



College of Science and Mathematics

Department of Mathematics

## 2017 – 2018 DISCRETE MATH SEMINAR (DMS)

### Friday, September 22, 2017

SPEAKER: Axel Brandt, Davidson College

TITLE: *“Optimization, Probability, and Modeling as a tool in Extremal Graph Theory”*

ABSTRACT: Similar to optimization, questions in extremal graph theory ask for a maximum or minimum of a parameter under certain constraints. Although convex programming provides a powerful tool to solve numerical optimization questions, questions in extremal graph theory have historically been approached by ingenuity and trial-and-error. Recently, Razborov developed the theory of flag algebras, which provides a method of translating an extremal graph theory problem to a semidefinite programming problem. In this talk, we will explore the process of this translation.

### Friday, October 20, 2017

SPEAKER: Babak Moazzez, Kennesaw State University

TITLE: *“Spread of Influence in Graphs via Integer Programming: A polyhedral Study”*

ABSTRACT: Spread of influence in a network can be modeled and studied within the concept of dynamic monopolies in graphs. We give an integer programming formulation for finding a minimum dynamic monopoly in an undirected graph. The corresponding  $0 - 1$  polytope and its facets are studied and several families of facet defining inequalities are introduced. Computational experiments have been performed to show the strength of the IP formulation and its facet defining inequalities.

### Monday, February 19, 2018

SPEAKER: Ahmad Peivandi, Georgia State University

TITLE: *“Assignment Problems with Complementarities”*

ABSTRACT: The problem of allocating bundles of indivisible objects without transfers arises in the assignment of courses to students, of computing resources like CPU time, memory and disk space to computing tasks and the truck loads of food to food banks. In these settings the complementarities in preferences are small compared with the size of the market. We exploit this to design mechanisms satisfying efficiency, envy-freeness and asymptotic strategy-proofness.

Informally, we assume that agents do not want bundles that are too large. There will be a parameter  $k$  such that the marginal utility of any item relative to a bundle of size  $k$  or larger is zero. We call such preferences  $k$ -demand preferences. Given this parameter we show how to represent probability shares over bundles as lotteries over approximately (deterministic) feasible integer allocations. The degree of infeasibility in these integer allocations will be controlled by the parameter  $k$ . In particular, ex-post, no good is over allocated by at most  $k - 1$  units.

### Monday, March 5, 2018

SPEAKER: David Clark, Grand Valley State University

TITLE: *“Anti-games on Steiner Triple Systems”*

ABSTRACT: In this talk, we turn tic-tac-toe upside down and discover an interesting game hiding behind it. More specifically, we explore a combinatorial game that is inspired by a cross of tic-tac-toe, SET, and the concept of “caps” in finite geometry. In Anti-Tic-Tac-Toe, the objective of tic-tac-toe is reversed: Two players take turns selecting points and the first player to get 3 in a row loses the game. Steiner Triple Systems turn out to be a perfect place to play Anti-Tic-Tac-Toe: These are structures consisting

of a set of points together with some “lines” of 3 points each, such that every pair of points appears in exactly one line — features which match traditional tic-tac-toe well. We will demonstrate winning strategies on two types of Steiner Triple Systems which have strong geometric connections. We will also see how the losing player can take advantage of substructures within these systems in order to put off their inevitable loss for as long as possible (thus removing the one endearing feature of tic-tac-toe: its brevity). These games originate from, and provide excellent opportunities for, undergraduate research.

**Monday, March 19, 2018**

**SPEAKER: Infinite Horizons Lecture**

Kim Ruane, Tufts University

TITLE: “*Linear Algebra in the Real World*”

ABSTRACT: After telling you a bit about my days at KSU and how I ended up where I am today, I will discuss some applications of Linear Algebra that I like to cover when I teach this class for undergraduates. The main one I will focus on is the connection between Linear Algebra and the Page Rank Algorithm used by search engines such as Google. There is a very simple idea behind page rank and it uses elementary ideas from Linear Algebra and Graph Theory. Of course, the implementation of this simple idea is much more difficult but the linear algebra behind the basic principle is something we teach in a first year Linear Algebra course. I tend to present applications of linear algebra as soon as I start to see the students freaking out over the abstraction they are faced with in the course!

**Monday, April 23, 2018**

**SPEAKER:** Jan Strydom, KSU student

TITLE: “*DAGs*”

ABSTRACT: We will discuss what Directed Acyclic Graphs (DAGs) are, and some of the applications and software which make use of DAGs.

**Wednesday, February 22, 2017**

**SPEAKER:** Ariel Keller, Emory University

TITLE: “*On Disjoint Cycles and Degree Conditions*”

ABSTRACT: We consider degree sum conditions sufficient to imply the existence of  $k$  vertex disjoint cycles in a graph. In particular,  $\sigma_t(G)$  is the minimum degree sum over all sets in  $G$  of  $t$  independent vertices. We prove that if a graph  $G$  has order at least  $7k + 1$  and  $\sigma_4(G) \geq 8k - 3$ , with  $k \geq 2$ , then  $G$  contains  $k$  disjoint cycles.