# Workshop
# Stochastic processes - Actuarial science and Finance

Venue/Location: Vietnam Institute for Advanced Study in Mathematics

from 31/07/2017 to 03/08/2017

Monday

**Stefan Ankirchner** (*University of Jena*)
Title: ***Optimal position targeting via decoupling fields***.
Abstract: In this talk we consider a variant of the basic problem of the calculus of variations, where the Lagrangian is convex and subject to randomness adapted to a Brownian filtration. We solve the problem by reducing it, via a limiting argument, to an unconstrained control problem that consists in finding an absolutely continuous process minimizing the expected sum of the Lagrangian and the deviation of the terminal state from a given target position. Using the Pontryagin maximum principle we characterize a solution of the unconstrained control problem in terms of a fully coupled forward-backward stochastic differential equation (FBSDE). We use the method of decoupling fields for proving that the FBSDE has a unique solution.
*The talk is based on joint work with Alexander Fromm, Thomas Kruse and Alexandre Popier.*

**Long Ngo Hoang** (*Hanoi National University of Education*)
Title: ***Numerical approximation for stochastic non-colliding particle systems***.
Abstract: In this talk we present a semi-implicit Euler-Maruyama approximation scheme for Dyson Brownian motion and some other non-colliding particle systems. The convergence of the scheme is established in both path-wise and strong senses.
*This is a joint work with Dai Taguchi (Osaka university).*

**Thomas Kruse** (*University of Duisburg-Essen*)
Title: ***Multilevel Picard approximations for high-dimensional nonlinear parabolic partial differential equations***.
Abstract: In this talk we present a family of new approximation methods for high-dimensional PDEs and BSDEs. A key idea of our methods is to combine multilevel approximations with Picard fixed-point approximations. Thereby we obtain a class of multilevel Picard approximations. Our error analysis proves that for semi-linear heat equations, the computational complexity of one of the proposed methods is bounded by $O(d\,\epsilon^{-(4+\delta)})$ for any $\delta > 0$, where $d$ is the dimensionality of the problem and $\epsilon \in (0, \infty)$ is the prescribed accuracy. We illustrate the efficiency of one of the proposed approximation methods by means of numerical simulations presenting approximation accuracy against runtime for several nonlinear PDEs from physics (such as the Allen-Cahn equation) and financial engineering (such as derivative pricing incorporating default risks) in the case of $d = 100$ space dimensions.
*The talk is based on joint work with W. E, M. Hutzenthaler, and A. Jantzen.*

**Gaëlle Baetz** (*BNP Paribas Cardif Asia*)
Title: ***Cardif Asia key challenges linked to' market-to-model' valuation***.
Abstract: The regulatory and markets requirements are leading the insurance companies to enhance their valuation capabilities. The 'mark-to-model' valuation are now broadly used for liabilities reserving, capital and solvency calculation and internal studies but raises specific challenges for the industry.
After a presentation of BNP Paribas Cardif activity in Asia, the presentation will first give a global overview of the operational, technical and managerial issues related to models for Cardif Asia entities. A focus will be then done on the 'market-to-model' cash flows valuation presentation and how Cardif Asia is managing the related challenges.

Tuesday

**Xiang Yu** (*The Hong Kong Polytechnic University*)
Title: ***Optimal consumption under non-addictive habit formation in incomplete markets***.
Abstract: This paper studies the optimal consumption under the non-addictive habit formation preference in semimartingale models. The utility function is defined on the whole real line which allows the non-negative consumption to fall below the habit formation level. To avoid the path-dependence in this problem, we propose to work on a set of auxiliary processes. However, the non-negative consumption constraint becomes a path-dependent constraint on auxiliary primal elements. In the formulation of the dual problem, the stochastic Lagrange multipliers appear. It is revealed in this paper that the optimal consumption can be obtained via the construction of the stochastic Lagrange multiplier using the optimal solution from the auxiliary unconstrained dual problem. An endogenous stopping time $\tau^*$ is provided such that it is optimal for the individual to forgo consumption completely before $\tau^*$. After the stopping time $\tau^*$, the path-dependent constraint on the auxiliary process ceases to bind which implies that our optimal non-negative consumption can be constructed using the solution of the auxiliary unconstrained utility maximization problem.
*This is the joint work with Erhan Bayraktar, University of Michigan.*

**Dylan Possamaï** (*Columbia University, IEOR department*)
Title: ***Moral hazard, limited liability, slavery and golden parachutes***.
Abstract: This talk will consists first in an overview of recent progresses made in contracting theory, using the so-called dynamic programming approach. The basic situation is that of a Principal wanting to hire an Agent to do a task on his behalf, and who has to be properly incenticized. We will show that in general, this may lead to situations where Agents can be rewarded negatively. We will discuss an extension of this model introducing limited liability, its solution, as well as its economic consequences.
*This is mainly based on a joint work with Anthony Réveillac (INSA Toulouse) and Stéphane Villeneuve (TSE).*

**Robin Pendrigh** (*BNP Paribas Cardif Taiwan*)
Title: ***Selected questions about applied stochastics in insurance***.
Abstract: In this talk, we review some outstanding questions and challenges encountered by insurance technicians when applying stochastics. After generalizing the nature and purposes of stochastic modelling in insurance, we attempt to provide a structured yet familiar formulation of these selected problems, from the elaboration of inputs to the analysis and communication of outputs. These considerations may inspire complementary ways to bridge practical actuarial cases with research.

**Randal Douc** (*Telecom Sud Paris*)
Title: ***Posterior consistency for partially observed Markov models***.
Abstract: We establish the posterior consistency for a parametrized family of partially observed, fully dominated Markov models. The prior is assumed to assign positive probability to all neighborhoods of the true parameter, for a distance induced by the expected Kullback-Leibler divergence between the family members' Markov transition densities. This assumption is easily checked in general. In addition, we show that the posterior consistency is implied by the consistency of the maximum likelihood estimator. The result is extended to possibly non-compact parameter spaces and non-stationary observations. Finally, we check our assumptions on a linear Gaussian model and a well-known stochastic volatility model.

**Nguyen Van Quang** (*Vinh University*)
Title: ***Some results on laws of large numbers***.
Abstract: This talk presents some our research results on laws of large numbers . Namely, we will present the following problems: Laws of large numbers in noncommutative probability; laws of large numbers for random variables; laws of large numbers for random sets; laws of large numbers for array of random variables in convex combination space.

**Ali Devin Sezer** (*Middle East Technical University, Institute of Applied Mathematics, Ankara, Turkey*)
Title: ***Backward Stochastic Differential Equations with Nonmarkovian Singular Terminal Values***.
Abstract: We solve a class of BSDE with a power function $f(y) = y^q$, $q > 1$, driving its drift and with the terminal boundary condition $\xi = \infty \cdot \mathbf{1}_{B(m,r)^c}$ (for which $q > 2$ is assumed) or $\xi = \infty \cdot \mathbf{1}_{B(m,r)}$, where $B(m, r)$ is the ball in the path space $C([0, T])$ of the underlying Brownian motion centered at the constant function $m$ and radius $r$. The solution involves the derivation and solution of a related heat equation in which $f$ serves as a reaction term and which is accompanied by singular and discontinuous Dirichlet boundary conditions. Although the solution of the heat equation is discontinuous at the corners of the domain the BSDE has continuous sample paths with the prescribed terminal value.
*The talk is based on joint work with Thomas Kruse and Alexandre Popier*

Thursday

**Mikhail Urusov** (*University of Duisburg-Essen*)
Title: ***Optimal execution with stochastic order book depth and finite resilience***.
Abstract: We consider the problem of optimal trade execution in an illiquid market, where the price impact is created by trading in a limit order book. We first generalise the pioneering Obizhaeva-Wang model with a constant order book depth to a model with time-varying but deterministic order book depth and discuss new qualitative effects appearing here. Then we generalise the model by making the order book depth stochastic and discuss further new qualitative effects that arise after the second generalisation.
*This is a joint work with Antje Fruth and Torsten Schöneborn.*

**Corina Constantinescu** (*University of Liverpool, UK*)
Title: ***An application of risk theory***.
Abstract: We will use a risk theory model approach to analyse the risk of Japanese mortgages market.

**Chao Zhou** (*National University of Singapore*)
Title: ***Investment Decisions and Falling Cost of Data Analytics***.
Abstract: We study how the cost of data analytics and the characteristics of investors and investment opportunities affect investment decisions and their data analytics. We show that the falling cost of the data analytics raises investors? leverage, financially constrained or highly risk-averse investors use less data analytics, the quantity of data analytics is highest with mediocre investment opportunities and it is lowest with a high or low expected return opportunities. Due to the increased leverage, the falling cost of data analytics may lead to higher losses during the crises. This is a joint work with J. Keppo and H.M. Tan.

**Ali Devin Sezer** (*Middle East Technical University, Institute of Applied Mathematics, Ankara, Turkey*)
Title: $rM/G/1$ ***queue: remaining service time dependent arrivals and iid service times***.
Abstract: We study a generalization of the $M/G/1$ system (denoted $rM/G/1$) with independent and identically distributed (iid) service times and with an arrival process whose arrival rate $\lambda_0 f(r)$ depends on the remaining service time $r$ of the current customer being served. We derive a natural stability condition and provide a stationary analysis under it both at service completion times (of the queue length process) and in continuous time (of the queue length and the residual service time). In particular, we show that the stationary measure of queue length at service completion times is equal to that of a corresponding $M/G/1$ system. For $f > 0$ we show that the continuous time stationary measure of the $rM/G/1$ system is linked to the $M/G/1$ system via a time change. As opposed to the $M/G/1$ queue, the stationary measure of queue length of the $rM/G/1$ system at service completions differs from its marginal distribution under the continuous time stationary measure. Thus, in general, arrivals of the $rM/G/1$ system do not see time averages. We derive formulas for the average queue length, probability of an empty system and average waiting time under the continuous time stationary measure. We provide examples showing the effect of changing the reshaping function on the average waiting time.
*The talk is based on joint work with Benjamin Legros*

**Baris Balcioglu** (*Sabanci University, Istanbul*)
Title: ***The "Sensitive" Markovian Queueing System***.
Abstract: In this talk, we consider the Mn/Mn/c/K+Mn queueing system where customers arrive according to a Poisson process with state-dependent rates. Moreover, the rates of the exponential service times and times-to-abandonment of the queued customers can also change whenever the system size changes. This implies that a customer may experience different service rates throughout the time she is being served. Similarly, a queued customer can change her patience time limits while waiting in the queue. Thus, we refer to the analyzed system as the "sensitive" Markovian queue. We conduct an exact analysis of this system and obtain its steady-state performance measures. The steady-state system size distribution yields itself via a birth-death process. The times spent in the queue by an arbitrary or an eventually served customer are represented as the times until absorption in two continuous-time Markov chains and follow Phase-type distributions with which the queueing time distributions and moments are obtained. Then, we demonstrate how the Mn/Mn/c/K+Mn queue can be employed to approximately yet accurately estimate the performance measures of the Mn/GI/c/K+GI type call center.

**Huu Du Nguyen** (*Vietnam Institute for Advanced Study in Mathematics*)
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