### CALENDAR

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<th>Date</th>
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| Wednesday, November 4 | Curves Seminar                             | Speaker: Tony Geramita, Queen’s University  
Title: Waring-like Decompositions for Homogeneous Polynomials (Talks I and II)  
Abstract Attached |
|                       | Time: 3:00 p.m.  
Place: Jeffery 319 |  
Minutes to be circulated |
| Wednesday, November 4 | Department Meeting                         | Speaker: Josué Daniel Vázquez Becerra, Queen’s University  
Title: Second order freeness: a free probability study of fluctuations of random matrices, Part II  
Abstract Attached |
|                       | Time: 3:30 p.m.  
Place: Jeffery 234 |  |
| Thursday, November 5  | Seminar on Free Probability and Random Matrices | Speaker: Kannappan Sampath, Queen’s University  
Title: Vertical equidistribution of the Kloosterman angles  
Abstract Attached |
|                       | Time: 4:30 p.m.  
Place: Jeffery 110 |  |
| Friday, November 6    | Number Theory Seminar                      | Speaker: Toh Rui, University of Toronto  
Title: Dynamical systems with random switching  
Abstract Attached |
|                       | Time: 11:00 a.m.  
Place: Jeffery 422 |  |
| Friday, November 6    | Department Colloquium                       | Speaker: Nathan Grieve, UNB  
Title: Diophantine approximation constants for varieties over function fields  
Abstract Attached |
|                       | Time: 2:30 p.m.  
Place: Jeffery 234 |  |
| Monday, November 9    | Algebraic Geometry Seminar                 | Speaker: Nathan Grieve, UNB  
Title: Diophantine approximation constants for varieties over function fields  
Abstract Attached |
|                       | Time: 4:30 p.m.  
Place: Jeffery 319 |  |

Items for the Info Sheet should reach Anne (burnsa@mast.queensu.ca) by noon on Monday. The Info Sheet is published every Tuesday.

**Wednesday, November 4, 3:00 p.m. Jeffery 319**  
**Curves Seminar**

**Speaker**: Tony Geramita  
**Title**: Waring-like Decompositions for Homogeneous Polynomials (Talks I and II)

**Abstract**: The well known Waring Problem in Number Theory asks for a minimal decomposition of an integer \( n \) into a sum of \( d^\text{th} \) powers. E.g. LaGrange’s famous Four Square Theorem asserts that every integer is a sum of \( \leq 4 \) squares of integers, and those integers \( \equiv 7 (mod \ 8) \) cannot be written as a sum of fewer than 4 squares. There is also the theorem that every integer is a sum of \( \leq 9 \) cubes of integers. Such bounds exist for all powers, as was proved by Hilbert.

Let \( R = \mathbb{C}[x_0, \ldots, x_n] = \bigoplus_{i=0}^\infty R_i \) (\( R_i \) the vector space of homogeneous polynomials of degree \( i \)) be the standard graded polynomial ring. If \( F \in R_2 \) then \( F \) can be represented
by a symmetric \((n + 1) \times (n + 1)\) matrix. That matrix, in turn, is congruent to a diagonal matrix of rank \(r \leq n + 1\) with 1's on the main diagonal. Another way to say that is that

\[ F = L_1^2 + \cdots + L_r^2 \]

where the \(L_i\) are linear forms. I.e. every quadratic polynomial is a sum of at most \(n + 1\) squares of linear forms. Waring's Problem for homogeneous polynomials asks for decompositions of forms of degree \(d > 2\) as sums of \(d\)th powers of linear forms.

After a brief introduction to the history of the (mostly) successful attacks on Waring's Problems for polynomials, I will begin a discussion of some generalizations of these problems and of recent work I have done in dealing with these generalizations.

It is anticipated that there will be two weeks of talks on this subject.

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**Thursday, November 5, 4:30 p.m. Jeffery 110**

**Seminar on Free Probability and Random Matrices**

**Speaker:** Josué Daniel Vázquez Becerra

**Title:** Second order freeness: a free probability study of fluctuations of random matrices, Part II

**Abstract:** Second order freeness is a feature exhibited in the large limit by random matrix ensembles such as the orthogonal Gaussian random matrices and the orthogonal Wishart random matrices. Its main purpose is to help determine the asymptotic behaviour of the covariance of traces of products of random matrices; this is comparable to the description of the asymptotic behaviour of the expectation of the trace of products of random matrices that we get from freeness.

Seminar website: [http://www.mast.queensu.ca/~mingo/seminar/] (http://www.mast.queensu.ca/~mingo/seminar/)

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**Friday, November 6, 11:00 a.m. Jeffery 422**

**Number Theory Seminar**

**Speaker:** Kannappan Sampath

**Title:** Vertical equidistribution of the Kloosterman angles

**Abstract:** Let \(e(x) = \exp(2\pi i x)\) and for \(a \in \mathbb{F}_p^*\), let

\[ K(p, a) = \sum_{x_0, x_1 \in \mathbb{F}_p \atop x_0 + x_1 = a} e\left(\frac{x_0 + x_1}{p}\right) \]

denote the Kloosterman sum. By a theorem of Weil, there are "angles" \(\theta_{p, a} \in [0, \pi]\) such that \(-K(p, a) = 2\sqrt{p} \cos(\theta_{p, a})\). Following Deligne's Weil I, Katz proved (with error terms) that the sets \(\{\theta_{p, a}\}_{a \in \mathbb{F}_p^*}\) become equidistributed in \([0, \pi]\) as \(p \to \infty\) with respect to the Sato-Tate measure

\[ \frac{2}{\pi} \sin^2(\theta) d\theta. \]

With due apologies to the experts, we will attempt to sketch an outline of the proof of this result.

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**Friday, November 6, 2:30 p.m. Jeffery 234**

**Department Colloquium**

**Speaker:** Tobias Hurth

**Title:** Dynamical systems with random switching

**Abstract:** In this talk, I will describe some aspects of the ergodic theory for dynamical systems with random switching. These systems arise from switching between deterministic flows from a finite collection at random times. In particular, we will consider conditions under which there is a unique invariant measure that is also absolutely continuous. For some examples in one and two dimensions, we
will describe the density of the invariant measure. The talk is based on work with Yuri Bakhtin, Sean Lawley and Jonathan Mattingly.

Monday, November 9, 4:30 p.m. Jeffery 319
Algebraic Geometry Seminar
Speaker: Nathan Grieve
Title: Diophantine approximation constants for varieties over function fields

Abstract: Let $K$ be a field of characteristic zero, and let $X$ be a projective variety defined over $K$. We define approximation constants, depending on a choice of very ample line bundle $L$ on $X$ and a point $x$ in $X$ defined over the algebraic closure of $K$, extending the theory developed by McKinnon-Roth for the case that $K$ is a number field. We then use an effective version of Schmidt's subspace theorem applicable to the case that $K$ is a function field, due to J.T.-Y. Wang, to give a sufficient condition for such approximation constants to be computed on a proper $K$-subvariety of $X$. We also indicate how our approximation constants are related to volume functions and Seshadri constants.