Graduate Student Research Presentations
Exposés de recherche par les étudiants gradués
(Org: **Svenja Huntemann** (Dalhousie))

FATIMAH ALRUHAYMI, Memorial University
Skolem-type Sequences and Rosa

Let S be a set of positive integers. A Skolem-type sequence is a sequence of $i \in S$ such that every $i \in S$ appears exactly twice in the sequence at positions a_i and b_i, and $|b_i - a_i| = i$. These sequences might contain empty positions, which are filled with null elements. A Skolem defined and studied Skolem sequences in order to generate solutions to Heffter's difference problems. Later, Skolem sequences were generalized in many ways to suit constructions of different combinatorial designs. Alexander Rosa made the use of these generalizations into a fine art.

BEN CAMERON, Dalhousie University
Graph Properties, Polynomials, and Simplicial Complexes

An independent set in a graph is a set of vertices no two of which are adjacent, but can be thought of as an induced subgraph that has the property of not containing an induced copy of K_2. Recent work has generalized this idea to define a P-set to be a subgraph that does not contain an induced copy of a specified list of graphs defined by P, a graph property. From this point of view we can generalize simplicial complexes and polynomials associated with independence to the P-generating polynomial and P-complex of a graph for any such graph property P. We provide general results about the P-generating polynomials and their roots, consider specific properties, and examine the connections between simplical complex theory and the P-complex. (This is a joint work with Jason Brown.)

LAUREN DEDIEU, McMaster University
Newton-Okounkov Bodies of Peterson and Bott-Samelson Varieties

The study of toric varieties is a beautiful part of algebraic geometry. It is an old and active area of research, and has connections with polyhedral geometry, commutative algebra, combinatorics, and symplectic geometry. Its elegant structure also makes it an invaluable tool in other areas of research such as coding theory, physics, and algebraic statistics.

The theory of Newton-Okounkov bodies is a generalization of the rich theory of toric varieties; it associates a convex body to an arbitrary variety (equipped with auxiliary data). Although initial steps have been taken for formulating geometric situations under which the Newton-Okounkov body is a rational polytope, there is much that is still unknown. In particular, very few concrete and explicit examples have been computed thus far. During my graduate studies I have been working on explicitly computing Newton-Okounkov bodies of Peterson and Bott-Samelson varieties. These varieties arise, for instance, in the geometric study of representation theory. In this introductory level talk, I plan to motivate why this theory is important.

SHAHID KHAN, University of Calgary
Portfolio Signed Graphs

A signed graph is formed by assigning a $+$ or $-$ to each edge of a graph. A signed graph is said to be clusterable if its nodes can be partitioned into sets such that all positive edges join nodes in the same cluster, while all negative edges join nodes in different clusters. Signed graphs provide an ideal framework to model positive and negative relations between entities and, as a result, have been extensively used in areas like social network analysis. Here, we investigate a more recent application to investment portfolio management. The first author and Pirzada [Clusterability of portfolio signed graphs, in *Proceedings of the Second Symposium on Games and Decisions in Reliability and Risk (GDRR)*, Belgirate, Italy, May 19-21, 2011] introduced the term *portfolio signed graph* (PSG) for a signed graph whose nodes represent assets in an investment portfolio and whose

edges represent positive or negative correlations between assets. They showed that a portfolio that gives rise to a clusterable PSG is more predictable and hence, more risk-averse than a non-clusterable portfolio. In this talk, we study PSGs in detail and establish a relationship between the variance of a portfolio and the clustering properties of the corresponding PSG. This is joint work with Muhammad Ali Khan (University of Calgary).