

Abstracts of Faculty Talks

Mathematical Association of America
Allegheny Mountain Section Meeting
University of Pittsburgh,
Saturday, April 12th, 2008

Benedum Hall Rm 424

10:15-10:30

Walks in Affine Weyl Groups

Patrick Headley, Gannon University

Consider a plane tiled with equilateral triangles. You could take a walk from one triangle to another in which each step is between triangles that share a side. These walks are the simplest interesting example of an idea with some nice combinatorial properties and surprisingly deep connections with algebra.

10:35-10:50

A Parameter Space of Properly Discontinuous Affine Groups

Robert Sulman, Penn State Beaver Campus

Each fixed point-free affine map of Euclidean space (of any dimension) is affinely conjugate to a normal form. The "coordinates" of a second generator can be identified with a point of the same space on which it acts (viewed as a parameter space of groups). The given group will be isomorphic to $\mathbb{Z} + \mathbb{Z}$ and act properly discontinuously if and only if this point does not lie on a certain member of a family of curves kept invariant by the primary generator. In dimension two this curve is the kernel of the "Residue", a homomorphism from {normalized affine maps} into the reals. The conjugacy classes of two dimensional properly discontinuous affine groups G isomorphic to $\mathbb{Z} + \mathbb{Z}$ are described in terms of the Residue. In the parameter space, each point of the kernel of the Residue is the limit point of each conjugacy class.

10:55-11:10

The Plane of GWB Functions

John Tolle, Carnegie Mellon University

This talk presents a possible research project for an undergraduate. We all know that though the natural logarithm function grows without bound, the growth is very slow. But as "very slow" is a comparative phrase, we usually seek to understand its snail's-pace growth relative to some other slowly-growing function, such as a root function. The relative growth rates can be established using l'Hopital's Rule, but the result is a sort of one-dimensional view of growth without bound (GWB).

In this talk, we develop a two-dimensional perspective by looking at solutions to a simple first order differential equation. By adjusting parameters, we examine the underlying assumption concerning the growth of solutions. Then we extract the solutions. We will end up with the following classes of functions:

- * exponential functions
- * "doomsday functions"
- * polynomial functions
- * linear functions
- * root functions
- * factorial "functions"
- * hyperexponential ("greedy") functions
- * logarithmic functions

By comparing growth assumptions which led to each class of functions, we can understand the relative growth rates from a perspective which l'Hopital's Rule cannot give us.

11:15-11:30

Cantor, Apollonius and Sierpinski: Julia Sets Generated from Multiple Circle Inversion

Daniel M. Look, Indiana University of Pennsylvania

A rational map is generated from multiple geometric circle inversions and the resulting dynamics are studied. We take three circles with equal radius and center them at the cube roots of unity. For a point z there exists an inversion image about each of these circles. We take the arithmetic mean of the three inversion images to be the image of z under "3-Circle Inversion". This process produces a family of degree 3 rational maps with parameter r , the common radius. When this parameter is real the Julia sets produced are either Cantor sets or Apollonian gaskets. When we allow the parameter r to be any complex number we lose the geometric intuition of the map but the resulting Julia sets display a remarkable diversity producing Cantor sets, Apollonian gaskets, Sierpinski curves and other topological structures.

Benedum Hall Rm 426

10:15-10:30

The mathematics of JPEG

Larry Downey, Penn State Erie

We will discuss the mathematics behind the lossy compression algorithm known as JPEG, and the challenges such algorithms pose to the field of Image Forensics.

10:35-10:50

Riemannian immersions and submersions of finite type

Ivko Dimitric, PSU Fayette

A submanifold $X:M^n \rightarrow E^m$ of Euclidean space is of finite type (k-type) if the position vector x can be decomposed into a sum of k vector-Eigenfunctions of the Laplacian on M^n : $x=c+x_1+\dots+x_k$, $c=\text{constant}$, $x_i \neq \text{constant}$, $\Delta x_i = \lambda_i x_i$, $i=1,\dots,k$. Including also the case of submersions.

10:55-11:10

Isosceles Heron Tetrahedra

Jason Lingle-Martin, Indiana University of Pennsylvania

Heron tetrahedra are the three-dimensional analogue of Heron triangles. A Heron tetrahedron has integer edges, integer surface area, and integer volume. In 1992, R. H. Buchholz gave a partial classification of tetrahedra according to their edges. In 2006, C. Chisholm and J. A. MacDougall completed this classification. In 2001, Jan Fricke gave a more geometric classification. He identified four special types of Heron tetrahedra: (1) semi-regular (four congruent faces), (2) right-angle-vertex, (3) right-angle-face, and (4) isosceles-face tetrahedra. He suggests that these types are distinct, but does not give a complete justification. I will discuss these classifications and complete the argument that Fricke's four types are distinct by showing that there are no isosceles Heron tetrahedra with four congruent faces.

11:15-11:30

Cyclotomic Polynomials of the Second Kind

Javier Gomez-Calderon, Penn State New Kensington

In this talk we will discuss a class of polynomial that can be considered as cyclotomic polynomials of the second kind. For example, we will show that these polynomials are irreducible over the field of the rational numbers, and that they can be determined recursively as the classic cyclotomic polynomials.

Benedum Hall Rm 523

10:15-10:30

Student vs King Kong

Karen Bolinger, Clarion University

Students taking a course in mathematical modeling take on many big challenges that take them away from the familiarity and comfort of traditional mathematics courses. We give a top ten list of monumental hurdles faced by students as they learn to apply mathematics to solve real world problems.

10:35-10:50

An Integration Technique from the Past

Antonella Cupillari, Penn State Erie-The Behrend College

In 1748, after ten years of hard work, Maria Gaetana Agnesi (1718-1799) published the first Calculus book designed for teaching and written in Italian: *Istituzioni Analitiche ad uso della Gioventu' Italiana* (Analytic Institutions for the use of the Italian Youth). In the introduction to her work, Agnesi wrote: ". . . when considering the Integral Calculus, the Reader will find a completely new method for Polynomials, which has not appeared anywhere else; it belongs to the famous and never sufficiently praised Count Jacopo Riccati..." What was this new method? Was it really about polynomials?

10:55-10:10

One particular problem in Calculus 2.

Boon Ong, Behrend College

This talk will discuss summing one particular series which ended up using many topics discussed in Calculus 2. The series requires doing an improper integral which requires by parts, trig substitution and partial fraction to find the anti-derivative. While taking limit to find the integral, one also requires the L'Hopital Rule.

11:15-11:30

Beat the Pumps with Algebra

Kimberly Burch, IUP

Students find word problem assignments uninteresting, grumbling that they only want the formulas and failing to see any relevance to their lives. To alleviate their complaints and demonstrate the relevance of algebra to their lives, students will complete a semester-long project modeling the price of gasoline at a service station of their choice. Students will collect data for a sequence of weeks and employ graphing calculators to develop a model to predict both short- and long-term prices of gas. Students will be guided in developing interesting questions to investigate, such as the best time of the day, week, or month to buy gasoline. Using regression techniques discussed in class, they will develop appropriate models of price variations. Then, to contrast with results from our rural community, comparable data from a metropolitan area (Pittsburgh, PA) service station will be provided to enable students to test the universality of their models. The models will be presented !

via a poster presentation where students will share their findings in a relaxed classroom setting.

Benedum Hall Rm 525

10:15-10:30

Distinguishing the Vertices of Cycles and Paths

Henry E. Escudro, Juniata College

A famous problem in graph theory that has received considerable attention in the past 35 years is that of distinguishing the vertices of a graph in some manner. Different methods have been introduced by various people. In this talk, we look at one way to distinguish the vertices of cycles and path by coloring edges.

10:35-10:50

Random walks through an infinite candy bowl

John W. Hoggard, Edinboro University of Pennsylvania

In anticipation of the many students who will be visiting my office and eating from my bowl of candy as the end of the semester approaches, I will consider what happens to the distribution of candies if we make random drawings from the bowl. To avoid running out of candy (horrors!), we arrange for a method to replace candy as we eat, essentially creating an infinite candy bowl (joy!). We then consider the probability of different long term candy distributions which might occur. Finally we must ask: Could this possibly have a real world application?

10:55-11:10

Some Puzzling Arrangements

Marc Brodie, Wheeling Jesuit University

Which arrangements of black-and-white squares are permissible for a crossword puzzle? How many such arrangements are there? This talk will answer the first question, and present some results established in an on-going attempt to answer the second.

Benedum Hall Rm 720

10:15-10:30

Using an Interwrite Pad to Get Students More Involved in Mathematics Classes

Pam Wovchko, WV Wesleyan College

Come and see a demonstration of how to use the Interwrite pad to make your classroom more interactive. We will discuss the logistics of purchasing and operating the Interwrite pad, as well as the advantages and disadvantages of implementing this technology. Some attendees will get to use the Interwrite pad during the talk.

10:35-10:50

Lessons learned from the Freshman Dream Product Rule

Jon Beal, Clarion University

This talk will highlight various educational experiences students have while exploring the Freshman Dream Product Rule. Particular attention will be paid to the use of CAS to enhance mathematical learning.

10:55-11:10

Visual Manipulations

Theodore S. Erickson, Wheeling Jesuit University

The computer algebra software Mathematica 6.0 contains a new command: Manipulate. The presenter will demonstrate visual representation of the Rectilinear Crossing Number and the Four Numbers Game. Other examples are under development.

11:15-11:30

Use the Casio ClassPad 300 to teach Number Theory

Michael McConnell, Clarion University

As a handheld Computer Algebra System, the Casio ClassPad provides many opportunities for students to explore concepts in Number Theory. The ClassPad performs calculations quickly, providing the students with data to make conjectures. The students can devote their time to proving the conjectures, rather than generating the data.

In the talk I will focus on how my class used the ClassPad to explore connections between Pell's Equations and Continued Fractions.

Benedum Hall Rm 722

10:15-10:30

Problem 11249; an integer sequence tale.

Carl F. Letsche, Indiana University of Pennsylvania

Though simple to state and understand, the problem required a mixture of brute force, a clever recursive structure, and dumb luck.

10:35-10:50

The least is the best!!-Minimizing Cost while Meeting Nutritional Requirements

Yu-Ju Kuo, Indiana University of Pennsylvania

The "Dietary Problem" is important in our daily lives. The key issue is whether you get enough nutrition from your choice of foods, while at the same time paying the minimum cost or consuming the minimum calories. In this talk, we will set up the Dietary Problem as a linear programming model, discuss how the solution appears on a graph, and then use Excel's Solver feature to solve the problem.

10:55-11:10

Boscovich and the Notion of Continuity

Radoslav Dimitric, DBRI

I will present Boscovich's idea of continuity and explore the extent of his anticipation of the Dedekind cut.

Benedum Hall Rm 823

10:15-10:30

Geometer's Sketchpad in Introductory Calculus Class

Lalitha Subramanian, Potomac State College of West Virginia University

Post secondary introductory mathematics classes like College Algebra, Trigonometry, Introductory Calculus, etc. have diverse students ranging from fresh-from-high school to back-to-school adult learners. Instructors often experience difficulty in reaching out to all types of learners. The dynamic interactive nature of Geometer's Sketchpad helps them cater to all types of learners. This session presents some classroom demonstrations with Sketchpad that could be effectively used in Introductory Calculus classes.

10:35-10:50

Illuminating Group Lattices

Nancy Rodgers, Hanover College

We will demonstrate how to use the software program, Groups Unlimited, (www.groupsunlimited.net) so that students can have hands-on experience with finite groups in a colorful and exciting format. By working visually with subgroup lattices, generating sets, mod n groups, dihedral groups, permutation groups, quotient groups, and direct products from an extensive group library, students can deepen their understanding and appreciation of basic concepts in group theory.

10:55-11:10

Problems with Complex Exponentials and Fractals

Joshua C. Sasmor, Seton Hill University

The computation of powers of complex numbers usually requires the use of the complex logarithm. This function has a branch cut in it, and when using non-integer powers, the result of this branch cut is a systemic discontinuity in the fractal images which use these powers. The definitions of the sets involved fractals need to be changed to accommodate this discontinuity and this talk will discuss my research into these sets.

11:15-11:30

Concept Mapping in Introductory Calculus Class - A Project Summary

Lalitha Subramanian, Potomac State College of West Virginia University

This presentation summarizes the results of an experiment integrating concept mapping in a one-semester introductory calculus class, as part of Project ACCESS activities.