Faculty Talk Schedule & Abstracts

MAA Allegheny Mountain Section Meeting
Juniata College
Saturday, April 8, 2006

	10:10 – 10:25	10:30 – 10:45	10:50 – 11:05	11:10 – 11:25
B200		**Earthquakes and Mathematics** *Yu-Ju Kuo* *Indiana University of Pennsylvania*	**Richter doesn't have a Monopoly on Earthquake Magnitude Scales. We have one for Ethiopia!** *Richard Brazier* *Penn State DuBois*	**Patterns in Cycle Diagrams of Digit Sum Functions** *Dean Morrow* *Washington & Jefferson College*
C210	**The Math Science Partnership of Southwestern Pennsylvania** *Japheth Wood* *Chatham College*	**Concrete Ideas of Congruence for Future Teachers** *J. Lyn Miller* *Slippery Rock University*	**A Self-Contained Fully-Online Calculus Course** *John Tolle* *Carnegie Mellon University*	**Who's The Man?: The Question that Made My Students Fight About Mathematics** *Pam Miltenberger* *WV Wesleyan College*
C212	**Completely Independent Critical Cliques** *John Lattanzio* *Indiana University of Pennsylvania*	**A Tale of Two Tickets** *Marc Brodie* *Wheeling Jesuit University*	**Graph Theory and Combinatorics Demo** *Kimberly Burch* *Indiana University of Pennsylvania*	**Amalgamations of Combinatorial Designs** *Michael N. Ferencak* *University of Pittsburgh at Johnstown*
C225	**Decomposition and Factoring of Polynomials** *Javier Gomez-Calderon* *Penn State New Kensington*	**Developing a Matrix Package -- Phase II** *Wayne Daniel* *West Liberty State College*	**Vertex Replacement Rules** *Michelle Previte* *Penn State Erie*	**How many samples do I need? Logistic regression and power** *Michael A. Rutter* *Penn State Erie*
C232	**Surjective mappings and Repelling points** *Larry Downey* *Penn State Erie*	**The Symmetric Product of a Surface** *Boon Ong,* *Penn State Erie*	**Second Order Optimality Conditions for a Nonsmooth Optimization Problem** *Elena Constantin,* *University of Pittsburgh at Johnstown*	**Sierpinski Curve Julia Sets for the Weierstrass Elliptic p-Function** *Daniel M. Look* *Indiana University of Pennsylvania*

10:10 – 10:25

The Math Science Partnership of Southwestern Pennsylvania **C210**
Japheth Wood, Chatham College

The speaker has been a higher educational participant in a multi-year NSF funded Math Science Partnership program whose goal is to improve student learning of K-16 math and science in the southwestern Pennsylvania region. This talk will give a brief overview of the program and highlight some successes and challenges it has faced.

Completely Independent Critical Cliques **C212**
John Lattanzio, Indiana University of Pennsylvania

If K is an r-clique of G and the chromatic number of G decreases by r upon the removal of all of the vertices in K, then K is called a critical r-clique. Two critical cliques are completely independent provided that no vertex in one clique is adjacent to a vertex from the other. An infinite family of graphs is constructed which demonstrates that for every pair of natural numbers r and s, there exists a vertex critical graph which admits a critical s-clique and a critical t-clique that are completely independent.

Decomposition and Factoring of Polynomials **C225**
Javier Gomez-Calderon, Penn State New Kensington

In this talk we will consider the relationship between the decomposition of a polynomial f(x), as the composite of two polynomials, and the factorization of f(x) – f(y) as a product of irreducible factors.

Surjective mappings and Repelling points **C232**
Larry Downey, Penn State Erie

Repelling Points are points in the range of certain mappings that help understand the mapping, especially concerning the openness of the mapping. That these points exist has been understood for some time, but not formalized. We will give some new results concerning Repelling Points, and see how this notion is related to an old question of W.Rudin.

10:30 – 10:45

Earthquakes and Mathematics **B200**
Yu-Ju Kuo, Indiana University of Pennsylvania
This talk will discuss several numerical methods that are used in study of earthquakes. The first case is how to use numerical integration to predict the displacement from the earthquakes based on the acceleration data collected from field. The second case is how to use image smoothing process to filter the unreasonable displacement data collected from the sensors. The third case is how to use a higher order edge-detection method to find the location of jumps created by the earthquakes.

Concrete Ideas of Congruence for Future Teachers **C210**
J. Lyn Miller, Slippery Rock University
Even in courses for non-majors, the traditional triangle congruence theorems serve as a useful basis for developing abstract reasoning skills. In addition, however, students in such courses, and especially future elementary and middle school teachers, can be helped to recognize how congruence plays a role in the physical world as well. This talk will highlight some activities that I use with my future teachers to help them better understand (I hope!) and apply ideas of triangle congruence in physical or computer settings.

A Tale of Two Tickets **C212**
Marc Brodie, Wheeling Jesuit University
Lotto-type lottery games, in which players choose k of the numbers from 1 through n, are useful in the classroom as they provide "real-world" illustrations of many of the basic concepts from probability—elementary counting techniques, sample space, classical probability, odds, etc. Furthermore, many students feel a sense of satisfaction when their computations yield the same results as those stated on the playslips. In this talk we use the Missouri Lotto and the stated odds on the playslips to provide a meaningful illustration of the rule for the probability of the union of two events. This example led to a very surprising result.

Developing a Matrix Package -- Phase II **C225**
Wayne Daniel, West Liberty State College
Recent additions to MathTop, an object-oriented mathematics package under development at WLSC, are illustrated though examples from applied mathematics and statistics. Currently, the primary component of MathTop is a generic matrix package that seamlessly handles matrices over any field provided the field is either a built-in data type or a user supplied data type (that is, a class). At present MathTop provides support for matrices over the real field, the complex field, the rational field, and the field of integers modulo p where p is a prime number. In addition, MathTop provides support for matrices over more general structures, such as commutative rings, provided the requested operations do not require division of matrix elements in the internal algorithms. Finally, MathTop provides support for element-wise Boolean operations for matrices over any structure that provides the same Boolean operations on its elements (that is,'and', 'or', 'xor', and 'not' operations).

The Symmetric Product of a Surface **C232**
Boon Ong, Penn State Erie
It is shown in a paper of Dold and Thom that taking infinite symmetric product abelianizes a space. But for a 2-dimensional space, we do not need to take infinite symmetric product to abelianize the space. Here the homotopy group of the symmetric product of a surface is calculated using the Seifert Van Kampen theorem.

10:50 – 11:05

Richter doesn't have a Monopoly on Earthquake Magnitude Scales. We have one for Ethiopia! **B200**
Richard Brazier, Penn State DuBois
Although traditionally earthquake magnitudes are announced in the media as 6.7 on the Richter scale, there are many different ways to calculate a magnitude. We look at several methods in general and develop a Local Magnitude scale for Ethiopia, East Africa. This is a generalized inverse or regression problem with 58 parameters and 3460 pieces of data.

A Self-Contained Fully-Online Calculus Course **C210**
John Tolle, Carnegie Mellon University
In 2003, the Open Learning Initiative (OLI) at Carnegie Mellon University decided to expand its existing catalogue of fully-online higher education courses to include a calculus course. OLI is presently funded by the William and Flora Hewlett Foundation, which desires to make higher education accessible to everyone with internet access. The OLI courses, therefore, must be fully self-contained and allow for self-directed study. They may, however, also be used by institutions who elect to offer credit upon completion, or who incorporate the OLI materials into a mixed strategy of partly-online and partly-classroom-based instruction.

Development of the Calculus course began in Summer 2004, with a tentative outline of four major units: (1) Graphs and Functions, (2) Analysis of Functions, (3) Differential Calculus, and (4) Integral Calculus. Units 1 and 2 are nearly complete. This talk introduces the course and invites review and feedback. I will access the course online to demonstrate some of its features, and distribute a hard copy document which further describes the course and includes instructions on how to access the non-public version.

I am especially interested in feedback from mathematics educators concerning two very nonstandard features of the course: (1) Before ever introducing the derivative, we have a module which surveys global and pointwise properties of functions, e.g., monotonicity, boundedness, the intermediate value property, convexity, continuity, differentiability, and integrability. (2) Our approach to the limit initially separates verbal descriptions of local and asymptotic behavior of functions from notational/symbolic descriptions, tying the two together at the end.

Graph Theory and Combinatorics Demo **C212**

Kimberly Burch, Indiana University of Pennsylvania

The Tower of Hanoi is a puzzle familiar to many mathematicians. I introduced this puzzle in my undergraduate graph theory and combinatorics class. This puzzle helped students explore Hamiltonian cycles in n-cube graphs and to better understand recursion formulas. A child's stacking toy was used in lecture to demonstrate the legal moves used in solving the puzzle. The students used a penny, nickel, dime, and quarter at their desks with a piece of paper having three circles to serve as their poles. While studying graph theory, the students found a Hamiltonian cycle through the n-cube graph by keeping track of the moves used in solving the puzzle for n coins. The puzzle was also used when we discussed recursion formulas. By counting the number of moves needed to solve the puzzle for n coins, the students determined the recursion formula for the solution to the Tower of Hanoi problem for n coins. This hands-on approach to investigating recursion formulas helped to demystify the concept in an entertaining way.

Vertex Replacement Rules **C225**

Michelle Previte, Penn State Erie

Given an initial graph G, one may apply a rule $\mathcal R$ to G which replaces certain vertices of G with other graphs called replacement graphs to obtain a new graph ${\mathcal R}(G)$. By iterating this procedure, a sequence of graphs $\{{\mathcal R}^n(G)\}$ is obtained. When each graph in this sequence is normalized to have diameter one, the resulting sequence may converge in the Gromov-Hausdorff metric to a fractal.

In this talk, vertex replacement rules will be defined and examples will be given of replacement rules which yield converging and diverging normalized sequences of graphs. Also, formulas for the topological and Hausdorff dimensions will be given as well as examples of rules which do and do not yield fractals.

Second Order Optimality Conditions for a Nonsmooth Optimization Problem

Elena Constantin, University of Pittsburgh at Johnstown **C232**

The goal of this talk is to provide second order necessary conditions for the existence a minimizer for a constrained mathematical programming problem with locally Lipschitz data using Clarke's generalized derivative and P\'{a}les and Zeidan's second order directional derivative. Second order sufficient conditions are given in the case where the constraint set is a convex subset of a finite dimensional normed space. Some examples are analyzed.

11:10 – 11:25

Patterns in Cycle Diagrams of Digit Sum Functions **B200**

Dean Morrow, Washington & Jefferson College

The cycle diagrams of the integer functions $g_{r,k}(n) = rs(n)+k$, where s(n) is the sum of the digits of n, are examined to find patterns of translation and symmetry in central points. The existence of these patterns is then proved in various situations.

Who's The Man?: The Question that Made My Students Fight About Mathematics

Pam Miltenberger, WV Wesleyan College **C210**

In my History of Mathematics class, students were required to write a paper about a famous mathematician and to participate in a "Who's the Man?" contest. Students were to select a mathematician who lived prior to 1600 and to write a short page paper. On the day of the contest, students had two minutes to convince fellow classmates that the mathematician they selected was "the man." Unbeknownst to the students, they were voting on several other categories. Before each vote, the students were given one more chance to campaign for their mathematician. Later in the semester, the same assignment, with slight modifications, was given for mathematicians who lived after 1600. The enthusiasm the "Who's the Man?" contests generated was remarkable. Admittedly, the students did not have a "real" fight, but they did "play" fight about whose mathematician was better. Overall, the catchy title, ownership of a mathematician, and good old-fashioned competition brought out the best in my students.

Amalgamations of Combinatorial Designs **C212**

Michael N. Ferencak, University of Pittsburgh at Johnstown

Simply put, an amalgamation of a combinatorial structure is an identifying of some of the components of the structure. Once this is done, the characteristics (necessary conditions for a structure to be the amalgamation of a given design) that the amalgamated structure inherits from the original structure are identified. If possible, these necessary conditions are shown to be sufficient. Toward this end, a structure is then defined to have the characteristics necessary for it to be the amalgamation of a given design. This structure is called an outline of the design. Then, if this outline structure can be shown to in fact be the amalgamation of a structure that was our original design, then the necessary conditions derived from the amalgamation are also sufficient.

Why bother? The technique of amalgamations proves quite useful for answering questions involving the embedding of partial designs in complete designs of the same variety. We will give a few examples of such results and end with a tasty open problem.

How many samples do I need? Logistic regression and power **C225**

Michael A. Rutter, Penn State Erie

Biologists and other researchers are often concerned about the statistical power of their studies. Given limited time and/or funds, the number of possible samples is often fixed, making the probability of detecting significant differences low. Due to high levels of pollution, Presque Isle Bay in Erie, PA has been declared an "Area of Concern." In order to be delisted as an AOC, liver and skin tumor incidence rates in Presque Isle Bay must be no higher than nearby, unimpacted, reference sites. Since tumor incidence rates increase as a function of age, logistic regression is an appropriate tool for comparing tumor incidence rates. For this project, the power of detecting significant differences in tumor rates was calculated via simulation using the open source statistical package R. Previous studies of tumor rates have concentrated on sampling AOC sites rather than reference sites. However, the results of these simulations indicate that higher power can be achieved if the reference sites are sampled more frequently.

Sierpinski Curve Julia Sets for the Weierstrass Elliptic p-Function **C232**

Daniel M. Look, Indiana University of Pennsylvania

The Sierpinski curve is an amazing topological construct. There exists a homeomorphic copy of any 1-dimensional curve that is locally connected and connected within the Sierpinski curve. In this sense the Sierpinski curve is a "Universal Set". Here we discuss the existence of Sierpinski curve Julia sets for the Weierstrass Elliptic p-function on certain lattices.