SMS Doctoral Day 2024 – Program

Basel, May 3, 2024

10:00 - 10:05	**Introduction** Joachim Rosenthal (Swiss Mathematical Society)
10:05 - 10:20	**Modeling lower-truncated and right-censored insurance claims with an extension of the MBBEFD class** Selim Gatti (ETH Zürich)
10:30 - 10:45	**Topology meets geometric measure theory** Denis Marti (UNI Fribourg)
10:55 - 11:30	*Coffee Break / Poster session*
11:30 - 11:45	**Asymptotic time behaviour of Vlasov-type equation** Antoine Gagnebin (ETH Zürich)
11:55 - 12:10	**Mappings of finite distortion and metric surfaces** Damaris Meier (UNI Fribourg)
12:20 - 13:30	*Lunch*
13:30 - 13:45	**Zaremba's Conjecture for Geometric Sequences** Elias Dubno (UNI Zürich)
13:55 - 14:10	**Periodic geodesics in self-similar spaces** Nicola Paddeu (UNI Fribourg)
14:20 - 14:50	*Coffee Break / Poster session*
14:50 - 15:05	**Counting points of bounded height on certain elliptic curves** Marta Dujella (UNI Basel)
15:15 - 15:30	**Robust Data-Driven Modeling of Partially Observable Networks** Ramzi Dakhmouche (EPFL)

Modeling lower-truncated and right-censored insurance claims with an extension of the MBBEFD class

Selim Gatti (ETH Zürich)

In general insurance, claims are often lower-truncated and right-censored because insurance contracts may involve deductibles and maximal covers. Most classical statistical models are not (directly) suited to model lower-truncated and right-censored claims. A surprisingly flexible family of distributions that can cope with lower-truncated and right-censored claims is the class of MBBEFD distributions that originally has been introduced by Bernegger (1997) for reinsurance pricing, but which has not gained much attention outside the reinsurance literature. Interestingly, in general insurance, we mainly rely on unimodal skewed densities, whereas the reinsurance literature typically proposes monotonically decreasing densities within the MBBEFD class. We show that this class contains both types of densities, and we extend it to a bigger family of distribution functions suitable for modeling lower-truncated and right-censored claims. In addition, we discuss how changes in the deductible or the maximal cover affect the chosen distributions.

Topology meets geometric measure theory

Denis Marti (UNI Fribourg)

In this talk we explore the intersection of metric geometry and differential topology and ask which aspects of the structure are necessary to obtain interesting statements. More precisely, we focus on metric manifolds - topological manifolds with compatible metrics - and investigate to what extent results from geometric measure theory remain applicable in this context.

Asymptotic time behaviour of Vlasov-type equation

Antoine Gagnebin (ETH Zürich)

I will talk about Vlasov-type equations on the torus $\mathbb{T}^d$, PDE's that model confined plasma physics when you neglect collisions between particles and external magnetic effects. I will talk about a class of equilibria for such equations and look at the asymptotic stability in time for this kind of equilibrium. I will present the famous work of Landau (1946) concerning linear evolution and then give a new result for the asymptotic stability of the dynamic of ions in plasma.

Mappings of finite distortion and metric surfaces

Damaris Meier (UNI Fribourg)

In this talk, we define and examine distortion of mappings within a two-dimensional setting. We observe that mappings with integrable distortions preserve the key topological properties of complex analytic functions, including continuity, openness, and discreteness. This remains true even in the general case where the domain is a metric surface and the target is the Euclidean plane.

Zaremba's Conjecture for Geometric Sequences

Elias Dubno (UNI Zürich)

There are only a handful of explicit sequences known to satisfy the strong version of Zaremba's conjecture, all of which were obtained using essentially the same algorithm. In this talk, we discuss

a refined algorithm using the folding lemma for continued fractions, which both generalizes and improves on the old one.

Periodic geodesics in self-similar spaces

Nicola Paddeu (UNI Fribourg)

We briefly introduce sub-Finsler geometry and self-similar spaces. We prove that in self-similar spaces non-singular periodic geodesics must be constant.

Counting points of bounded height on certain elliptic curves

Marta Dujella (UNI Basel)

In number theory, one often uses a notion of height to measure the arithmetic complexity of certain objects. I will explain what we mean by this for points on an elliptic curve E over a number field K. Given a real number B, it is often useful to have good bounds on the number of points of $E(K)$ with height at most $\log B$, which we denote by $\mathcal{N}(B)$. While classical results give good bounds for a fixed elliptic curve, in general it is hard to get uniform results. This problem can be simplified if we assume the existence of a nontrivial point of finite order in $E(K)$. I will present my result for uniformly bounding $\mathcal{N}(B)$ in this family of curves.

Robust Data-Driven Modeling of Partially Observable Networks

Ramzi Dakhmouche (EPFL)

Real-world complex systems often miss high-fidelity physical descriptions and are typically subject to partial observability. Learning dynamics of such systems is a challenging and ubiquitous problem, encountered in diverse critical applications which require interpretability and qualitative guarantees. For that matter, I will introduce a new approach to address this problem in the case of network systems, with known topology. Specifically, I will present a new scheme -dubbed Symbolic Distribution Flow Learner (SDFL)- to model network probability distribution flows governed by ODEs. In particular, the scheme's sample complexity will be analyzed and its performance illustrated on the prototypical problem of Kuramoto networks and a standard benchmark of single-cell RNA sequence trajectory data. Last, I will conclude with ideas to tackle this problem in the unknown topology setting.