# Abstracts of Faculty Talks

Mathematical Association of America
Allegheny Mountain Section Meeting
Clarion University
Saturday April 9th, 2011

## 10:15 – 10:30

**Pat Schulte, Penn State University, STC 123**
*MATHO – a Great Game for College Algebra Students*
See how the classic Bingo game can be adapted for review in a College Algebra class. A demonstration of the game and directions for constructing the game will be provided.

**Michael Jackson, Grove City College, STC 125**
*Rectified and Truncated Simplex Number Sequences*
Polytope number sequences are sequences of positive integers based on the geometry of a polytope. The polygonal numbers (2 dimensional polytope numbers) are well known and date back to the Pythagoreans. More recently H.K. Kim has outlined a process to create the polytope number sequence for any uniform polytope in any dimension. H.K. Kim also found formulas for the number sequences of the regular polytopes involving binomial coefficients. In this talk, we will review H.K. Kim's process for creating polytope number sequence, and give formulas for the rectified simplex numbers and the truncated simplex numbers. We will also discuss the geometric connections of our formulas. (Joint work with Peter Jantsch and Doug Smith.)

**Emily H. Sprague, Edinboro University, STC 134**
*Mathematics of Musical Consonance, A First Year Experience*
A First Year Experience course I designed, The Mathematics of Musical Consonance, was approved for offering in Fall 2011. At the heart of the course students explore original sources which confront Greek frustrations with the inadequacy of the rational numbers to describe perfectly the musical intervals of Western tonality. We then briefly review standard problems in tuning systems and examine a bit of the mathematics of the nineteenth century approaches to their solution. We do not omit mention of the parallel evolution in aesthetics.

**Paul Becker, Penn State Erie, The Behrend College, STC 136**
*Factoring Error-Correcting Codes*
The extended Hamming codes have been widely used for reliably storing and transmitting binary information. They represent data as vectors (words) in self-dual vector spaces. Distance between code words permits error-correction; these codes achieve a theoretical maximum distance. In this talk, we use linear and abstract algebra to factor the Hamming code of length 24 into codes of length 8. We then discuss the possibility of creating new self-dual codes by reversing the process.

**Robert W. Vallin, Slippery Rock University, STC 138**
*Some Mathematics of KenKen Puzzles*
KenKen (also called KenDoku) is an arithmetic and logic puzzle invented by Tetsuya Miyamoto in 2004. KenKen Puzzles have a little more mathematics behind them then the wildly popular Sudoku puzzles. In this talk, we introduce the puzzles and look for the solutions to two problems: how many types of puzzles are there and is there a pattern to the solutions?

**Henry Escuadro, Juniata College, STC 120**
*Recognizing Triangular Line Graphs*
The triangular line graph of a graph G is the graph T(G) whose vertex set consists of the edges in G with two vertices in T(G) adjacent if and only if their corresponding edges in G belong to common triangle in G. A graph H is said to be a triangular line graph if there is some graph G for which T(G)=H. While closely related to line graphs, triangular line graphs have been difficult to understand and characterize. In his paper, Van Bang Le provides a characterization of triangular line graphs. However, Le's characterization does not lend itself to an efficient algorithm. In fact, Le posed the problem of determining the complexity of recognizing triangular line graphs. This work settles the question posed by Le.

# 10:35 – 10:50

**David Offner, Westminster College, STC 123**
*Packing the Hypercube*
Let G be a subgraph of the n-dimensional hypercube Q_n. We consider two problems: First, is it possible to cover all vertices of Q_n using vertex-disjoint copies of G? Second, is it possible to cover all edges of Qn using edge-disjoint copies of G? In the late 80's, Stout announced that for all G, and for n sufficiently large, it is possible to cover any given proportion < 1 of the vertices of Q_n, and conjectured that the same is true for edges. We will present a proof of this conjecture.

**John Lattanzio, Indiana University of Pennsylvania, STC 125**
*Generalized Matrix Graphs and Completely Independent Critical Cliques*
A k-dimensional n-square matrix is defined and certain properties of such matrices are investigated. Two particular graph constructions involving k-dimensional n-square matrices are given and the graphs so constructed are called matrix graphs. Properties of matrix graphs are determined and an application of matrix graphs to completely independent critical clique is provided. Some attention is given to this application and its relationship with the double-critical conjecture that the only vertex double-critical graph is the complete graph.

**Paul Olson, Penn State Erie, STC 134**
*Generating Power Series from Geometric Series*
The idea of infinite series can be found in our calculus courses. Geometric series provide convenient examples for both convergent series and divergent series. By focusing on (convergent) geometric series and partial fraction decomposition, we have a technique that allows us to generate Maclaurin series (and Taylor series) for certain rational functions. I will give examples of this technique during the talk. Some of my students really enjoyed generating power series in this fashion. Since the technique increased student enthusiasm for learning about power series we thought the technique may be useful to other instructors of calculus.

**Michael Woltermann, Washington and Jefferson College, STC 136**
*n^3/p^2: A "forgotten" Formula?*
I spent a sabbatical in spring 2010 revising a translation by David Antin of "Triumph der Mathematik" or "100 Great Problems of Elementary Mathematics" by Heinrich Dörrie. This talk will focus on a problem about conic sections and Dörrie's solution of it.

**John Thompson, University of Pittsburgh at Johnstown, STC 138**
*Napier's Log*
John Napier is credited with developing logarithms. We will examine the development of his initial "logarithm" and how it relates to our modern day logarithms.

**Shelly Bouchat, Slippery Rock University, STC 120**
*Minimal Free Resolutions and Cellular Complexes*
In this talk, we will consider a specific type of graph, called a tree. From this tree, we will form an algebraic object, called an ideal, from which we will generate a sequence of maps, called a free resolution. This sequence of maps can then be represented by a geometric object, called a cellular resolution. The talk will concentrate on how to obtain the cellular resolution given a minimal free resolution.

# 10:55 – 11:10

**Zachary Kilpatrick, University of Pittsburgh, STC 123**
*Bumps in Piecewise Smooth Neural Fields with Synaptic Depression*
We study the linear stability of stationary bumps in piecewise smooth neural fields with synaptic depression. The continuum dynamics is described in terms of a nonlocal integrodifferential equation, in which the integral kernel represents the spatial distribution of synaptic weights between populations of neurons whose mean firing rate is taken to be a Heaviside function of local activity. Synaptic depression dynamically reduces the strength of synaptic weights in response to increases in activity. Discontinuities in the depression variable associated with a bump solution means that bump stability cannot be analyzed by constructing the Evans function for a network with a sigmoidal gain function and then taking the high-gain limit. However, linear stability can be formulated in terms of solutions to a system of pseudo-linear equations that account for the sign of the perturbation at the bump boundary. Bumps can destabilize in the presence of sufficiently strong depression. In one-dimension, instabilities are dominated by shift perturbations that evolve into traveling pulses. In two dimensions, instabilities are dominated by a D1 symmetric perturbation of the circular bump boundary, which leads to traveling spots.

**Gregor Olšavský, Penn State Erie, The Behrend College, STC 125**
*Finding Idempotents in the Clean Ring Z_n*
Will show that any ring of the form Z_p^s is a clean ring and has only trivial idempotents. Then use the natural homomorphism from Z_n into the direct product formed using the factorization of n as p_1^s1 p_2^s2...p_m^sm to count and find the idempotents in Z_n.

**Boon Ong, Penn State Erie, The Behrend College, STC 134**
*The Exponential of a Square Matrix*
Given a square matrix A, we know the exponential of A helped solve the autonomous linear differential equation x'(t)=Ax(t). But apart from the series definition of exp(A) and using diagonalizability of A (or in some cases, knowing all the eigenvectors of A), we know of very few other method to find exp(A). This talk will use the Partial Fraction Decomposition of r the reciprocal of the characteristic polynomial of A to help us analyzed and eventually find exp(A) without finding any eigenvector.

**James Sellers, Penn State University, STC 136**
*Enumeration of Line-Hamiltonian Multigraphic Degree Sequences*
In this talk, we will consider an enumeration problem which is very closely related to recent graph-theoretic results of Lai and Liang. In particular, we will discuss their characterization of

integer partitions which can be realized as the degree sequence of a multigraph G with the property that the line graph of G is Hamiltonian, and we will prove a closed formula for the number of such degree sequences which is a straightforward linear combination of values of the unrestricted partition function p(n).   The talk will be accessible to a wide audience.

**David Prier, Gannon University, STC 138**
*An Open Problem in Graph Theory:  The Inverse Domination Number Problem*
The problem of the title is: can the inverse domination number of a finite simple graph with no isolated vertices ever exceed its vertex independence number? I will introduce background material and then explain this open problem. I will state previous results and gear the talk toward an undergraduate audience.

**Korey Kilburn, Edinboro University of Pennsylvania, STC 120**
*A Method to Integrate e^(ax)sin(bx) and e^(ax)cos(bx) without Integrating by Parts*
Often, especially in areas of differential equations, it is necessary to integrate functions of the form e^(ax)sinx and e^(ax)cosx.  Most students would attack this problem by integrating by parts.  Another useful method is to employ Euler's formula and incorporate both the real and imaginary components of the expression in order to arrive at a solution.  I will take 15 minutes to quickly demonstrate the general idea of the technique.  This talk should be accessible to students with an understanding in calculus, trigonometric functions, and the complex number system.

# 11:15 – 11:30

**Natacha Fontes-Merz, Westminster College, STC 123**
*The Chromatic Polynomial of the Join of Two Graphs*
In this talk, we will present an algorithm for calculating the chromatic polynomial of the join of two graphs when the chromatic polynomials of the original two graphs are known.  We will begin by calcuating the chromatic polynomial of the join of two path graphs, and then show how this calculation can be used to compute the chromatic polynomial of the join of any two graphs.

**Jacqueline Jensen, Slippery Rock University, STC 125**
*An Applied Approach to Minitab Projects for Elementary Statistics*
A requirement of the elementary statistics course at Slippery Rock University is that the students have a working understanding of Minitab.  To get away from the usual data-crunching assignments, requiring students to only submit Minitab printouts, we assign projects requiring students to summarize, in a professional memo, their analysis of open-ended questions. Examples of such projects will be given, as will examples of completed student projects.

**Tim Flowers, Indiana University of Pennsylvania, STC 134**
*Asymptotics of Families of Polynomials*
It is well known that both Bernoulli polynomials and Euler polynomials on a fixed interval are asymptotically sinusoidal.  A recent paper by Borwein, Calkin, and Manna uses an idea of Strodt to generalize Bernoulli and Euler polynomials and view them as members of a family of polynomials.  We use these ideas to study the asymptotics of non-uniform Strodt polynomials. We will describe the experimental process which led to conjectures.  In addition, we will state and illustrate several asymptotic results.

**D.J. Galiffa, Penn State Erie, The Behrend College, STC 136**
*Generating Functions: From Number Theory to Orthogonal Polynomials*
In this talk, we address the nature and utility of generating functions and the role they play in various fields of mathematics, like Number Theory and Orthogonal Polynomials. We begin by

discussing a number of methods that produce generating functions and supplement this with examples related to the Fibonacci Sequences and classical orthogonal polynomial sequences. We conclude with some remarks regarding the obtaining of generating functions for the Charlier polynomials.

**Hollie Buchanan, West Liberty University, STC 138**
*Slitherlink and Circuits in Grids*
Inspired by popular logic puzzles, we consider the grid graph $G_(m,n)$, count circuits of various types, and investigate minimal examples of these puzzles.

**Antonella Cupillari, Penn State Erie, The Behrend College, STC 120**
*A "Pioneering" Book on Proofs by E.S. Loomis*
The booklet "Original Investigation; or How to Attack an Exercise in Geometry" written by Elisha Scott Loomis (1852-1940) appeared in 1901, and was reprinted several times, with the ninth printing appearing in June 1954. It includes a variety of geometry problems and theorems, with a lengthy discussion of the steps required for their solution. The Original Investigation also includes discussions on logic methods and suggestions for both teachers and students, generated by Loomis' long teaching experience. Indeed he had started his life as a farmer in Ohio and then had become an engineer, but he spent decades as a professor and the head of the mathematics department at Cleveland West High School. Loomis is also known for the book "The Pythagorean Proposition," a collection of more than 250 proofs of the famous theorem. This talk will present a biography of Loomis and a brief look at the contents of the booklet.