Eastern Pennsylvania and Delaware Section of the
Mathematical Association of America

Student Contributed Poster Session Abstracts

Temple University

SERC Lobby, 10:10 am – 10:40 am

March 24, 2018

Student Posters

Graduate Posters

Samantha Pezzimenti, Bryn Mawr College

Title: Immersed Lagrangian Fillings of Legendrian Knots

Abstract: A classic question in knot theory is: Given a smooth knot in the 3-sphere, what surfaces in the 4-ball can it bound? A version of this question can also be asked about Legendrian knots, which are smooth knots that satisfy an additional geometric condition imposed by a contact structure. The natural question is now: Given a Legendrian knot in the 3-sphere, what Lagrangian surfaces in the 4-ball can it bound? Whereas a smooth knot can always be filled by an infinite number of topologically distinct surfaces, the Seidel Isomorphism says that a Legendrian knot polynomial determines the genus of any embedded Lagrangian filling. I will describe how this polynomial also gives restrictions on immersed Lagrangian fillings.

Danielle Smiley, Bryn Mawr College

Title: Estimates on Oscillatory Singular Integral Operators

Abstract: The field of Harmonic Analysis dates back to the 19th century, allowing a layered collection of results and techniques in which we may dip our 21st century pens. Through examining the origin of the one-dimensional (Hilbert\&Riesz), two-dimensional (Fourier) and the n-dimensional oscillatory singular integral transforms, we build a timeline showcasing the players and their results in bounding such deeply-rooted operators over Lebesgue and Hardy Spaces. I will explain key advances in techniques, such as van der Corput type lemmas, Littlewood-Paley theory, maximal operators and Calderon-Zygmund theory, and highlight their connections with current research.

Undergraduate Posters

Will Cameron, King's College

Title: My Axiom System

Abstract: During freshman year in intro to logic course, we constructed our own axiom systems, which consisted of, axioms, consistency models, independence models, and a theorem or two. We went on to prove our theorem(s) using the axioms we constructed. For our Junior Seminar course at King's, we revisited the same axiom system to see the progress we have made as mathematicians.

Sida Li, Swarthmore College

Title: The Impact of Spike-Frequency Adaptation on Balanced Network Dynamics

Abstract: A dynamic balance between strong excitatory and inhibitory neuronal inputs is hypothesized to play a pivotal role in information processing in the brain. We test this theory of balanced networks with more physiological neuronal modeling assumptions. We examine the impact of spike-frequency adaptation on balanced dynamics. We incorporate adaptation into binary and integrate-and-fire neuronal network models in order to analyze the theoretical effect of adaptation in the large network limit and perform an extensive numerical investigation of the model adaptation parameter space. Our analysis demonstrates that balance is well preserved for moderate adaptation strength even if the entire network exhibits adaptation. In the common physiological case in which only excitatory neurons undergo adaptation, we show that the balanced operating regime in fact widens relative to the non-adaptive case. We hypothesize that spike-frequency adaptation may have been selected through evolution to robustly facilitate balanced dynamics across diverse cognitive operating states.

Victorya Richardson, Temple University

Title: A functional comparative genomics approach to identify male-driven adaptation in promiscuous lineages of Great Apes

Abstract: Male reproductive genes encode among the fastest evolving class of proteins across an array of taxa, including Great Apes. Although it has been hypothesized that sexual selection drives this rapid divergence through such processes as sperm competition, we remain uncertain about the specific reproductive nature of these rapidly evolving reproductive genes. Here, we apply a functional comparative genomics approach to identify over-representation of specific gene sub-networks involved in male reproduction and the evolutionary mechanism involved in their divergence. We estimate selection coefficients genome-wide for proteins in gorillas, bonobos, and chimps using humans as an outgroup, expecting polygamous bonobos to harbor a greater fraction of positively selected male sperm genes. Further, we map genes evolving under positive directional selection across a series of male reproductive networks to identify co-evolving genes. Overall, this approach provides a functional landscape of adaptive gene networks among male reproductive genes across our most closely related species.

Jonathan Tostado-Marquez, Swarthmore College

Title: Failed Power Domination

Abstract: A power dominating set of a graph G is a subset S of vertices of G for which application of the power domination process results in all vertices joining S. The first part of power domination process enlarges S by adding to it all of its neighbors: that is, if u is neighbor of a vertex in S, then u joins S. The next step of the process states that if there is a vertex v in S that has exactly one neighbor u not in S, then u joins S. This step is iterated until there are no more vertices in S with exactly one neighbor not in S. We introduce a new graph parameter, the failed power domination number of a graph G, FP(G), to be the maximum cardinality of a subset S of vertices of G that is not a power dominating set. We determine formulas for the failed power domination number of several graph families such as complete graphs and multipartite graphs. We also determine a formula for the failed power domination number of the corona of two graphs.

Zara Williams-Nicholas, Swarthmore College

Title: Zero-Diagonal Minimum Rank over Generalized Fields

Abstract: The goal of the minimum rank problem is to determine the minimum rank of a given family of matrices associated with a particular graph. The classic minimum rank problem examines real, symmetric matrices whose diagonal is allowed to be free, and whose off-diagonal nonzero entries are determined by the edges of the graph. In 2012, the minimum rank problem was investigated for real, symmetric matrices where the diagonal entries are restricted to be zero. We consider the minimum zero-diagonal rank problem over fields other than R. Given a graph G with vertices v_1, …, v_n and a field F, we say a symmetric matrix A in M_n(F) is associated with G if the (ij)-entry of A is nonzero if and only if v_i is adjacent to v_j. Let SF(G) denote the set of all matrices in M_n(F) associated with G and define mr_0F(G) = min{A | A is in SF(G)}. For certain graph families, including cycle graphs and tadpole graphs, we are able to determine mr_0F(G) for all fields F. We also extend work of Leong (2014) to compute mr_0Z2(G) for additional graph families.