Southwestern Undergraduate Mathematics Research Conference 2013

hosted by the University of New Mexico

March 1 – March 3, 2013

ABSTRACTS

SATURDAY, March 2nd

Student Talks, Parallel Session 1A, SMLC Auditorium

8:20 BRIAN VALENZUELA, University of Arizona. Mentor: Moysey Brio.

Arbitrary Precision of Riemann-Siegel Approximation of Riemann Zeta Function off of critical line

Arbitrary Precision of the Riemann-Siegel Approximation of the Riemann Zeta Function off of the critical line Abstract: The Riemann-Siegel formula is a specialized formula used for computing values of the famous transcendental function, the Riemann Zeta function on the critical line s = + it and numerically verifying the correctness of the Riemann hypothesis. We provide a power series expansion agreeing with the Riemann-Siegel function that can be used for determining values of the Riemann Zeta function on or off of the critical line. The Series expansion was derived via method of stationary phase and the use of previous studies of Riemanns Zeta function, namely the works of EO Tuck and GR Pugh. The implementation of this series in arbitrary precision arithmetic allows us to study the properties of the zeta function as well as study the series accuracy in determining the values corresponding to the t-values (height) of the zeros of the function.

8:43 ANDREW HERRING, University of New Mexico. Mentor: Alex Buium.

Parameterizing Quaternion Pythagorean Triples.

Solutions to the Pythagorean equation $x^2 + y^2 = z^2$ have been completely parameterized over the integers, and more generally over all unique factorization domains. Little is known however about the solutions over non-commutative rings. Throughout this project, we have tried to produce a parameterization of the solutions to the Pythagorean equation in the ring of rational quaternions. To this end, we have adapted a technique of Dickson to produce an infinite family of rational quaternion Pythagorean triples starting from a single such triple. To furnish these "starting triples" we have tried to parameterize the equation $x^2 + y^2 = 1$ for rational quaternions x and y. We show that the existence of such a parameterization is guaranteed by the fact that a certain quadric surface in $\mathbf{A}^8$ has a rational point. The resulting parameterization in five parameters gives infinitely many "starting triples" of the form $(x, y, 1)$ from which we may use our adaptation of Dickson's method to generate (infinitely many) infinite families of rational quaternion Pythagorean triples.

9:06 STEPHEN PIETROMONACO, University of New Mexico. Mentor: Mathew Blair.

L^p Asymptotics on the Zonal and the Sectoral Harmonics

I will discuss results on the asymptotics of two special families of spherical harmonics: the zonal and sectoral harmonics. Important consequences in the classical limit of quantum physics will also be discussed.

Student Talks, Parallel Session 1B, SMLC 120

8:20 KATHERINE BOSSALLER, Northern Arizona University. Mentor: Stephen Wilson.

Symmetries of Generalized Circulant Graphs

In general, circulant graphs are undirected graphs with a cyclic group of symmetries. In this talk I will be discussing the edge-transitivity of a new class of circulant graphs called C graphs. I will also discuss some of the other properties of these new graphs and some open questions concerning these and other graphs like them.

8:43 MICHAEL ZOWADA, Northern Arizona University. Mentor: Jeff Rushall.

Three Dimensional Hadamard Array Constructions

An overview of complex Hadamard matrices, Vandermonde matrices and Yang's product construction will be presented in order to show how a three dimensional complex Hadamard array of every order can be created. Several images will be given to show how these arrays can be depicted.

9:06 ALEX GUTIERREZ, Arizona State University. Mentor: John Little

Co-Circular Central Configurations of Four Vortices

The Newtonian n-body problem is a well-studied question in celestial mechanics with many practical applications. Of particular interest is the study of central configurations in which each mass accelerates towards the center of mass at a rate proportional to its displacement from the center of mass and where the proportion of the displacement is the same for each mass. Central configurations can be used to

find periodic solutions to the n-body problem. One interesting variant of the n-body problem is the study of the central configurations of Helmholtz vortices, whirlpools on an infinite horizontal surface consisting of a perfect fluid. A configuration in both the n-body and n-vortex problem is central if and only if it satisfies the Albouy-Chenciner (AC) equations. We use the AC equations to study the central configurations of four vortices from the point of view of algebraic geometry. In a recent paper Cors and Roberts completely characterize the central configurations of four bodies when all four lie on the same circle. We replicate these results *mutatis mutandis* for the four-vortex problem and conjecture that there do not exist co-circular central configurations of four vortices that have two vorticities of each sign.

Student Talks, Parallel Session 1C, SMLC 356

8:20 GABRIEL ARRILLAGA, University of New Mexico. Mentor: Helen Wearing.

Modeling the In-host Dynamics of Dengue Virus

The mosquito-borne RNA virus Dengue has a unique pathology in that secondary infections can be far more life-threatening than primary infections. There appear to be two related 'defects' in the human immune system that it has evolved to exploit. My research seeks to construct a differential equation model of Dengue's in-host dynamics, and then use a combination of analytical and numerical techniques to examine its implications.

8:43 JOSEPH DEAGUERO, University of New Mexico. Mentor: Helen Wearing.

Modeling Dengue Strain Competition Within a Mosquito

Mathematical modeling has become an important tool in understanding the spread and persistence of infectious diseases. In multi-strain pathogens, such as dengue virus, understanding within-host infection dynamics is increasingly important to better inform transmission dynamics at the between-host level. Until recently, research in this area has primarily focused on the interaction of pathogen strains within vertebrate hosts, but neglected to consider key interactions within invertebrate vectors. Using the dengue virus and its mosquito vector, Aedes aegypti, as a case study, we develop a within-vector mathematical model of infection dynamics. Our differential equation model specifically considers virus dynamics both within the midgut and the salivary glands of the mosquito. An infection can only be transmitted to a vertebrate if a virus strain can escape the midgut barrier and replicate within the salivary glands. We use our model to ask how competition between strains within a mosquito affects transmission of the virus to humans. We also examine whether mosquitoes could transmit multiple strains simultaneously, which could partially explain recent data on human co-infections.

9:06 ASHLEY WEBBER, Arizona State University. Mentor: Eric Kostelich.

The Mathematical Modeling of Multifocal Brain Tumors

This talk will discuss some stochastic modeling approachesfor the growth of high-grade malignant brain tumors (glioblastomamultiforme) on realistic geometries. I will describe and justifythe addition of an Ornstein-Uhlenbeck process to model the localgrowth rates of the tumor and will show qualitatively good agreementwith actual patient cases of multifocal tumors.

Student Talks, Parallel Session 2A, SMLC Auditorium

10:00 LAUREN CRIDER, Arizona State University. Mentor: Douglas Cochran

Maximum-Entropy Surrogation in Multi-Channel Signal Detection

Abstract: Statistical tests for a common but unknown signal component in several noisy time series are used for signal source detection with multiple sensors, for example in the application of radar. One such test, which is provably optimal under certain conditions, compares the generalized coherence (GC) estimate formed from the time series data to a particular threshold. The GC estimate is a function of the Gram matrix consisting of samples from the time series data. This test may be performed if each pair of sensors reports only a scalar inner product, rather than its full data vector, to a central processing location. However, this test is only ideal when each sensor is connected by a common edge in the network graph. This talk presents a new method, called Maximum-entropy surrogation, which is used for completing the Gram matrix when some entries are missing (when some sensors do not share an edge in the network graph). Maximum-entropy surrogation thereby allows a GC estimate to be computed from incomplete data.

10:23 ANASTASSIYA SEMENOVA, University of New Mexico. Mentor: A.Korotkevich.

Visualization and algorithm for simulations of electro-magnetic field in an elemntary cell of a layer of metamaterials

Metamaterials are artificially made materials with nano scale metallic inclusions in a dielectric host medium. Due to this structure, when light, which is considered to be an electro-magnetic wave in this

case, interacts with metamaterials, electric and magnetic fields interact resonantly with free electrons of metallic inclusions. One of the results of this electromagnetic interaction of light with metamaterials is negative refraction. The metamaterials with the negative refractive index are of special interest because they can be used to create materials with the zero refractive index or to create super lens that will resolve objects whose sizes are smaller than the wavelength of light. In this project, we derive the governing equations that describe electric and magnetic fields in metamaterials. Then, we numerically solve these equations. As a result, we are able to make numerical simulations of the electric and magnetic fields in metamaterials.

Student Talks, Parallel Session 2B, SMLC 120

10:00 TARYN LAIRD, Northern Arizona University. Mentor: Jeff Rushall

Trees of Irreducible Numerical Semigroups, Part 1

A 2011 paper by Blanco and Rosales describes an algorithm for constructing a directed tree graph of irreducible numerical semigroups with xed Frobenius numbers. After providing background information, we will construct the algorithm and then give some examples of these directed tree graphs.

10:23 JOSE MARTINEZ, Northern Arizona University. Mentor: Jeff Rushall

Trees of Irreducible Numerical Semigroups, Part 2

This talk will focus on the study of trees of irreducible numerical semigroups which are generated by an algorithm published by Blanco and Rosales in 2011. We will examine problems relating to the structure of the trees and look at new findings. (This is a continuation of the talk presented by Taryn Laird).

Student Talks, Parallel Session 2C, SMLC 356

10:00 MARZIA SHAH, Arizona State University. Mentor: Jay Abramson.

Tuberculosis in the USA

The purpose of this study is to analyze the trends of the infectious disease of Tuberculosis (TB) in the United States from 1960-2009 using data retrieved from the World Health Organization. In brief, TB is a bacterial infection originating in the lungs, caused by the bacteria mycobacterium tuberculosis. This study determined the best curve fit for the growth rate of the disease through fundamental calculus techniques, thus pinpointing the years when a fluctuation in growth rate occurred. The meaning of such fluctuations was interpreted. Specifically, around 1990, the number of TB cases began to decline at an increasing rate, as depicted by the change in concavity of the graphical evaluation. This study explored the causes of this shift by analyzing health initiatives led by the American Lung Association to minimize TB. The results of this study provide usefulness in determining the time period it takes for future health initiatives to make significant impact on the community. Additionally, the techniques used can also help trace the trends of other medical diseases.

10:23 JASON YOUNG, Arizona State University. Mentor: Sharon Crook.

Neural Network Model of Drosophila Antennal Lobe

There exists the objective to construct a mathematical model of the neural processes in the Drosophila antennal lobe, olfactory processes in fruit flies. This is significant because the Drosophila antennal lobe is biologically a model system for human olfaction. Therefore, this relatively simple system can be used to learn more about how vertebrates like humans smell because the process is similar. Each antennal lobe is made up of several small bulbs called glomeruli. Each of these glomeruli have four different types of neurons associated with them. First there are Olfactory Receptor Neurons (ORNs) which receive chemical input. Then there are Excitatory Local Neurons (eLNs) and Inhibitory Local Neurons (iLNs) which receive input from the ORNs and communicate with each other between glomeruli. Then the output is the Projection Neuron (PN) for each glomerulus. The overall goal is to understand the networking that goes on between the input and the output by modelling the groups of the individual neurons mathematically. The voltage behavior of each of these types of neurons can be mathematically modelled by a series of ordinary differential equations. Through experimentation, flies are given an olfactory stimulus which activates activity in the antennal lobes. The neural activity is recorded and ultimately used as a simulation. This simulation program is intended to be used publicly by anyone studying the neural networks in the Drosophila Antennal Lobe.

Student Talks, Parallel Session 3A, SMLC Auditorium

1:10 ALEXANDER ELKHOLY, Arizona State University. Mentor: Armbruster

Simulating Consumer Behavior in a High-Tech Market Environment

In a technology market higher quality products are frequently released with fluctuations in price, and these new products make older products obsolete. Because of this customers can develop expectations

that influence purchase behavior. We seek to create a tool that can model these expectations and their impact on products market share. This talk will discuss the framework used to develop our models and will include a demonstration of the tool we have developed to run simulations.

JEFFREY GORDON, University of New Mexico. Mentor: Francesco Sorrentino
Interplay Between Energy-Market Dynamics and Physical Stability of a Smart Power Grid

A smart power grid is currently being envisioned for the future in which, among other features, users would be able to play the dual role of consumers as well as producers and traders of energy, thanks to emerging renewable energy production and energy storage technologies. As a complex dynamical system, any power grid is subject to physical instabilities. With existing grids, such instabilities tend to be caused by natural disasters, human errors, or weather-related peaks in energy demand. We analyze the impact, upon the stability of a smart grid, of the energy-market dynamics arising from users ability to buy from and sell energy to other users. The stability analysis of the resulting dynamical system is performed assuming different proposed models for this market of the future, and the corresponding stability regions in parameter space are identified. We test our theoretical findings by comparing them with data collected from some existing prototype systems.

1:56 KATLIN FORSTER, Arizona State University. Mentor: Tom Taylor.
Comparing Extremism, Martyrdom and Symbolic DNA of Terrorism in Twitter from July 2011 to January 2012

The following is an undergraduate thesis presentation within the communications and mathematics fields. The research presented here is conducted by learning background information pertaining to martyrs and terrorists along with recent methods of searching modes of mass communications. Questions relating to Symbolic DNA of Terrorism (Rowland and Theye, 2008) and martyrdom within Twitter are answered by searching Twitter using Mathematica. Determining the communication around martyrs, a connection is made between communication of martyrdom and the presence of patterns Symbolic DNA of Terrorism in Twitter.

2:19 RACHEL BARROSO, University of Arizona. Mentor: Bruce Bayly
Life in Industry

As an undergraduate, decisions about pursuing a career in industry vs. academia may be both overwhelming and confusing. The best way to really make a decision is to get first hand experience in both fields so you can decide which is a better fit. In this brief presentation, I will talk about my experience in an industry based internship with ExxonMobil Chemical Company and how this experience shaped my decision in pursuing a career in engineering following graduation.

Student Talks, Parallel Session 3B, SMLC Auditorium
1:10 MICHAEL WOODWARD and DANE JACOBSON, Northern Arizona University. Mentor: Ernst.
Mathematics of The Game Spinpossible

The game Spinpossible is played on a 3 by 3 board of scrambled tiles numbered 1 to 9, each of which may be right-side-up or up-side-down. The objective of the game is to return the board to the standard configuration where tiles are arranged in numerical order and right-side-up. This is accomplished by a sequence of "spins", each of which rotates a rectangular region of the board by 180 degrees. The goal is to minimize the number of spins used. It turns out that the group generated by the set of spins allowed in Spinpossible is identical to the symmetry group of the 9 dimensional hyper-cube. A number of interesting results about Spinpossible have been shown either computationally or analytically. Using brute-force, Sutherland and Sutherland verified that every scrambled board can be solved in at most 9 moves. In this talk, we will relay our progress on finding a short proof of this fact.

1:33 KENNETH QIAN, Arizona State University. Mentor: Nicolas Lanchier.
Theory and Applications of Evolutionary Game Theory

Evolutionary game theory is a relatively new but rising branch of traditional game theory. In traditional game theory, developed by the Hungarian mathematician John von Neumann, one looks at the players of a game, their strategies, and then tries to make a prediction on the outcome of the game. One of the key tenets to traditional game theory is that the players always make rational decisions (that is, decisions that serve to maximize their expected utility). Evolutionary game theory is an application of game theory to the evolution of traits in a population. In particular, it tries to answer the question: Why is one specific trait of a population dominant over another? By looking at a population and observing the different traits and how they perform over time, we can also try to predict what will happen to the population in the long run. Will one trait win out over another? Or will there be coexistence between these

traits? Evolutionary game theory has become extremely important in modeling population dynamics in evolution, and complements Darwin's natural selection theory. Surprisingly, by using evolutionary game theory, we can conclude that it is not always the case that the desirable traits (ones that are supposedly more fit than others) will win out over others in the long run.

1:56 NICOLE TAYLOR, Arizona State University. Mentor: Lanchier.
Galam's Voting Systems and Public Debate Models Revisited

Serge Galams voting systems and public debate models are used to model voting behaviors of two competing opinions in democratic societies. Galam assumes that individuals in the population are independently in favor of one opinion with a fixed probability p, making the initial number of that type of opinion a binomial random variable. This analysis revisits Galams models from the point of view of the hypergeometric random variable by assuming the initial number of individuals in favor of an opinion is a fixed deterministic number. This assumption is more realistic, especially when analyzing small populations. Evolution of the models is based on majority rules, with a bias introduced when there is a tie. For the hierarichal voting system model my mentor, Nicolas Lanchier, and I were able to derive an explicit formula for the probability that one type of opinion wins given any group size greater than three and any initial count of that opinion. Using the public debate model we derived an explicit formula for the probability that one type of opinion wins given any initial count of that opinion with group size three.

2:19 HAYDEN COLVIN, Arizona State University. Mentor: Glenn Hurlbert.
Game Theory: Ropes

We explored the knots problem, turning it into a game dubbed Ropes and Knots and using game theory to attempt to "solve" the game; as in, come up with a single winning strategy to win every eventuality of the game. To do this, we played through the game many times and used winning strategies that we found to be in common in each game to come up with single, unifying strategies. In result, we found the solution to several permutations of the game, and came several steps closer to solving the game as a whole. This problem demonstrates the usefulness of game theory in problems that otherwise might not be thought of as games to begin with.

Student Talks, Parallel Session 3C, SMLC 356
1:10 LENA SNYDER, Arizona State University. Mentor: Eric Kostelich
Computational Modeling of Glioblastoma Multiforme

Glioblastoma Multiforme is an aggressive and deadly form of brain cancer with a median survival time of about a year. Due to the unique growth of each tumor, it is difficult to anticipate where the tumor will spread in the brain.This unpredictability makes treatment planning difficult. Archival patient data of MRI scans depicting the progress of different tumors have been helpful in developing a model to predict Glioblastoma proliferation, but the scans lack important information from the tumors initial growth period. Currently the model is being improved to more accurately reconstruct these early stages using a basic mathematical model defined by principles of diffusion to represent the rate of growth and directionality of the tumor over time.A partnership with Barrow Neurological Institute has allowed for increased access to patient data in order to improve the accuracy of the model using Mimics (Medical Image Software for Engineering on Anatomy). The goal of this research is to produce a model capable of predicting patient specific tumor growth under various treatment options such as surgery, chemotherapy, or radiation, to provide insight on which treatment is best for each patient.

1:33 MORGAN QUEZADA, Arizona State University. Mentor: Tom Taylor
Analyzing Glycan Nodes using Support Vector Machines

Preventative care is just as important in the medical world as treatment of diseases. Recent breakthroughs in early cancer detection save millions of lives. However, current procedures for detecting cancer can be inaccurate and invasive. I will discuss a rising form of cancer detection using glycan nodes instead of proteins as cancer biomarkers and how they can be used to develop more effective treatment plans for cancer patients.

1:56 KAVIAN TOOSI, Arizona State University. Mentor: Henian Chen.
Is the MAOA Gene a Significant Predictor of Happiness?

For centuries, scientists and philosophers have investigated factors that may influence a person's happiness; however, only recently has genomic data collection reached a point where research into the possible genetic explanation of happiness has become prevalent. The purpose of this study is to specifically analyze the statistical relationship between the MAOA gene and a person's happiness score based on the

Subjective Happiness Scale. To generate a linear regression model with significant predictor variables of happiness, we examined how happiness scores varied across factor levels for numerous variables (i.e. gender, age, income, etc.) using two-sample t-tests. In the interest of studying how these variables vary across different MAOA expression levels, we performed analysis of variance to compare the mean values of each continuous variable at each expression level. Finally, we generated two linear regression models: one that would include all significant predictor variables for happiness, and another that would examine the interaction term for MAOA and age. As a result of this analysis, we found several of the variables of interest to be significant predictors of happiness in a linear model. These factors include gender, health, marriage, religion, and most importantly, the MAOA gene. While MAOA was deemed significant, it only accounted for 2% of the variation in happiness scores. Therefore, further research into the relationship between genetics and happiness should be conducted.

SUNDAY, March 3rd

Student Talks, Parallel Session 4A, SMLC Auditorium

8:20 YURIDIA LEYVA and AUDREY PADILLA , University of New Mexico. Mentor: Cristina Pereyra.
Monsters

While it is now widely known that there is an interesting class of functions, often known as pathological functions, which are everywhere continuous yet nowhere differentiable, this result stunned and infuriated 19th century mathematicians. They previously believed that continuous functions were differentiable almost everywhere. In this presentation, we consider these everywhere continuous nowhere differentiable functions (ECNDs). We look at their history, construction, and applications. In particular, we demonstrate that the Takagi function T(x) is everywhere continuous, yet nowhere differentiable.

8:43 LAURA NAKOLAN, University of Arizona. Mentor: Bruce Bayly
The Algebra Academy: A Project-Based Approach to Teaching

This talk will focus on what it is like to be an Undergraduate Teaching Intern in the Algebra Academy, a five-week program geared towards getting incoming high school freshman interested in an prepared for their upcoming algebra classes. Included in the presentation will be the goals of the Algebra Academy, the different projects and field trips that the students experienced, as well as what the teachers and interns themselves learned from this project-based program.

9:06 RAFAEL HARO, University of Arizona. Mentor: Bruce Bayly.
Euler-Bernoulli Beam Derivation

The equations made by Leonardo Euler and DanielBernoulliarethoroughlyexplained. Using the variousforceson the beam and finding its curvature it is possible to find thedeflectionfrom equilibrium, slope, bending moment, shear force and the load. Combining the equation with newton's second law it is possible to solve for the dynamic beam equation. Then creating it into a Matlab code to capture the position of a beam in motion with respect to time. The beam identified is an HE160A I-beam, commonly used for support for the construction of buildings. The four constants in the differential equation were found to be -0.004, 0.003,0.004, and -0.003.

Student Talks, Parallel Session 4B, SMLC 120

8:20 ALESSANDRA GRAF, Northern Arizona University. Mentor: Jeff Rushall
A New Graceful Labeling for Pendant Graphs

A graceful labeling of a graph G with q edges is an injective assignment of labels from $\{0, 1, \ldots, q\}$ to the vertices of G such that when each edge is assigned the absolute value of the difference of the vertex labels it connects, the resulting edge labels are distinct. A labeling of the first kind for coronas $C_n \odot K_1$ occurs when vertex labels 0 and $q = 2n$ are assigned to adjacent vertices of the n-gon. A labeling of the second kind occurs when $q = 2n$ is assigned to a pendant vertex. Previous research has shown that all coronas $C_n \odot K_1$ have a graceful labeling of the second kind. In this presentation we will show that all coronas $C_n \odot K_1$ with $n \equiv 3, 4 \pmod 8$ also have a graceful labeling of the first kind. No knowledge of graph theory is required for this talk.

8:43 ANDREW BAXTER, University of New Mexico. Mentor: Janet Vassilev
Numerical Semigroups, Basically Full Ideals and their closures

Numerical Semigroups, Basically Full Ideals and their closures A Numerical Semigroup is a subset of the Natural Numbers S with a binary operation such that it is, associative, abelian, has an identity and has a finite complement with the Natural Numbers which we call its gaps G(S). Numerical semigroups

can be denoted by their minimally generating elements a1,...,an such that

$$< a1, a2, ..., an >= x \in N | x = k1 * a1 + \ + kn * an, k1, ...kninN$$

In particular we will discuss basically full ideals in numerical semigroups and their closures.

9:06 SELINA GILBERTSON, Northern Arizona University. Mentor: Dana Ernst.
Investigations of T-avoiding elements of Coxeter groups

Coxeter groups can be thought of as generalized reflections groups. In particular, a Coxeter group is generated by a set of elements of order two. Every element of a Coxeter group can be written as an expression in the generators, and if the number of generators in an expression is minimal, we say that the expression is reduced. We say that an element *w* of a Coxeter group is T-avoiding if *w* does not have a reduced expression beginning or ending with a pair of non-commuting generators. In this talk, we will state the known results concerning T-avoiding elements and discuss our current work in classifying the T-avoiding elements in Coxeter groups of type *F*.

Student Talks, Parallel Session 4C, SMLC 356

8:20 BRYAN TOM, Arizona State University. Mentor: Glenn Hurlbert.
Aging AIDS in the United States

According to the Center for Disease Control (CDC), an agency within the federal government under the Department of Health and Human Services, approximately 1,148,200 people were living with HIV infection at the end of 2009 and an estimated 48,298 individuals were diagnosed with AIDS in 2009. With such high numbers it is important for researchers to understand the demographic of those individuals living with this disease in efforts to target their research efforts towards those in which it will have the greatest impact. In particular, it is critical for researchers to target research on individuals living with HIV in different sex categories and various age groups. With new surveying techniques being developed by the CDC, better data has become available about those living with acquired immunodeficiency syndrome (AIDS) since 1981. We can now begin to understand the demographic of persons living with AIDS in the United States. Through utilizing a multiple linear regression model, this research hopes to answer the questions: What is the age and sex demographic of individuals living with AIDS currently and how have these demographics changed over the past thirty years.

8:43 KATHERINE FREELAND, University of New Mexico. Mentor: Michael Sonksen.
An Exploration of Cancer Reoccurrence and Mortality Trends Using the SEER Data Set

Reoccurrence and Mortality Trends Using the SEER Data Set Using the SEER data set, a massive publicly availably cancer database, we wish to explore several questions concerning cancer reoccurrence and mortality trends. These questions include the possible relationship between radiation and cancer reoccurrence, cancer specific mortality trends by region, and model development to better predict survival time. The data set captures a wide scope of demographic information, as well as treatment and diagnostic information that we believe will enhance our understanding of treatment effects and mortality prediction. To examine the relationship between radiation and cancer reoccurrence we will use propensity scores which allow for the estimation of treatment effects when treatment assignment is not random. Logistic regression with random effects will be used to assess mortality trends across regions. Lastly, the Cox proportional hazards model will be used to better predict mortality using the variables captured by the SEER data set.

9:06 HAVELL MARKUS, Arizona State University. Mentor: May Boggess
Statistical Estimation GlomerulusFiltrationRate

The kidneys are responsible for carrying out one of the vital functions in our body; filtration of the accumulated waste out of the blood. The filtration occurs in a tiny unit inside the kidneys called the glomerulus, which is an intertwined capillary. A high glomerulus filtration rate (GFR) indicates the kidneys are functioning properly; however, a decline would indicate the kidneys are improperly functioning. Thus an early detection of a reduction in the GFR is essential. Due to the anatomical considerations, the GFR cannot be measured directly; therefore, the clearance rate of an inert marker is used as a proxy. Serum concentrations of the marker obtained overtime creates an interesting statistical problem: how to calculate the standard errors of the GFR. The intent of this paper is to demonstrate how to apply the delta method to approximate the standard errors, thus allowing the provision of an interval estimate rather than just a point estimate of GFR.

Student Talks, Parallel Session 5A, SMLC Auditorium

10:00 TAYLOR CORCORAN, STACI SMITH, QIMING SHAO, Univ of Arizona. Mentor: David Glickenstein.
GEOCAM: Geometric Evolution on Computational Abstract Manifolds

One component of the Geometric Evolution on Computational Abstract Manifolds (GEOCAM) project is a computer simulation called the development that takes an abstract two or three dimensional manifold and displays it either unfolded into the plane embedded in three-dimensional space. This simulation also allows the user to explore the surface of the manifold from the point of view of a small insect. This talk focuses on several features of the development that are specific to two dimensional manifolds and the mathematics behind the simulation.

10:23 JUSTIN DAHLGREN, University of Arizona. Mentor: Bruce Bayly
Making an Organization for Members While Benefiting the Community

Opinions will always differ when it comes to the most effective way to run or base an organization, and these opinions are usually derived from experience. The method I would like to describe, in an attempt to have others follow, is one that has been truly remarkable and surprising. In developing and promoting an environment focused on member benefits and improvement, the community has arguably been the most to benefit from such growth. As president of the University of Arizona Math Club, I will explain the transformation the club has undergone tosurpass all expectations andreach this level of success.

Student Talks, Parallel Session 5B, SMLC 120
10:00 GEORGE AMAYA, University of Arizona. Mentor: Bruce Bayly.
The Mathematics of Gambling - Probability and Pseudo Random Numbers

The odds of winning a game of Keno can be calculated using mathematical probability. The purpose of this research is to show that we can simulate game play by using computer programs and produce probabilities similar to the theoretical probabilities. Three pseudo random number generators were used to simulate game play including the random number generator from MatLab. The output from the programs resulted in probabilities having the same distribution.

10:23 ANTONY SANCHEZ, Arizona State University. Mentor: Wolfgang Kliemann
Invariant Measures for Hybrid Stochastic Systems

Dynamical systems give one the ability to analyze the way systems evolve through time. Usually these are differential equations that model real world phenomena. Unfortunately, these models are limited in the sense that they cannot account for random events that may occur like friction or wind resistance. However, these random developments can often be modeled with Markov chains and processes. By uniting the two models one can study how these dynamical systems behave with the perturbation induced by Markov processes, but in doing so create a hybrid system where one now must simultaneously study the dynamical system and Markov process. We begin by presenting a natural generalization of limit sets for the hybrid system. Namely, we give a notion that describes the long term behavior of these hybrid systems. Afterwards, we prove the existence of invariant measures for these hybrid systems via the KrylovBogolyubov theorem. We supply concrete examples with visuals that provide insight to the behavior of these systems."