List of Faculty talks and abstracts
(alphabetical by last name)

A New Degree Program in Mathematics Education

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Clarion University has implemented a new graduate program in Mathematics Education that integrates pedagogical issues with the study of mathematical topics relating to the secondary mathematics curriculum. The goal of the program is to deepen teachers understanding of mathematics and to improve the quality of mathematics teaching through reform teaching practices.

The talk will note opportunities for collaboration with Clarion University to implement such a program at other institutions.

Complexity of Equivalence

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We will examine equivalence relations and how the complexity structure can be studied by the use of descriptive set theory.

Some Interesting Absolute Values

Robert E. Buck
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One of the major problem areas students have in algebra and precalculus courses is in working with absolute values, another is in graphing, particularly lines and the conic sections. This approach ties the two areas together in a way that the students seem to find interesting, and which forces them to think about the two cases in the absolute value definition. I replace x andy in the equations of the conic sections with x + x and L + respectively. This results in some really "neat" which they enjoy, but that require them to consider the definition of absolute value several times for each equation. Playing with lines, circles, ellipses, and hyperbolas (or even the trig functions) can give many really unusual pictures. The real bencflt is that when doing standard topics, such as so’ving absolute value equations, there are relatively few mistakes caused by not understanding the definition. A period or two spent on this also seems to improve their ability to work with the standard conic sections.

A Generalization of Convexity

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We introduce a generalized notion of convex sets and give a few elementary but beautiful results. We hope to provide a topic for further study, and we suggest a few related open problems as well as some good exercises for undergraduate students.

Third and fourth order recursive sequences and Dickson Polynomials

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Let $D_d(x,a)$ denote the Dickson polynomial defined by $D_d(x,a) = xD_{d-1}(x,a) - aD_{d-2}(x,a)$ where $D_0(x,a) = 2$ and $D_1(x,a) = x$. Dickson polynomials have been extensively studied by many authors. In this talk we will consider the polynomials $H_d(x)$ and $J_d(x)$ defined by $H_d(x) = xH_{d-1}(x) - xH_{d-2}(x) + H_{d-3}(x)$ and $J_d(x) = xJ_{d-1}(x) - (x^2/2)J_{d-2}(x) + xJ_{d-3}(x) - J_{d-4}(x)$, respectively.

Pólya's Patterns

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In this presentation, we will discuss the problem of coloring the vertices or faces of a cube say with three colors and then determining the number of possible patterns that can arise by such colorings. This discussion will lead to the central ideas of Pólya's Enumeration Theorem (PET), often referred to as the fundamental theorem of enumerative combinatorial analysis. We conclude with the solution of the stated problem as an easy application of PET.

Knot graphs and knot colorings

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Using colorings of graphs related to knots, we prove the Kauffman-Harary coloring conjecture for an important subclass of alternating knots. A "Short" Differential Equations Course

A "Short" Differential Equations Course

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Non-Affiliated

We discuss the aspects and outcomes of an introductory differential equations course designed to cover less material and offer more detail.

Some Geometer's Sketchpad Demos for Future K-6 Teachers

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This talk will share a few of the explorations we've made using Geometer's Sketchpad in my Elementary Geometry course (for future K-6 teachers). Topics include isosceles triangle results, variations on the interior angle theorem for polygons, features of parallel lines, and the general version of the Pythagorean Theorem. All are easily adapted either to student assignments or instructor-only demos; I use a mixture of both in my course.

Addition of Surreal Numbers

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Brett Myers (a senior mathematics major) and I have been exploring surreal numbers and their use in analyzing certain combinatorial games over the last year. Brett has analyzed special cases of the game of Red-Blue Hackenbush and also special cases of the game of Toads and Frogs . I wish to examine the use of his results to explore new games in which a finite number of the Brett's games are played simultaneously. Analysis of these new games lead naturally to the use of the addition of surreal numbers.

The homotopy of the Symmetric Product of Bouquet of Circles.

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It has been known that a wedge of k circles is homotopy equivalent to the plane with k points removed. By looking at a plane with k points removed, we could write down, using linear algebra, the symmetric product of a wedge of k circles and complement space of an arrangement. As a consequent, we see that the symmetric procut of a wedge of k circles is the unionof subtorii in a big torus.

Vertex Replacement Rules with More Than One Replacement Graph

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We will introduce vertex replacement rules, show convergence of the sequences of graphs determined by certain replacement rules, and state a conjecture about the convergence of these sequences for general replacement rules.

Introduction to Research Seminar: a new course in the math major.

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How do we prepare our students for their senior projects? How do we teach math majors to read, write and speak about mathematics? Introduction to Research seminar was added to our major this year to try to fufill these needs. Ideas, stumbling blocks and persistent questions will be discussed.

An Undergraduate Senior Project - The Geometry of Permutations

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Consider the set of permutations of S={1,2,...,n}. Each permutation is treated as a point in n dimensional Euclidean space. The geometry of this set is examined. The standard Euclidean distance between points in n dimensional space is defined and the set of distances between the points in S is studied. Several simple and interesting properties regarding the geometry and distances between the points in S are derived. The distances and permutation inversions are related in a simple way, and each correspond to certain restricted number partitions, for consecutive integers and consecutive even integers. By using Mathematica, moderate to large examples could be generated and studied. This enabled patterns and properties to be extracted from the examples, that would have otherwise been difficult to observe from examples obtained by hand.

New Results for Hyperbinary Partitions

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In this talk, we will define hyperbinary partitions (following the work of Bruce Reznick, Herb Wilf, and Neil Calkin). We then consider the partition function which enumerates these hyperbinary partitions and prove, via elementary means, a very nice congruence property. All of the proof tools needed are elementary. The talk will be self-contained and accessible to all. (This is joint work with my undergraduate student Kevin Courtright.)

An introduction and application of a lumped-parameter model for intracranial fluid dynamics.

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An introduction to lumped-parameter, compartmental, models for fluid dynamics is given. Specific attention will be paid to one such model for intracranial fluid dynamics. This model is then used to simulate steady-state infusion tests. The conductance to CSF outflow is measured clinically and calculated from the model. Requiring agreement between these two versions of the same parameter allows estimations to be made about other model parameters which represent physiologically relevant features. In particular the relatively small flow of extra-cellular fluid into, and out of, the interstitial brain tissue can be approximated from the model. Due to the magnitude of these flows they are very difficult to measure. A discussion is presented on how variations in model parameters affect the susceptibility to intracranial hypertension and edema in simulated CSF outflow blockages. A brief overview of current implementations of this model is also presented.