Poster Session Abstracts

On Strong Euler Approximation for SDEs Driven by Levy Processes

Fanhui Xu *University of Southern California*
ABSTRACT: A SDE driven by an α-stable process is studied. The existence and uniqueness of a strong solution is proved by utilizing regularity results of parabolic-type Kolmogorov equations and computing the rate of convergence of Euler approximating processes. The L_p-error is provided for both truncated and nontruncated models under the assumption that $\beta > 1 - \frac{\alpha}{2}$, and the solution is the L_p-limit of Euler approximations.

Admission Predictors for PhD Success: Preliminary Results

Timmy Ma & Karen Wood *University of California, Irvine*
ABSTRACT: There are many factors that can be collected on students in a mathematics PhD program: bachelor's GPA, bachelor's major, GRE scores, gender, URM status, institution tier, etc. We are in the process of analyzing and studying data collected from students entering a mathematics program at a southern California institution over the course of 9 years. In this poster we will present demographic data as well some preliminary results of our study, in which we seek to identify which factors, if any, significantly contribute to the probability of a student succeeding in obtaining a PhD through the mathematics program.

Investigation on Card Shuffling

Lana Kazma *Los Angeles Pierce College*
ABSTRACT: The Purpose of our project is to determine how many shuffles needed to get a well-shuffled deck and to determine which shuffle is better. In this project we have studied three kinds of shuffles (the Top-to-Random Shuffle, the Riffle Shuffle and the Thorop Shuffle). We have defined the three shuffles and we stated some examples using different number of cards and different numbers of shuffles to see how the result is affected. Also, we have defined the Markov Chain , Transition Probability and Transition Matrix. We gave example about the transition matrix then we gave more explanation about the transition matrix. For larger deck size, we made many simulations using R program and we used one of the statistical tests which is Chi-square test. Two Hypothesis are used for this experiment: The null Hypotheses H_0 (the deck is well- shuffled) and The Alternative Hypotheses H_a (the deck is not well shuffled). If the null hypothesis is true then the proportion of p-values < 0.05 , the z-score < 1 and vice versa. Our result shows that it takes less shuffles for a deck of the same size to be well-shuffled using Riffle Shuffle versus the Thorop Shuffle.

DNA Regulation Using Percolation Theory

Elizabeth Zhao *University of California, Irvine*
ABSTRACT: DNA (deoxyribonucleic acid) is a molecule that contains our genetic code. Gene expression is the process by which that genetic code from DNA is used in the synthesis of a functional gene product, usually a protein. In every cell, the DNA is tightly coiled many times around proteins called histones and

is packaged into thread-like structures called chromosomes. However, in order for gene expression to occur, a segment of DNA has to be unwounded by histone acetyltransferase (HAT). HAT transfers an acetyl group to the histones which loosens the bonds between the DNA and histones. We are interested in how many histones must be deactivated in order for transcription to occur. Deactivating one histone will most likely not allow transcription to occur because it would still be tightly packed. One way we can model this system mathematically is through the idea of percolation. Percolation is a probabilistic model which deals with critical phenomena. This usually means that there is a natural parameter in the model at which the behavior of the system drastically changes. In our case, it is whether or not gene expression occurs. Using MATLAB, we were able to model this system by running many simulations and graphing our results. From the graphs, we were able to conclude that there is an ultrasensitive response between the number of HAT present and probability of gene expression.

Optimal Differentiation and Proliferation of Chlamydia Trachomatis

Huasong Zhang *University of California, Irvine*

ABSTRACT: Chlamydia Trachomatics is a bacterium, which has two forms within a unique developmental cycle: infectious form EB (Elementary Body) and noninfectious form RB (Reticulate Body). When EB invade host cell, it will start to convert into RB. We are interested in the conversion rate in which EB converts to RB and proliferation rate of RB, and the probability of having a certain amount of EB and RB population at time t.

Fluid dynamics of red blood cell transport in capillaries predicts optimal throughput

Jie Zhang *University of California, Irvine*

ABSTRACT: Red blood cells (RBCs) must move throughout our bodies to deliver oxygen. RBCs are around 8 microns in diameter, while capillaries (the smallest part of our circulatory system) are around 6 microns in diameter, so these cells must squeeze. Previous researchers have used computational fluid dynamics to understand RBC transport, including squeezing in capillaries. However, in humans, RBCs make up around 40% of blood by volume, therefore they do not just interact with capillaries but with each other too. This leads to a particularly challenging "fluid-structure" fluid dynamics problem. Here, we develop a computational fluid dynamics simulation based on the immersed boundary method with a novel scheme for periodic boundary conditions. We simulate multiple RBCs in a capillary. We find that the more crowded the capillary, the slower the RBCs flow. Surprisingly, there is significant slowdown even far below the crowding limit (100% of volume fraction). This slowdown is due to a long-range interaction between RBCs mediated by the fluid. Therefore, the throughput of RBCs exhibits a maximum with respect to RBC density. Even more surprisingly, the optimal throughput occurs at around 40% of volume fraction, similar to the value in humans. We speculate that the RBC density in humans is optimized for maximum throughput through capillaries.

A Level Set Approach to Solving the Poisson Equation in Irregular Domains with Robin Boundary Conditions

Victoria Arias *University of California, Merced*

ABSTRACT: We consider the Poisson equation in irregular domains with Robin boundary conditions and present a numerical method that produces second-order accurate solutions and gradients in the L_∞-norm.

An Analysis of the Global Population Genetics of Malaria Resistance

Benjamin Juarez *University of California, Merced*
ABSTRACT: The World Health Organization reports that 3.2 billion people in 95 countries are at risk of being infected with malaria. With nearly 1 million deaths per year worldwide, malaria represents one of the deadliest infectious diseases. Because malaria first infected humans thousands of years ago, genetic mutations providing natural resistance to malaria have been under positive selection. Prior studies of genes promoting resistance to malaria analyzed only targeted populations experiencing malaria in the present. However, such studies may miss beneficial mutations carried by individuals who today live in areas where malaria infections are rare. We take a global-approach by studying a large collection of whole-genome sequencing data (the 1000 Genomes project) to look for past signals of malaria resistance. In this study, we focus on five gene locations linked to malaria resistance: HBB, ABO, ATP2B4, G6PD, CD40LG. We use SamTools and the human reference genome to report on the global nucleotide diversity of these target genes. In the future, we plan to extend our studies to the complete set of over 20 genes known to confer resistance to malaria. Understanding the complete genetic diversity of genes associated with malaria resistance will provide valuable information towards developing therapeutic targets to this important infectious disease.

Emphasizing Mathematical Elegance while Teaching

James Godzik *California State University, Fullerton*
ABSTRACT: We begin with a children's book about group theory to serve as an example of exciting students' interest in mathematics. We then highlight the disservice that is done to the elegance of the rational root theorem, quadratic formula, and second fundamental theorem of calculus when we teach just their mechanics. To end, we use problems from measure theory to suggest two ways we can promote the success of students in upper division math classes.

Stabilize a Sandpile

Doo Ree Kim *University of California, Irvine*
ABSTRACT: A sandpile is a function that maps the vertices of a graph to the natural numbers. A vertex is stable if its image is smaller than the number of edges incident. In toppling, for every unstable vertex, one sand is sent down every incident edge - in other words, the number of edges incident is subtracted from the image and one is added to the image of each neighboring vertex. We map graphs with varying edges and sinks and topple the sandpiles to stabilize the vertices. We determine the conditions under which a sandpile is stabilized.

Approximation and Convergence in the Estimation of Random Parameters in Linear Holomorphic Semigroups Generated by Regularly Dissipative Operators

Melike Sirlanci *University of Southern California*
ABSTRACT: We model the diffusion of alcohol through the skin by diffusion equation in which the parameters related to factors that depend only on the individual in the population are assumed to be random variables. We develop an abstract approximation and convergence framework for the estimation of random parameters in infinite dimensional dynamical systems governed by regularly dissipative operators in a Gelfand triple setting. Our approach combines some recent results for random abstract parabolic systems with ideas contained in a treatment of Prohorov metric convergence of approximations in the estimation

of random parameters in abstract dynamical systems based on aggregate or population data. Our convergence results rely on the well-known Trotter-Kato theorem from linear semigroup theory.

Extended Symmetric Functions

Ilknur Egilmez *University of Southern California*

ABSTRACT: We investigate analogs of symmetric functions arising from an extension of the nilHecke algebra defined by Naisse and Vaz. These extended symmetric functions form a subalgebra of the polynomial ring tensored with an exterior algebra. We define families of bases for this algebra and show that it admits a family of differentials making it a sub-DG-algebra of the extended nilHecke algebra. The ring of extended symmetric functions equipped with this differential is quasi-isomorphic to the cohomology of a Grassmannian. We also introduce new deformed differentials on the extended nilHecke algebra that when restricted makes extended symmetric functions quasi-isomorphic to $GL(N)$-equivariant cohomology of Grassmannians.