General Mathematics Seminar
of the
University of Luxembourg
in cooperation with the
Luxembourg Mathematical Society

November, 2013

Tuesday, November 5, 2013 at 17.00 **Campus Kirchberg, Room B02**

Prof. Louis H. Y. Chen
(National University of Singapore)

Approximating dependent rare events.

Abstract: The Poisson limit theorem for the binomial distribution was implicitly proved by Abraham de Moivre (1712) in his solution to the problem of finding the number of trials that gives an even chance of getting k successes. However, it was Siméon-Denis Poisson (1837) who first gave an explicit form of the Poisson distribution and proved the limit theorem. The Poisson limit theorem suggests that the binomial distribution can be approximated by the Poisson distribution with the same mean if the success probability p is small and the number of trials n is large. It took more than 100 years before Prohorov (1953) proved that the total variation distance between the binomial distribution and the Poisson distribution with the same mean is of the order of p regardless of the values of n (or equivalently, regardless of the value of the mean np). Le Cam (1960) generalized Prohorov's result to sums of independent Bernoulli random variables with unequal success probabilities. Using Stein's method, Chen (1975) generalized and improved Le Cam's result to sums of dependent Bernoulli random variables. Since then Poisson approximation has been extensively studied, developed further and generalized. It has also been applied to a large number of problems in many different fields, which include computational biology, random graphs and large-scale networks, computer science, statistical physics, epidemiology, reliability theory, game theory, and financial mathematics. In this talk, we will give a historical account of the development of Poisson approximation using Stein's method, present two recent applications,

one on maximal arithmetic progressions and the other on bootstrap percolation, and discuss generalizations to compound Poisson approximation, Poisson process approximation and multivariate Poisson approximation. We will also touch on approximation by polynomial birth-death distributions and Poisson approximation for functionals of general Poisson random measures. This talk is based on a joint paper with Adrian Roellin.

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Tuesday, November 12, 2013 at 17.00 **Campus Kirchberg, Room B02**

Prof. Lassina Dembélé
(Warwick Mathematics Institute)

Hilbert modular forms and applications.

Abstract: Hilbert modular forms were introduced in the 19th century as a natural generalisation of classical modular forms to totally real number fields. Today, they find applications in a wide range of areas, including number theory and robust communication networks. In this talk, we will review their definition starting with the classical setting, and discuss some of their applications.

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Tuesday, November 19, 2013 at 17.00 **Campus Kirchberg, Room B02**

Prof. Francesco Bonsante
(University of Pavia)

Globally hyperbolic flat space-times in dimension 3

Abstract: The notion of globally hyperbolic space-time plays a crucial role in relativity. By a celebrated theorem of Choquet-Bruhat and Geroch, assuming that the space-time is Einstein, the first and the second fundamental forms of any Cauchy surface determine the geometry of the whole space. In the talk we will revise this notion focussing on the 3D case. In particular we will describe the Mess parameterization of the moduli space of globally hyperbolic flat structures on the manifold $S \times \mathbb{R}$, where S is a closed surface of genus at least 2. This parameterization is given in terms of global invariants of the space, so it is not directly related to the embedding data of a Cauchy surface. In the final part of the talk, I will describe a recent work with Andrea Seppi where we pointed out the relation between the embedding data of any convex Cauchy surface and the Mess parameterization.

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Tuesday, November 26, 2013 at 17.00 **Campus Kirchberg, Room B02**

Prof. Xavier Caruso
(University of Rennes)

Skew polynomials and factorization.

Abstract: If K is a field equipped with an endomorphism σ, one defines the non-commutative ring $K[X, \sigma]$ as the usual ring of polynomials over K except that one twists the multiplication according to the rule $Xa = \sigma(a)X$ when a in a scalar in K. Skew polynomials appear naturally in several contexts (e.g. semi-linear algebra, theory of differential equations) as an important tool to approach difficult problems. In this talk, after having introduced skew polynomials and presented many examples showing their connections to different questions, I will focus on the problem of factoring them over various fields. Theoretical and practical results will be both discussed.