Abstracts of Faculty Talks
Mathematical Association of America
Allegheny Mountain Section Meeting
Washington and Jefferson College
Saturday, April 11, 2015

10:15 - 10:30

Terry Blakney, Penn State Erie - The Behrend College, Burnett 015
*The Power of Plinko **
This talk will center around the vast resources available for introducing mathematical and statistical concepts by variations on the Plinko game board from path searching, probabilities and Pascal.

Michael Woltermann, Washington and Jefferson College, Burnett 016
$x^2 + y^2 = N$ *
Does Diophantus' method from his Arithmetica (as hinted at in II.8) give all rational solutions to $x^2 + y^2 = N$?

Rick Adkins, Indiana University of Pennsylvania, Burnett 103
*S-COAM-Interdisciplinary Scholarship Program for Applied Mathematics **
The National Science Foundation funded Scholarships Creating Opportunities for Applying Mathematics (S-COAM) project at Indiana University of Pennsylvania, while increasing the number of students pursuing mathematics degrees, is unique in its goal of establishing a supportive connection of Masters students with undergraduates through scholarship cohort activities. During the last five years, one million dollars of need-based scholarships supported over 70 students seeking a major in a mathematical area or a mathematics minor with another science-related major. Through this project more students took advanced mathematics courses, enhancing their preparation for the workforce and further studies. In this presentation, we share best practices and activities for engaging and retaining a diverse group of students, outcomes from our program, as well as identify effective strategies based on the research literature and the program assessments.

Jared Burns, Seton Hill University, Burnett 109
*Continuity in Banach Spaces **
We discuss some continuity behavior of a typical (in the sense of porosity and category) derivative within certain Banach spaces of Frechet differentiable functions.

Among others, let $(D[0,1], ||.||)$ be the Banach space of functions with everywhere (on $[0,1]$) existing derivatives such that for any $f \in D[0,1]$, $||f|| := \sup|f| + \sup|f|$. Here we use $\wedge(u,a)$ to be the oscillation of the function u at the point a. Let E be an arbitrary closed nowhere dense subset of $[0,1]$. Let $G := \{f \in D[0,1] : inf\{x \in E\} \wedge (f', x) > 0\}$. Then G is a dense open subset of $D[0,1]$, and furthermore, G is co-porous in $D[0,1]$.

Barry Minemyer, The Ohio State University, Burnett 203
*Geometry of Triangles Using Edge Lengths **
I will give a simple technique to compute the distance between two points in an n-dimensional "flat" triangle (or simplex) using only the edge lengths of that triangle (and the barycentric coordinates of the points). A neat application of this technique is that it allows for a simple calculation of the volume of an n-dimensional triangle using only the edge lengths. This formula for the volume is computationally simpler than any method that I am aware of (for n large). I will start the talk with all relevant definitions, and so this should be accessible to any students with a good background in linear algebra.

Catherine Stenson, Juniata College, Burnett 209
*Herding Faculty **
At the beginning of the 2013-2014 academic year, Faculty Marshal David Sowell begged Juniata faculty members to line up correctly for Opening Convocation. It was his last year as faculty marshal, and he said he wanted to go out with a passing gradeat least a 60 %. This raises an interesting mathematical question: What does it mean to be 60 % successful in getting people to line up ? We will look at several mathematical approaches to this problem and find out if Dr. Sowell and the Juniata faculty get a passing grade.

10:35 - 10:50

Geoff Dietz, Gannon University, Burnett 015
*The Trouble(TM)-Some Simulation **
The game Trouble, featuring the beloved "Pop-o-matic bubble," has been a kid favorite for decades. Unlike some other games aimed at younger children, Trouble gives choices to the players and includes interaction between the players. We investigate to what degree these choices impact the game, namely the winner of the game and the length of the game. Using a C++ program written to simulate the game, we present evidence that choices made (including where to sit relative to other players) can significantly improve (or lessen) one's probability of winning and can affect the average length of a game. Please note that "How to make a 5-year-old cry x % of the time" is not a subtitle of this talk and so all information should only be used for good and not for evil.

Shelly Bouchat, Indiana University of Pennsylvania, Burnett 016
Hole-y Betti Numbers
Given a graph, we can consider the ideal whose minimal generating set corresponds to all paths of a specified length in the graph. This ideal is called a path ideal of the graph. In this talk, we will focus on tree graphs. This talk will focus on how counting i-dimensional holes in a complex corresponds to counting the Betti numbers in a minimal free resolution. Basic definitions and examples will be given, but a basic understanding of abstract algebra is helpful.

Kimberly Burch, Indiana University of Pennsylvania, Burnett 103
*Designing a Major in the Mathematical Sciences **
How does a mathematics department design and maintain robust major programs? The MAAs Committee on the Undergraduate Program in Mathematics (CUPM) has answered this in its 2015 Curriculum Guide. Individual course design and overall program structure must be considered together. We offer a general set of cognitive and content goals to aid this consideration. A successful major offers a program of courses that gradually and intentionally leads students from basic to advanced levels of critical and analytical thinking, while encouraging creativity and excitement about mathematics. Copies of the 2015 Curriculum Guide brochure will be distributed to all attendees of this talk.

Ivko Dimitric, Penn State Fayette, Burnett 109
*n-Step Maps **
I discuss some examples of n-step maps of one (real) variable, defined by the property that the n-th iterate of any such map is the identity map. These kinds of maps may occur in discrete dynamical systems, however the behavior of the map is deterministic, rather than chaotic. Many examples occur among linear fractional maps and we produce an easily applicable criterion for a linear fractional map to be n-step as well as discuss the discrete version of the problem.

Chad Kuhns, West Liberty University, Burnett 203
*GeoGebra In and Out of the Classroom **
Open-source (free!) GeoGebra software has the potential to substantially enhance several courses. At the heart of this potential is GeoGebra's robust ability to update numerical and visual data dynamically. We will showcase some of the functionality of the software with a view to using it for presentations in lecture and for homework projects.

Janet Harding, Washington and Jefferson College, Burnett 209
*The Effect of Cooperative Learning Groups on Mathematics and Statistics Anxiety in a College Mathematics Class **
A quasi-experimental study was conducted during the Spring and Fall semesters of 2014. Students were taught in either a traditional or cooperative learning classroom. At the beginning and end of the semester, math and statistics anxiety measurements were collected. Results of multiple two way ANOVAs will be discussed.

10:55 - 11:10

Anne Quinn, Edinboro University, Burnett 015
*A Mathematical Analysis of the Best Strategies in the Attribute Game of SET **
The game of SET is a fast paced game where three cards make a SET if, for each attribute, the values on the cards are either all the same or all different. Each card can be identified by four attributes, each of which has three values: number (1, 2, 3), color (red, green, purple), symbol (diamond, oval, squiggle), and shading (open, striped, solid).

Daniel Galiffa, Penn State Erie, The Behrend College, Burnett 016
*Discrete Structure Relations for Orthogonal Polynomials **
In this talk, we discuss the development a discrete analogue of the so-called continuous Schrodinger via the theory of classical discrete orthogonal polynomial sequences. We first establish this difference equation in a general context and give an overview of the specific solutions involving each of the discrete Sheffer sequences (the Meixner, Charlier and Krawtchouk polynomials). In turn, we also develop a firstorder difference equation for each of these polynomials, the derivation of the latter two does not appear in the literature. We then supplement our analysis by graphing several solutions to our Schrodinger equation and conclude our with some future directions.

Dan Shifflet, Clarion University of Pennsylvania, Burnett 103
*A Template for Inquiry Based Learning **
Number Theory does not require a lot of previous knowledge. Students must have a rudimentary understanding of the integers, proof, logic, and, well, thats about it. This makes the course a prime candidate in which to implement an inquiry based learning teaching strategy such as the Moore Method. In this talk I will outline the day-to-day format I am currently using as well as modifications that can be made to better suit another instructors teaching style. We will also discuss preliminary observations of student attitudes and improvement in an inquiry based learning course.

Monica VanDieren, Robert Morris University, Burnett 109
*Multivariable Calculus Comes to Life with CalcPlot3D **
CalcPlot3D is a free applet designed to help students visualize three dimensional concepts including vectors, surfaces, directional derivatives, gradients, and vector fields. In this presentation I will discuss my experience using the applet in Multivariable Calculus and introduce the audience to some of the features of the program.

Boon Ong, Penn State, The Behrend College, Burnett 203
*How Many Obtuse Triangles? **
R. Guy has an extensive explanation of how to calculate the chances that a chosen triangle on a plane is acute. I will go through that and then attempt to do the same computation to calculate the probability that a chosen triangle on the surface of a sphere is obtuse. The end result was an ugly definite integral which I could only compute via a Computer Algebra system like Maple or Mathematica.

Duane Farnsworth, Penn State Fayette, Burnett 209
Beautiful Mathematics Deserves Beautiful Documents
For mathematical writing that is simply a mix of prose and mathematical notation, LaTeX provides a flexible set of tools for creating documents that are of publishable quality. However, the quality often diminishes when we wish to include diagrams or graphs from external sources. In this talk, we will discuss how to avoid this problem by using the open source tools TikZ and gnuplot to produce such images natively. Other benefits of using these tools will also be discussed.

11:15 - 11:30

Carl Yerger, Davidson College, Burnett 015
*PathWalker-Breaker Games on Complete Bipartite Graphs **
Maker-Breaker games were introduced by Erdos and Selfridge as a generalization of Tic-Tac-Toe. We consider the following variant on the standard Maker-Breaker game. In this variant, called the PathWalker-Breaker game, the "Walker" acquires the edges of a path consecutively. In other words, at any given moment of the game we have her positioned at some vertex v of a graph G, and on her turn, she moves along an edge e of G that is (i) incident with v and (ii) has not been acquired by Breaker. On Breaker's move, he can acquire any edge not already owned by Walker. In this talk, Walker's goal is to visit as many vertices as she can, and consequently, Breaker's goal is to reduce the number of vertices visited by Walker. The game ends when there is no edge from Walker's current position to an unvisited vertex along edges not acquired by Breaker. We investigate the problem of playing the PathWalker-Breaker game on a complete bipartite graph, supplementing similar results of Espig et al, who investigated a similar question on the complete graph. This is joint work with Chenxiao Xue of Davidson College.

Javier Gomez-Calderon, Penn State University, Burnett 016
*Cyclotomic Polys of the Second Kind **
We show a list of similarities between cyclotomic polynomials and what we call cyclotomic polys of the 2nd kind. We provide a recursive method to construct these polynomials and show some applications.

Dan Radelet and Greg Wisloski, Indiana University of Pennsylvania, Burnett 103
*Knowledge Retention in Introductory Linear Algebra **
Introductory linear algebra classes are notoriously difficult to teach; students who had been successful in largely computational classes, such as Calculus, have difficulty with this different type of class that is more concept-based. These students are still successful with computations, but do not obtain or retain the conceptual knowledge necessary for higher level courses. The speakers undertook a yearlong study of the introductory linear algebra students at IUP with the goal of introducing measures that would both improve the overall performance of students as well as improve knowledge retention for future courses. The speakers will demonstrate that the use of short online concept quizzes led to a dramatic improvement in both areas.

Emily Sprague-Pardee, Edinboro University of Pennsylvania, Burnett 109
*Beautiful Fighting Mathematics **
"'Problems worthy of attack, prove their worth by fighting back (Piet Hein)," quoted Anna Salamon during the documentary "Julia Robinson and Hilbert's Tenth Problem." Anna went on to say,

"When the math fights back, that's when it's beautiful!"

Sometimes mathematics fights back by exhibiting logically consistent results that run contrary to every instinct.

In this expository talk we intermix the finite with the infinite; first by remembering Gabriels horn – whose surface may be polished but whose interior can never be filled – then by unpacking the promise that any three-dimensional sphere can be decomposed and reassembled into any number of spheres, each of which has the same volume as the original The Banach-Tarski paradox. We illustrate that while paradoxes mark the boundaries of scientific meaning, they feed our aesthetic imagination, opening our eyes to beauty.

Beautiful mathematics should intrigue everyone from the youngest pre-calculus students through the most seasoned professors, and so this talk will will something to each participant.

Rick White, Edinboro University of Pennsylvania, Burnett 203
*What is the True Value of Pi? **
The value of Pi is calculated using various metrics.

* student friendly talk