UNIVERSITY OF MICHIGAN
Department of Mathematics

Seminar & Events Bulletin: Financial/Actuarial Mathematics

01-01-2013 to 06-30-2013

Thursday, January 10, 2013	
2:30pm-7:00pm	**Financial/Actuarial Mathematics** -- Ross Kravitz (UM) *Thesis Defense: Problems in Optimal Stopping and Control* -- 1360 East Hall

Friday, February 22, 2013	
3:00pm-4:00pm	**Financial/Actuarial Mathematics** -- Pierre Patie (Cornell University) *Fluctuation theory for completely asymmetric Markov processes* -- 1360 East Hall

Thursday, February 28, 2013	
3:00pm-4:00pm	**Financial/Actuarial Mathematics** -- Darinka Dentcheva (Stevens Institute of Technology) *Risk-averse optimization via stochastic order constraints* -- 1360 East Hall

Tuesday, March 12, 2013	
3:00pm-4:00pm	**Financial/Actuarial Mathematics** -- Steve Shreve (Carnegie Mellon University) *Diffusion scaling of a limit-order book model* -- 1360 East Hall

Thursday, March 21, 2013	
3:00pm-4:00pm	**Financial/Actuarial Mathematics** -- Igor Cialenco (Department of Applied Mathematics, Illinois Institute of Technology) *Dynamic Conic Finance* -- 1360 East Hall

Thursday, March 28, 2013	
3:00pm-4:00pm	**Financial/Actuarial Mathematics** -- Mykhaylo Shkolnikov (UC Berkeley) *Asymmetrically colliding Brownian particles in stochastic portfolio theory and beyond* -- 1360 East Hall

Thursday, April 04, 2013	
3:00pm-4:00pm	**Financial/Actuarial Mathematics** -- Jin Ma (USC) *Pathwise Stochastic Taylor Expansion and Forward Path-Dependent PDEs* -- 1360 East Hall

Thursday, April 11, 2013	
3:00pm-4:00pm	**Financial/Actuarial Mathematics** -- Thaleia Zariphopoulou (Oxford University and UT Austin.) *Postponed to Fall* -- 1360 East Hall

Tuesday, April 16, 2013	
3:00pm-4:00pm	**Financial/Actuarial Mathematics** -- Umut Cetin (London School of Economics) *Explicit construction of a dynamic Bessel bridge of dimension 3* -- 1096 East Hall

Thursday, April 18, 2013	
2:50pm-4:00pm	**Financial/Actuarial Mathematics** -- Umut Cetin (London School of Economics) *Risk aversion of market makers and asymmetric information* -- 1360 East Hall

Tuesday, April 23, 2013	
3:00pm-4:00pm	**Financial/Actuarial Mathematics** -- Sebastian Jaimungal (University of Toronto) *Robust Market Making* -- 1360 East Hall

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Tuesday, April 30, 2013	
1:30am-3:30am	**Financial/Actuarial Mathematics** -- Yu-Jui Huang (UM) *Thesis Defense: Topics in Stochastic Control with Applications to Finance* -- 1096 East Hall

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Abstracts

Financial/Actuarial Mathematics
Thursday, January 10, 2013, 2:30pm-7:00pm
1360 East Hall
Ross Kravitz (UM)
Thesis Defense: Problems in Optimal Stopping and Control

I will describe the three problems that I studied in my thesis, and discuss two of them in some detail. The first problem comes from mathematical finance, and involves the stability of exponential utility maximization with respect to market perturbations. We use the theory of BMO martingales to obtain conditions under which stability is guaranteed. The second problem comes from mathematical statistics, and is a extension of the classical sequential analysis problem of verifying a statistical hypothesis with a minimum number of observations. We consider an infinite sequence of Brownian Motions which have drift equal to zero or one, which may only be observed one at a time. If our goal is to find a B.M. with drift one, how should we observe the channels, and at what confidence threshold should we stop observation?

Financial/Actuarial Mathematics
Friday, February 22, 2013, 3:00pm-4:00pm
1360 East Hall
Pierre Patie (Cornell University)
Fluctuation theory for completely asymmetric Markov processes

We study the class of completely asymmetric standard processes living on an interval of the real line, that is for strong Markov processes having jumps only in one direction. This class of processes, which are a natural generalization of one dimensional-diffusions, arises naturally in risk theory. It also encompasses many interesting instances such as branching processes with immigration, spectrally negative LÃ©vy processesâ€¦ Under mild conditions, we present two original methodologies for characterizing the Laplace transform of their first exit times from an interval. We also discuss several potential theoretic properties and provide an expression of their resolvent densities. Finally, we illustrate our techniques by easily recovering the well-known fluctuation identities of spectrally negative LÃ©vy processes. The talk is based on joint work with Vincent Vigon (IRMA, Strasbourg, France)

Financial/Actuarial Mathematics
Thursday, February 28, 2013, 3:00pm-4:00pm
1360 East Hall
Darinka Dentcheva (Stevens Institute of Technology)
Risk-averse optimization via stochastic order constraints

Stochastic orders formalize preferences among random outcomes and are widely used in statistics and economics. We focus on stochastic optimization problems involving stochastic order relations as constraints. These constraints relate performance functionals, depending on our decisions to benchmark random outcomes shaping the risk according to the distribution of the benchmark. Necessary and sufficient conditions of optimality and duality theory for these problems will be presented. The analysis puts additional light on the expected utility theory, the dual (rank-dependent) utility theory, and the theory of coherent measures of risk. We prove that Lagrange multipliers associated with two different formulations of these constraints can be identified with utility functions, or with rank-dependent utility functions. Furthermore, we demonstrate that mean-risk models with law invariant coherent risk measures appear as Lagrangian relaxations of the problem with stochastic dominance constraints. The optimization models with stochastic order constraints provide a link between various approaches for risk-averse optimization.

The results contribute to the theory of composite optimization in vector spaces because the stochastic order relations are defined by a continuum of compositions of convex non-smooth functions with possibly non-convex smooth functions.

Implications for portfolio optimization will be discussed.

Financial/Actuarial Mathematics
Tuesday, March 12, 2013, 3:00pm-4:00pm
1360 East Hall
Steve Shreve (Carnegie Mellon University)
Diffusion scaling of a limit-order book model

With the movement of trading away from the trading floor onto electronic exchanges - and the accompanying rise in the volume of order submission - has come an increase in the need for tractable mathematical models of the whole limit order book. The problem is inherently high-dimensional and the most natural description of the dynamics of the order flows has them depend on the state of the book in a discontinuous way. We examine a popular discrete model from the literature and describe its limit under a diffusion scaling inspired by queueing theory. Interesting features include a process which is either "frozen" or diffusing according to whether another diffusion is positive or negative. This is joint work with Christopher Almost and John Lehoczky.

Financial/Actuarial Mathematics
Thursday, March 21, 2013, 3:00pm-4:00pm
1360 East Hall
Igor Cialenco (Department of Applied Mathematics, Illinois Institute of Technology)
Dynamic Conic Finance

We develop a framework for narrowing the theoretical spread between ask prices and bid prices of derivative securities in models of discrete time markets with transaction costs using dynamic coherent acceptability indices studied in Bielecki, Cialenco, and Zhang (2010). Aside from the use of acceptability indices as a tool, our approach is very much rooted in the literature studying good deal bounds as a vehicle to narrow the no-arbitrage interval. We first formulate and prove a no-good-deal version of the fundamental theorem of asset pricing (FTAP) using a family of dynamic coherent risk measures. The obtained results generalize to dynamic market model set-up the version of FTAP proved in Cherny and Madan (2010) in the static conic finance framework. We use the market model setup suitable for dividend-paying securities in markets with transaction costs. Finally, we discuss some applications of this theory to path dependent options and compute the good-deal ask and bid prices generated by dynamic gain-loss ratio (a particular dynamic acceptability index).

Financial/Actuarial Mathematics
Thursday, March 28, 2013, 3:00pm-4:00pm
1360 East Hall
Mykhaylo Shkolnikov (UC Berkeley)
Asymmetrically colliding Brownian particles in stochastic portfolio theory and beyond

We will discuss systems of Brownian particles on the real line, which interact by splitting the local times of collisions among themselves in an asymmetric manner. These can be identified with the collections of ordered processes in a Brownian particle system, in which the drift coefficients, the diffusion coefficients, and the collision local times for the individual particles are assigned according to their ranks. Such processes can be viewed as generalizations of those arising in first-order models for equity markets in the context of stochastic portfolio theory, and are able to correct for several shortcomings of such models while being equally amenable to computations. We also show that, in addition to being of interest in their own right, such systems of Brownian particles arise as universal scaling limits of systems of jump processes on the integer lattice with local interactions. In particular, this result extends the convergence of TASEP to its continuous analogue.

This is joint work with Ioannis Karatzas and Soumik Pal.

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Financial/Actuarial Mathematics
Thursday, April 04, 2013, 3:00pm-4:00pm
1360 East Hall
Jin Ma (USC)
Pathwise Stochastic Taylor Expansion and Forward Path-Dependent PDEs

In this talk we first revisit the notion of pathwise stochastic Taylor ex- pansion, and prove a new result that extends our previous works to a more general setting, in terms of the newly developed notion of path-derivative initiated by Dupire. We will then show how this new form of pathwise Tay- lor expansion could lead to a notion of stochastic viscosity solution for a class of fully nonlinear SPDEs and the corresponding Path-dependent PDEs (PPDEs), without having to invoke the stochastic characteristics for the lo- calization. We will discuss the issues of consistency, stability, and comparison principles for the stochastic viscosity solutions. In the semilinear case, we show that the PPDE, whence the SPDE, is well-posed in our new framework.

This is a joint work with Rainer Buckdahn and Jianfeng Zhang.

Financial/Actuarial Mathematics
Thursday, April 11, 2013, 3:00pm-4:00pm
1360 East Hall
Thaleia Zariphopoulou (Oxford University and UT Austin.)
Postponed to Fall

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Financial/Actuarial Mathematics
Tuesday, April 16, 2013, 3:00pm-4:00pm
1096 East Hall
Umut Cetin (London School of Economics)
Explicit construction of a dynamic Bessel bridge of dimension 3

Given a deterministically time-changed Brownian motion Z starting from 1, whose time-change V(t) satisfies V(t) > t for all t > 0, we perform an explicit construction of a process X, adapted to the filtration generated by Z and another independent Brownian motion, which is a Brownian motion in its own filtration and hits zero for the first time at V(T), where T := inf{t>0: Z_t =0}. Our construction relies on a combination of enlargement of filtration and filtering techniques. The resulting process X may be viewed as the analogue of a 3-dimensional Bessel bridge starting from 1 at time 0 and ending at 0 at the random time V(T). We call this a dynamic

Bessel bridge since V(T) is not known in advance. Our study is motivated by insider trading models with default risk, where the insider observes the firm's value continuously on time.

This is a joint work with L. Campi and A. Danilova.

Financial/Actuarial Mathematics
Thursday, April 18, 2013, 2:50pm-4:00pm
1360 East Hall
Umut Cetin (London School of Economics)
Risk aversion of market makers and asymmetric information

We analyse the equilibrium impact of market makers' risk aversion on the equilibrium in a speculative market consisting of a risk neutral informed trader and noise traders. The unwillingness of market makers to bear risk causes the informed trader to absorb large shocks in their inventories. The informed trader's optimal strategy is to drive the market price to its fundamental value while disguising her trades as the ones of an uninformed strategic trader. This results in a mean reverting demand, price reversal, and systematic changes in the market depth. We also find that an increase in risk aversion leads to lower market depth, less efficient prices, stronger price reversal and slower convergence to fundamental value. The endogenous value of private information, however, is non-monotonic in risk aversion.
Based on a joint work with A. Danilova.

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Financial/Actuarial Mathematics
Tuesday, April 23, 2013, 3:00pm-4:00pm
1360 East Hall
Sebastian Jaimungal (University of Toronto)
Robust Market Making

An agent who wishes to make markets by posting limit buy and sell orders is faced with modelling the arrival rate and volume of marker orders which hit/lift their posted orders. No model can capture the true behaviour of the marketâ€™s data generating process (DGP), hence, simplifying assumptions are often made. A natural question then arises: â€œhow can the agent account for the fact that they know their model is inaccurate?â€• i.e., how can uncertainty in the Knightian sense be addressed? In this talk, I formulate the question through a robust optimal control problem in which the agent is ambiguity averse to Poisson random measures. Specifically, the agent considers a reference measure (representing the simplified model) and all equivalent measures (representing candidate models) and penalizes them according to a quasi relative entropy. Surprisingly, the robust control problem can be reduced to solving a coupled non-linear system of ODEs, which in certain limiting cases can be solved exactly. The optimal postings show that the agent protects themselves from ambiguity in distinct ways depending from where the ambiguity stems. Interestingly, in some cases, the agent behaves as if they have perfect knowledge of the DGP but apply CARA utility; however, in general the ambiguity averse agent cannot be recast as a risk-averse one. Numerical experiments will illustrate several interesting economic insights into the problem.

This is joint work with Ã•lvaro Cartea (University College London) and Ryan Donnelly (University of Toronto)

Financial/Actuarial Mathematics
Tuesday, April 30, 2013, 1:30am-3:30am
1096 East Hall
Yu-Jui Huang (UM)
Thesis Defense: Topics in Stochastic Control with Applications to Finance

This thesis is devoted to PDE characterization for stochastic control problems when the classical methodology of dynamic programming does not work. Under the framework of viscosity solutions, a dynamic programming principle (DPP) serves as the tool to associate a (nonlinear) PDE to a stochastic control problem. Unfortunately, a DPP is in general difficult to prove, and may fail to be true in some cases. In this thesis, we investigate three different scenarios where classical dynamic programming does not work. The first one is quantile hedging in the presence of arbitrage, the second one is robust growth-optimal trading, and the third one is a stochastic differential game of control and stopping. In each of the cases, we propose methods to circumvent the lack of a classical DPP.