MD-DC-VA Section MAA Spring 2007 Meeting at Roanoke College

Contributed Paper Abstracts

Robert P. Bennell, Virginia Military Institute

Development of a Freshman Mathematical Modeling Course for majors in Applied Mathematics

When developing the curriculum for the new VMI degree in Applied Mathematics we had identified a requirement for students to receive early, and continued, exposure to the modeling and solution of "real world" problems. Starting AY 2006-07 we have run two, one credit hour, freshman Mathematical Modeling courses. This talk will cover the aims and objectives of the courses, a description of the topics that we have included, the difficulties we have encountered, and an assessment of the success (or otherwise) of the courses to date. All feedback from the audience, particularly suggestions for future projects, will be gratefully received.

James V. Blowers, Retired US Army

Solving Some 7th-degree Equations Using Dominoes

In a recent issue of Math Horizons, a problem was to prove that a particular sum of two 7th roots was irrational. This leads to solving a seventh-degree equation, and applying the circulant theory of Dan Kalman and James White reduces it to a combinatorial problem of placing dominoes on a string of squares.

Owen Byer and Deirdre Smeltzer, Eastern Mennonite University

Exploring Loci in Geometry

Although the notion of a locus is familiar, it is not a prominent part of a typical geometry course. Geometer's Sketchpad allows one to easily investigate the locus of a given property and gives insight into how to proceed with proof. We will illustrate with several examples.

Dipa Choudhury, Loyola College

Tensor Product and Quasi-Positive Definite Operators

Let V1, V2, ..., Vn be finite dimensional inner product spaces over the same field R or C, and W be the tensor product. A Hermitian linear operator T on W is said to be Quasi-Positive definite if the Hermitian form <Tw,w> is positive for all non zero rank one tensors w in W. We study the properties of such operators, in particular, their negative inertia and the relationship between their largest and smallest eigenvalues.

Marshall M. Cohen, Morgan State University

Does XxY homeomorphic to XxZ imply Y homeomorphic to Z? -- A Survey

I give a survey of classical non-cancellation theorems for Cartesian products in topology. Part I of the talk will give examples eminently suitable for a beginning topology class, involving half-spaces, cubes and Euclidean spaces. I first learned these from my teacher Morton Brown at the University of Michigan in the 1960's. Part II will survey famous examples in geometric topology due to Bing, Whitehead (an example related to the Poincare' conjecture), Mazur, Stallings, Cannon and West.

David Kung, St. Mary's College of Maryland

The day I learned to shut up and let my students talk

It seemed like a simple question: Can you always inscribe a square in a triangle? Then I let my students loose on it. What they did taught me more about math - and teaching - than I expected.

Chris Lee, Jan Minton, Roland Minton, and Jeff Spielman, Roanoke College

Calculus at Roanoke College: Reading, Writing, and Clicking

An overview of calculus at Roanoke College will include discussion of a "laboratory" component, guided reading assignments, use of a classroom response system, and evening faculty support.

Alex Meadows, St. Mary's College of Maryland

Using Tornadoes to Prove Regularity for PDEs

In the theory of Partial Differential Equations, a big question is to decide when solutions to the PDEs must be continuous or differentiable or many times differentiable. We use a new idea called Tornado Solutions to show solutions of a certain class of PDEs must be continuous.

Kane Nashimoto, James Madison University

Odds and Ends in Statistics

I plan to present some findings in statistics that are rather counterintuitive. It is intended for students and, especially, for instructors of elementary statistics.

Marcus Pendergrass, Hampden-Sydney College

The Tourist Game

There are two players, the Tourist and the Guide. Both are located at the same node in a strongly connected directed graph. The Guide is going to choose one of the available out-edges, and take the Tourist to the next node. But before he does so, the Tourist places a bet on the edge she thinks the Guide will select. If the Tourist's guess is correct, she wins, and receives a payoff proportional to her bet. If she is incorrect, she loses the amount of her bet. The Guide then takes the Tourist to the next node (via the edge he chose), and the game repeats from there. The Tourist's goal is to maximize her expected fortune over time. The Guide's goal is to minimize the Tourist's expected fortune.

Jeffrey L. Spielman, Roanoke College

Using the Bootstrap to Learn Applied Statistics

The presenter is a mathematician who has taught statistics courses at all undergraduate levels. A recent sabbatical, in which bootstrap resampling was the main topic of study, provided the impetus for a much deeper understanding of what applied statistics really is.

Brian Sutton, Randolph-Macon College

From Random Matrices to Stochastic Operators

Random matrices have applications to problems in a surprising number of fields, including quantum physics, combinatorics, and number theory. There is even a chance that they may help prove the Riemann Hypothesis. We argue that many random matrix phenomena are actually approximations of phenomena seen in stochastic differential equations, and that much of the theory of random matrices may be subsumed and extended by a theory of stochastic differential equations.

Ahlam Tannouri, Morgan State University

Finite Mathematics with Excel: Does it make a difference?

For business major, how much time should we spend navigating through the simplex method versus modeling word Problem? Does Excel Help getting us closer to achieve the goal of the course? I will talk about my experience teaching 3 classes of finite mathematics.

Bruce Torrence, Randolph-Macon College

Arithmetic Combinations

Is it possible to write a given positive integer as an arithmetic expression in which each of the numbers 1 through n appears exactly once? For instance, using the numbers 1 through 4 one may write 17=1^3+4^2. What is the smallest number not obtainable as such an expression? How many ways can a given number be expressed as such an arithmetic combination? The British television show Countdown has a numbers game in which players try to construct a 3-digit target number as an arithmetic combination of some randomly chosen smaller numbers. What strategies are best? In this talk we will explore methods for investigating such matters.

Bill Wardlaw, U. S. Naval Academy
The Extended Euclidean Algorithm
The extended Euclidean algorithm is well known - at least to those who know it well. This will be a trivial talk showing how to find the gcd of two (or more) integers and write it as a linear combination gcd(a, b) = xa + yb without "backtracking" through the remainders. The talk is hoped to convince you to show this method to your students and to use it yourself, because too many number theory and abstract algebra books do it by backtracking. The talk will be understandable to students at all levels, and they are encouraged to attend.

Student Contributed Paper Abstracts

Salem Abadi, Virginia State University
Cevian Algebra
The Cevian Algebra is defined on the points in the interior of a triangle, and the theory of automorphisms of the Cevian Algebra is used to determine certain line concurrences and collinearities associated with the Cevian box.

Laurel Booth, James Madison University
Mutual Orthogonality and Minimal Generating Conditions of Multiple Gerechte Designs
A look at various mathematical properties contained in Gerechte designs of size 5x5 and 4x4. These include number of mutually orthogonal boards as well as some conditions on the initial clues in order to result in a unique solution.

Jonathan Celso, Loyola College in MD
Got Baggage? An approach to solving the airplane boarding time problem.
This talk pertains to the annual Mathematical Contest In Modeling, in which my team received the meritorious honor. The problem is centered around minimizing total boarding time on an airplane. I will discuss (on behalf of my team) how seating priority in terms of carry-on baggage does minimize boarding time on an airplane. (COMAP Meritorious)

Jonathan Celso, Loyola College, Maryland
Salary Determination and Discrimination in the NHL
In the labor market of economics, wages should be determined by the Marginal Revenue of the Company times the Marginal Product of the Worker. I will explain and use a centered multiple regression model in order to find out 1) What characteristics currently make up an NHL player's salary 2) Does draft order and coming from a hockey-rich nation, like Russia and other Eastern European countries, affect salary after holding Marginal Revenue and Marginal Product constant? In other words, do we have a statistical discrimination? As a result, I will show how mathematics and statistics can be applied to other fields, such as Econometrics.

Jason Fox, James Madison University
The Aeroacoustics of 3D Coanda Jet Flows
This paper extends the theory of mathematically predicting the Turbulent Mixing Noise Emitted by a plane 2D wall jet to the case of a 3D Coanda jet. The effect of key flow characteristics are discussed, extensions to the model are suggested, and comparison with experimental results are presented.

Kendra Hildreth, St. Mary's College of Maryland
Overcoming Math Anxiety at the Middle School Level
Working with middle school students can be a trying and uplifting experience. Math anxiety is a common problem, typically starting in middle school, that will plague students in later years. Using a variety of assessments, I identified levels of math anxiety and developed appropriate interventions in a handful of middle school students. In this talk I will report on the results (and challenges) of these efforts.

Kihyuk Hong, Henry Pao, and Kartik Trehan, Johns Hopkins University

Simulated Annealing as a Flexible Tool for Refined Districting

We will discuss our solution to COMAP MCM Problem A: Gerrymandering. We show how simulated annealing can be used as a flexible tool in solving the territory-partitioning problem, and apply it to three real-world problems. (COMAP Honorable Mention)

Brett Jefferson, Morgan State University

Grid Colorings: The Even Distribution Conjecture

Consider a finite set of nodes arranged in an $a \times b$ rectangular pattern. Can the nodes be colored with *c* colors such that no four corners of any rectangle have the same color? Such a coloring is called a properly *c*-colored grid. This project expands on the work of the Grid Coloring group at the 2006 SPIRAL Program.

Allison Johnson, Benjamin Leard, and Megan Mifflin, James Madison University

Power to the People: Solving the Problem of Gerrymandering

We address the issue of Gerrymandering by creating an algorithm that generates simple shapes of state districts that include equal populations. We then apply the algorithm to the state of New York and find that our method creates districts that more fairly represent voters of the state and keep district shapes simple. (COMAP Meritorious)

Jessica Kline, Virginia Tech

Sudokus or Pseudo Clues?

This talk is about the Clock Sudoku (created by Laura Taalman and Philip Riley), which is a variation of the traditional Sudoku puzzle. I will explain how this puzzle works and discuss the combinatorial nature in which the total number of grids is counted.

Mike Pohl and Victor Fedorov, University of Richmond

Preventing Gerrymandering: the Unit-Based Shortest Splitline Algorithm

In the current "winner takes all" approach to electing US House of Representative members two major factors determine the significance of any vote. The first is the natural distribution of the voting population, while the second is how that distribution is subdivided into voting constituencies. Our aim was to develop a simple automated system for redistricting that optimized the shapes of congressional districts with respect to compactness, contiguity, geographical and regional factors. We also sought a system that was practical, cheaply implementable, and transparent to all groups involved in the voting process. (COMAP Meritorious)

Katherine Toman, St. Mary's College of Maryland

Polynomial Parameterizations of Topological Knots

Knot Theory is an increasing important field of mathematics, with applications in biology, chemistry and physics. Recent mathematics research is also influenced by this exciting and new branch of topology. Undergraduate mathematics researchers have focused on three-dimensional polynomial parameterizations which allow for algebraic and topological viewpoints. Questions pertaining to minimal polynomial degree and algebraic manipulation are raised by this new outlook.

Rob Tompkins, Virginia Tech

Latin Squares, Tilings, and Overlap-Free Sequences

The Morse-Thue binary sequence is famous for avoiding the appearance of any overlaps: strings of the form cxcxc where c has one digit and x is a string of finite (possibly zero) length. We generalize this sequence from binary to an arbitrary finite alphabet of integers based upon Latin-Squares. This leads to a tiling of the our sequence by rows of the Latin-Square. The resulting sequences derived from finite length Latin-Squares do not contain any overlaps.

Nakeya D. Williams, Morgan State University
Continuous Mathematical Models of Red Blood Cell Production
This paper will focus on developing and solving ordinary differential equations that model red blood cell production. The development of the equations will be discussed as well as the solution to those equations. The parameters involved will illustrate items that affect the number of red blood cells.

Student Contributed Poster Abstracts

Zack Johnson, Longwood University
Shackled Nim
Through an independent study, I explored the game of Nim and its variations. I investigated a variation of Nim and deduced a method for solving the game as well. Shackled Nim, as I called it, has no set amount of rows or pearls within each row, but a player may take only up to n pearls from any one row.

Ashley Swandby, Longwood University
Pre-processing Techniques in cDNA Microarray Data
cDNA Microarrays have become an important tool for biologists in determining gene function in response to different treatments. Before biological results can be obtained, the data must be pre-processed to produce meaningful numerical data that minimizes non-biological variation. In this poster, the mathematics behind several image processing and normalization techniques are presented along with examples to show the appropriate use of various techniques.

Katherine Toman, St. Mary's College of Maryland
Polynomial Parameterizations of Topological Knots
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