Strength in Numbers

A Graduate Workshop in Number Theory and Related Areas

Queen's University, Kingston, Canada

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Abstracts for Plenary Talks

Mathematics

- **Wen Ching Winnie Li**, Pennsylvania State University
  Title: Primes and zeta functions
  Abstract: The distribution of prime numbers has been one of the central topics in number theory. It has a deep connection with the analytic behavior of the Riemann zeta function. The concept of "primes" also arises in other context. For example, in a compact Riemann surface, as introduced by Selberg, primitive closed geodesic cycles play the role of primes; while in a finite quotient of a tree and more generally, a finite-dimensional building, for each positive dimension, there are primes of similar nature. In this talk we shall discuss the distributions of such primes and their connections with the analytic behavior of the associated zeta functions.

- **Angela Gibney**, Rutgers University
  Title: Introduction to the moduli space of curves
  Abstract: The moduli space of stable n-pointed curves of genus g has played an important role in the literature: as a means of learning about smooth curves and their degenerations, as a model for moduli spaces generally, and as a test variety for developing theories in algebraic geometry. In this lecture, I will introduce the moduli space of curves.

- **Matilde Lalín**, Université de Montréal
  Title: Moments of L-functions over function fields
  Abstract: We will start by exploring the problem of finding moments of the Riemann zeta function and Dirichlet L-functions, including the first main results and the standard conjectures. We will then discuss the problem for function fields. Finally, we will present a result about the first moment of L-functions associated to cubic characters over $\mathbb{F}_q(t)$, when $q \equiv 1 \bmod 3$. The case of number fields was considered in previous work, but never for the full family of cubic twists over a field containing the third roots of unity. This is joint work with C. David and A. Florea.

- **Chantal David**, Concordia University
  Title: Extremal Primes for elliptic curves without complex multiplication.
  Abstract: There are several distribution questions associated to the reduction of an elliptic curve E over $\mathbb{Q}$ as p varies over the primes that are studied in the literature, as the Sato–Tate conjecture, the Lang–Trotter conjecture, or the Koblitz conjecture. The Sato-Tate conjecture was proved recently by Taylor, joint with Clozel, Harris and Shepherd-Barron, but the other conjectures are still open. In order to gain some evidence for those conjectures, it is natural to consider them in average over the primes, or to look for non-trivial upper bounds.

  We explain the techniques used towards those results, and apply them to a new distribution question: given an elliptic curve E over $\mathbb{Q}$, how many primes p are such that the reduced curve has the maximal (or minimal) possible number of points modulo p? Those are called the *extremal primes* of E.

  If E is a complex multiplication (CM) curve, an asymptotic for the number of extremal primes was determined by James and Pollack. For the case of non-CM curves, we explain how to obtain some upper bounds, using the Chebotarev Density Theorem and results on the distribution of the fractional part of p. Our results are conditional to the GRH. This is joint work with A. Gafni, A. Malik, N. Prabhu and C. Turnage-Butterbaugh.

Psychology

- **Erin Maloney**, University of Ottawa
  Title: Math Anxiety: What it is, Who it Hurts, and What we can do
  Abstract: Basic math skills are important for success in school and everyday life, yet many people experience apprehension and fear when dealing with numerical information. While math anxiety is prevalent and detrimental to learning math and engagement in math and science, there are simple and effective strategies that can help. In this talk, I provide an overview of past research that has investigated the association between math anxiety and math achievement, social and cognitive factors that can cause math anxiety, characteristics of students that can increase their susceptibility to it, and efforts that educators can take to remedy the condition.