Talks

Erhan Bayraktar (University of Michigan)
On the Multi-Dimensional Controller and Stopper Games

We consider a zero-sum stochastic differential controller-and-stopper game in which the state process is a controlled diffusion evolving in a multi-dimensional Euclidean space. In this game, the controller affects both the drift and the volatility terms of the state process. Under appropriate conditions, we show that the game has a value and the value function is the unique viscosity solution to an obstacle problem for a Hamilton-Jacobi-Bellman equation. (Joint work with Yu-Jui Huang. Available at `http://arxiv.org/abs/1009.0932`.)

Vaclav Benes
Some Surprisingly Simple Combined Control and Stopping Problems

We solve the variational inequality describing the optimal stopping of a Brownian motion whose drift is the control. The form of the solution is the same for a wide class of final charge and running cost of control functions that are symmetric, smooth, and convex.

Sourav Chatterjee (Courant Institute)
Invariant Measures and the Soliton Resolution Conjecture

The soliton resolution conjecture for the focusing nonlinear Schrödinger equation (NLS) is the vaguely worded claim that a global solution of the NLS, for generic initial data, will eventually resolve into a radiation component that disperses like a linear solution, plus a localized component that behaves like a soliton or multi-soliton solution. Considered to be one of the fundamental problems in the area of nonlinear dispersive equations, this conjecture has eluded a proof or even a precise formulation till date. I will present a theorem that proves a "statistical version" of this conjecture at mass-sub-critical nonlinearity. The proof involves a combination of techniques from large deviations, PDE, harmonic analysis and bare hands probability theory.

Mark Davis (Imperial College London)

Pathwise Stochastic Calculus and Applications to Pricing Realized Variance

For a price path of a financial asset, the realized variance is the sum of squares of log-increments of the price over a finite partition of the time interval. Most of the literature on this subject studies the continuous-time limit which, when the price is modelled as a continuous semimartingale, is the quadratic variation of the log-returns process.
Recent research has focused on model-free approaches to pricing and hedging questions. However, there is an immediate problem of interpretation of the continuum limit. An answer is provided Föllmer's 1981 paper "Calcul d'Ito sans probabilités," where an Ito formula is derived just using real analysis, for paths having the "quadratic variation property."
For some applications we need an Ito formula valid for functions whose second derivatives are not continuous. The standard approach to this in stochastic analysis goes via the Tanaka formula and local time, so the question arises whether we can have a pathwise theory of local time. Föllmer and collaborators initiated a study of this question, and there are further contributions by Bertoin. We find there are decisive advantages in following an approach advocated by Vovk (2012) in which discrete sampling is carried out using "Lebesgue" partitions rather than the "Riemann" partitions of other authors. Among other results, we obtain by this approach a pathwise local time formula exactly analogous to Levy's 'downcrossing' representation. (Joint work with Jan Oblój, Oxford University)

Jerome Detemple (Boston University)

A Structural Model of Dynamic Market Timing: Theory and Estimation

This paper derives and analyzes dynamic timing strategies of a fund manager with private information. Endogenous timing strategies generated by various information structures and skills, and associated fund styles are identified. Endogenous fund returns are characterized in the public information of an uninformed observer. Econometric methods for style analysis are developed. New tests of timing skill are proposed and their detection ability is analyzed. An application to a universe of hedge fund indices shows significant timing ability in specific categories of hedge fund styles.

Darrell Duffie (Stanford University)
INFORMATION PERCOLATION IN SEGMENTED MARKETS

This talk shows how to calculate the equilibria of dynamic double-auction over-the-counter markets in which agents are distinguished by their preferences, information, and bilateral contact probabilities each period. Over time, agents are privately informed by bids and offers. Investors are segmented into classes that differ with respect to information quality, including initial information precision as well as "market connectivity," the expected frequency of their bilateral trading opportunities. We characterize endogenous information acquisition and show how learning externalities affect information gathering incentives. In particular, comparative statics for static and dynamic models may go in opposite directions. Information acquisition can be lower in more "liquid" (active) dynamic markets. Joint work with Semyon Malamud (EPFL) and Gustavo Manso (MIT and U.C. Berkeley).

Nicole El Karoui (UPMC Paris VI and LPMA)
A SINGULAR JOURNEY IN OPTIMISATION PROBLEMS INVOLVING INDEX PROCESS

In the late 80's, Prof. Karatzas introduced me to singular control problems, and their links with optimal stopping. Whatever the problem, the running supremum of an Index process played a key role. As showed by Whittle in bandit problem, the introduction of some additional parameter (cost of retirement in the bandit problem) allows us to introduce convex analysis techniques in combination with dynamic programming. Bandit problems, that received renewed interest in economy, are very nice illustration of these ideas with the "following the winner" rule introduced by Gittings (1964). Pathwise derivation and change of times are the major ingredients of the proofs, leading in certain cases to a surprising characterisation of optimal solutions as the Skew Brownian motion in Brownian bandit.

The same ideas were applied successfully to various problems in Mathematical Finance as American option, portfolio insurance, optimal consumption problems, and martingale theory since in any problems the index appears as a non linear derivative of quantity of interest. In supermartingale theory, the idea is to replace of usual additive decomposition by the max-plus decomposition (where the addition is replace by the sup). Closed form of the max-plus derivative may be found from the max-martingale introduced by Azéma-Yor, and even earlier by L.Bachelier (1900).

Hans Föllmer (Humboldt University Berlin)
Some Martingale Aspects of Financial Bubbles

We discuss some recent developments in the probabilistic analysis of financial bubbles, usually framed in terms of the Riesz decomposition of a supermartingale into a "fundamental" potential and an additional martingale. We will focus on the effect of filtration shrinkage (joint work with Ph. Protter), the slow birth of a bubble (joint work with F. Biagini and S. Nedelcu), and the appearance of bubbles in the robust valuation of cash flows in terms of convex risk measures (joint work with B. Acciaio and I. Penner).

Robert Fernholz (INTECH)
A Second-Order Model of the Stock Market

A first-order model for a stock market is a model that assigns to each stock in the market a return parameter and a variance parameter that depend only on the rank of the stock. First order models capture much of the relative variance structure of a stock market, and can reproduce the capital distribution of the market. However, first-order models are ergodic in the sense that each stock asymptotically spends equal average time at each rank, and this ergodicity property does not seem to be present in actual markets. This lack of verisimilitude is the motivation to consider the next level of complexity: second-order models. A second-order model for a stock market is a model that assigns the return and variance parameters based on both the rank and the name of the stock. The ergodicity property is no longer present in second-order models.

Wendell Fleming (Brown University)
Max-plus stochastic processes and control.

The Maslov idempotent calculus provides a framework for a variety of asymptotic problems, including large deviations for Markov diffusion processes described by stochastic differential equations. The asymptotic limit is described through a deterministic optimization problem. This limit still retains a “stochastic” interpretation, in which expectations are linear with respect to “max-plus” addition and scalar multiplication. The first part of the lecture will discuss max-plus stochastic differential equations, with associated Hamilton-Jacobi-Bellman partial differential equations and variational inequalities. The second part is concerned with controlled max-plus stochastic differential equations and associated two-controller, zero-sum differential games. As an example, the solution to the max-plus version of the classical Merton optimal consumption problem is given.

John Geanakoplos (Yale University)
Hyperbolic Discounting with Stochastic Discounts

TBA

Paolo Guasoni (Boston University and Dublin City University)
Market Depth and Trading Volume Dynamics

We derive the process followed by trading volume, in a market with finite depth and constant investment opportunities. A representative investor, with a long horizon and constant relative risk aversion, trades a safe and a risky asset with a liquidity cost proportional to trading speed. An ordinary differential equation identifies the trading policy and welfare, and we compute explicit asymptotics in the high-liquidity limit. Then trading volume follows approximately an Ornstein-Uhlenbeck process. The model predicts that volume increases with liquidity, volatility, and risk aversion. It also entails an endogenous ban on both leverage and short-selling of illiquid assets. (Joint work with Marko Weber.)

Michael Harrison (Stanford GSB)
STOCHASTIC CONTROL AT WARP SPEED

In this talk I will describe a novel class of stochastic control problems arising in the theory of corporate finance.* These are problems in which a controller determines both the drift coefficient μ and the volatility coefficient σ of a one-dimensional diffusion process. There are natural lower bounds on both μ and σ, strictly positive in the latter case, and to simplify the analysis one can impose upper bounds on μ and σ as well. The controller's reward structure is one that induces bang-bang control of both μ and σ, so as we relax the artificial upper bounds we approach a limit regime in which an optimal control chooses "infinite drift" in one part of the state space, and chooses "infinite volatility" in another part. The former notion was made rigorous in the 1980's by the theory of optimal singular control, but a proper mathematical treatment of the latter notion has yet to be developed. [*A problem of this type occurs in current work by Peter DeMarzo, which extends in certain ways the model and analysis of P. DeMarzo and Y. Sannikov, Optimal Security Design and Dynamic Capital Structure in a Continuous-Time Agency Model, J. of Finance, Vol. 61 (2006), 2681-2724.]

Jan Kallsen (Christian-Albrechts-Universität zu Kiel)
OPTIMAL INVESTMENT FOR GENERAL CONTINUOUS PRICE PROCESSES UNDER SMALL TRANSACTION COSTS.

Cvitanic and Karatzas (1996), Loewenstein (2000) and others gained the fundamental insight that optimal investment problems under proportional transaction costs are equivalent to frictionless problems relative to some fictitious shadow price process. More recently, this idea has been used in order to actually determine optimal portfolios in concrete models. In this talk we consider an investor with constant relative risk aversion facing a market with a general continuous asset price process and small proportional transaction costs. Based on informal perturbation arguments involving the shadow price process, we derive first order asymptotics for the no-trade region and the loss of utility due to transaction costs. Applied to a setup with random endowment, these results lead to utility indifference prices and hedging strategies.

Alex Kontorovich (Yale)
INTEGRAL APOLLONIAN GASKETS

Apollonius of Perga prized the problem of constructing circles tangent to given objects (as always, with straightedge and compass). In Leibnitz's notebooks, one finds this construction iterated ad infinitum, giving rise to a beautiful fractal in the plane. Via Descartes' Kissing Circles Theorem, one observes the existence of configurations in which all curvatures are integral. We will discuss recent progress on various statistical questions about these integers, and describe some of the technology (automorphic forms, homogeneous dynamics, expander graphs) used in the proofs.

John Lehoczky (Carnegie Mellon University)
SIMULATING THE GREEKS IN FINANCE

Beginning with the work of Broadie and Glasserman (1996), Fournie et al (1999, 2001), Benhamou (2000, 2001, 2003), and the subsequent work of many other authors, the derivatives of the price of a derivative security with respect to important parameters (i.e. the "Greeks") were shown to be represented as expected values. Consequently, they could be estimated using Monte Carlo methods. The approach is based on the integration by parts formula of the Malliavin calculus, and it has been shown to have significant advantages over finite difference methods when the payoff function is discontinuous, for example in the case of barrier options. We review this approach and introduce variance reduction methods that offer further advantages in the estimation of the Greeks.

Soumik Pal (University of Washington)

Transportation Inequalities for Rank-Based Processes

Transportation inequalities are a popular class of functional inequalities that compares the Wasserstein distance between probability measures with the relative entropy or the Dirichlet form. We apply such inequalities to the study of rank-based processes in the context of stochastic portfolio theory. For example, we obtain fluctuation estimates of local times of "collisions" between ranked particles, and explicit bounds on the probability that a given portfolio "beats the market." (Partly based on joint works with Tomoyuki Ichiba and Misha Shkolnikov.)

Vilmos Prokaj (Eötvös Loránd University)
Some Sufficient Conditions for the Ergodicity of the Lévy Transformation

In the talk I shall present a new approach to the old standing open problem of the ergodicity of the so called Lévy transformation of the Wiener space. This transformation T sends a Brownian motion B into another one by the formula integrating the sign of B with respect to B. The main result is that the question related to the behavior of the sequence obtained by evaluating the iterated paths at time 1. Roughly speaking, if the expected hitting time to small neighborhoods of zero does not grow faster than the inverse of the size of the neighborhood then even strong mixing of the Lévy transformation follows. Some ideas how to deal with this sequence will be also presented.

Birgit Rudloff (Princeton University)
Time Consistency and Calculation of Risk Measures in Markets with Transaction Costs

Set-valued risk measures appear naturally when markets with transaction costs are considered and capital requirements can be made in a basket of currencies or assets. Definitions of different time consistency properties in the set-valued framework are given. It is shown that in the set-valued case the recursive form for multivariate risk measures as well as an additive property for the acceptance sets is equivalent to a stronger time consistency property called multi-portfolio time consistency. As an example, we consider the superhedging problem in markets with proportional transaction costs. Furthermore, we discuss the explicit calculation of set-valued risk measures including the Average Value at Risk and the set of superhedging portfolios.

Walter Schachermayer (University of Vienna)
PORTFOLIO OPTIMISATION UNDER TRANSACTION COSTS

We give an overview of some old and some new results on portfolio optimisation under transaction costs. The emphasis will be on an asymptotic point of view when proportional transaction costs tend to zero.

Mykhaylo Shkolnikov (Mathematical Sciences Research Institute)
LARGE SYSTEMS OF DIFFUSIONS INTERACTING THROUGH THEIR RANKS

Systems of diffusion processes (particles) with rank-based interactions have been studied heavily due to their importance in stochastic portfolio theory and the intriguing relations with particle systems appearing in statistical physics. We study the behavior of this particle system as the number of particles gets large. By obtaining a large deviations principle (LDP), we will show that the limiting dynamics can be described by a porous medium equation with convection, whereas paths of finite rate are given by solutions of appropriately tilted versions of this equation. This is the first instance of an LDP for diffusions interacting both through the drift and the diffusion coefficients. Based on joint work with A. Dembo, N.V. Krylov, S.R.S. Varadhan and O. Zeitouni.

Steven Shreve (Carnegie Mellon University)
SOMETHING OLD, SOMETHING NEW

In the recent paper "Planar diffusions with rank-based characteristics and perturbed Tanaka equations," Fernholz, Ichiba, Karatzas and Prokaj provide an exhaustive analysis of a two-dimensional diffusion whose dynamics depend on which component has the larger value. The calculation of the transition density of this diffusion relies on ancient work by Karatzas and

Shreve. This talk reviews that work and relates it to the present paper by Fernholz, et. al.

Mihai Sîrbu (University of Texas at Austin)
Stochastic Perron's Method in Linear and Non-Linear Problems

We introduce a stochastic version of the classical Perron's method to construct viscosity solutions to linear parabolic equations associated to stochastic differential equations. Using this method, we construct easily two viscosity (sub and super) solutions that squeeze in between the expected payoff. If a comparison result holds true, then there exists a unique viscosity solution which is a martingale along the solutions of the stochastic differential equation. The unique viscosity solution is actually equal to the expected payoff. This amounts to a verification result (Ito's Lemma) for non-smooth viscosity solutions of the linear parabolic equation. We show how the method can be extended to non-linear problems, like free boundary problems associated to optimal stopping or Dynkin games and Hamilton-Jacobi-Bellman equations in stochastic control. The presentation is based on joint work with Erhan Bayraktar.

William Sudderth (University of Minnesota)
Some Finitely Additive Dynamic Programming

The finitely additive probability theory of Dubins and Savage can be used to formulate stochastic dynamic programming problems with general state and action spaces. Some classical results can be generalized and their proofs simplified.

Nizar Touzi (Ecole Polytechnique)
Viscosity Solutions of Fully Nonlinear Path-Dependent PDEs

We propose a notion of viscosity solutions for path dependent fully nonlinear parabolic PDEs. One typical example is the path dependent HJB equations,ă which can also be viewed as viscosity solutions of second order

Backward SDEs and G-martingales. The definition is based on a nonlinear optimal stopping problem, and is consistent with the notion of classical solution in the sense of Dupire's functional Itô calculus. We prove the existence, uniqueness, stability, and comparison principle for the viscosity solutions. Our approach is to use a variation of Peron's approach to prove the comparison principle.

Thaleia Zariphopoulou (UT Austin and Oxford-Man Institute)
QUALITATIVE PROPERTIES OF OPTIMAL INVESTMENT AND WEALTH PROCESSES IN LOGNORMAL MARKETS

In this talk, I will discuss trading horizon effects, the time monotonicity and the spatial concavity/convexity of the optimal investment policies in the classical Merton problem. I will also provide alternative representations of the optimal wealth processes in terms of space-time harmonic functions and present some new results for the risk tolerance, hitting probabilities and target investment levels. (Joint work with Sigrid Kallblad)

Poster Session 1

Christopher Almost (Carnegie Mellon University): A model for the limit order book in heavy traffic.

Michail Anthropelos (University of Piraeus): Agents' strategic behavior and risk-sharing inefficiency.

Vladimir Cherny (Oxford University and Oxford Man Institute): Portfolio optimisation under nonlinear drawdown constraint in a general semimartingale market.

Amogh Deshpande (University of Warwick): Role of minimal martingale measure in risk-sensitive control portfolio optimization.

Philipp Deutsch (University of Vienna): The log optimal portfolio under proportional transaction costs and the shadow price: The geometric Ornstein-Uhlenbeck process..

Mathieu Dubois (London School of Economics): The effect of estimation in large portfolios: an interplay between risk-aversion and the number of stocks.

Thomas Emmerling (University of Michigan): On the impulse control of jump diffusions.

Nikolaos Englezos (University of Piraeus): Stochastic viscosity solutions and maximum principle for control optimality of infinite horizon FBSDEs.

Arash Fahim (University of Michigan): A Monte Carlo method for fully non-linear parabolic partial differential equations with boundary conditions.

Pavel Gapeev (London School of Economics): Perpetual convertible bonds in models with random dividends under asymmetric information.

Peter Hieber (TU München): First-passage times of continuously time-changed Brownian motion.

Yu-Jui Huang (University of Michigan): Robust maximization of asymptotic growth under covariance uncertainty.

Tomoyuki Ichiba (University of California, Santa Barbara): Combinatorial aspects and strong/weak solutions of diffusions with rank-based characteristics.

Xanthi-Isidora Kartala (Athens University of Economics and Business): Stochastic Burgers PDEs with random coefficients and a generalization of the Cole-Hopf transformation.

Mikhail Krayzler (TU München): Pricing of guaranteed minimum benefits in variable annuities.

Martin Larsson (Cornell University): Filtration shrinkage, strict local martingales, and the Föllmer measure.

Haibo Li (Wayne State University): Strong convergence of the predictor-corrector methods for jump diffusions with Markovian switching.

Arnaud Lionnet (Oxford-Man Institute): Quadratic reflected BSDEs and American options.

Martial Longla (University of Cincinnati): Some aspects of modeling dependence.

Adam Majewski (Scuola Normale Superiore, Pisa): Stochastic Portfolio Theory and Benchmark Approach to finance - comparison and its extensions.

Scott Robertson (Carnegie Mellon University): Utility based pricing in the large claim, nearly complete limit.

Poster Session 2

Mohamed Boutayeb (Lorraine University): A sliding window based approach for nonlinear filtering.

Mircea Nica (Xi'an Jiaotong-Liverpool University): Stochastic flows with unbounded jumps associated with nonlinear SPDEs.

Adriana Ocejo (University of Warwick): Regularity properties of optimal stopping values arising from stochastic volatility models.

José Orihuela (Universidad de Murcia): Lebesgue property for convex risk measures on Orlicz spaces.

Krzysztof Paczka (University of Oslo): On the maximal inequality in the G-framework.

Friedrich Penkner and Johannes Temme (University of Vienna): A trajectorial interpretation of Doob's martingale inequalities.

Nicolas Perkowski (Humboldt-Universitaet zu Berlin): The existence of dominating risk free measures.

Silika Prohl (Princeton University and NYU): Numerical approximation of parabolic SPDE driven by a Poisson random measure and application in mathematical finance.

Mohamed Riad Remita (Badji Mokhtar University): Hedging European option in a market created by interacting agents.

Dan Ren (Boston University): Optimal stopping time for the last passage time and maximum time.

Neofytos Rodosthenous (London School of Economics): Perpetual American options in diffusion-type models with running maxima and drawdowns.

Rafael Serrano-Perdomo (Universidad de los Andes, Bogota): Ornstein-Uhlenbeck transition evolution operators and mild solutions of HJB equations in Banach spaces.

Yousef Talafha (Wayne State University): Mean-variance portfolio selection under regime-switching diffusion asset models: a two-time-scale limit.

Plamen Turkedjiev (Humboldt-Universitaet zu Berlin): Approximating BSDEs with least squares regression.

George Vachadze (College of Staten Island and CUNY): Entrepreneurial risk, financial globalization, and chaos.

Pedro Vitoria (University of Oxford): Infinitesimal mean-variance and forward utility.

Gu Wang (Boston University): Optimal portfolios for hedge funds and their managers.

Yihren Wu (Hofstra university): The information content of volatility demand.

Hao Xing (London School of Economics): Convergence to the exponential utility maximization problem.

Xiang Yu (University of Texas at Austin): Utility maximization with additive consumption habit formation in incomplete semimartingale markets.

Changyong Zhang (University of Leoben): Rate of convergence of weak Euler approximation for nondegenerate SDEs.

Guangliang Zhao (Wayne State University): Regularization and stabilization of hybrid diffusion system.