Blackwell-Tapia Conference
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POSTERS

Ron Buckmire
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"On Numerical Solutions of a Nonlinear Heat Equation with Square Root Reaction Term"

Interest in calculating numerical solutions of a highly nonlinear parabolic partial differential equation with fractional power dissipative terms that occurs in plasma physics motivated an investigation of the heat equation with a square root dissipative term. Analysis of the numerical behavior of solutions of a corresponding ordinary differential equation with square root terms is conducted. Nonstandard finite differences are utilized in the approximation of numerical solutions to both the model ordinary and partial differential equations. Numerical results are obtained, presented and analyzed.

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"Appreciating the Connections Between Cultural Diversity and Mathematics: The Mathematics of the Inca"

The Inca Empire - the greatest pre-Columbian empire on the American continent - extended from Ecuador to central Chile for more than eight thousand kilometers. Its capital Cuzco was established in the high Peruvian Andes.

This highly advanced civilization developed a decimal system used to run the empire - in particular, to build the 22,500 kilometer road structure and monumental architecture.

Classroom activities, involving the mathematics of the Inca, for the course "Mathematics in Non-European Cultures" for non mathematics and science majors offered at Millersville University of Pennsylvania, will be presented.

Lyrial Chism
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"On Independence Polynomials and Independence Equivalence in Graphs"

Michelle Craddock
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"Geometric Properties Inherited from Banach Lattices to Fremlin and Wittstock Tensor Products"

Edray Herber Goins
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"Using Parallel Computing to Search for High Rank Elliptic Curves"

An elliptic curve is a certain type of cubic polynomial equation. The "rank" of such a curve is a measure of the number of rational points. This project seeks to find curves with "large" rank by sieving through several hundreds of millions of examples. The mathematical theory demands that, for each example, one search for points on thousands of related quartic curves. For the computing application we use a high performance computing cluster and distribute the search load. This project was joint work with Shweta Gupte and Jamie Weigandt, done under the supervision of Edray Goins.

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"Approximation of Discontinuous Solutions in Fully Convex Optimal Control Problems"

Silvia Jimenez
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"Local fields in Nonlinear Power Law Materials"

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"Inversion Algorithm for the Distorted Circle and Line Source Trajectory"

Computed Tomography is presently one of the most prominent and efficient medical imaging modalities. The principle is to recover the inner structure of an object given its line integrals along a set of lines intersecting a curve. The curve is usually referred to as source trajectory, and the line integrals are obtained by sending an X-ray beam through the object. The image is reconstructed via inversion of the acquired cone beam data. We propose an exact filtered backprojection algorithm for inversion of the cone beam data when the x-ray source trajectory is composed of a distorted circle and a line segment. The length of the scan is determined by the region of interest, and it is independent of the size of the object. With few geometric restrictions on the curve, we show that we have an exact reconstruction. Numerical experiments demonstrate good image quality.

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"Towards a Theoretical Framework of Urban Growth"

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"A Note on Length-Biased and Current Duration Sampling"

In the analysis of longitudinal data, two semi-parametric models that are often used are the Cox proportional hazards model and the accelerated failure time model. In Cox proportional hazards model for failure time, one assumes that the covariate effect is captured via a proportional constant between hazard functions, with unspecified underlying hazard functions. In accelerated hazards model, the hazards functions are related via the scale–time change, which is a function of covariates and the parameters. In a medical setting, current duration sampling require knowledge of the duration of the disease of a group of patients up to the present, but length-biased sampling requires time needed to observe the full duration of the disease of the sampled patients. In this talk, some results on current duration and length-biased sampling for the accelerated failure time model and Cox proportional hazards model are presented.

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"Evaluation of Rotavirus Models with Coinfection and Vaccination"

Rotavirus diarrhea causes a disproportionate amount of the world's childhood mortality. Approximately 611,000 children die each year due to complications of rotavirus infections. In this study we evaluate rotavirus vaccination using four different methods. We look at the epidemiological history of the disease and vaccination against the disease, then we evaluate the effectiveness of vaccination first using a cost-benefit analysis, then using an ordinary differential equations-based model, and last through computer simulations in Matlab.

We do a traditional cost-benefit analysis as suggested by the Public Health Service of the United States to evaluate the costs and benefits of implementing a rotavirus vaccination program in Egypt with the RotaRix vaccine. Our results show that given the current standards of care in Egypt, it would be more cost-beneficial for Egypt not to use the rotavirus vaccine.

We formulate a model of the spread of rotavirus diarrhea based on a continuous time ordinary differential equations model of two viral strains of influenza. We expand this influenza model to include the case of co-infection. We further expand the original model to explore the effects of vaccination.

We used computer simulations to further analyze the effect of vaccination as a control method. These simulations show that the spread of the disease is highly sensitive to the levels of cross-immunity between the strains, and the level of vaccination in the population. We found that the dynamics observed in the new model are similar to the dynamics observed in the original model. We found the minimum levels of vaccination necessary in this model to eradicate severe rotavirus disease and minimum levels of cross-immunity between the strains.

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"Underreporting in the Generalized Poisson Regression Model"

Daniel Rios-Doria
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"Spatial and Temporal Dynamics of Rubella in Peru, 1997-2006"

Kimberly Sellers
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"Introducing Conway-Maxwell-Poisson Regression for Modeling Count Data"

Poisson regression is a popular tool for modeling count data and is applied in a vast array of applications from the social to the physical sciences and beyond. Real data, however, are often over- or under-dispersed and thus are not conducive to Poisson regression. We propose a regression model based on the Conway-Maxwell-Poisson (CMP) distribution to address this problem. The CMP regression generalizes the well-known Poisson and logistic regression models and is suitable for fitting count data with a wide range of dispersion levels. Taking a GLM approach and taking advantage of exponential family properties, we discuss model estimation and inference, and illustrate the usefulness of CMP regression with real datasets.

Authors: Kimberly F. Sellers (Georgetown University), and Galit Shmueli (University of Maryland College Park)

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Alberto Teguia
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"A Mathematical Theory of Stochastic Microlensing"

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"Modeling the Mechanical Properties of Large Ovine Arterial Walls Using both In-vivo and In-vitro Data"

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"A Complete Solution to the Generalized Climbing Stairs Problem"
Edray Herber Goins, Department of Mathematics, Purdue University Talitha M. Washington, Department of Mathematics, University of Evansville

Let S be a subset of the positive integers and M be a positive integer. Mohammad K. Azarian, inspired by work of Tony Colledge, considered the number of ways to climb a staircase containing n stairs using "step-sizes" s € S and multiplicities at most M. In this project, we find a solution via generating functions, i.e., an expression that counts the number of partitions of $n = \sum_{s \in S} m_s$ s satisfying $0 \leq m_s \leq M$. We use this to answer a series of questions posed by Azarian and we conclude by posing an open problem.

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"African American Women in Mathematics"

As an African American woman studying mathematics I have noticed the lack of other African American woman in my math courses. Even though the number of African American men in these courses is very small as well, it is still significantly larger than that of woman and I am curious and excited to find out why this occurs. Since there continues to be studies that show the same trends of African American students falling behind their peers when it comes to mathematics I believe that there are answers to why this occurs and what can be implemented in the classroom to change these statistics (Ambrose, Levi, & Fennema, 1997). For these reasons I have explored my proposed questions more deeply in the African American Women in Mathematics Project.

Research Questions and Methodology: Over the summer I took the time to explore a research question which really interested me. The question of interest: What factors influence African American woman to shy away from mathematics in college? I thought that it would be very interesting to take a closer look and try to understand why these factors occur. I also had the time to look at a second question that looks at families,

friends, and media and their influence on the choice of a college major for African American women.

The African American Women in Mathematics Project uses qualitative methods to examine factors influencing the choice of college major by African American women and family influence of major. I created a list of interview questions that I asked several African American women involved in the REAL Program and Summer Academy. This data heavily supported the literature that I read as well as did interviewing professionals in the math and/or education field.

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"An Algebraic Characterization of the q-ary Images of q^n-ary Codes Invariant Under a Permutation"

Gilbert Ymbert
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"Continued Study of Multigrid and its Applications with Gauss-Seidel"