Department of Mathematics

Joint Risk & Stochastics and Financial Mathematics Seminar in 2019/20

Seminars are listed in reverse chronological order, most recent first

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Thursday 12 March - Eduardo Ebi Jaber

Reconciling rough volatility with jumps
Starting from hyper-rough Volterra Heston models, for which we provide new existence uniqueness and stability results for any Hurst index in (-1/2,1/2], we construct a Markovian approximating class of one dimensional Heston-type models parametrized by a fast mean reversion speed and an unconstrained Hurst index. This class does not only enjoy closed form solutions for its Fourier-Laplace transform but is also able to mimick hyper-rough implied-volatility surfaces for any Hurst index in (-1/2,1/2]. More remarkably, for H smaller -1/2, sending the mean reversion to infinity, we obtain convergence of the reversionary model towards Lévy processes such as the IG-NIG.
Joint work with Ryan McCrickerd.

Thursday 27 February - Andreas Sojmark (Imperial College)

Dynamic default contagion: From Eisenberg--Noe to the Mean-field
In this talk, we will start by constructing a simple dynamic network model for interbank default contagion in the vein of the seminal clearing payment frameworks of Eisenberg & Noe (2001) and Rogers & Veraart (2013). The key feature, and main novelty, is a combination of stochastic dynamics for the banks' external assets together with a realistic balance sheet methodology for determining early defaults (on interbank obligations). This then leads to the study of random default contagion events in continuous time. After first developing the model for a finite number of banks, we display a law of large numbers effect, which allow us to pass to the mean field limit of the interbank model. Thus, we can study default contagion via a conditional McKean–Vlasov type problem that respects the original network topology.

Thursday 13 February - Soren Christensen (CAU)

Nonparametric learning in stochastic control - exploration vs. exploitation
One of the fundamental assumptions in stochastic control of continuous time processes is that the dynamics of the underlying (diffusion) process is known. This is, however, usually obviously not fulfilled in practice. On the other hand, over the last decades, a rich theory for nonparametric estimation of the drift (and volatility) for continuous time processes has been developed. The aim of this talk is to make a

first (small) step to bringing together techniques from stochastic control with methods from statistics for stochastic processes to find a way to both learn the dynamics of the underlying process and control good at the same time. To this end, we study a toy example motivated from optimal harvesting, mathematically described as an impulse control problem. One of the problems that immediately arises is an Exploration vs. Exploitation behavior as is well known in Machine Learning. We propose a way to deal with this issue and analyse the proposed strategy asymptotically.

Thursday 30 January - Blanka Horvath (King's College)

Data Anonymisation, Outliers Detection and Fighting Overfitting with Restricted Boltzmann Machines
We propose a novel approach to the anonymisation of datasets through non-parametric learning of the underlying multivariate distribution of dataset features and generation of the new synthetic samples from the learned distribution. The main objective is to ensure equal (or better) performance of the classifiers and regressors trained on synthetic datasets in comparison with the same classifiers and regressors trained on the original data. The ability to generate unlimited number of synthetic data samples from the learned distribution can be a remedy in fighting overfitting when dealing with small original datasets. When the synthetic data generator is trained as an autoencoder with the bottleneck information compression structure we can also expect to see a reduced number of outliers in the generated datasets, thus further improving thegeneralization capabilities of the classifiers trained on synthetic data. We achieve these objectives with the help of the Restricted. Boltzmann Machine, a special type of generative neural network that possesses all the required properties of a powerful data anonymiser.

Based on joint work with Alexei Kondratyev and Christian Schwarz.

Thursday 5 December - Renyuan Xu (University of Oxford)

Learning Mean-Field Game
Motivated by the online Ad auction problem for advertisers, we consider the general problem of simultaneous learning and decision-making in a stochastic game setting with a large population. We formulate this type of games with unknown rewards and dynamics as a generalized mean-field-game (GMFG), with the incorporation of action distributions.

We first analyze the existence and uniqueness of the GMFG solution, and show that naively combining Q-learning with the three-step fixed-point approach in classical MFGs yields unstable reinforcement learning algorithms. We then propose an approximating Q-learning algorithm and establish its convergence and complexity results. The numerical performance shows superior computational efficiency. This is based on joint work with Xin Guo (UC Berkeley), Anran Hu (UC Berkeley) and Junzi Zhang (Stanford).

Tuesday 26 November - Philipp Illeditsch (University of Pennsylvania)

The Effects of Speculation on Constrained Households
We study how financial speculation affects households who do not participate in financial markets. We show that the consumption/wealth shares of households decrease because they forego they equity premium and pay the liquidity premium for cash (a negative inflation risk premium in our model) by putting all their savings in a short term bank account but not because investors are speculating. In an infinite horizon economy, non participation in financial markets would lead to consumption/wealth shares of households that go to zero whereas in our OLG model with finite life expectancy it only leads to a decrease in the households' average consumption share and thus allows us to study the effects of financial speculation on non participating households.

Interestingly, financial speculation in the stock market due to disagreement about expected output growth does not affect households' aver- age consumption share and even lowers its volatility. In contrast, disagreement about output growth increases the cross-sectional consumption volatility of speculators. Disagreement has no effect on average valuation ratios and lowers their volatility if speculators have the same time preferences. Otherwise valuations are on average lower and more volatile. Precautionary savings increase and thus interest rates decrease when household do not invest in the stock market. Disagreement raises the interest rate volatility and thus the consumption growth volatility of households but has no effect on its mean unless speculators have different time preferences. Stock market volatility tends to decrease with disagreement. While the stock market risk premium increases and is countercyclical due to household non participation in financial markets, disagreement has no effect on the risk premium unless speculators have different time preferences."

Thursday 21 November - Francesco Russo (ENSTA Paris, Institut Polytechnique de Paris)

The title and abstract can be found here.

Thursday 7 November - Stefano Duca and Philip Gradwell (Chainalysis)

Cryptocurrencies: what the data tells us about a new financial market
Cryptocurrencies have generated much hype and controversy, but they have also generated vast amounts of financial data. Not only are they traded on exchanges, via spot and derivatives, but they are also transacted on the blockchain. This potentially allows for detailed analysis of this new financial market. However, interpretation of the data is complex due to the pseudo-anonymity of blockchain transactions and the immaturity of markets. Chainalysis, the leading blockchain analytics company, will describe the state of cryptocurrency data, their latest understanding of the crypto-economy, and frame the open questions for a debate on the frontiers of cryptocurrency research.

Thursday 24 October - Eugene Feinberg (Stony Brooks University)

Solutions for Zero-Sum Two-Player Games with Noncompact Decision Sets
The classic theory of infinite zero-sum two-player games has been developed under the assumptions that either the decision set of at least one of the players is compact or some convexity/concavity conditions hold. In this talk we describe sufficient conditions for the existence of solutions for two-person zero-sum games with possibly noncompact decision sets for both players and the structure of the solution sets under these conditions. Payoff functions may be unbounded, and we do not assume any convexity/concavity-type conditions. For such games expected payoffs may not exist for some pairs of strategies. These results imply several classic facts, and they are illustrated with the number guessing game. We also describe sufficient conditions for the existence of a value and solutions for each player.

The talk is based on joint papers with Pavlo O. Kasyanov and Michael Z.

Thursday 10 October - Simone Scotti (Université Paris Diderot)

Alpha-Heston stochastic volatility model
We introduce an affine extension of the Heston model where the instantaneous variance process contains a jump part driven by α-stable processes with $\alpha\in(1,2]$. In this framework, we examine the implied volatility and its asymptotic behaviors for both asset and variance options. In particular, we show that the behavior of stock implied volatility is the sharpest coherent with theoretical bounds at extreme strikes independently of the value of $\alpha\in(1,2)$. As far as volatility options are concerned, VIX-implied volatility is characterized by an upward-sloping behavior and the slope is growing when α decreases.
Furthermore, we examine the jump clustering phenomenon observed on the variance marketand provide a jump cluster decompositionwhich allows to analyse the cluster processes. The variance process could be split into a basis process, without large jumps, and a sum of jump cluster processes, giving explicit equations for both terms. We show that each cluster process is induced by a first ``mother" jump giving birth to a sequence of ``child jumps". We first obtain a closed form for the total number of clusters in a given period.
Moreovereach cluster process satisfies the same α-CIR evolution of the variance process excluding the long term mean coefficient that takes the value 0.We show that each cluster process reaches 0 in finite time and we exhibit a closed form for its expected life time.We study the dependence of the number and the duration of clusters as function of the parameter α and the threshold used to split large and small jumps.

Joint work with Ying Jiao, Chunhua Ma and Chao Zhou