Department of Mathematics

Joint Risk & Stochastics and Financial Mathematics Seminar in 2018

Seminars are listed in reverse chronological order, most recent first

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Thursday 13 December - Charles Bertucci (Université Paris-Dauphine)

Optimal stopping in mean field games

Mean field games are model in which a continuum of indistinguishable players face a game in which they interact between each other only through mean field terms. Such models have been introduced by Lasry and Lions in 2006. The most commonly studied case is the one in which the players control their velocity and interacts through a running/terminal cost. I will begin by recalling the main features of this seminal model as well as some results. Then I will explain how we can establish new results in a mean field game in which the players can decide to exit the game.

Thursday 29 November - Tiziano De Angelis (University of Leeds)

Dynkin games with incomplete and asymmetric information

We study Nash equilibria for a two-player zero-sum optimal stopping game with incomplete and asymmetric information. In our set-up, the drift of the underlying diffusion process is unknown to one player (incomplete information feature), but known to the other one (asymmetric information feature).
We formulate the problem and reduce it to a fully Markovian setup where the uninformed player optimises over stopping times and the informed one uses randomised stopping times in order to hide their informational advantage. Then we provide a general verification result which allows us to find Nash equilibria by solving suitable quasi-variational inequalities with some non-standard constraints. Finally, we study an example with linear payoffs, in which an explicit solution of the corresponding quasi-variational inequalities can be obtained.

The talk is based on https://arxiv.org/abs/1810.07674

Thursday 15 November - Miklos Rasonyi (CEU)

Ergodic properties of certain financial models
We consider certain Markov chains in random environments and prove their stochastic stability as well as a law of large numbers for their functionals. The results apply, in particular, to variants of rough volatility models which can be regarded as Markov chains in a Gaussian stationary environment.

Thursday 8 November - Johannes Muhle-Karbe (Carnegie Mellon University)

A Risk-Neutral Equilibrium Leading to Uncertain Volatility Pricing
We study the formation of derivative prices in equilibrium between risk-neutral agents with heterogeneous beliefs about the dynamics of the underlying. Under the condition that the derivative cannot be shorted, we prove the existence of a unique equilibrium price and show that it incorporates the speculative value of possibly reselling the derivative. This value typically leads to a bubble; that is, the price exceeds the autonomous valuation of any given agent. Mathematically, the equilibrium price operator is of the same nonlinear form that is obtained in single-agent settings with strong aversion against model uncertainty. Thus, our equilibrium leads to a novel interpretation of this price. (Based on joint work with Marcel Nutz)

Thursday 1 November - Kwok Chuen Wong (DCU)

Portfolio Optimisation with Semivariance
In this talk, I shall investigate dynamic portfolio management using semivariance of portfolio payoff as a portfolio risk measure. Comparing with variance which is widely used in the literature, semivariance is considered to be more plausible risk measure because semivariance penalizes adverse situations only. However, in the literature, it was shown that mean-semivariance optimisation under the Black-Scholes model has no optimal solution.
Inspired by this non-existence result, I shall establish necessary and sufficient conditions under which the mean-semivariance optimisation possesses an optimal solution. I shall suggest the models under which such sufficient conditions are satisfied, thus, under these models, the explicit optimal solution to mean-semivariance optimisation can be obtained; such models can be applied into the themes of insurance. Besides, I shall establish that utility-semivariance optimisation possesses an optimal solution even under the Black-Scholes model. In

numerical studies, among mostly encountered market values of different model parameters, it is astonishing to observe that embedding downside risk measure into utility maximization framework can significantly reduce the downside risk of the optimal portfolio payoff with an asymmetrically tiny loss in utility.

This talk is based on joint works with Paolo Guasoni, Phillip Yam, and Harry Zheng.

Thursday 4 October - Zachary Feinstein (Washington University)

Pricing debt in interbank networks under comonotonic endowments
In this talk we present formulas for the pricing of debt and equity of firms in a financial network under comonotonic endowments. We demonstrate that the comonotonic setting provides a lower bound to the price of debt under Eisenberg-Noe financial networks with consistent marginal endowments. Such financial networks encode the interconnection of firms through debt claims. The proposed pricing formulas consider the realized, endogenous, recovery rate on debt claims. Special consideration will be given to the setting in which firms only invest in a risk-free bond and a common risky asset following a geometric Brownian motion.

Thursday 24th May 2018 - Mike Ludkovski (UC Santa Barbara)

Capacity Expansion Games: Non-zero-sum Switching/Multiple Stopping Equilibrium
We consider non-zero-sum stochastic games of timing. Our motivation is from competitive capacity investment for a duopoly of two distinct producers. The producers are exposed to stochastically fluctuating costs and interact through aggregate supply. Capacity expansion is modeled in terms of timing strategies, i.e. repeated real options. The overall market is then described through the stochastic factor (X_t) that captures short-term fluctuations and the (relative) capacity that summarizes the current market organization. Working in a continuous-time diffusion framework, we characterize and analyze the resulting Nash equilibrium and game payoffs using tools of optimal stopping. An example of competing green and fossil-fuel producers will be used as illustration. The second part of the talk will then consider ongoing work extending this model to a stationary switching game characterized via a sequence of switching thresholds. Joint work with Rene Aid (Paris Dauphine, Part I) and Liangchen Li (UCSB, Part I and II).

Monday 30 April 2018 - Albert N. Shiryaev (Steklov Mathematical Institute)

Optimal Stopping Procedures in financial models with disorder of trends ("drift-bubbles")

We consider the financial model

$$X(t)=[aI(t<R)+bI(t>R)]+B(t)$$

where B is a Brownian motion, R is random positive variable, a and b some constants (known or unknown). Many financial models can be described by a similar way. For example, the stock AAPL (Apple computer stock) can be modelled using the above (here we consider the interval from September 1984 until the end of 2012). In the given Apple model we shall assume that the time R when the drift changes is uniformly distributed on the interval. In our talk we describe theoretical results on optimal stopping ("American options") of discovering the disorder time R (with some minimal risk) and practical results for the Apple stock.

Thursday 26 April - Lukasz Stettner (Institute of Mathematics, Polish Academy of Sciences)

Long Run Risk Sensitive Control and Portfolio Optimization

I'm going to present several results concerning risk sensitive control of discrete and continuous time Markov processes over infinite time horizon and then similar results concerning risk sensitive portfolio optimization. The last problem is closely related to asymptotics of optimal power utility from terminal wealth. The talk shall consist of published and new results. The approach will be mainly probabilistic. Major problems and difficulties will be pointed out.

Thursday 15 March - Sergio Pulido (ENSIIE)

Affine Volterra Processes

A growing body of empirical research indicates that volatility fluctuates more rapidly than Brownian motion, which is inconsistent with standard semimartingale models. Fractional volatility models and their relatives have emerged as compelling alternatives- however, their non-Markovian structure makes computations more difficult. We show that, for a large class of such models, it is nonetheless possible to compute the characteristic function by solving an integral equation similar to the Riccati equations associated with standard affine processes. Joint work with Eduardo Abi Jaber and Martin Larsson.

Wednesday 7 March - Alfred Galichon (New York)

Topics in Equilibrium Transportation

Motivated by problems from Economics, I will present a framework for "Equilibrium Transport", which embeds the Monge-Kantorovich "Optimal Transport" problem, but is more general, and more natural in some applications. In the discrete case, this framework allows for a unified description of Gale and Shapley's stable marriage problem, as well as Koopmans and Beckmann's optimal assignment problem. I will sketch the link with "Galois connections" and recent results by Trudinger on the local theory of prescribed Jacobian equations. I will then turn to computational issues, and will present an extension of Sinkhorn's algorithm that allows for efficient approximate computation of these problems. Finally, I will discuss the statistical estimation of these models.

Thursday 1 March - Jan Palczewski (Leeds)

(Un)discounted Optimal Stopping Problems and Applications

I will talk about an infinite horizon optimal stopping problem with a functional comprising of a running reward and a final reward. I will establish the feasibility of the stopping problem, prove the existence of optimal stopping times and a variational characterisation (in the viscosity sense) of the value function when interest rates are not uniformly separated from 0. These results rely on certain ergodic properties of the underlying (non-uniformly) ergodic Markov process. I will further sketch how these results apply to impulse control problems with average cost per unit time functional and, if time allows, present an example of optimal control of a battery for provision of Fast Reserve balancing service to National Grid.

Wednesday 21 February 2018 - Budhi Surya (Victoria University of Wellington)

A Rating-Based Model of Credit Risk Under Non-Markov Chains

In many credit risk applications, the rating based model of Jarrow-Lando-Turnbull (Journal of Finance, Vol. 50, p. 53-86, 1995) has been widely used for the pricing and hedging of corporate bonds. The model is driven by a continuous-time absorbing Markov chain. However, there have been mounting empirical evidences to suggest the contrary, see e.g. Frydman and Schuermann (Journal of Banking and Finance Vol. 32, p.1062-1075, 2008), that bonds of the same credit rating can move at different

rates to other credit ratings and that the incorporation of past credit information helps improve the Nelson-Aalen estimate of cumulative default intensity. Based on these empirical findings, I propose a new rating based model of credit risk under a non-Markov chain. The model is developed based on the mixture of continuous-time absorbing Markov chains moving at different speeds, where the mixture occurs at a random time. Variety of associated distributional properties of the Markov mixture process are discussed, for example the transition matrix, the default-time distribution and forward default intensity. Identities are explicit in terms of the Bayesian update of switching probability and intensity matrices of the underlying Markov chains despite the mixture process is non Markovian. They form non-stationary function of time and have the ability to capture heterogeneity and past credit information when conditioning on available information (either full or partial) up to current time. Their availability in closed forms offers appealing features for applications in credit risk.

Reference:
B.A. Surya. (2017). Distributional properties of the mixture of continuous time absorbing Markov chains moving at different speeds. Stochastic Systems - INFORMS Applied Probability Society.

Thursday 15 February - Cristina Di Girolami (Pescara)

Path Dependent Stochastic Calculus, an Infinite Dimensional PDE and Financial Perspectives

This talk develops some aspects of stochastic calculus via regularization for path dependent random variables. After some brief reminds on stochastic calculus in a general Banach space B, main interest will be devoted to the case when B is the space of real continuous functions defined on $[-T; 0]$, $T > 0$ and the process is the window process $X(.)$ associated with a continuous real process X which, at time t, it takes into account the past of the process. If X is a finite quadratic variation process (for instance Dirichlet, weak Dirichlet), it is possible to represent a large class of path-dependent random variable h as a real number plus a real forward integral in a semiexplicite form. This representation result of h makes use of a functional solving a path dependent infinite dimensional partial differential equation of Kolmogorov type. Two recent general existence results of its classical solutions related to different classes of final conditions will be presented. The decomposition result generalizes, in some cases, the well known Clark-Ocone formula which is true when X is the standard Brownian motion W. Some examples will be given explicitly developed and discussed.

This is a joint work with Francesco Russo (ENSTA ParisTech Paris).

Thursday 1 February - Denis Villemonais (Lorraine)

Exponential convergence of conditioned processes

In a previous work in collaboration with Nicolas Champagnat, we provided necessary and sufficient criterion for the uniform exponential convergence of Markov processes conditioned not to be killed. This criterion, and hence the uniform exponential convergence, only applies to cases where the conditioned process is uniformly exponentially ergodic. Our aim during this talk is to present applications to a new framework of assumptions that entails the non-uniform exponential convergence of conditioned Markov processes. In this new framework, most of the difficulties usually involved in proving the convergence of a conditioned Markov process to a quasi-stationary distribution are easily overcome.

Thursday 18 January - Christine Gruen (Toulouse School of Economics)

On games with asymmetric information

In this talk we will consider two player zero sum games where the two players have access to different informations about payoffs and the dynamics driving the game. We assume that the players can observe the actions of their opponents, which allows them to guess the private information of the other player. Optimal strategies in these games are thus much more complex than in games where both players have access to the same information. Not only do the players aim to optimise a payoff while not giving away too much information, but they choose their strategy in order to optimally manipulate the beliefs of the other players while defending themselves against the manipulation of their adversary. This typical behaviour is found in a large class of games, notably also for stopping games on which we will concentrate in this talk.