PhD Away Days 2019

October 18 – 21, 2019, Bordeaux

Titles & Abstracts

Alexandre LECESTRE «*Maximum Likelihood Estimation*»

Abstract. The maximum likelihood estimation (MLE) is probably the most popular estimation method in statistical inference. In the first part, I will introduce the MLE in the context of parametric estimation with the example of esti- mating the mean and the variance of a normal distribution. Then, we will see that under some regularity conditions on the model, the MLE has good theoretical guarantees.

Alexey KALUGIN «*Quantum groups following Feigin*»

Abstract. Quantum groups were first discovered in mathematical physics around 80's and latter Drinfeld and Jimbo gave mathematical definition of quantum groups by specific generators and relations. Since then quantum groups have proved their great importance in various subjects in mathematics and physics but for non specialists Drinfeld and Jimbo's definition may seem to be ad hoc. I will give an introduction to the theory of quantum groups following Feigin. In this approach quantum groups appear naturally from study of cohomology of symmetric powers.

Alisa GOVZMANN «*Étale fundamental group*»

Abstract. I motivate the construction of the étale fundamental group: We start with the definition of the classical fundamental group of a topological space as the group of its deck transformations. In the category of schemes with the étale topology we do an analogue construction which amounts to finding a analog of the universal cover in this category and the group of its automorphisms. I provide a well-known example from number theory which shows that a certain étale fundamental group is the same as the absolute Galois group of a field.

Baptiste HUGUET «*Poincaré inequality*»

Abstract. In this talk I will present intertwining relation between Markov semi-groups on manifolds and its application to functional inequalities. In particular, we will prove Poincaré inequality for non log-concave measure.

Daniel Berhanu MAMO «*Classical and geometric modular forms*»

Abstract. In this talk, we present and compare the classical and geometric modular forms. We also define functions on lattices and functions on elliptic curves which will lead to the definition of Geometric modular forms. Then later we define Tate curves which can be used to define a q-expansion definition of modular forms.

Diptaishik CHOUDHURY «*Comparing metrics at boundary of infinity of quasi-fuchsian manifold*»

Abstract. We will compare the Thurston metric with that of the hyperbolic metric at the boundary at infinity of a quasi fushsian manifold hyperbolic 3-manifold. We will prove an explicit inequality between the two in terms of the associated schwarzian derivative. The proof will be via comparing associated Epstein surfaces, which will be defined.

Eduardo IBARGUENGOYTIA «*Algebra and Bundles*»

Abstract. The talk is intended to present algebraic and categorical views on the subject of fiber bundles. I will mention how this is related to the objects of interest in geometry, and also how such views allow to more general types of constructions and new questions to emerge (e.g. SuperVector bundles and algebraic K-theory).

Emiliano TORTI «*On quadratic equations of negative discriminant* »

Abstract. In this talk, i will address the problem of classifying negative discriminants of quadratic equations in one variable underlining, despite the apparent elementary setting, the central role that this problem plays in modern number theory.

Filippo MAZZOLI «*About the dual volume*»

Abstract. In this talk I will give a brief introduction to the notion of dual volume of hyperbolic 3-manifolds and will describe how it relates to the study of their geometry.

Guenda PALMIROTTA «*Lewy's example, a smooth linear PDE with no solution*»

Abstract. It was long believed that any «reasonable» partial differential equation, without boundary conditions imposed, should have many solutions. The surprise came in 1957. Hans Lewy gave an embarrassingly simple counter-example which showed that in this case the set of solutions may be empty. In this talk we are going to discuss about the problem which is probably the most primitive in partial differential equations theory, namely to know whether an equation does, or does not, have a solution. In this context, the famous theorem, the Cauchy–Kovalevskaya theorem, will be introduced.

Thi Hanh VO «*Short closed geodesics with self-intersections*»

Abstract. Our main point of focus is the set of closed geodesics on hyperbolic surfaces. For any fixed integer k, we are interested in the set of all closed geodesics with at least k self-intersections. Among these, we consider those of minimal length and investigate their self-intersection numbers. We prove that if the surface has at least one cusp, the self-intersection numbers are exactly k for all large enough k.

Jared ASUNCION «*Elliptic Curve Primality Proving*»

Abstract. In this talk, we will review the definition of an elliptic curve, talk about its group structure and say a little bit about its endomorphisms. The main theorem, an idea put forward by Goldwasser-Kilian in 1983, uses the theory of elliptic curves. It is the basis of the Atkin-Morain algorithm – an algorithm which can be used to prove the primality of (large) integers. Towards the end of the talk, we will use PARIDroid to run the algorithm.

Jill ECKER «*The low-dimensional algebraic cohomology of the Witt and the Virasoro algebra with values in tensor densities modules*»

Abstract. The aim of our work is to compute the first and the second algebraic cohomology of the Witt and the Virasoro algebra with values in general tensor densities modules. We are interested in the full algebraic cohomology and not only the sub-complex of continuous cohomology, meaning we do not put any continuity constraints on the cochains. The talk will start with a short introduction to the Witt and the Virasoro algebra. In a second step, we will briefly recall the Chevalley-Eilenberg cohomology of Lie algebras with values in general tensor densities modules. In a third step, we will compute the first algebraic cohomology in order to provide a warm-up example and to illustrate our algebraic techniques. Finally, we will discuss the computation of the second algebraic cohomology.

Juntong CHENG «*An introduction to model selection*»

Abstract. The aim of model selection is to construct data-driven criteria to select a model among a given list. There are widely motivated in many situations such as signal analysis. In these situations, classical asymptotic analysis breaks down and one needs to introduce an alternative approach that we call non-asymptotic. When the target quantity s to be estimated is a function, this allows in particular to consider models selection criteria to choose from the data what is the best approximating model to be considered.

Gastón VERGARA-HERMOSILLA «*Long-time Behaviour of a Model of Rigid Structure Floating in a Viscous Fluid in equilibrium*»

Lara DAW «*Asymptotic Properties of Fractional Brownian Motion III - Asymptotic Properties of Fractional Brownian Motion*»

Abstract. Many natural phenomena in various areas including finance, biology, etc. are very well modeled via classical processes in probability theory, called fractional Brownian Motion and Brownian Motion. These random objects admit several interesting and surprising aspects, which make their study a rich field.
Part III: After introducing the notion of 2 densities: Logarithmic density and Pixel density. We introduce what is known by the sojourn sets associated to fractional Brownian motion and compute the densities of these sets.

Luca NOTARNICOLA «*Finding small roots of integer polynomials modulo N*»

Abstract. In this talk we study the problem of finding small solutions to univariate polynomial equations $F(x) \equiv 0 \pmod{N}$ of degree $d > 1$. In 1996, Don Coppersmith proposed an algorithm for finding such small solutions in polynomial time, relying on the celebrated Lenstra-Lenstra-Lovasz algorithm (or more commonly, LLL) of 1982 for lattice reduction. In particular, this algorithm has several important consequences, including cryptography. We will first introduce Coppersmith's algorithm and and give an overview of lattice reduction. We will also point out several applications and discuss examples, time permitting.

Marcu-Antone ORSONI «*Reproducing kernels of holomorphic function spaces*»

Abstract. In this talk, I will introduce the notion of reproducing kernels and give examples of Hilbert spaces of holomorphic functions which admit reproducing kernels. Finally, I will give some applications of this notion in functional analysis.

Mariagiulia DE MARIA «*Quadratic Reciprocity Law*»

Abstract. In this talk, we will discuss one of the favorites theorems for number theorists: the Quadratic Reciprocity Law (QRL). As of 2000, 196 distinct published proofs were counted. In this talk, I will first state the statement of the QRL, and give some history of this problem. I will then try to motivate the reason why it sparks so much interest, and therefore give some of its applications to number theoretical results. Finally, if time allows, I will present the proof given by Gauß in his *Disquisitiones Arithmeticae*.

Massimo NOTARNICOLA «*Asymptotic Properties of Fractional Brownian Motion II - Two fundamental Gaussian Processes: Brownian motion and fractional Brownian motion*»

Abstract. Many natural phenomena in various areas including finance, biology, etc. are very well modelled via classical processes in probability theory, called fractional Brownian Motion and Brownian Motion. These random objects admit several interesting and surprising aspects, which make their study a rich field.
Part II: We define two fundamental Gaussian Processes: Brownian motion and fractional Brownian motion and give some properties.

Minh Nhat DOAN «*Some identities on hyperbolic surfaces*»

Abstract. In this talk, I would like to introduce some identities on hyperbolic surfaces for instance: Basmajian's Identity, McShane's Identity, Bridgeman's Identity, Luo-Tan's Identity. Then we will see the simple idea behind them.

Pietro SGOBBA «*On the multiplicative order of* $n \pmod p$»

Abstract. Let n be an integer. For a prime p not dividing n we recall the definition of the multiplicative order of $n \bmod p$ and some of its properties. Letting p vary over the prime numbers we obtain a special sequence of integers. We study the natural density of primes for which the order of $n \bmod p$ lies in a given arithmetic progression, and we point out that Kummer theory plays a natural role in the expression of this kind of densities. This problem can be generalized to finitely generated groups of integers.

Robert BAUMGARTH «*What is a martingale?*»

Abstract. As we shall see, it is helpful to view all martingales in terms of gambling. But, of course, the tremendous importance of martingale theory derives from the fact that martingales crop up in very many contexts.

Sebastiano TRONTO «*Field Extensions and Elliptic Curves*»

Abstract. In this talk I will give an introduction to my research topic, that is the study of field extensions that arise from points of elliptic curves. In order to make the talk accessible to everyone, I will start by recalling the basics of field extensions and Galois theory.

Valentin GARINO «*Asymptotic Properties of Fractional Brownian Motion I - Introduction to general stochastic processes*»

Abstract. Many natural phenomena in various areas including finance, biology, etc. are very well modelled via classical processes in probability theory, called fractional Brownian Motion and Brownian Motion. These random objects admit several interesting and surprising aspects, which make their study a rich field.
Part I: We introduce the required tools for the study of general stochastic processes.