Using each point in a segment of the plane as a starting point for our iteration, we color the point according to how many iterations it takes until successive iterates are within some small tolerance of each other. This is similar to the process by which the well-known Newton's method fractal is obtained, yet the images are much different.

Ilhan Izmirli, George Mason University
Experimental Mathematics as a Pedagogical Tool
11:10 am, 2015 Forbes Hall
The term "experiment" in mathematics refers to the use of computational techniques to investigate mathematical structures and their fundamental properties and patterns to make mathematical predictions. These predictions can then be verified or falsified on the basis of additional computational experiments or deductive techniques. There are obvious pedagogical advantages to this approach – most notably, gaining insight and intuition, discovering new patterns and relationships, testing (falsifying) conjectures, and suggesting approaches for a formal proof. In this talk we will describe the objectives and main tools of experimental mathematics and give some examples of its uses. We will conclude by an interesting example, the falsification Euler's sum of powers conjecture.

Abstracts

Brant Jones, James Madison University
Solitaire Mancala Games
11:35 am, 2012 Forbes Hall
Mancala games are played by sowing stones among pits on a game board. Because all of the stones in a given pit must be removed and then sown on each turn, the analysis of game play leads naturally to the study of number theoretic properties of the game board. As a player, one of the strategic goals in the game is to set up a single chain of moves that allows the capture of all available stones. In this talk, we consider the question of when it is possible to construct such a "slam" board given only partial information about the number of stones on the board. This is joint work with Laura Taalman and Anthony Tongen.

Emek Kose, St. Mary's College of Maryland
Vector Fields and Differential Forms for Optical Design
10:45 am, 2012 Forbes Hall
For many applications (surveillance, medical imaging, photography, robot navigation) it is very desirable that a camera has a wide field of view. An elegant solution to the problem of wide angle imaging is using cameras coupled with mirrors. Such imaging devices are called catadioptric sensors. The main problem of catadioptric sensor design is determining the mirror shape that will realize a given projection. The prescribed projection determines a vector field
which should be normal to the sought after mirror surface, however generally this vector field is not exact. We overcome the limitations of traditional catadioptric systems using the Frobenius Integration Theorem for differential forms. We will describe several applications including micro-mirror arrays.

Betty Mayfield, Hood College
A History of Math Course for Teachers
11:35 am, 2058 Forbes Hall
NCTM, in its Professional Standards, lets us know that secondary mathematics teachers should understand the history of mathematics and let it inform their teaching. Last summer I taught a course for in-service teachers in the history of mathematics. I found lots of great resources and would love to share them with others.

Alex Meadows, St. Mary's College of Maryland
Can Soap Bubbles help me clean up my Photographs?
8:50 am, 3012 Forbes Hall
The mathematical study of soap film surfaces has inspired much research at the intersection of geometry and analysis, including Douglas' result that won him the first Fields medal. Image processing has recently become popular with a sizable portion of the applied mathematics community. We will describe an interesting relationship between these two subjects, recently discovered by Vixie, et al. The talk will be accessible to those who remember they took a course in analysis once.

Keith Mellinger, University of Mary Washington
Developing Problem Solving Skills
8:50 am, 2058 Forbes Hall
The first-year seminar program at the University of Mary Washington requires all first-year students to take a process-driven seminar style course. I co-developed a course for this program titled "Pirates, Liars, and Pigeons," a course completely devoted to the art of problem solving with absolutely no prerequisite apart from solid high school algebra skills. The course has an emphasis on speaking and writing assignments, a tricky topic for mathematics courses, and the discussion-based format makes it an exciting challenge for the instructor. In 15 minutes or less, I hope to share my preparation, content, experiences, and outcomes.

Minah Oh, James Madison University
An Applied Project for Linear Algebra Students: The Finite Element Method
11:35 am, 2015 Forbes Hall
In this talk, I will discuss an applied project for linear algebra students. The Finite Element Method (FEM) is an efficient method one can use to find a good approximation for the exact solution to a given PDE. Not only are its applications in science and engineering tremendous, but it is also an excellent application of linear algebra. In this project, students were introduced to the FEM through a very simple differential equation problem. Through this simple example, the students learn the essential idea of the FEM by using linear algebra. Furthermore, they see the applications of FEM so that they can see linear algebra in action in the real world.

James Parson, Hood College
The Farey Approach to Elementary Number Theory
11:35 am, 3012 Forbes Hall
The English geologist John Farey published a short note in 1816 about patterns that he observed when he wrote lists of fractions with bounded denominator in numerical order. Farey's patterns are closely related to the basic facts of life in elementary number theory. In this talk, I will explain Farey's observations and a few related aspects of the fractional perspective on elementary number theory that I recently used in a number-theory class aimed principally at in-service teachers.

Don Spickler, Salisbury University
Linear: Maxima Edition
10:45 am, 2015 Forbes Hall
The Linear project is an ongoing software development project at Salisbury University that was started in 2007 with the goal of developing an easy to use teaching and exploration tool for undergraduate linear algebra courses. The package was designed, written and is maintained by both faculty and students at Salisbury University. Our latest addition to the package is the incorporation of the Maxima computer algebra system as a back-end calculation engine, giving Linear the capability of a full CAS while still remaining easy to use, cross platform, and free. In addition to adding many options, as a result of the use of Maxima, we incorporated a LaTeX parsing engine into the display system for textbook-like displays of matrices and expressions. In this talk we will demonstrate some of the advances made to the latest version of the program and showcase some of its more pedagogical features.

Jeffrey Steckroth, Christopher Newport University
A graphical Investigation of the AC Method of Factoring
3:25 pm, 2012 Forbes Hall
Factoring non-prime trinomials of the form ax^2+bx+c, where $a \neq 1$ can be handled easily if one uses the AC Method. Related to this method of factoring is the “Slip-Slide” technique, which relies on the same critical value to determine factors: the product of “a” and “c.” Until recently this method was accepted by its legion of users because it worked, not because it was grounded in something meaningful and logical. Finally, thanks to a novel graphical approach made possible by dynamic geometry software, the secret of this method has been exposed once and for all. The presenter will share his findings both graphically and algebraically to finally answer the question, “Why does this work?” This topic should interest all who teach courses in which factoring is an essential skill.

Laura Taalman, James Madison University
Homework is Dead. Long live Homework.
11:10 am, 2058 Forbes Hall
Wolfram, Cramster, Google, Aardvark, Koofer, Jiskha, and Slader have killed homework as a gradable tool. How do we get past this and make homework effective again? In this talk we will discuss the ways in which homework as we previously knew it can be abandoned in favor of methods that both reduce the grading burden on faculty and increase the responsibility that students take for their work.

Abstracts

Gwyneth Whieldon, Hood College
Coefficients of Waring's Problem
3:00 pm, 3014 Forbes Hall
Waring's problem for monomials was recently solved by Enrico Carlini, Maria V. Catalisano, and Anthony V. Geramita. This talk will survey Waring's problem for polynomials and describe the formulas given in Carlini, Catalisano, and Geramita's paper for the powers of linear forms necessary for a monomial M in terms of its multidegree. We give explicit formulas for the coefficients gamma_i whose existence was proved in their paper, and a discussion of the software experimentation used to produce these - and some follow-up undergraduate level problems which could be attacked via similar methods.

Student Abstracts by Author

David Darwin (Senior), Randolph-Macon College
Solving for Constants of Number Derivatives on the Integers modulo n
3:25pm, 3012 Forbes Hall
Let Z_n denote the ring of integers modulo *n*. A number derivative, *D,* is a function that obeys the product rule from basic calculus. For a given *n* there may be multiple number derivatives defined on Z_n. A *constant* of a number derivative *D* is an element of Z_n that is mapped to zero by *D*. The purpose of this talk is to identify the set of constants of a given number derivative on Z_n for any given n.

Ashley Marzzarella (Senior), Christopher Newport University
Digital Calculus
3:00 pm, 3012 Forbes Hall
Currently conducting research on the effectiveness of his "hybrid" calculus course vs his "traditional" course, my advisor enlisted me as a teaching assistant/research assistant/tutor. This role has provided me with the opportunity to develop skills in locating existing digital resources as well as creating my own digital resources tailored to the specific course. We will demonstrate how to create four different types of digital resources, making use of: Bamboo Tablets with SMART Notebook, SMART Sympodium/SMART Board with SMART Notebook, ScreenChomp for iPad, and Camtasia/Jing. We will exemplify how quickly and simply one can create and share one's own digital teaching aids as well as the myriad of possibilities for what can be accomplished with digital resources.

Catherine O'Doherty (Senior), University of Mary Washington
Explanation of the Matrix Exponential
3:00 pm, 2058 Forbes Hall
We explore the exponential of square matrices, examining methods for finding the exponential including diagonalization, canonical forms, and the Laplace transform. We note uses for the matrix exponential, such as the state transition matrix.

Kelly Scott (Senior), University of Mary Washington
Anti-blocking Sets
3:25 pm, 2058 Forbes Hall
Finite projective planes consist of points and lines that together satisfy a set of three axioms. In such planes, one can naturally look at objects satisfying some synthetic condition. For instance, a blocking set is a set of points that does not contain a line, but does contain a point of every line in the plane. So, they "block" all lines. In this talk, we consider the possibility of a set of points that can never be expanded to a blocking set. We call these sets "anti-blocking."

Ryan Vaughan (Junior), University of Mary Washington
On the Contractibility of Finite coH-Spaces
3:25 pm, 3014 Forbes Hall
We use results from a 1966 paper of Stong on finite topological spaces to prove that finite co-Hopf spaces are necessarily contractible. This result is dual to a theorem of Stong on the contractibility of finite Hopf spaces, though neither proof dualizes to give the other. As a consequence, for any fixed finite space X, the set of homotopy classes [X, Y] does not admit a non-trivial natural group structure in Y.