Cheerful Stochastics besides Corona Risk

Book of abstracts

October 28, 2020

Updated: October 23

Introduction and practical information

Now it's time for the traditional PhD/postdoc-gathering for Stochastics and Risk which will take place in Abels Utsikt and online on October 28th, 09.30 - 16.30. All PhD students and postdocs have the opportunity to give a 15-minute talk on their research. In addition, Jocelyne Bion-Nadal (École Polytechnique) will give an introductory talk and Kristina Rognlien Dahl (UiO) will introduce the SCROLLER project. As a member of the section, you can attend either in person or online. There are breaks for coffee and cakes, and we provide lunch baguettes from Elvebredden catering. At 18.00 those who have registered for it will go out to dinner to Olivia Restaurant at Aker Brygge. A three-course dinner is included and you you pay for drinks yourself. Welcome!

Enclosed you find the titles and abstracts for the talks of the gathering in chronological order.

The workshop organizers: Alexander, Andreas, Dennis and Emel

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Abstracts

9:30 - 10:20

Dynamic convex operators: Application to risk measuring and risk indifference pricing

Jocelyne Bion-Nadal

Invited speaker – CMAP, Ecole Polytechnique

Dynamic convex operators is a fundamental tool both for the analysis of risks and for pricing in incomplete markets.

In the first part of the talk, we review the theory of dynamic risk measures. The concept of fully dynamic risk-measures offers the possibility of changing the risk perspectives over time. It fits well the study of both short and long term investments. We provide also expicit constructions of time consistent fully dynamic risk measures.

In the second part we propose a dynamic risk indifference pricing criteria derived from a fully-dynamic family of risk measures on the L_p-spaces for $p \in [1, \infty]$. Dynamic risk-indifference pricing is an alternative to utility-indifference pricing. In this dynamic framework we analyse whether the risk-indifference pricing criterion actually provides a proper convex price system. It turns out that the analysis is quite delicate and necessitates an adequate setting and the extension of the price operators and underlying risk measures.

Furthermore, we consider the relationship of the fully-dynamic risk-indifference price with no-good-deal bounds.

This second part is based on a joint work with Giulia Di Nunno "Fully-dynamic risk-indifference pricing and no-good-deal bounds" to appear in SIAM Journal on Financial Mathematics.

10:40-11:00

Regularization by noise in SPDEs

Fabian Andsem Harang

We will present some recent ideas on how noise provides a regularizing effect in certain spdes with multiplicative noise. The framework is based on "infinite dimensional" averaged fields and non linear Young integration framework. This talk is based on a joint work with Prof. Rémi Catellier at University of Nice.

A case of spatio-temporal modelling of wind speed data

11:00-11:20

Mihaela Puica

The current research aims at deriving a good wind speed measurement at any desired location starting from several gridded time series of meteorological data. The project thus deals with spatio-temporal random fields in an original way: by modelling the time component in a probabilistic AR fashion and the spatial one within a kriging framework. The results show that such a technique is both tractable and in line with the field data.

A stochastic epidemical model for the spread of HIV virus

11:20-11:40

Jasmina Djordjevic

A stochastic SICA epidemic model for HIV transmission, described by stochastic ordinary differential equations, and discuss its perturbation by environmental white noise is introduced. The existence and uniqueness of the global positive solution to the stochastic HIV system is proven, and conditions under which extinction and persistence in the mean hold, are given. The theoretical results are illustrated via numerical simulations.

Maximum principles for infinite dimensional Volterra time-changed dynamics

11:40-12:00

Michele Giordano

Our goal is to maximize the performance functional

$$J(u) = \mathbb{E}\left[\int_0^T F(t, X^u(t), u(t))dt + G(X^u(T))\right]$$

where the process X is an infinite dimensional controlled stochastic evolution equation driven by a time-changed Lévy process with value in a separable Hilbert space H, and a time dependent unbounded linear operator A:

$$dX_t = A_t X_t dt + \beta(t, X_t^u, u_t)dt + \int_H \sigma(t, X_t^u, \xi)\mu(dt, d\xi)$$

We provide a framework for the study of the driving noise, in which we deal with two information flows, which we are going to consider as partial to each other. We provide a sufficient and a necessary maximum principle for both filtrations, and study a form of backward stochastic differential equation which naturally arises in this framework.

Joint work with Giulia Di Nunno.

13:00 - 13:50

The SCROLLER project: A Stochastic ContROL approach to machine Learning with applications to Environmental Risk models

Kristina Rognlien Dahl

Invited speaker – Universitetet i Oslo

In this talk, we present the research plan and current status of the SCROLLER project. The project is funded by the Research Council of Norway. The core idea of the project is to study the connections between stochastic analysis, in particular stochastic control and stochastic optimization, risk theory and machine learning. In the talk, we will present the different subprojects as well as the SCROLLER-participants.

Furthermore, we will present an ongoing part of the SCROLLER project where we are working on environmental contours and optimal design. In this project, we minimise the risk of the cost of a structural design with respect to two different risk measures: Value at risk (VaR) and conditional value at risk (CVaR). This is done by connecting the design optimisation problem to environmental contours.

13:50 -14:10

Copulas and Sklar's theorem in infinite dimensions

Dennis Schroers

Copulas describe statistical dependence between the components of multivariate random variables in full generality by virtue of Sklar's theorem. Although they are used and defined for certain infinite dimensional objects (e.g. Gaussian processes, Markov processes or infinite dimensional Archimedean copulas) there is no prevalent notion of a copula as an infinite dimensional law that unifies these concepts. To this end we define copulas as probability measures on product spaces and formulate Sklar's theorem in this general setting.

Afterwards we use this result on Banach spaces to construct cylindrical probability measures with predefined marginals and underlying copula. This induces the functional analytic problem of finding criteria in which cases the obtained cylindrical law induces a real probability measure, which is in general difficult to decide. We solve this problem in the p-Wasserstein space on the space of p-summable sequences (including separable Hilbert spaces) and show that copulas effectively solve a restricted optimal coupling problem. Joint work with Fred Espen Benth and Giulia Di Nunno.

Approximating the covariance operator of the solution to the stochastic wave equation

14:10-14:30

Andreas Petersson

The problem of approximating the covariance operator of the mild solution to the stochastic wave equation on bounded domains in Euclidean space is considered. The equation is linear (but inhomogeneous) and driven by Gaussian noise, which ensures that this operator determines the law of the solution. Existence and uniqueness for an operator-valued integral equation for the covariance based on the semigroup representation of the mild solution is proven, along with an accompanying error decomposition formula for general approximations of the covariance. As an example, a temporal semidiscretization based on a rational approximation of the semigroup is considered. The presentation concludes with a discussion on how this discretization can be used to derive error bounds for a fully discrete method based on finite elements. Joint work with Annika Lang and Mihály Kovács.

Approximating expected value of an option with non-Lipschitz payoff in fractional Heston-type model

14:30-14:50

Anton Yurchenko-Tytarenko

We consider option pricing in a framework of the fractional Heston-type model with $H > 1/2$. As it is impossible to obtain an explicit formula for the expectation $Ef(S_T)$ in this case, where S_T is the asset price at maturity time and f is a payoff function, we provide a discretization schemes $\hat{Y}^n$ and $\hat{S}^n$ for volatility and price processes correspondingly and study convergence $Ef(\hat{S}^n_T) \to Ef(S_T)$ as the mesh of the partition tends to zero. The rate of convergence is calculated. As we allow f to be non-Lipschitz and/or to have discontinuities of the first kind which can cause errors if S_T is replaced by $\hat{S}^n_T$ under the expectation straightforwardly, we use Malliavin calculus techniques to provide an alternative formula for $Ef(S_T)$ with smooth functional under the expectation.

15:10 -15:30

Memory and Anticipation: Stochastic Maximum Principle

Emel Savku

The main reason that regime-switching models received a lot of attention by the researchers is the ability of these models to capture the different modes of the financial market easily. Moreover, in the real world, investors tend to look at the historical performance of the risky assets. Hence, we study a stochastic optimal control problem for a delayed Markov regime switching jump-diffusion model, which combines both of these motivations. We establish necessary and sufficient maximum principles for such a system and prove the existence-uniqueness theorem for the adjoint equations which are represented by an anticipated backward stochastic differential equation with jumps and regimes. We illustrate our results by a problem of optimal consumption from a cash flow with delay and regimes. Joint work with Gerhard Wilhelm Weber.

15:30-15:50

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Andrea Fiacco

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15:50-16:10

Development of a data-driven warning system for runway conditions

Alise Danielle Midtfjord

During the winter season, contamination of runway surfaces with snow, ice, or slush causes potential economic and safety threats for the aviation industry. The presence of these materials reduces the available tire–pavement friction needed for retardation and directional control. The aim of this work is to develop a model to classify the level of the surface friction between the tires of the aircraft and the runway during aircraft landing, to provide pilots and airport operators with accurate and real time information about the runway conditions. This is done using a machine learning algorithm that takes as input several data features such as runway temperature, weather conditions, type of runway as well as the gradient of weather conditions over time.

Stratospheric Temperature Modelling

16:10-16:30

Mari Dahl Eggen

A stochastic model for daily stratospheric spatial mean temperature is proposed. The proposed model is a sum of a deterministic seasonality function and a mean-reverting stochastic process. Data analysis suggests that an AR(4) process should be used to model the deseasonalized temperature data in question, corresponding to a CAR(4) process. The residuals of the AR(4) process turn out to be NIG distributed random variables scaled with a time dependent volatility function. This initial analysis suggests that an approach used to derive stochastic models for temperature on ground level may also be used to derive stochastic models for stratospheric temperature. Stochastic models for stratospheric temperature can be used in analyses giving enhanced knowledge of sudden stratospheric warnings, and the dynamics of the stratosphere in general. This enhanced knowledge is believed to be important in the work of improving long-term weather forecasts.
