Eastern Pennsylvania and Delaware Section of the
Mathematical Association of America

Student Contributed Paper Session Abstracts

Franklin & Marshall College

March 14, 2015

Student Speakers

Graduate Session I-A
STA 105

Eric Stachura, Temple University
Title: The Physics (and Mathematics) of Negative Refraction
Time: Session I-A 1:40pm STA 105
Abstract: *The notion of Negative Refraction goes back to the work of the Russian Physicist Victor Veselago in the 1960's. Negative Refraction deals with the propagation of light in a substance which has a negative refractive index. It was not until the early 2000's that it was experimentally verified that such substances can be created in the laboratory- they (as of now) do not exist in nature. The realm of application of such materials is tremendous; for instance, such materials have the ability to focus light perfectly (this is the notion of a "superlens"). In this talk I will discuss some differences between negative refractive index materials and standard ones (i.e. those having positive refractive index), including the Snell Law of Refraction and Fermat's principle of least action. I will end by discussing applications of this line of research, including to the study of nonlinear Partial Differential Equations.*

Andre Strong, Amadou Hama, Delaware State University
Title: Bayesian and k-Nearest Neighbor Classification for Detection of Breast Cancer and Osteoporosis
Time: Session I-A 2:00pm STA 105
Abstract: *In this work we present statistical pattern recognition techniques to detect breast cancer and bone disease (osteoporosis) using i) Bayesian and ii) k-Nearest Neighbor classification with leave-one-out cross-validation. For the bone dataset we calculate textural image features, namely Laws features and edge histogram features. In the Bayesian approach we use multivariate Gaussian distributions to approximate the probability density function of each class (healthy, diseased). We then use the Bayesian decision rule to classify samples. This approach yielded a classification accuracy of approximately 93% on the UCI breast cancer dataset and 83% on the TCB bone dataset. The k-nearest neighbor technique identifies the closest k samples to the query sample using the Euclidean distance in the utilized feature space and then applies majority voting to predict the label of query sample. This method produced an accuracy rate of 58% on Bone data and 97% on breast cancer data.*

Matthew Neil Moore, Delaware State University
Title: The Application of Normalized Graph Cut Partitioning to Image Registration
Time: Session I-A 2:20pm STA 105
Abstract: *Image registration is a major research topic in the fields of image processing, computer vision, and biological and medical imaging. The objective of image registration is to find an approximate or ideally-exact geometric transformation between two images of the same scene or object, known as the reference and source images. The reference and source images in this problem have typically been acquired under varying conditions, so they may include viewpoint, sensor, and temporal variations. One may choose a linear transformation model to identify global misalignments, or an elastic model to address local deformations of the visual scene in the most general scenario. In this talk, we discuss the use of image segmentation, i.e. the partitioning of images into regions, for the image registration process. We investigate how segmentation may be affected by particular transformations, rigid or elastic, and propose a segmentation-based image registration algorithm.*

Ryan Evans, University of Delaware
Title: The Sixty-Six Billion Dollar Eigenvector
Time: Session I-A 2:40pm STA 105
Abstract: *The web-giant Google is one of the highest grossing web-sites, bringing in sixty-six billion dollars in revenue in 2014 alone. It is hard to imagine that a simple eigenvector problem lies at the heart of the companys success. In this talk we will review Googles PageRank algorithm, which turns out to be a standard application of linear algebra. This talk will be based on "The Twenty-Five Million Dollar Eigenvector: Linear Algebra Behind Google" by Kurt Bryan and Tanya Leise.*

Undergraduate Session I-B
STA 109

Stefan Busheski, Franklin and Marshall College
Title: From Quantum Mechanics to Financial Modelling
Time: Session I-B 1:40pm STA 109
Abstract: *Based on the principles of Quantum Mechanics we can build a mathematical model to describe the financial market. Utilizing the wave functions with the corresponding operators of the stock market, one can derive the Schrodinger equation to describe the stock price. This quantum model of the stock market is useful in calculating the expectation value of the rate of return and making predictions on the probability of the distribution of the Schrodinger equation i.e. the price fluctuation of the stock as a function with respect to time.*

Kathryn Sutcliffe, Elizabethtown College

Title: Optimal Strategies for Probability Bingo
Time: Session I-B 1:55pm STA 109
Abstract: *Probability Bingo is a variation of bingo with an element of strategy. Players choose their own numbers for their cards, and random numbers are generated by summing the pips on the upfaces of a pair of rolled dice. This talk explains optimal strategies by viewing the game as a coupon collecting problem.*

Cara Sulyok, Ursinus College

Title: Optimal Controls in a Mathematical Model of Agroecosystems
Time: Session I-B 2:10pm STA 109
Abstract: *Alfalfa is the most cultivated forage legume in the world and is used primarily to feed cattle. A pest, the potato leafhopper (PLH), causes costly damage to the host-plant alfalfa and chemical pesticides are unsafe. The goal is to investigate alternative farming techniques for pest management to minimize the alfalfa damage. More precisely, based on data and results from field experiments that integrate predators and polyculture farming (plant diversity) approaches, this project developed a mathematical model for designing cost-effective and environmentally-safe control strategies to minimize the plant damage. The mathematical model of a system of non-linear differential equations was created and shown to accurately fit results from open-field experiments and predict outcomes for scenarios not covered by experiments. Optimal control theory, including Bang-Bang controls, was used to determine optimal and practical pest management strategies to minimize the plant damage and the impact on revenues from milk production for farmers.*

Thyme Greenfield, Bloomsburg University

Title: Comparing Canonical and Non-Canonical Link Functions in Generalized Linear Models
Time: Session I-B 2:25pm STA 109
Abstract: *One of the most important statistical tools in prediction is the Generalized Linear Models (GLM). A GLM consists of three components; the outcome variable, a set of explanatory variables, and a link function relating the outcome variable to the mean of a linear combination of the explanatory variables. If the distribution of the outcome variable belongs to the exponential family, there is a natural choice of the link function called 'canonical'. However, in some cases it may be advantageous to utilize a non-canonical link. Here we present a simulation study of a comparison of canonical and non-canonical link functions. We consider two types of outcomes, namely binary and ordinal. Both canonical and non-canonical link functions are used and model adequacy is assessed. A computer program in R is developed for this comparison. It is found that the performance of non-canonical and canonical link functions is about the same.*

Undergraduate Session I-C
STA 110

Emily Nguyen, Muhlenberg College
Title: Computing the Dimension of Cantor Sets
Time: Session I-C 1:40pm STA 110
Abstract: *Zaremba conjectured that every natural number is the denominator of a reduced finite continued fraction with absolutely bounded partial quotients. We can pose similar questions about the set of continued fractions whose partial quotients belong to a subset of the natural numbers, or an alphabet. To investigate these questions, we must consider the dimension of the Cantor set of continued fractions with partial quotients belonging to the alphabet. In particular, Bourgain and Kontorovich have considered the Hausdorff dimension of these Cantor sets in their investigation of Zarembas conjecture. In this talk, I will discuss a method for calculating the dimension of the Cantor set. We are indebted to Bumby for this method, which was later improved upon by Jenkinson and Pollicott.*

Jeremy Fus, Muhlenberg College
Title: n-Pythagorean Triples
Time: Session I-C 1:55pm STA 110
Abstract: *We generalize the idea of Pythagorean triples to n-Pythagorean triples; that is, triples (a, b, c) that satisfy $a^2 + b^2 = nc^2$ for some square free integer n. Each n-Pythagorean triple, x, is a solution to $Q(x) = 0$, where Q is the quadratic form $Q(x, y, z) = x^2 + y^2 - nz^2$. We prove by descent that the orthogonal group of the 2-Pythagorean quadratic form acts transitively on the primitive null vectors of Q in $\mathbb{Z}^3$.*

Eric Chavis, Muhlenberg College
Title: Introduction to APBRmetrics
Time: Session I-C 2:10pm STA 110
Abstract: *In this talk, we will cover the basic tenets of APBRmetrics, which can be viewed as the basketball analog to sabermetrics. Through case studies of different teams and players, we will see how player statistics such as WOR, offensive rating, and defensive rating, relate to different team-dependent statistics and overall team success. We will also discover what statistics should be most valued when building a basketball team, which will lead into a discussion of under/overvalued players in the NBA.*

Undergraduate Session I-D
STA 114

Franklin Loeb, Arcadia University
Title: The danger of ignoring hierarchical data
Time: Session I-D 1:40pm STA 114
Abstract: *We will give an introduction to Hierarchical Linear Modeling, including the rationale for its development, its applications, and some of its limitations. Secondarily we will present the results of our Monte Carlo Simulation showing how multilevel data influences the true type I error rate of one sample t-tests.*

Stephanie Roscher, Xinling Wang, Arcadia University
Title: Imputation and related statistical methods
Time: Session I-D 1:52pm STA 114
Abstract: *We will review several methods for dealing with missing data, including list-wise and pair-wise deletion, mean substitution, regression, and multiple imputation. We will also present our findings regarding the relative accuracy of these techniques.*

Matthew Hoffman , Arcadia University
Title: Outlaw p-values and confidence intervals? The current debate
Time: Session I-D 2:04pm STA 114
Abstract: *Just last month, the journal Basic and Applied Social Psychology issued an editorial banning p-values and confidence intervals from all future papers. Instead, they favor the use of descriptive statistics and measures of effect size. Needless to say, this has initiated a heated debate among statisticians. This talk reviews this debate and presents some related measures of effect size.*

Elizabeth Begley, Xi Xia , Arcadia University
Title: Statistical techniques for balancing samples
Time: Session I-D 2:16pm STA 114
Abstract: *Propensity scores represent the conditional probability of being in the treatment group given the covariate(s). They are used to match the control and treatment groups in the statistical analysis of observational data. We will review several techniques related to propensity scores and will compare them to other techniques including ANCOVA.*

QianYi Cheng, Yimeng Zhang, Yaxuan Zhou, Arcadia University
Title: Using the efficient frontier model to optimize investment portfolios
Time: Session I-D 2:28pm STA 114
Abstract: *Modeling Portfolios is an important topic in financial and actuarial fields. An investors goal for investing is a combination of stocks is to minimize the risk and maximize the returns of profits. Our talk identifies the most efficient portfolio based on the efficient frontier model.*

Eric Macchi, Yihao Gu, Arcadia University
Title: Does auto- insurance red-lining still exist?
Time: Session I-D 2:40pm STA 114
Abstract: *The existence of insurance redlining, charging higher premiums in either low-income or minority neighborhoods, continues to be a controversial topic in the automobile insurance industry. In our actuarial study, we look at country-wide data to determine if automobile insurance is less affordable and/or less available for minority and low income insureds.*