Abstracts of Faculty Talks

Mathematical Association of America
Allegheny Mountain Section Meeting
Indiana University of Pennsylvania
Saturday, April 06, 2013

10:15–10:30

Jason McCarty, Indiana University of Pennsylvania, Stright 231
What is Algebraic Topology?

Topology studies abstract shapes and continuous functions between them, while algebra studies abstract sets of numbers and operation-preserving functions between them. Although these subjects may seem quite dissimilar, algebraic topology successfully uses algebra to answer topological questions, and vice-versa. I will introduce homotopy groups, one of the fundamental ideas of algebraic topology, and discuss some applications.

Alfred Dahma, Indiana University of PA, Stright 232
A Norm Inequality for Matrices

In this talk, I will discuss an inequality relating the singular values of a square matrix to the matrix entries themselves. In presenting this inequality, I will also discuss the absolute value and polar decomposition of matrices. The proof of the inequality will use characteristics of self adjoint matrices and Holder's inequality.

J. Lyn Miller, Slippery Rock University, Stright 240
"Reverse" Tasks in Mathematics for Elementary Teachers

Textbook problems for future elementary teachers are sometimes no more than "bigger" versions of grade school problems, giving the preservice teacher little chance to develop additional understanding of a concept beyond what his/her pupils will encounter. One can foster deeper understanding through "reverse" tasks: a simplistic example is creating a data set with a specified median, rather than mimicking the children's task of finding a median for a given data set. This talk will share several kinds of "reverse" tasks used in teaching a mathematics for elementary teachers course that covers set theory, number systems, probability, and statistics.

Peter Olszewski, Penn State Erie, The Behrend College, Stright 327
The Use of Exam Wrappers to Motivate Student Learning

Millennial students tend to have short attention spans, are overly grade-driven, and lack proper study skills. There is a decided gap between how professors expect students to learn and how students actually learn. Learning how to learn is essential for success in college and in life. Motivated by a seminar on teaching millennials hosted by Penn State's Schreyer Institute for Teaching Excellence, I adopted Exam Wrappers in my College Algebra II class. Exam Wrappers are a series of surveys that require students to reflect on how they learn. Will the reflection

alone help improve how students learn? In this presentation, I will share several examples of exam wrappers along with experiences regarding their effectiveness and examine the impact on learning outcomes by prompting students to reflect on how they learn.

Papiya Bhattacharjee, Penn State Erie, The Behrend College, Stright 329
Ring Extensions

If R and S are two commutative rings with identity, and f:R→S is an injective ring homomorphism, then we can consider R as a subring of S, and we say that R→S is a ring extension. An extension of rings R→S is a *p-extension* if given any s∈S there exists an r∈R such that sS=rS; that is, the principal ideals in S are generated by elements in R. Again, an extension of rings R→S is a *pg-extension* if given any nonzero s∈S there exists an r∈R such that sS∩R=rR. In general, neither one of the two extensions implies the other. In this talk Dr. Bhattacharjee will discuss these various extensions of commutative rings, and describe under what conditions one extension implies the other. Furthermore, if time permits, the speaker will mention other types of ring extensions, such as, essential extension, rigid extension, and regular localization, which are related to p-extension and pg-extension.

John Chrispell, Indiana University of Pennsylvania, Stright 331
High Performance Computing Resources and XSEDE

The availability of computing is changing the landscape of problems that can be examined by scientists and engineers. Access to super computers and high performance computing resources may not be as difficult as you think. In this talk we will showcase the Extreme Science and Engineering Discover Environment XSEDE. Discussion of the resources available to faculty and students and the procedure for gaining access will be given.

Dan Radelet, IUP, Stright 333
Funny Powers: Discrete Calculus on Rising Factorials

We will define rising factorials and explore interesting properties of their sums and differences that mimic common operators from Calculus. We will also explore the effect of altering the weights of these sums using signed binomial coefficients. Applications exist for Bessel sequences of vectors in frame theory.

Marshall Whittlesey, California State University San Marcos, Stright 340
A Course in Spherical Geometry for Undergraduates

A century ago, spherical geometry (the study of geometric objects on the surface of a 3-dimensional ball) was a standard part of the mathematics curriculum in high schools and colleges. Its applications were needed by many people: anyone who wanted to navigate on the surface of the earth by using the stars needed to know something about the subject. However, in the decades since the 1940s, it has slowly disappeared from the curriculum for most students, and today most mathematicians only learn about it as a short topic in geometry survey courses. In this talk we survey some of the standard theorems of spherical geometry and compare them to those of plane geometry. These include: (1) the spherical law of cosines and how to use it easily to determine the distance between two cities (2) the spherical Pythagorean theorem, unknown to most mathematicians and how it compares with the plane Pythagorean theorem (3) the AAA congruence theorem for spherical triangles, a surprising contrast to plane geometry where AAA only guarantees similarity of triangles and (4) the area theorem for triangles which states how to

calculate the area of a spherical triangle from its angles. We also will discuss some of the interesting applications of spherical geometry in astronomy, mainly how to determine the time of sunrise and sunset. We also briefly mention applications of spherical geometry to crystallography and the study of the regular polyhedra (e.g., how explicitly to construct them and how to determine the angles between faces.) We suggest spherical geometry as a good subject for future high school teachers to learn, but also think more mathematicians should be generally aware of its theorems and applications.

10:35–10:50

Ivko Dimitric, Penn State Fayette, Stright 231
Classification of 2-Type Hopf Hypersurfaces of Complex Projective Space

We consider standard embedding of a complex projective space into Euclidean space of Hermitian matrices E. Thus every submanifold of CP^m is viewed as lying in some E. We classify Hopf (real) hypersurfaces which are of 2-type i.e. those whose position vector in E can be decomposed into two vector eigenfunctions of the Laplacian.

Boon Ong, Behrend College, Stright 232
Difference Equation from Askey-Wilson Structure Equation

Let D_q be the Askey-Wilson Difference Operator. This linear operator acts very much like the normal differentiation. In this talk we are looking for the set of polynomials {P_n} where each P_n is of degree n such that D_q (P_n) = [n]_q (P_{n-1}). The equation generates many interesting first order difference equations which we will solve by iterations. And eventually we will solve the D_q-Appell Equation.

Melissa Sovak, California University of Pennsylvania, Stright 240
An Alternate Approach to Teaching Introductory Statistics

Students often fail to grasp the bigger picture behind the methods introduced in introductory statistics courses. In addition to failing to connect each analysis technique to the larger contextual picture, students also often fail to connect technique to technique in order to form a complete analysis of any given data set. For instance, analysis techniques that are introduced early on in the semester are often completely left out of later analyses when students begin inference testing in the latter portion of the semester. This talk aims to offer a solution to presentation of the material in an introductory level statistics course to ensure that students more thoroughly understand how to pair techniques and can appropriately offer a holistic analysis approach to each data set. Sample course schedules and lecture approaches will be presented.

Shelly Bouchat, Slippery Rock University, Stright 327
Cell Phones: Classroom Distraction or Classroom Attraction?

We have all battled with our students to stop texting, websurfing, and other distracting activities that happen through the use of cell phones. After many semesters of trying to police my cell phone ban in class, I decided to use cell phones as a learning tool in my classes. This talk will discuss the use of cell phones as a clicker based input system through the company Top Hat

Monocle. In particular, we will discuss the capabilites of a cell phone based clicker system that exceed that of the traditional clicker system.

Larry Feldman, IUP, Stright 329
Negabinary Numbers

Interesting patterns occur with base negative 2 numbers. I will show how base -2 works and how it relates to base 10. I will also briefly show computation in base negative 2.

Brian Sharp and Ed Donley, IUP, Stright 331
Incorporating 3D Printing into Your Classroom

3D printers provide opportunities to strengthen connections between each of the STEM areas. For example, students investigating wind power can construct a mathematical model of a windmill, fabricate the windmill using a 3D printer, and then test the efficiency of their windmill. Using their results, student can refine their models and continue the engineering process. In this session, the audience will see a 3D printer in action and discuss various ways that 3D printers can enhance STEM experiences.

Gary Stoudt, Indiana University of PA, Stright 333
Hippocrates Quadrature of a Lune and Calculus

It is reasonably well-known how Hippocrates of Chios (ca 460-ca 380 BC) found the area of a so-called "lune." We will review this calculation but more importantly look at some of the Greek geometry background of the language used in his calculation. We will also see how it relates to some fairly easy calculus problems.

Kate Overmoyer, Clarion University, Stright 340
Teaching Analysis: Reflections on a First Experience

During my first year as an Assistant Professor at Clarion University, I taught Introduction to Real Analysis. In this talk, I will share my experience in making the transition from teaching mainly service mathematics courses to teaching an upper level course. I will discuss the expectations I had before the course, the problems I encountered throughout the semester, what I have learned, and what I will do differently next time.

10:55–11:10

Larry Downey, Edinboro University, Stright 231
A Solution to a Question of Walter Rudin

In his book "Functions on a Polydisc", Walter Rudin posed an open question concerning bilinear operators. The question was partially answered in the 1970's. The pursuit of a complete answer led to the study of points associated with general functions which we call Repelling points, which are both a topic of study on their own and which have advanced the completion of an answer to Rudins' original question.

Duane Farnsworth, Clarion University of Pennsylvania, Stright 232
The Numerical Range of a Matrix

In this talk, we will describe a certain correspondence between square matrices and sets of numbers in the complex plane. For this correspondence, the set of complex numbers associated with a given matrix is called the numerical range of the matrix. We will also take a brief look at some of the interesting questions that are associated with numerical ranges. Even though the basic ideas are easily conveyed to anyone with a bit of knowledge of linear algebra, some of these questions do not yet have complete answers.

Terry Blakney, Penn State Erie, The Behrend College, Stright 240
Project Ideas for Teaching Statistics

Teaching the Undergraduate statistics curriculum concentrates on the methodology of what to do after you have the data. The talk concentrates on project ideas to give the student ownership of the data. I will review 2 or 3 projects that have been well received by my students in giving them exposure to sampling data and their takeaways.

Adam Nogaj, Gannon University, Stright 327
Impact of Online Scheduling on Math Center Use

In March, 2012, the Gannon University Math Center migrated to an online scheduling system, allowing students to self-schedule appointments from any computer or device with Internet access. Before this switch, Math Center use was down a total of 14% from the previous academic year. After unveiling the service, Math Center business rose 46% compared to the same time frame from the previous year. Strong growth has continued into the 2012-2013 calendar, and several other divisions within the Gannon University Student Success Center (tutorial and otherwise) have adopted online scheduling in wake of the Math Center's successes.

Dan Shifflet, Clarion University of Pennsylvania, Stright 329
Why 6174 is (Currently) my Favorite Number

I am a big fan of numbers. For a long time my favorite was 3435. There is a simple, yet beautiful reason why. It is the only number (besides 1) equal to the sum of its digits each raised to the power of the digit. That is, 3435 = 3^3+4^4+3^3+5^5. But now 6147 has supplanted 3435 in my eyes. Why? Come and find out!

Jeff Wheeler, University of Pittsburgh, Stright 331
A Fermat's Last Theorem for Polynomials

We prove a version of Fermat's Last Theorem for polynomials and introduce the audience to the open (?) Number Theory problem known as the abc Conjecture. The conjecture has claimed to be proven In August 2012 by Shinichi Mochizuki.

Greg Wisloski, Indiana University of PA, Stright 333
Pricing of Convertible Bonds as Derivatives

In this talk, we will look at the pricing of convertible bonds via the method of option pricing. We will look at a simple example, as well as the underlying stochastic differential equation and its solutions.

Douglas Puharic, Edinboro University of Pennsylvania, Stright 340
A Freshmen Course: The Mathematics of Baseball

Edinboro University offers multiple courses that are classified as First Year Experience courses. I recently developed and taught an FYE course called, "The Mathematics of Baseball." I will begin with a discussion of the development of the course and the move from a Statistics focused course to a survey of mathematics course. I will then discuss the result of the first time teaching the course, the good and the bad. I will then finish with my future plans for the course.

11:15–11:30

Adam Roberts, Clarion University, Stright 231
An Example of a Bijective, Continuous Function from a Topological Space to Itself that is Not a Homeomorphism

Every first course in topology encounters the issue that there are continuous bijections that are not homeomorphisms. Examples of this abound but if the domain and codomain of the function are the same space the issue becomes more complex. This talk will discuss some of the spaces for which every continuous bijection is a homeomorphism and then construct an elementary (but not familiar) space that has a function that is a continuous bijection but not a homeomorphism.

Daniel Galiffa and Jennifer K. Ulrich, Penn State Erie, Stright 232
Developing a Discrete Analogue of the Time-Independent Schrödinger Equation via Discrete Orthogonal Polynomial Sequences

Chapter 2 of the recent monograph "On the Higher-Order Sheffer Orthogonal Polynomial Sequences" (Galiffa, 2013) presents how the classical continuous orthogonal polynomial sequences can be used to solve the time-independent Schrödinger equation, which is a second-order differential equation with variable coefficients (entitled the Schrödinger Form). Moreover, the chapter subsequently demonstrates the specific details of how two of the continuous Sheffer Sequences, i.e. the Laguerre and Hermite polynomials, solve this form. The presenters of this talk have currently developed a discrete analogue of the aforementioned results by considering a finite difference operator, as opposed to the standard differential operator, in achieving the Schrödinger Form. The general results in regard to developing this so-called Discrete Schrödinger Form will be presented, as well as the specific details of how each of the three discrete Sheffer Sequences (the Meixner, Charlier and Krawtchouk polynomials) solve this form. We complete the talk by discussing the ramifications of this discrete analogue and addressing future directions to consider.

David Offner, Westminster College, Stright 240
A New Lower Bound for a Variation of Cops and Robber on the Hypercube, with an Application to Graph Searching

The game of Cops and Robber is a two-player, perfect-information game played on an undirected graph G. A robber and a fixed number of cops each occupy vertices of G, and take turns moving to adjacent vertices. The cops win if a cop ever occupies the same vertex as the robber. The cop number is the minimum number of cops required to guarantee a winning strategy for the cops, and this number can be interpreted as a measure of the difficulty of searching the graph. In this talk, we give a new lower bound on the cop number for the n-dimensional hypercube in the variation of the game where only one cop is allowed to move on each turn. Additionally, we connect Cops and Robber to another class of vertex pursuit games, Graph Searching, where any number of cops may move on a turn, but the robber is not visible to the cops, and may be infinitely fast. Our result also provides a new lower bound for the cop number in this setting.

Ryan Higginbottom, Washington & Jefferson College, Stright 327
Priming the Pump: Using Reading Assignments to Foster Efficient, Flexible Class Periods

Class periods work better when everyone is prepared---this is no revolutionary idea. And while professors have control over their own preparation, ensuring that students are prepared for class is a different matter. In this presentation I will discuss the reading assignments I have incorporated into some of my 200-level classes and I will describe the benefits I have seen as a result. In short, my classes have become more efficient and helpful, and I have been able to be more responsive to concerns and difficulties students encounter in the course material.

Dr. Leandro Junes, California University of Pennsylvania, and Dr. Rigoberto Florez, The Military College of South Carolina, Stright 329
A Conjecture about Triangular Numbers and Prime Numbers

We discuss several results that relate triangular numbers, factorials and prime numbers. In particular, we state an analog to Fortune's conjecture for the product of triangular numbers. That is, if T is the product of triangular numbers, are there infinitely many primes of the form $T \pm 1$? We provide strong evidence that suggest that this conjecture is true and show that there are infinitely many cases for which $T \pm 1$ is composite. Undergraduate students with a passion for number theory will find this talk entertaining and understandable.

Ed Donley, Indiana University of Pennsylvania, Stright 331
Using Fundamental Algebra and Calculus Concepts for Image Processing

Some simple image processing algorithms are great applications for illustrating fundamental algebra and calculus concepts. Histogram equalization, using linear functions, and gamma correction, using power functions, will be used to restore old, faded photographs and poorly lighted photographs. Partial derivatives, the gradient, and the Laplacian will be used to detect edges of objects within images. The author will implement these algorithms in Mathematica, but they could be implemented just as easily in many other software environments.

Michael Woltermann, Washington and Jefferson College, Stright 333
The Average Area of a Triangle in a Parabolic Sector

The problem is to find the average area of the triangle formed by joining three points taken at random in a parabola whose base is b and altitude is h. This was problem 248 in the Mathematical Visitor, 1880 from Enoch Beery Seitz. His solution was published in 1893. This was the topic for a Senior MathTalk at W&J, Fall 2012.

Heather Parizek, Penn State University, DuBois Campus, Stright 340
Math 097: Improving Retention in Pre-Calculus and Calculus Courses Through Small Group Tutoring at Penn State DuBois

In order to improve retention in Pre-Calculus and Calculus courses, Penn State DuBois offers Math 097, a 1-credit tutoring class to be taken concurrently with a traditional math course. Students are required to meet once a week in small groups with a peer tutor to ask questions, review homework, or prepare for exams in their traditional math course. Students not only learn course material, but also improve study skills. Working in small groups encourages the students to become active learners and fosters relationships that lead to more learning outside the class setting. Successes, failures, and strategies for implementing such a course will be discussed.