Eastern Pennsylvania and Delaware Section of the
Mathematical Association of America

Student Contributed Paper Session Abstracts

Delaware Valley University

November 14, 2015

Student Speakers

Undergraduate Session I-A
LFSC 101

Catherine Deng, Gia Storti, University of the Sciences
Title: The Tower of Hanoi
Time: Session I-A 1:10pm LFSC 101
Abstract: *The Tower of Hanoi is a well-known game that involves 3 pegs and a variable amount of discs. We will discuss the history and the logistics of the puzzle in addition to the different methods of how mathematics can be applied in order to solve the puzzle. The minimum number of moves to solve the puzzle is also found mathematically, dependent on the number of discs present. There are also variations of the original puzzle that we will introduce.*

Sabal Yousef, Ryan Paulukinas, University of the Sciences in Philadelphia
Title: Pascal's Triangle
Time: Session I-A 1:23pm LFSC 101
Abstract: *Pascal's triangle was named for Blaise Pascal, a* 17^{th} *century mathematician. However, the theory dates much further back through Chinese origins, as a Chinese mathematician by the name of Jia Xian created this triangular representation of coefficients. In this talk, we will give the general history behind Pascal's Triangle and its uses in other subjects. To form the pattern, begin with 1 followed by a row of two 1's. Afterwards each value is calculated by summing the values of the two diagonal preceding numbers above. Based on this, any end values would result in 1. Pascal's triangle can be used to determine the coefficients in binomial expansions. There are also many reoccurring patterns like the hockey stick pattern, hidden hexagon squares, diagonals, the fibonacci sequence, and the Sierpinski triangle. Major fields to which Pascal's triangle can be applied to are algebra, probability, and number theory.*

Luke Conover, Taylor Scott, University of the Sciences in Philadelphia
Title: Fibonacci Sequence
Time: Session I-A 1:36pm LFSC 101
Abstract: *In this presentation, we will be discussing the Fibonacci Sequence. the history, mathematics, and applications of the topic will be discussed.*

Amy Lai, Kimberly Waters, University of the Sciences in Philadelphia
Title: A Mathematical Analysis of M.C Eschers Art
Time: Session I-A 1:49pm LFSC 101
Abstract: *While it is recognized that the art of M.C. Escher had mathematical influence, the full role of mathematics is often not recognized. Although Escher had no formal, upper-level education in mathematics, he often examined published material and spoke with mathematical experts of the time to incorporate this field into his work. Some of the overlooked elements of Escher's work include tessellations, platonic solids, hyperbolic space, and topology. This presentation will examine some of these components in more depth and show the relation to Eschers work.*

Dylan Tomares, Barbara Rojas, University of the Sciences in Philadelphia
Title: Triangulation: The History of Global Positioning
Time: Session I-A 2:02pm LFSC 101
Abstract: *The Global Positioning System (GPS) is a satellite-based navigation system that helps provide information on location. We use GPS mostly to help us find our way from place to place. GPS follows the same methods of triangulation that were performed manually for over 400 years before. Most of the journeys out at sea depended on precise triangulation. Triangulation first appeared as a method for making maps in the mid 1500s, introduced by the Flemish mathematician Gemma Frisius. For this presentation we will discuss the importance of triangulation and the mathematics behind the process.*

Courtney Messenger, Edwin Fluck , University of the Sciences
Title: The History and Concepts of Infinity
Time: Session I-A 2:15pm LFSC 101
Abstract: *In this presentation, we will be talking about the history of the concept of infinity as it has progressed through the millennia. It was a brainchild of the early philosophers and dates back to 490 BC. Throughout the eras, infinity moved from a concept in philosophy to a theory in mathematics. Today, mathematicians use the concept of infinity to reason through modern day scenarios. We will be focusing on thought provoking applications of infinity.*

Undergraduate Session I-B
LFSC 102

J.T. Ferrara, Bucknell University
Title: Constructive Galois Theory with Linear Algebraic Groups
Time: Session I-B 1:10pm LFSC 102
Abstract: *A fundamental aspect of the Inverse Galois Problem is describing all extensions of a base field K with a given Galois group G. A constructive approach to this problem involves the theory of generic polynomials. In our work, we show the existence of and explicitly construct generic polynomials for various groups, over fields of positive characteristic. The methods we develop apply to a broad class of connected linear algebraic groups defined over finite fields satisfying certain conditions on cohomology. In particular, we use our techniques to study constructions for unipotent groups, certain algebraic tori and solvable groups, and symplectic groups. An attractive consequence of our work is the construction of generic polynomials in the optimal number of parameters for all cyclic 2-groups over most fields of positive characteristic. This contrasts with a theorem of Lenstra, which states no cyclic 2-group of order ≥ 8 has a generic polynomial over $\mathbb{Q}$.*

Trevor Adriaanse, Bucknell University
Title: Predicting Alzheimer's Disease with Microarray Gene Expression Data
Time: Session I-B 1:23pm LFSC 102
Abstract: *Alzheimer's disease is a neurological disorder chiefly present in the elderly that affects functions of the brain such as memory and logic, eventually resulting in death. There is no known cure to Alzheimer's and evidence points to the possibility of a genetic link. This study analyzes microarray data from patients with Alzheimer's disease and disease-free patients in order to evaluate and determine differential gene expression patterns between the two groups. The statistical problem stemming from this data involves many predictor variables with a small sample size, preventing the use of classical statistical approaches from being effective. We use a novel three-step approach: first, we screen the genes in order to keep only the genes marginally related to the outcome; second, we implement a sparse sufficient dimension reduction to retain only predictors relevant to the outcome; lastly, we perform a hierarchical clustering method to group genes that exhibit mutual dependence.*

Elizabeth Bloom , Nick Mandarano, Saint Joseph's University
Title: Multiple Sclerosis, Lattitude, and Sunlight: Developing Correlations between MS and the Latitude Theory
Time: Session I-B 1:36pm LFSC 102
Abstract: *Multiple Sclerosis (MS) is a neurological disease in which the flow of information within the brain is slowed. The foundation of our work is based on the hypothesis that Multiple Sclerosis becomes more prevalent as distance grows from the equator. After using an optimization technique to calculate a weighted population center for several countries, we plotted those locations against country prevalence and ran regression models. The regressions suggested a positive linear relationship between distance from equator and MS prevalence. While this data does not confirm causation, it indicates a relationship between the sunlight exposure and the onset of MS. This data is consistent in suggesting an environmental cause, particularly Vitamin D deficiency, as a root of MS.*

Samuel Edwards, Gettysburg College
Title: How Now Brown Tau: Finding Weakly Sum-Free Sets
Time: Session I-B 1:49pm LFSC 102
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. In this presentation, we specifically focus on the groups that are the countable Cartesian products of the cyclic group of order 2. These groups are very special since they can be viewed as an r-dimensional vector space over the cyclic group of order 2. This has many applications, especially in coding theory.*

Aawaz Raj Pokhrel, Gettysburg College
Title: Minimum size of spanning set in finite cyclic group
Time: Session I-B 2:02pm LFSC 102
Abstract: *Within finite Abelian groups,a subset $A \subseteq G$ is said to span G if the h- fold span,denoted $h \pm A$ is exactly equal to G.Here we explore the minimum size of such spanning set for cyclic groups..This quantity is denoted by $\phi \pm (G, h)$.We will discuss on the conjecture of the value of h which spans the entire set with only two set element subset*

Undergraduate Session I-C
LFSC 103

Christopher Tran, Arthur Newell, Delaware State University
Title: Brownian Dynamics of a Charged Particle Passing Through a Magnetic Plate
Time: Session I-C 1:10pm LFSC 103
Abstract: *We seek to study the Brownian motion of charged particles passing through magnetic obstacles of different shapes. We will study the effect that such a field may have on the particles and what role noise has in this system. The equations that describe the dynamics of the particle are a coupled set of stochastic quasi linear differential equations with additive noise. In general, these equations cannot be solved analytically and thus we will find their solution numerically. Our results show that the shape along with the noise affects the particle's path.*

Lauren Rusiloski, Delaware Valley University
Title: Effects of Fourier Series and Transformations on Chemistry
Time: Session I-C 1:23pm LFSC 103
Abstract: *Chemistry often involves the measurement of properties which are the aggregate of many fundamental processes. A variety of techniques have been developed for extracting information about these underlying processes. Fourier analysis is one of the most important and is very widely used in crystallography, X-ray adsorption spectroscopy, NMR, vibrational spectroscopy (FTIR) etc... In our study of Fourier analysis concept of Fourier Transform is introduced, Fourier Transforms of some common functions are considered. We will learn more about the how to deal with discrete data through the use of a Discrete Fourier Transform, basics of filtering methodology and convolution via the Frequency domain The software MATLAB is applied to investigate numerically and graphically results obtained. Results have direct applications in NMR spectroscopy, seismology, circuits, signal processing, control theory, and other technical areas.*

Karla Keler, Ruth Trubnik, Delaware Valley University
Title: Prescribing Drug Dosage
Time: Session I-C 1:36pm LFSC 103
Abstract: *"Prescribing drug dosage" Karla Keler Delaware Valley University Abstract Problem Identification: How can the doses and the time between doses be adjusted to maintain a safe but effective concentration of the drug in the blood The concentration in the blood resulting from a single dose of a drug normally decreases with time as drug is eliminated from the body. We are interested in what happens to the concentration of the drug as doses are given at regular intervals. The goal is: How to Schedule for a Safe but effective Drug Concentration. For most drugs there is concentration below which the drug is ineffective and a concentration above which the drug is dangerous. How can the dose and the time between doses be adjusted to maintain a safe but effective concentration? In this study we consider two cases : drug injected directly into the bloodstream and drug taken orally. The software MATLAB is applied to investigate numerically and graphically results obtained.*

Erin Nese, Ruth Trubnik, Delaware Valley University
Title: Mathematical Modeling in the Food Industry: A Model of Heat Transfer by Conduction
Time: Session I-C 1:49pm LFSC 103
Abstract: *Heat transfer is one of the most important and most common engineering disciplines in food processing. There are many unit operations in the food industry where steady or unsteady state heat transfer takes place such as sterilization, dehydration, and freezing. Heat transfer in these operations is of vital importance and affects the design of equipment, safety, nutritional and sensory aspects of the product. This research is focused on mathematical modeling of heat transfer by conduction. A general rule for proceeding is followed and two models are applied. The equations of heat flow in a rod and spherical coordinates are studied. The software MATLAB is applied to numerically and graphically investigate temperature distribution that results from various values of thermal diffusivity constants. Ultimately, the study results in a relationship between mathematics and food science, building on the knowledge of heat transfer.*

Undergraduate Session I-D
LFSC 104

Craig Siekierka, Misericordia University
Title: Reimann Sums
Time: Session I-D 1:10pm LFSC 104
Abstract: *"If $\sum a_n$ is conditionally convergent and $r \in R$, then there exists a rearrangement of terms of $\sum a_n$ that converges to r." I will explain, using the harmonic series, how the limit of an infinite series can be whatever you choose the sum to be by simply rearranging the order that you add the terms. I am writing a computer program to demonstrate this theorem.*

Sharif Moustafa, Muhlenberg College
Title: On the Differences between Consecutive Prime and Semi-prime Numbers
Time: Session I-D 1:23pm LFSC 104
Abstract: *This talk shows that the average of the first n terms in the OEIS (On-line Encyclopedia of Integer Sequences) sequence A001223, the difference between consecutive primes, is on the order of $O(\log(n))$. Furthermore, the behavior of several interesting variations on A001223 are explored and discussed.*

Shantel Silva, Villanova University
Title: Completely Puzzling Latin Squares
Time: Session I-D 1:36pm LFSC 104
Abstract: *Mathematical mysteries arise from the simplest of everyday problems. Who knew a quilting circle could set the perfect setting for a discussion on Latin squares? In combinatorics, a Latin square is an $n \times n$ array filled with n different symbols, each occurring only once in each row and once in each column. A Latin square is row complete if every sequence of two distinct values appears exactly once in the rows of the square. For example, if the sequence (1,2) appears in the first row, 2 will never follow 1 in any of the other rows. In this talk, we will discuss the perplexing problems that arise when constructing row complete Latin squares of various sizes.*

Jiao Xu, Kutztown University
Title: Coinbinatorics
Time: Session I-D 1:49pm LFSC 104
Abstract: *Its a rainy afternoon, Sara and Joe develop a small game to pass the time: they take a fair coin and label one side with 1 and the other with 2. They take turns to toss the coin, and each of them records the sum of the numbers obtained from the coin throws separately. The first person to reach a sum of 86 or beyond is the winner. It is apparent that if Sara goes first, she will have a small advantage over Joe. But how small is her advantage? We will find out in this talk!*

Graduate Session I-E
LFSC 105

Shana Brown, Delaware State University
Title: Graph Cut Energy Minimization Techniques for Image Segmentation
Time: Session I-E 1:10pm LFSC 105
Abstract: *In this paper we use graph cut methods to solve the image segmentation problem. Image segmentation is used to partition pixels of an image that have a strong correlation (color, intensity, texture) into different regions such as object and background. Graph cut algorithms are efficient ways to solve computer vision and computer graphics problems. They use a graph model to represent the visual content and identify the optimal cuts that divide the image into regions by energy function optimization. The energy function includes a data and a smoothness term, and is embedded in a weighted and directed graph. The optimal solution is obtained by finding a minimum cut. We study and compare multiple graph cut techniques including methods that approximate geodesic distances for segmentation. Next, we measure segmentation accuracy using a function of the color error, regions size, and number of final regions.*

Ryan Evans, University of Delaware
Title: Reaction Kinetics in Optical Biosensors
Time: Session I-E 1:30pm LFSC 105
Abstract: *Many chemical reactions of interest in biological systems involve a stream of chemical reactants flowing through a fluid-filled volume. Such surface-volume reactions occur during blood clotting and drug absorption. Scientists simulate these reactions experimentally in an optical biosenor, an instrument in which reactants are convected through a flow cell, over a surface to which other reactants are confined. In this talk we discuss a mathematical model for surface-volume reactions in optical biosensors that involve multiple simultaneous. We will also summarize some preliminary results.*

Matthew N. Moore, Delaware State University
Title: Analysis of the Chebyshev Spectral Collocation Method for Numerical Solutions of Non-Linear Partial Differential Equations
Time: Session I-E 1:50pm LFSC 105
Abstract: *Partial differential equations (PDE's) play a major role in fields including physics, engineering, biology, chemistry, business and modeling. The difficulty of PDE's is that analytic or exact solutions can be obtained only in particular instances, which leads to the importance of numerical methods for PDE's. For practical purposes, a few things need to be considered to determine the proper numerical method to apply to the problem of interest. The considerations are: rate of convergence and ease of implementation. We consider a scheme known as spectral methods, which are known to have a high rate of convergence for solutions of PDE's. A downside to spectral methods is that they are sometimes difficult to implement. We investigate what is known as the Chebyshev spectral collocation method and discuss its relationship to other spectral methods and its advantage in implementation over the other methods. We also include numerical results of various non-linear PDE's.*

Azubuike Okorie, Delaware State University
Title: Synthetic Shape Segmentation using Snakes
Time: Session I-E 2:10pm LFSC 105
Abstract: *Snakes are energy minimizing parametric contours guided by internal, external, and image-based forces. They are designed to converge to lines and edges which are attributes of object boundaries. They are used extensively in computer vision and medical image analysis to locate objects of interest in images. In this work we apply active contour segmentation to synthetic white shapes on a dark background. We examine the effect of different shapes, initialization, and addition of noise on the convergence of active contours. We also investigate the effects of variations of snake parameters; more specifically how the parameter values of elasticity, rigidity, viscosity, and external force weight influence the convergence to final solution. We study the numerical scheme of the snake PDE, and combine the theoretical insights with our findings from our shape delineation experiments to predict the range of values for which these parameters are more likely to produce good numerical solutions.*