

Abstracts of Faculty Talks  
Mathematical Association of America  
Allegheny Mountain Section Meeting  
Westminster College  
Saturday, April 5, 2014

**10:15 - 10:30**

**James Sellers, Penn State University, Patterson Hall 106**

*Congruences for Fishburn Numbers*

The Fishburn numbers, originally considered by Peter C. Fishburn, have been shown to enumerate a variety of combinatorial objects. These include unlabelled interval orders on  $n$  elements,  $(2 + 2)$ -avoiding posets with  $n$  elements, upper triangular matrices with nonnegative integer entries and without zero rows or columns such that the sum of all entries equals  $n$ , non-neighbor-nesting matches on  $[2n]$ , a certain set of permutations of  $[n]$  which serves as a natural superset of the set of 231-avoiding permutations of  $[n]$ , and ascent sequences of length  $n$ . However, as far as we know, the Fishburn numbers have not been studied from an arithmetic point of view. In this talk, we prove that the Fishburn numbers satisfy infinitely many Ramanujan-like congruences modulo certain primes  $p$  (the set of which we will easily describe in the talk). This is joint work with George Andrews.

**Jeffrey Wheeler, University of Pittsburgh, Patterson Hall 107**

*Assigning Value to the Valueless*

An alternate title of this talk would be: “The Cauchy Principle Value Method for Divergent Integrals and Related Ideas in Divergent Series”. I will present a document I put together to answer thoughtful Calc 2 students’ questions regarding an improper integral of an odd function over a symmetric interval. This leads nicely to a discussion of divergent series. This document will be on my webpage and may be shared with your thoughtful students.

**Paul Becker & Jennifer Ulrich, Penn State Erie, The Behrend College, Patterson Hall 108**

*A Simple Introduction to a Simple Sporadic Group*

The extended binary Golay code has been widely used in digital communication. It is an extremal, doubly-even, self-dual, linear code of length 24. This code has a surprisingly large automorphism group – the sporadic Mathieu group  $M_{24}$ , with 244823040 elements. In this talk, we compare several very different constructions of the Golay code; each construction provides a different view of the group  $M_{24}$ . The talk will be accessible to anyone who has taken (or is taking) an introductory group theory course.

**David Offner, Westminster College, Patterson Hall 205**

*Counting Matrices Over a Finite Field with all Eigenvalues in the Field*

Given a finite field  $F$  and a positive integer  $n$ , we give a procedure to count the  $n \times n$  matrices with entries in  $F$  with all eigenvalues in the field. We give an exact value for any field for values of  $n$  up to 4, and prove that for fixed  $n$ , as the size of the field increases, the proportion of matrices with

all eigenvalues in the field approaches  $1/n!$ . As a corollary, we show that for large fields, almost all matrices with all eigenvalues in the field have all eigenvalues distinct. The proofs of these results rely on the fact that any matrix with all eigenvalues in  $F$  is similar to a matrix in Jordan canonical form, and so we proceed by enumerating the number of  $n \times n$  Jordan forms, and counting how many matrices are similar to each one. A key step in the calculation is to characterize the matrices that commute with a given Jordan form and count how many of them are invertible.

**Heather Parizek, Penn State DuBois, Patterson Hall 207**

*Math Options: A Girls in STEM day at PSU DuBois*

Every May Penn State DuBois hosts over 200 7<sup>th</sup> grade girls for a day of fun and career exploration in STEM (Science, Technology, Engineering and Math) fields. At Math Options, girls from local schools come to campus to participate in activities and learn more about careers in STEM fields from local women in these professions. Middle school is a time when girls often feel pressured to ‘get off’ the academic STEM track. By offering them a positive experience with successful role models, we hope to encourage them to pursue these fields. Thanks to the help of local professionals, campus faculty, and current students we are able to offer this budget-friendly program to expand the horizons of local 7<sup>th</sup> grade girls interested in mathematics and science.

**10:35 - 10:50**

**Leandro Junes, California University of Pennsylvania, Patterson Hall 106**

*Undergraduate Research at Cal U: A Personal Experience*

The mathematics undergraduate research group at Cal U (CALURMA) has had some wonderful accomplishments in the last two years. Students have solved and published four open problems from the journal “The Fibonacci Quarterly” and submitted solutions to three more. I will talk about my personal experiences as a director and founder of this group. In particular, I will discuss how this group was formed, specific details on how we work and interact with each other, and how you can also form your own undergraduate research group. Faculty and students interested in publishable undergraduate research will find this talk informative and encouraging.

**Boon Ong, Penn State Erie, The Behrend College, Patterson Hall 107**

*How I used Telescoping Series*

Telescoping Series is usually taught in Calculus 2, but no exact definition is given. A few authors in textbooks attempt to give a “formula” to all telescoping series but they always turned out to be not very useful in solving a problem. But if we think of it as “method of difference”, it can be use even for finite sums. My talk will focus on how that method of difference was used in my paper to be published in JDEA with Dr. Galiffa.

**Rick White, Edinboro University of Pennsylvania, Patterson Hall 108**

*De Sitter Space, Projective Space, and 1-Sheeted Hyperboloids*

A one-sheeted hyperboloid is constructed out of a group generated by an invariant set of involution elements. We also show that the elements of the generating set can be identified with reflection about space-like geodesics in a three-dimensional De Sitter space and that the generated group is isomorphic to a subgroup of the Lorentz group.

**John Hoggard, Edinboro University of Pennsylvania, Patterson Hall 110**

*Using Graph Algorithms to Find Periodic Points*

Periodic points have a significant impact on the structure of the Julia set of a complex function, but solving explicitly to find periodic points is usually not possible. In this talk, I consider discretizing the problem and using graph algorithms to locate periodic points of multiple orders. A preliminary program (written by a computer science student) provides some initial (and sometimes surprising) results.

**Melanie Henthorn, Edinboro University of Pennsylvania, Patterson Hall 205**

*An Intriguing System of Equations*

In an introductory linear algebra course, students begin exploring techniques for solving systems of equations. In this talk, we will discover how Cramer's Rule and properties of Vandermonde Matrices actually unlock a puzzle of an "infinite by infinite" system of equations that has long been an interest of operator theorists.

**Melissa Sovak, California University of Pennsylvania, Patterson Hall 207**

*Using a Web-Based Clicker System to Enhance Student Interaction*

This presentation is designed to introduce participants to using the web-based clicker system, TopHat. This session will include an introduction to creating and editing a variety of differently formatted questions and integrating these to enhance and guide the lecture.

**Antonella Cupillari, Penn State Erie, The Behrend College, Patterson Hall 208**

*An Integrated Calculus Assignment in a Can*

How are the dimensions and shapes of the cans on a supermarket shelf chosen? Is their design driven by the need to minimize the material used? Is the storage space available on the supermarket shelf an issue? These were the opening questions for a first semester calculus series of three assignments focused on tuna cans. The assignments started with geometrical constructions, used calculus, required 3-dimensional thinking, and writing to discuss the results. And when the answers obtained were correct but not satisfactory, students dealt with one of the hardest situations: did the work done address the wrong questions?

**10:55 - 11:10**

**Anne Quinn, Edinboro University of Pennsylvania, Patterson Hall 106**

*Mathematics in the Game of SET*

The game of SET<sup>®</sup> is a fast paced game where players find "SET"s. 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). This game can be played by students from elementary school to college, and it inspires questions from a wide variety of traditional mathematical topics, such as the multiplication principle, combinations and permutations, divisibility, modular arithmetic, and mathematical proof. My talk will be based on mathematics published in an online workbook by [www.setgame.com](http://www.setgame.com) in 2011.

**Daniel Galiffa, Penn State Erie, The Behrend College, Patterson Hall 107**

*A Generalized Gaussian Quadrature*

In this talk, Gaussian Quadrature will be developed in the context of general classical hypergeometric orthogonal polynomials. An example using the Hermite polynomials, as opposed to the more typical Chebyshev polynomials, will be presented for emphasis.

**Lauren Williams, Mercyhurst University, Patterson Hall 108**

*The Number of Matchings which Commute with a Permutation*

In this talk, we will determine a formula for the number of matchings (fixed point free involutions) that commute with a given permutation. While this is an interesting combinatorial problem by itself, we will also provide motivation from representation theory. In particular, the number appears in a formula for the stable dimension of the space of fixed degree homogeneous polynomials on tensors under the action of a product of orthogonal groups. The material presented will be accessible to undergraduates who have completed a course in abstract algebra.

**Doug Puharic, Edinboro University of Pennsylvania, Patterson Hall 110**

*Fullerenes and Graphs and Embeddings. Oh my!*

A fullerene is a carbon molecule where each carbon atom is chemically bonded to three other carbon atoms and the atoms form pentagonal and hexagonal rings and this molecule can be viewed as a finite connected trivalent plane graph with pentagon or hexagon faces. We will investigate the concept of embedding the graph of a fullerene into a  $k$ -dimensional half-cube with a focus on preserving the distance between two vertices under this embedding.

**Hollie Buchanan, West Liberty University, Patterson Hall 205**

*Making the Universe Safe for Venn Diagrams*

We employ simple summation techniques to investigate some probabilistic questions about Venn diagrams and finite sets.

**Andrew George, Penn State Erie, The Behrend College, Patterson Hall 207**

*Teaching Math Beyond the Classroom: There's an App for that!*

Did you run out of time in today's class to cover that last enlightening example (one that would have helped students handle the extra twist on a similar homework exercise due tomorrow)? Do you wish you could extend the benefits of office hours to students who cannot attend? Or are you looking for a way to effectively present material for an online, hybrid, or "flipped" classroom? In this talk, I will present ways I have used a free iPad whiteboard app, Doceri, to provide just-in-time help for students outside of class and as a means of presenting material in an online math course. Such an app may be an effective tool for you to use in presenting content and offering timely help to students beyond the classroom.

**Jacqueline Jensen-Vallin, Slippery Rock University, Patterson Hall 208**

*Experiences Teaching Intermediate Algebra*

In the past two years, I have taught intermediate algebra in two different, but both student-centered, ways: first with mini-lectures and worksheets, and then with the addition of reading quizzes to preview material. This talk will discuss the specifics of these classes and compare/contrast the results from the courses. Student comments from each of these will also be discussed.

**11:15 - 11:30**

**Emily Sprague, Edinboro University of Pennsylvania, Patterson Hall 106**

*Approaching the Study of Mathematics through Music*

A musician who never learned mathematics commented wistfully to me a couple months ago that perhaps, when he was young, if they had only approached the mathematics through music, maybe he would have learned some. Well. We certainly use mathematics to describe musical structure, to measure our response to music and even to generate music. How might we reverse that process? In this talk we build on the work of musicians such as Pozzi Escot and John Clough who find examples of geometry, number theory, and algebra, not as generators of, but as exemplified by what can be heard in existing music. Time permitting, we begin to imagine a curriculum which might be developed.

**David Miller, West Virginia University, Patterson Hall 107**

*On a Genocchi-Peano Example*

Students learn early in a multivariable calculus class that functions of several variables can be discontinuous but continuous when restricted to specific paths. We will present an example given by Genocchi and Peano in the late 1800's that is a common two variable example in Multivariable Calculus. We will then define what we call a Genocchi-Peano example (GPE) and explore other two variable GPEs. Finally we will generalize to GPEs of many variables.

**Ivko Dimitric, Penn State Fayette, Patterson Hall 108**

*Drawing Tangents to Curves*

The Euclidean construction (with a ruler and compasses) of tangents to selected curves will be discussed. Three tangent problems are of interest: Drawing a tangent to a given point on a curve, drawing a tangent parallel to a given line, and drawing a tangent through a given point outside the curve. These tangent problems are solved for conics and the discussion is then carried over to some special curves like cycloid, cardioid and lemniscate, with a review of some classical methods used to treat these problems.

**David Prier, Gannon University, Patterson Hall 110**

*Knights and Kings on a Triangular Honeycomb Board*

This interactive talk will present some interesting results that came about due to an undergraduate research project. The idea of independence on a traditional and modified triangular honeycomb chessboard will be introduced. Solutions for the independence number of the Knights graph and the Kings graph have been solved entirely, and the proofs will be outlined. This talk is meant to be accessible to undergraduates, and possible future research topics will be presented.

**Terry Blakney, Penn State Erie, The Behrend College, Patterson Hall 205**

*Birthday's Effect on the Road to Cooperstown*

With this being the 75<sup>th</sup> anniversary of the Baseball Hall of Fame in Cooperstown, we will explore the impact of birthdays on the members of the Hall of Fame using some chi-square analysis and the potential pitfalls that one may arrive at in dealing with historical data.

**Paul Olson, Penn State Erie, The Behrend College, Patterson Hall 208**

*Rearrangements of Topics in some Mathematics Courses*

There are certain courses (precalculus mathematics, applied calculus) where the goal is to help students acquire mathematical skills for use in subsequent courses . Rearrangements of the order of topics allows the instructor time to emphasize the most difficult skills. It also allows a greater length of time during the course to develop those skills . I would like to share some specific examples of applying these ideas to precalculus and applied calculus.