Abstracts of Faculty Talks

Mathematical Association of America
Allegheny Mountain Section Meeting
Duquesne University
Saturday, April 8, 2017

10:15-10:30

Boon Ong, Penn State Erie **College Hall 446**

I did not mean linear combination when I tweeted A_np_{n-1}-B_np_n

This is a differential equation question on Chebyshev Polynomials of the Second Kind. M.H. Ismail have this problem of $p_n' = A_n p_{n-1} - B_n p_n$ for various orthogonal sets and orthonormal sets. And he even has exact formulas for calculating A_n and B_n. But in this talk I will approach the problem differently. I use only the Chebyshev Polynomials of the Second Kind, use the A_n and B_n formula for only a few small values of n and then proceed to using induction on n to prove the expression for A_n and B_n.

Carl Letsche, American Public University **College Hall 447**

Forums for Online Math Courses

Discussion forums are a common and important factor in online learning. We discuss several types of forums for topics in math, analyzing what works well, what doesn't, and why.

Jeffrey Jackson, Duquesne University **College Hall 449**

What is a Theorem?

General acceptance of a mathematical proposition P as a theorem requires convincing evidence that a proof of P exists. But what constitutes "convincing evidence?" I will argue that, given the types of evidence that are currently accepted as convincing, it is inconsistent to deny similar acceptance to the evidence provided for the existence of proofs by certain randomized computations.

David Prier, Gannon University **College Hall 346**

Inverse Domination an Open Problem in Mathematics

In Graph Theory, a set of vertices is dominating if every vertex of a graph is in the set or adjacent to something in that set. One could think of a country occupied by the Roman Army. A town would be dominated if it has an army base or if it is one road away from an army base. An inverse dominating set is another dominating set that is in the complement of a minimum dominating set. So, in our Roman Army example, if the Romans occupied a country with the fewest bases possible, invaders might try to overthrow the Romans by placing themselves in towns without Roman bases but still dominating the country. I will describe an open problem involving inverse domination and present some of the current results.

Gary Thompson, Grove City College **College Hall 351**

Mathematica Madness

Unexpected results in Mathematica, whether correct or incorrect, can be a conduit for some interesting discussions. We will look at a number of such odd results that have appeared in several courses.

10:35-10:50

Gerald Kruse, Juniata College **College Hall 446**

Interpolation to Generate Closed Formulas for Series

In this talk we will present an algorithm used to generate mathematical series which can be proved inductively. It's useful to generate Predicates to prove in a discrete math course, as well as an in-depth analysis in a Numerical Analysis course of the interpolation tools used. The sums in the first three predicates can be used as the three interpolating nodes, which produce a quadratic polynomial.

Kuei-Nuan Lin, Penn State Greater Allegheny **College Hall 447**

Semi-Flipped Classroom

I will share my new teaching structure/method on semi-flipped classroom. Then I will compare the outcomes between the traditional lecturing style of Fall 14 and the new teaching structure of Fall 15. I will also talk about the changes I made for Spring 16, Fall 16, Spring 17 after reading students' feedbacks.

Antonella Cupillari, Penn State Erie **College Hall 449**

The Greek Method for Pi in a Real Analysis Class

Sequences are a first important topic in the real analysis class, and they can be used to prove the fact that rational and irrational numbers are inseparable. In the attempt to show that calculus (and thus real analysis) was build on ideas that had been compounding for centuries, it might be a good idea to bring some Greek geometry in the real analysis class. This is an example of such a topic, showing the polygonal Greek construction for a non-trivial sequence that approximates pi and uses other irrational numbers.

Xiang Ji, Penn State New Kensington **College Hall 346**

Deformations of Courant Algebroids, Dirac Structures and More

Deformations of a Courant Algebroid $(E,\langle\cdot,\cdot\rangle,\rho,\circ)$ and its Dirac subbundle have been widely considered under the assumption that the pseudo-Euclidean metric $\langle\cdot,\cdot\rangle$ is fixed. We want to attack the same problem in a setting that allows $\langle\cdot,\cdot\rangle$ to deform. By Roytenberg, a Courant Algebroid is equivalent to a Symplectic graded Q-manifold of degree 2. From this viewpoint, we first extend the definition of a Q-vector field X on a graded manifold μ so that it also encodes other compatible geometric structures such as a Symplectic structure, and then define the submaniold $M \subset \mu$ of "coisotropic type" which naturally generalizes the concept of Dirac subbundles. It turns out the simultaneous deformations of X and M can be controlled by an L_∞-algebra under certain regularity conditions of X. This result applies to the deformations of a Courant algebroid and its Dirac structures, the deformations of a Poisson manifold and its coisotropic submanifold, the deformations of a Lie algebroid and its Lie subalgebroid, and hopefully more.

Ivko Dimitric, Penn State Fayette **College Hall 351**

Even out your odds

This is a second look at even and odd functions of a real variable which are simplest invariant functions that serve as building blocks of other functions in several ways (any function on a symmetric domain is the sum of an even and an odd function, Taylor series and Fourier series are infinite sums of even and odd terms). Because these concepts are easily defined and readily understood, one often takes it for granted that there is not much to say about these functions beyond the symmetry of their graphs and the like. We will consider even functions (graph symmetric about the y-axis), odd functions (graph symmetric about the origin), and self-invertible maps or involutions (graph symmetric about the line $y = x$). We give several non-trivial examples of these maps and point to some ways of their construction. In particular, we ask how functions which are neither even nor odd (neno functions) can produce even and/or odd functions in their compositions and whether we can write any even or odd function as a

composition of neno functions.

10:55-11:10

Maggie Habeeb, California University of Pennsylvania College Hall 446

Oblivious Transfer Protocols

In a 1-out-of-2 oblivious transfer protocol, the sender has two messages m_0 and m_1 and the receiver has a choice bit b. The receiver wishes to receive m_b, without the sender learning which message was received and the sender wants to ensure that the receiver receives only m_b. In this talk, we present ideas on using non-abelian groups to implement a 1-out-of-2 oblivious transfer protocol.

Jeffrey Wheeler, University of Pittsburgh College Hall 447

Musings from Three Years of BIG Classes

I will present my experiences and advice from three years of BIG classes at the University of Pittsburgh. I have had five student teams work on various problems for companies, a charity, and a Major League Baseball organization with all of the students earning experience which they greatly appreciated; many getting good jobs because of their work on these projects.

Nicholas Martin, Shepherd University College Hall 449

Minimizing the total distance traveled

The paper is intended to generalize an old Putnam problem: given n points on a line, find the location of another point no the same line with the property that the sum of its distances from all the n points is a minimum. We may view this is a transportation problem: given n stores along a road, find the location of k (k ¡ n) supply depots along the same road so that the total distance traveled from each depot to the stores that is supplies is minimal. We will have to decide, for each depot, which stores will it supply.

Jared Burns, Seton Hill University College Hall 346

Multiplicative Integration

In this talk, we briefly introduce the topic of Multiplicative Integration, and quickly survey some of the basic concepts of the topic. We will learn that this is a different notion of calculus. We will discuss some of the rules of the calculus, and along the way learn a new result pertaining to a version of a multiplicative fundamental theorem that is derived from a more general result in the speakers

work.

Tom Cuchta, Fairmont State University **College Hall 351**

The Bessel Difference Equation

This talk concerns similarities between the theory of differential equations and the theory of difference equations. Bessel functions are particularly useful special functions with a long history in differential equations. We will discuss a difference equation analogue of Bessel's differential equation whose solution obeys many properties similar to classical Bessel functions.

11:15-11:30

Qing Wang, Shepherd University **College Hall 446**

Modeling and Analysis of Tumor Growth in Response to a Combination Therapy Involving 4-1BB & IL-12

Preclinical studies have shown cooperative and even synergistic therapeutic benefit by combining 4-1BB agonists with multiple antitumor therapies including IL-12. In this study, we developed a multi-scale model using a system of impulsive ordinary differential equations (IODE) to describe the interaction between the immune system and tumor in response to the combination therapy involving 4-1BB and IL-12. Results of stability and sensitivity analysis will be discussed. This research was supported by NIH Grant P20GM103434 to the West Virginia INBRE.

John Tolle, Penn State DuBois **College Hall 447**

Let-Then-So: A Format for Teaching Integral Substitutions

We discuss a presentation format for students to use to write up integration-by-substitution problems, which applies to basic "u" substitution but can then be carried over to trigonometric substitution, integration by parts, etc. The intent is to help the student organize their work, to remember the logic behind the change of variable(s), and to see the importance of the object "dx" in an integral.

Tim Flowers, Indiana University of Pennsylvania **College Hall 449**

Inspiring Questions about m-ary Partitions

An integer partition of n is a way of expressing n as a sum of positive integers called parts. An m-ary partition is a partition with the condition that every part is a power of m. When we add further restrictions on the number of times

each part may be used, we get several interesting sets to study. In this talk, we will give an overview of some known results about m-ary partitions. Then, we will share how a question from the audience at last year's section meeting inspired a master's thesis and some new results.

John Lattanzio, Indiana University of Pennsylvania College Hall 346

Permutation Inversion Matrices

This presentation introduces what are believed to be original results pertaining to inversions in a permutation. First, an intriguing relationship exists between the number of inversions in a permutation and the number of inversions in a restricted permutation. This relationship and its connection to determinants will be briefly addressed. Second, the notion of a permutation inversion matrix (or PIM) will be introduced. A PIM contains additional information than a permutation matrix and arises naturally from a variation of a Rothe-Lehmer diagram for a permutation. Some of the basic properties of a PIM will be given.

Leandro Junes, California University of Pennsylvania College Hall 351

Non-attacking rooks on a Pascal like Triangle

We discuss several GCD properties that generalize from Pascal triangle to Hosoya triangle. In particular, we describe the GCD property for the Star of David. We also give a criterion to determine the GDC of "n" non-attacking rooks on the Hosoya triangle.