<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Event</th>
<th>Speaker</th>
<th>Location</th>
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<tbody>
<tr>
<td>Wednesday, August 26, 2015</td>
<td>3:00pm-4:00pm</td>
<td>Financial/Actuarial Mathematics  -- Katsumasa Nishide (Yokohama National University)  <strong>Heston-Type Stochastic Volatility with a Markov Switching Regime</strong></td>
<td>1360 East Hall</td>
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<td>Wednesday, September 09, 2015</td>
<td>4:00pm-5:00pm</td>
<td>Financial/Actuarial Mathematics  -- Yavor Stoev (UM)  <strong>Equilibrium with imbalance of the derivative market</strong></td>
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<td>Wednesday, September 23, 2015</td>
<td>4:00pm-5:00pm</td>
<td>Financial/Actuarial Mathematics  -- Johannes Muhle-Karbe (ETH and UM)  <strong>Information and Inventories in High-Frequency Trading</strong></td>
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<td>Wednesday, September 30, 2015</td>
<td>4:00pm-5:00pm</td>
<td>Financial/Actuarial Mathematics  -- Christian Keller (UM)  <strong>Pathwise classical and viscosity solutions of fully nonlinear SPDEs</strong></td>
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<td>Wednesday, October 14, 2015</td>
<td>4:00pm-5:00pm</td>
<td>Financial/Actuarial Mathematics  -- Andrea Cosso (Paris 7 (Diderot), LPMA)  <strong>Randomization method for optimal control of partially observed path-dependent SDEs</strong></td>
<td>1360 East Hall</td>
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<td>Thursday, October 15, 2015</td>
<td>3:00pm-4:00pm</td>
<td>Financial/Actuarial Mathematics  -- Jiro Akahori (Ritsumeikan University, Kusatsu, Japan)  <strong>Hedging Error as a Timing Risk and its Static Hedge</strong></td>
<td>1360 East Hall</td>
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<td>Wednesday, October 21, 2015</td>
<td>4:00pm-5:00pm</td>
<td>Financial/Actuarial Mathematics  -- Leonard Wong (University of Washington)  <strong>Geometry and Optimization of Relative Arbitrage</strong></td>
<td>1360 East Hall</td>
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<td>Wednesday, November 11, 2015</td>
<td>4:00pm-5:00pm</td>
<td>Financial/Actuarial Mathematics  -- Bahman Angoshtari (UM)  <strong>Predictable Investment Preferences</strong></td>
<td>1360 East Hall</td>
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<td>Tuesday, November 17, 2015</td>
<td>3:00pm-4:00pm</td>
<td>Financial/Actuarial Mathematics  -- Daniel Lacker (Brown University)  <strong>Liquidity, risk measures, and concentration of measure</strong></td>
<td>1360 East Hall</td>
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<td>Wednesday, November 18, 2015</td>
<td>4:00pm-5:00pm</td>
<td>Financial/Actuarial Mathematics  -- Daniel Lacker (Brown University)  <strong>Mean field limits for stochastic differential games</strong></td>
<td>1360 East Hall</td>
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<td>Wednesday, December 02, 2015</td>
<td>4:00pm-5:00pm</td>
<td>Financial/Actuarial Mathematics  -- Alex Cox (University of Bath, UK)  <strong>Model-independent bounds for Asian options: a dynamic programming approach</strong></td>
<td>1360 East Hall</td>
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<td>Wednesday, December 9, 2015</td>
<td>4:00pm-5:00pm</td>
<td>Financial/Actuarial Mathematics</td>
<td>Song Yao (University of Pittsburgh)</td>
<td>Robust Dynkin games</td>
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<td>Wednesday, December 16, 2015</td>
<td>3:00pm-4:00pm</td>
<td>Financial/Actuarial Mathematics</td>
<td>Sergey Nadtochiy (UM)</td>
<td>Endogenous Formation of Limit Order Books: the Effects of Trading Frequency</td>
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Abstracts

Financial/Actuarial Mathematics
Wednesday, August 26, 2015, 3:00pm-4:00pm
1360 East Hall
Katsumasa Nishide (Yokohama National University)

Heston-Type Stochastic Volatility with a Markov Switching Regime

We construct a Heston-type stochastic volatility model with a Markov switching regime to price a plain-vanilla stock option. A semi-analytic solution, which contains a matrix ODE is obtained and numerically calculated. Our model is flexible enough to provide a wide variety of volatility surfaces for the same volatility level but different regimes.

Joint work with Robert J. Elliott and Carlton Osakwe.

Financial/Actuarial Mathematics
Wednesday, September 09, 2015, 4:00pm-5:00pm
1360 East Hall
Yavor Stoev (UM)

Equilibrium with imbalance of the derivative market

We investigate the impact of imbalanced derivative markets - markets in which not all agents hedge - on the underlying stock market. The availability of a closed-form representation for the equilibrium stock price in the context of a complete (imbalanced) market with terminal consumption allows us to study how this equilibrium outcome is affected by the risk aversion of agents and the degree of imbalance. In particular, it is shown that the derivative imbalance leads to significant changes in the equilibrium stock price process: volatility changes from constant to local, while risk premia increase or decrease depending on the replicated contingent claim, and become stochastic processes. Moreover, the model produces implied volatility smile consistent with empirical observations.
Financial/Actuarial Mathematics
Wednesday, September 23, 2015, 4:00pm-5:00pm
1360 East Hall
Johannes Muhle-Karbe (ETH and UM)
Information and Inventories in High-Frequency Trading

We propose an equilibrium model for the short-term informational advantages crucial in high-frequency trading.

In this setting, risk-neutral insiders hold martingale inventories. In contrast, inventory aversion leads to autoregressive positions. These vanish in the continuous-time limit, while still yielding approximately the same returns. This illustrates how high-frequency trading allows to monetize information with very little inventory risk.

Joint work with Kevin Webster.

Financial/Actuarial Mathematics
Wednesday, September 30, 2015, 4:00pm-5:00pm
1360 East Hall
Christian Keller (UM)
Pathwise classical and viscosity solutions of fully nonlinear SPDEs

We establish well-posedness (existence, uniqueness, and stability) for a large class of parabolic SPDEs. If the coefficients of the SPDE are sufficiently regular, then our results hold true for classical solutions. In order to deal with less regular data, we present a notion of pathwise viscosity solutions. We operate in the framework of rough path theory. Thus we can study SPDEs in a pathwise manner.

This is crucial for proving our main results since we can then circumvent very difficult problems regarding null sets.

This is joint work with Rainer Buckdahn, Jin Ma, and Jianfeng Zhang.
In the present talk we introduce a general methodology, which we refer to as the randomization method, firstly developed for classical Markovian control problem in the paper: I. Kharroubi and H. Pham "Feynman-Kac representation for Hamilton-Jacobi-Bellman IPDE", Ann. Probab., 2015. As it is well-known, the dynamic programming method is the standard methodology implemented for the study of classical Markovian control problems, which allows to relate the value function to the Hamilton-Jacobi-Bellman equation through the so-called dynamic programming principle. The key feature of the dynamic programming method is that the knowledge of the value function allows, at least in principle, to find an optimal control for the problem. Alternatively, the Pontryagin maximum principle provides a set of necessary or sufficient conditions in terms of a system of adjoint backward stochastic differential equations for an optimal control. These very powerful and well-known methodologies break down (in the sense that they can not be directly implemented in a standard way) when we face control problems which present the following additional features: partial observation, path-dependence, delay in the control. On the other hand, the randomization method can be quite easily generalized and adapted to these more general control problems. The aim of the talk is to illustrate this latter point, starting with the presentation of the fundamental ideas of the randomization method.

The talk is based on a joint work in progress with E. Bandini, M. Fuhrman, H. Pham.

I will present a new framework of semi-static hedge of barrier options. First, after reviewing the context, we will show that its hedging error can be understood as a "timing risk", and secondly we claim that it can be hedged by an integration of semi-static hedges of different maturities. Third, I will introduce a hierarchy of semi-static positions, $n$-th one of which hedges the error by the $(n-1)$-th and so on. In a fairly general situations, the hierarchy is exact in that the hedging error vanishes.
Consider investing in an equity market. While classical financial theory suggests that the market portfolio is efficient, stochastic portfolio theory shows that the market can be beaten in the long run under realistic assumptions. Moreover, no forecasts of expected returns and covariances are needed to construct such relative arbitrages. Suppose we restrict to portfolios that are deterministic functions of the market weights (firm sizes divided by total market value). Under the conditions of diversity and sufficient volatility, we characterize all portfolios leading to relative arbitrages in two ways: first, as Fernholz's functionally generated portfolios, and second, as solutions to an optimal transport problem. The later leads naturally to an optimization problem, and we will introduce another approach in the spirit of maximum likelihood estimation of a log-concave density. Both approaches will be illustrated with simple empirical examples.

This is joint work with Soumik Pal.

We propose a new class of dynamic random investment preferences, called predictable utilities. These preferences are a cross between the classical expected utility model of Merton and the recent Forward Investment Preference model introduced by Musiela and Zariphopoulou, in the sense that the risk preferences are stochastic and updated by the forward approach at the end of each period while, within each period, the investor faces a classical expected utility maximization problem. In the binomial market setting, the existence of predictable utilities is established through a constructive argument, which relies on solvability of the inverse of the classical Merton investment problem, i.e. when the value function is given and the terminal utility function is to be found. As an application, we consider the problem of optimal investment in a market where asset returns can only be reliably modeled for a short time ahead.

Joint work with Thaleia Zariphopoulou and Xunyu Zhou.
Expanding on techniques of concentration of measure, we propose a quantitative framework for modeling liquidity risk using convex risk measures. The fundamental objects of study are curves of the form \( \rho(\lambda X) \) \( \lambda \geq 0 \), where \( \rho \) is a convex risk measure and \( X \) a financial position (a random variable), and we call such a curve an emphasis liquidity profile. For some notable classes of risk measures, especially shortfall risk measures, the shape of a liquidity profile is intimately linked with the tail behavior of the underlying \( X \). We exploit this link to systematically bound liquidity profiles from above by other real functions \( \gamma \), deriving tractable necessary and sufficient conditions for concentration inequalities of the form \( \rho(\lambda X) \leq \gamma(\lambda) \) for all \( \lambda \geq 0 \). These concentration inequalities admit useful dual representations related to transport-entropy inequalities, and this leads to efficient uniform bounds for liquidity profiles for large classes of \( X \). An interesting question of tensorization of concentration inequalities arises when we seek to bound the liquidity profile of a combination \( f(X,Y) \) of two positions \( X \) and \( Y \) in terms of the two individual liquidity profiles of \( X \) and \( Y \). Specializing to law invariant risk measures, we uncover a surprising connection between tensorization and certain time consistency properties known as acceptance and rejection consistency, which leads to some new mathematical results on large deviations and dimension-free concentration of measure.
Mean field game (MFG) theory generalizes classical models of interacting particle systems by replacing the particles with rational agents, making the theory applicable in economics and other social sciences. Most research so far has focused on the existence and uniqueness of Nash equilibria in a model which arises intuitively as a continuum limit (i.e. an infinite-agent version) of a given large-population stochastic differential game of a certain symmetric type. This talk discusses some recent results in this direction, particularly for MFGs with common noise, but more attention is payed to recent progress on a less well-understood problem: Given for each $n$ a Nash equilibrium for the $n$-player game, in what sense if any do these equilibria converge as $n$ tends to infinity? The answer is somewhat unexpected, and certain forms of randomness can prevail in the limit which are well beyond the scope of the usual notion of MFG solution. A new notion of weak MFG solutions is shown to precisely characterize the set of possible limits of approximate Nash equilibria of $n$-player games, for a large class of models.

We consider the problem of finding model-independent bounds on the price of an Asian option, when the call prices at the maturity date of the option are known. Our methods differ from most approaches to model-independent pricing in that we consider the problem as a dynamic programming problem, where the controlled process is the conditional distribution of the asset at the maturity date. By formulating the problem in this manner, we are able to determine the model-independent price through a PDE formulation. Notably, this approach does not require specific constraints on the payoff function (e.g. convexity), and would appear to be generalisable to many related problems. (Joint work with S. Kallblad).
We analyze a robust version of the Dynkin game over a set $P$ of mutually singular probabilities. We first prove that conservative player's lower and upper value coincide (let us denote the value by $V$). Such a result connects the robust Dynkin game with second-order doubly reflected backward stochastic differential equations. Also, we show that the value process $V$ is a submartingale under an appropriately defined nonlinear expectations up to the first time $\tau_*^-$ when $V$ meets the lower payoff process. If the probability set $P$ is weakly compact, one can even find an optimal triple $(P^*_\tau, \tau_\gamma)$ for the value $V_0$.

This is a joint work with Erhan Bayraktar.

In this work, we present a modeling framework in which the shape and dynamics of a Limit Order Book (LOB) arise endogenously from an equilibrium between multiple market participants (agents). On the one hand, the new framework captures very closely the true, micro-level, mechanics of an auction-style exchange. On the other hand, it uses the standard abstractions of games with continuum of players (in particular, the mean field game theory) to obtain a tractable macro-level description of the LOB. We use the proposed modeling framework to analyze the effects of trading frequency on the liquidity of the market in a very general setting. In particular, we show that the higher trading frequency increases market efficiency if the agents choose to provide liquidity in equilibrium. However, the higher trading frequency also makes markets more fragile, in the following sense: in a high-frequency trading regime, the agents choose to provide liquidity in equilibrium if and only if they are market-neutral (i.e. their beliefs satisfy certain martingale property). The theoretical results are illustrated with numerical examples.