Eastern Pennsylvania and Delaware Section of the
Mathematical Association of America

Student Contributed Paper Session Abstracts

Muhlenberg College

April 2, 2016

Student Speakers

Graduate Session I-A
TRUMBWR 305

Matthew N. Moore, Delaware State University

Title: Stability of the Chebyshev Spectral Collocation Method for Non-Linear Partial Differential Equations on Rectangular and Polar Grids

Time: Session I-A 1:10pm TRUMBWR 305

Abstract: *Many non-linear partial differential equations (PDEs) can be used to model natural phenomena. To name a few, the heat equation describes the distribution of heat over time, the Schrdinger equation describes the energy spectrum of a system and how it changes over time, the Navier-Stokes equation describes the velocity profile of fluid over time, and so on. For some non-linear PDES, an analytic solution can only be obtained if special restrictions are imposed. As for the general solution, the audience seeks numerical solutions and hope for accuracy with a tolerable, if not zero, error. We investigate the numerical solutions of particular non-linear time-dependent PDEs via the Chebyshev Spectral Collocation Method. Since the domain of our problem may be complex, the coordinate system we choose may affect the numerical method selected; hence we also investigate the stability of this method on both rectangular and polar grids.*

Jenifer Hummer, University of Delaware

Title: High School Geometry Textbooks' Opportunities for Reasoning-and-Proving

Time: Session I-A 1:30pm TRUMBWR 305

Abstract: *Reform efforts in the U.S. have placed an emphasis on reasoning and proving. Yet, previous geometry textbook analyses have found limited opportunities for reasoning and proving and lack of opportunities to engage students in high levels of rigor. This analysis investigated how two high school geometry textbooks address proving geometric theorems. One textbook was recently revised to meet Common Core State Standards (CCSS). The other was written in response to suggestions of the CCSS. Like previous studies conducted with pre-Common Core textbooks, the findings for opportunities to construct proofs and engage students in high levels of rigor were less than expected. These findings suggest that publishers and practitioners need to ensure that students are given adequate opportunities to construct proofs and gain conceptual understanding.*

Hussein Awala, Temple University
Title: On the Proof of the Friendship Theorem
Time: Session I-A 1:50pm TRUMBWR 305
Abstract: *In this talk we will discuss the proof of the Friendship Theorem. The origin of the Theorem or who gave it the human touch is still unknown.The proof presented is due to Paul Erdos,Alfred Renyi and Vera Sos, this was first and most accomplished proof given for the problem, But several other proofs exist. The proof uses a combination of combinatorics, and linear algebra. I will after show, how this problem leads to the study of Kotzig's Conjecture. This lecture is appropriate for any undergraduate student in mathematics.*

Amy Strosser, Villanova University
Title: Expander Families and the Isoperimetric Constant
Time: Session I-A 2:10pm TRUMBWR 305
Abstract: *Families of expander graphs have applications in computer science, cryptography, and error-correcting codes and are widely studied in spectral graph theory. In this talk, I will define the isoperimetric constant and explain its relation to graph expansion. Expander families are graphs that are sparse in the number of edges, but are also highly connected in the sense that the diameter is logarithmic in the number of vertices. In terms of a communication network, this means that communication between vertices is fast, but the network itself does not require a large number of connections.*

Undergraduate Session I-B
TRUMBWR 311

Deion Floyd, Eli Halpern, University of the Sciences
Title: The History of Algorithms
Time: Session I-B 1:10pm TRUMBWR 311
Abstract: *In this talk, we will discuss how algorithms have developed over the centuries, starting with the ancient Babylonians. We will show how algorithms have developed in efficiency as a need for faster computation has emerged.*

Matt Marshall, Tori Lugiano, University of the Sciences
Title: Sudoko
Time: Session I-B 1:22pm TRUMBWR 311
Abstract: *This presentation features a brief history of Soduko as well as the mathematics behind solving the iconic puzzle.*

Brianna Mengini, Brielle Okulicz, Jaden Daubert, University of the Sciences
Title: The History of Knight's Tour
Time: Session I-B 1:34pm TRUMBWR 311
Abstract: *In this talk, we present the history of the Knight's tour. A Knight's tour is a sequence of moves of a knight on a chessboard such that the knight visits every square only once.The Knight must end on a square that is one move away from the starting point in order for it to be a closed Hamiltonian Cycle. We will explain how it is solved.*

Richard Lichtenwalner, Kutztown University of Pennsylvania
Title: An 'Unreal' Infinity
Time: Session I-B 1:46pm TRUMBWR 311
Abstract: *In this talk we will discuss what hyperreal numbers are, how to perform operations in the hyperreal number system, and when and where this system is useful to utilize. It will be shown how the reals are related to the hyperreals and proofs will be given for justification. Infinitely small numbers called infinitesimals will be used and explained as well as infinitely large numbers.*

Dylan Arthur Gaspar, Kutztown University
Title: A Steiner Optimization of the Cable Trench Problem
Time: Session I-B 1:58pm TRUMBWR 311
Abstract: *In the field of graph theory, the Cable Trench Problem is a spanning tree problem that combines two of the more basic graph-theoretic problems: the Minimum Spanning Tree Problem and the Shortest Path Spanning Tree Problem. We currently have ways to determine solutions to both of these problems with certainty and in a reasonable amount of time. However, solutions of instances of the Cable Trench Problem can only be found through heuristic means that only approximate the optimal solution. These current heuristics are very accurate for the problem. My research is to determine the extent to which these solutions can be optimized by adding what are known as Steiner points into the graph, allowing for more versatility in how the vertices of the graph can be connected. Early results are promising, with improvements of* 15% *or more over the optimal solutions that do not incorporate Steiner points.*

Brent Keath, John Gallagher, Eastern University
Title: Triangular Tchaikaillon-Toe on an Affine Honeycomb Matrix
Time: Session I-B 2:10pm TRUMBWR 311
Abstract: *You may have played common games as a child such as Tic-Tac-Toe, Mancala, and Chess, but have you ever thought about the mathematics behind them? In this talk we will make some adjustments to these three common games and look at some of the interesting mathematical concepts that come about from these changes. We will see what conclusions we can draw from playing and analyzing these new games. We not only hope to inform you about our own findings, but we also hope to encourage you to do some research of your own about a particular game and see if you can find new strategies or discover mathematical principles that result from it.*

Undergraduate Session I-C
TRUMBWR 347

Maria Colaciello, King's College
Title: Revised Star Axiom System
Time: Session I-C 12:58pm TRUMBWR 347
Abstract: *We will define the general properties of an axiom system and its parts: primitive terms, axioms, and theorems. Then we will examine a specific axiom system that is based on a picture of a five-point star. The information stated in the four provided axioms will be used to prove a theorem in the given axiom system. Additional topics include consistency models and independence models.*

Bridget McGowan, King's College
Title: An Axiom System
Time: Session I-C 1:10pm TRUMBWR 347
Abstract: *During our Freshman Year, one of the first math classes that we took was Logic and Axiomatics. In this class we were required to develop our own axiom systems. Now almost three years later we have revamped our original systems. Today we will discuss what an axiom system is, explore the different parts of the system, and prove a theorem in the axiom system.*

Alexandra Weidtman, King's College
Title: Axiom System
Time: Session I-C 1:22pm TRUMBWR 347
Abstract: *In this presentation, we will consider an axiom system that was developed for the completion of a major course. We will consider the axioms, theorems, consistency model, and independence models that were created for the axiom system, as well as some of the proofs involved.*

Kayla Feairheller, King's College
Title: The Arrow Axiom System
Time: Session I-C 1:34pm TRUMBWR 347
Abstract: *Understanding the primitive nature of things is quite important. Join me in exploring how we can use these understandings and assumptions to create something bigger and better!*

Sharon Flores, Kings College
Title: The Battle of the Avengers
Time: Session I-C 1:46pm TRUMBWR 347
Abstract: *We will look at an axiom system made by Sharon Flores and from this system we will look at theorems derived. We will work through select proofs for these theorems and see consistency models along with independence models. The theme of this talk is Avengers and Battles.*

Theresa Marlin, DeSales University
Title: Degree sequences of partial Halin graphs
Time: Session I-C 1:58pm TRUMBWR 347
Abstract: *A Halin graph is a planar graph $T \cup C$, where T is a tree with at least 4 vertices and no vertices of degree 2, and C is a cycle through the leaves of T. In this talk, we discuss the characterization of the degree sequences of Halin graphs. We then explore the degree sequences of partial Halin graphs, which are spanning subgraphs of Halin graphs. We describe the properties that are observed in a partial Halin graph degree sequence and examine how these properties are incorporated into a graphical realization of the sequence.*

Michael Gottstein, Misericordia University
Title: Application of linear algebra to calculus
Time: Session I-C 2:10pm TRUMBWR 347
Abstract: *We will use elementary linear algebra in order to see how we can make calculations from calculus simpler. Specifically, we will use a change of basis matrix to calculate integrals of trigonometric functions.*

Undergraduate Session I-D
SHNKWLR 234

Amanda Long, Elizabethtown College
Title: The Monty Hall Problem and its Variations
Time: Session I-D 1:10pm SHNKWLR 234
Abstract: *Once the focal point of extreme controversy, the Monty Hall Problem takes a jovial game show concept and delves deep into probability theory and strategy. The game provides contestants with a choice of three doors, one concealing a car and two concealing goats. If informed of the location of a goat, should the contestant switch his initial choice of doors? Decorated mathematicians argued which strategy (sticking with or switching your initial choice) would help the contestant win the lavish prize, with the decision to switch proving to hold the higher odds. Since then, countless variations exist, including a mixed strategy approach to a game with more doors, two groups of doors, and multiple reveals. This presentation elaborates on this particular variation.*

Michael DiBella, Elizabethtown College
Title: An Implementation of Modern Portfolio Theory with Excel
Time: Session I-D 1:22pm SHNKWLR 234
Abstract: *I will give an overview of the mathematical concepts implemented in Modern Portfolio Theory. The primary goal of this theory, as developed by Harry Markowitz, is to construct a portfolio that has the smallest variance given a desired level of return. I will also demonstrate an Excel program that I coded which utilizes this theory to calculate an efficient portfolio based on a user's risk aversion.*

Jess Lehr, Elizabethtown College
Title: Cryptanalysis of the Hill Cipher
Time: Session I-D 1:34pm SHNKWLR 234
Abstract: *The Hill cipher is a classical cipher based upon matrix multiplication. In 2007, Bauer and Millward completed a ciphertext-only attack in which they recovered the individual rows of the encrypting matrix to reduce the work previously necessary to recover the entire matrix at one time. In 2015, Leap et al. improved Bauer and Millwards attack by changing the scoring statistic to the Index of Coincidence, making it possible to score all members of entire classes of rows by testing a single member of each class and decreasing the necessary work by a factor of $\phi(L)$, where ϕ is the Euler totient function and L is the length of the alphabet. This paper presents further improvements by focusing attention on subsequences of the putative plaintext instead of the rows of the matrix, thereby making the search more efficient and more amenable to implementation on multiple computer processors.*

Collin Davidson, Elizabethtown College
Title: Scheduling an NHL Season Using Integer Programming
Time: Session I-D 1:46pm SHNKWLR 234
Abstract: *This paper examines the creation of a schedule of games and travel itineraries for a professional sports league by solving an integer program with the objective of minimizing travel costs for the entire league. Some basic examples will be discussed as well as the computational complexity of the integer program.*

Arielle Roth, Elizabethtown College
Title: Does the Infinite Sum of the Recipricols of Primes Converge or Diverge?
Time: Session I-D 1:58pm SHNKWLR 234
Abstract: *I will answer this question using Euler's Product Formula, Taylor's Theorem, and the Integral Test. We know that the harmonic series diverges, but if we look at the sum of the reciprocals of the perfect squares, that sum converges. Does the infinite sum of the reciprocals of the prime numbers converge or diverge?*

Samuel Edwards, Gettysburg College
Title: How Now Brown Tau: Finding Weakly Sum-Free Sets
Time: Session I-D 2:10pm SHNKWLR 234
Abstract: *We define a weakly zero-h-sum-free set as a set where no h-termed sum of distinct elements from the set equals* 0*. Given a group G and a non-negative integer h, we investigate the maximum size of a subset of G that is weakly zero-h-sum-free,denoted $\tau\hat{\{\ \}}(G,h) = \max\{|A|\ |A \subseteq G, 0 \notin h\hat{\{\ \}}A\}$. We focus on the group $\mathbb{Z}_2^r$ and $h \geq 3$. The group $\mathbb{Z}_2^r$ is very special since it can be viewed as an r-dimensional vector space over the group $\mathbb{Z}_2$. This has many applications, especially in coding theory.*

Undergraduate Session I-E
SHNKWLR 340

Theresa Dewa, Carmela Straiton, Arcadia University
Title: Assessing the accuracy of Arcadia Universitys math placement test
Time: Session I-E 1:10pm SHNKWLR 340
Abstract: *Two years ago, Arcadia University revised the math placement test it gives to incoming students to see if they are ready to take calculus. We present the results of our analysis comparing the predictive ability of the new and old versions of the test.*

Liyuan (Hobbs) Zhang, Arcadia University
Title: Using the Buhlmann Technique to Analyze Credibility
Time: Session I-E 1:22pm SHNKWLR 340
Abstract: *Credibility theory refers to the quantitative methods insurers use to adjust future premiums for policyholders based on past experience. We will review the Buhlmann Technique for calculating credibility.*

Zhenbang Wang, Arcadia University
Title: Actual versus Effective Sample Size
Time: Session I-E 1:34pm SHNKWLR 340
Abstract: *Data are often clustered, such as students in classrooms. In this case, the effective sample size, which is a function of the intraclass correlation coefficient, is less than the actual sample size. My R-based simulations demonstrate that researchers should use the effective sample size in order to preserve accurate Type-I error rates.*

LinXing Yao, Arcadia University
Title: A calculus students dream: $(f(x) \cdot g(x))' = f'(x) \cdot g'(x)$ and $(f(g(x)))' = f'(g'(x))$
Time: Session I-E 1:46pm SHNKWLR 340
Abstract: *We investigate functions that satisfy the nave (and wrong) chain and product rules for derivatives. The key tools for this study are the notions of autonomous differential equations, iterations of functions, and periodic functions.*

Ronald Berna, Villanova University

Title: Modeling the 2013-2015 Ebola Outbreak in West Africa Using Differential Equations of SIR Form and Markov Matrices

Time: Session I-E 1:58pm SHNKWLR 340

Abstract: *The 2014-2016 Ebola outbreak in West Africa has been unprecedented in both epidemic size and geographic area affected, infecting over 27,000 individuals in Sierra Leone, Guinea, and Liberia. Despite the efforts of Doctors Without Borders and the World Health Organization, containment had been difficult due to political instability, a lack of medical infrastructure, public mistrust of health officials, and movement. Many modeling approaches for the epidemic have been attempted. We used an SIR model of time-dependent differential equations to model the spread of the current outbreak. Moreover, a hybrid model incorporating Markov matrix manipulation was utilized to mimic more reasonable, isolated population movement. With data from the current epidemic, these models were used to examine the implementation of proper burial practices, the effect of earlier or later intervention, and the optimal quarantine practices in order to assist present efforts and guide public health efforts in future outbreaks.*

Brandon Schneider, Muhlenberg College

Title: Expected Values for Time Until Untenability in Plya Urns

Time: Session I-E 2:10pm SHNKWLR 340

Abstract: *Plya urns have applications ranging from epidemiology and diminishing resources. The model consists of an urn containing a finite number of white and black balls. A ball is drawn from the earn, and depending on the color, a replacement rule is put into effect. An untenable state is reached when it is no longer possible to draw balls from the urn. This talk will explore the expected value of the number of draws to reach an untenable state.*