Book of Abstracts

Beatrice Acciaio (London School of Economics)
Mean-Field Optimization Problems and Non-Anticipative Optimal Transport

I will present two kinds of mean-field optimization problems that can be studied via non-anticipative optimal transportation. In the fist setting we take the point of view of a social planner, who aims at minimizing the average cost of a set of agents, where the cost is composed by an idiosyncratic part depending on each agent's type and action, and a mean-field term depending on the actions distribution over all agents. The second setting deals with the optimal control of stochastic dynamics of McKean-Vlasov type, where the associated cost functional is also of separable nature. These two different settings allow for a similar mathematical analysis, based on dynamic optimal transportation of non-anticipative nature. (Joint work with J. Backhoff, R. Carmona, and P. Wang)

Ivan Corvin (Columbia)
Fluctuations of Interacting Particle Systems

We will consider primarily the asymmetric simple exclusion process (ASEP) where particles make nearest neighbor exponential weighting time jumps on the lattice $\mathbb{Z}$ with different rates to the left and right, subject to the exclusion rule (one particle per site). We will sketch how to analyze its long-time, large-scale behavior using Bethe ansatz, duality, and Macdonald processes. These results (e.g. ASEP's scaling exponents) are predicted to describe a much larger universality class including most one-dimensional interacting particle systems.

Christa Cuchiero (University of Vienna)
Measure-Valued Polynomial Diffusions

We introduce polynomial diffusions taking values in the space of (probability) measures on a Polish space, extending the finite dimensional notion of polynomial processes to the infinite dimensional case. Our main goal is tractable dynamic modeling of (probability) measures with applications in large equity markets, capital distribution curve and term structure modeling as well as polynomial Volterra processes for rough volatility modeling. In the case of probability measures we provide a characterization of the corresponding extended generators, prove well-posedness of the associated martingale problems and recover the well-known Fleming–Viot process as special case. We obtain uniqueness of the martingale problem by establishing a formula for the conditional moments of the solution, which in the finite-dimensional case reduces to a matrix exponential. (Joint work with Martin Larsson and Sara Svaluto-Ferro)

Jaksa Cvitanic (Caltech)
Asset Pricing under Optimal Contracts

We consider the problem of finding equilibrium asset prices in a financial market in which a portfolio manager (Agent) invests on behalf of an investor (Principal), who compensates the manager with an optimal contract. We extend a model from Buffa, Vayanos and Woolley (2014), BVW (2014), by allowing general contracts. We find that the optimal contract rewards Agent for taking specific risk of individual assets and not only the systematic risk of the index by using the quadratic variation of the deviation between the portfolio return and the return of an index portfolio. Similarly to BVW (2014), we find that, in equilibrium, the stocks in large supply have high risk premia, while the stocks in low supply have low risk premia, and this effect is stronger as agency friction increases. However, by using our risk-incentive optimal contract, the sensitivity of the price distortion to agency frictions is of an order of magnitude smaller compared to the price distortion in BVW (2014), where only contracts linear in portfolio value and index are allowed. (Joint work with Hao Xing)

Bob Fernholz (INTECH)
Zipf's Law

"Zipf's law states that given some corpus of natural language utterances, the frequency of any word is inversely proportional to its rank in the frequency table. The law is named after the American linguist George Kingsley Zipf (1902–1950), who popularized it and sought to explain it, though he did not claim to have originated it." (From Wikipedia (2017).) This phenomenon will be explained.

J. Michael Harrison (Stanford)
Interesting one-dimensional diffusions that arise in stochastic games

The new century has brought a boom in the use of diffusion-related models in various branches of economic theory, including not only financial economics but also contract theory, information economics and stochastic games. In this talk I will review new research by Aaron Kolb (still unpublished), building on earlier work by Daley and Green (Waiting for news in the market for lemons, *Econometrica*, 2012), in which reflected Brownian motion and skew Brownian motion arise in novel ways and with novel accompaniment.

Tomoyuki Ichiba (University of California, Santa Barbara)
On a Class of Stochastic Differential Equations in a Financial Network Model

In this talk we start with a finite system of linear stochastic equations for the nodes in the financial network and study its limit, as we let the number of nodes go to infinity. Then we

shall consider the system with Lipschitz continuous coefficients in the limiting system. The limiting system can be similar to the mean-field limit but is now described by a system of equations where the coefficients depend on another process which has the identical law. We shall examine its properties with some explicitly solvable examples.

Johannes Muhle-Karbe (University of Michigan)
Equilibrium Liquidity Premia

We study equilibrium returns in a continuous-time model, where heterogenous mean-variance investors trade subject to quadratic transaction costs. We show that the unique equilibrium is characterized by a system of coupled but linear forward backward stochastic differential equations. Explicit solutions obtain in a number of concrete settings. The corresponding liquidity premia compared to the frictionless case are mean reverting; they are positive if the more risk-averse agents are net sellers. (Joint work with Bruno Bouchard, Masaaki Fukasawa, and Martin Herdegen)

Marcel Nutz (Columbia)
Supply and Shorting in Speculative Markets

We propose a continuous-time model of trading among risk-neutral agents with heterogeneous beliefs. Agents face quadratic costs-of-carry on their positions and as a consequence, their marginal valuation of the asset decreases when the magnitude of their position increases, as it would be the case for risk-averse agents. In the equilibrium models of investors with heterogeneous beliefs that followed the original work by Harrison and Kreps, investors are risk-neutral, short-selling is prohibited and agents face a constant marginal cost of carrying positions. The resulting resale option guarantees that the equilibrium price exceeds the price of the asset in a static buy-and-hold model where speculation is ruled out. Our model features three main novelties. First, increasing marginal costs entail that the price depends on the exogenous supply. Second, in addition to the resale option, agents may also value an option to delay, and this may cause the market to equilibrate *below* the static buy-and-hold price. Third, we introduce the possibility of short-selling; then the resale option for agents with short positions partly compensates the resale option for long agents. (Joint work with José Scheinkman)

Julien Reygner (CERMICS – École des Ponts ParisTech)
Equilibrium Large Deviations for Mean-Field Systems with Translation Invariance

This talk will be dedicated to the study of particle systems with mean-field interactions whose distribution is invariant by translations. Under the assumption that the system seen from its centre of mass be reversible with respect to a Gibbs measure, large deviation principles for its empirical measure at equilibrium are established. Particular examples of

such systems include McKean-Vlasov models without external potential, and systems of rank-based interacting diffusions. In connection with the latter model, we shall detail an application of our results to the study of atypical capital distribution in the framework of Stochastic Portfolio Theory.

Andrei Okounkov (Columbia)
BOXCOUNTING

This will be a leisurely introduction to random partitions and what one learns from them and about them in gauge theories.

Nicolas Perkowski (Humboldt)
SOME RECENT RESULTS IN GAME THEORETIC MATHEMATICAL FINANCE

Vovk's game theoretic, hedging based approach provides an alternative view on model free financial mathematics and allows for example to derive sample path properties of "typical price paths" and to set up a model free stochastic calculus. Also more quantitative results exist, such as Vovk's pathwise Dambis Dubins-Schwarz theorem or pathwise pricing-hedging dualities. I will present the main ideas and results of the approach, with an emphasis on applications to model free stochastic calculus and time permitting to model free pricing. (Joint work with R. Lochowski and D. Prömel)

Kavita Ramanan (Brown)
FLUCTUATIONS, CONCENTRATION AND LARGE DEVIATIONS FOR MEAN-FIELD GAMES

Consider a symmetric game with n players in which each player incurs a cost function and chooses a strategy that depends on its own state and on the state of the other players only through the empirical distribution of their states. The Nash equilibria of such symmetric n-player games are hard to analyze or even compute, but their limit, as the number of players goes to infinity, can be characterized in terms of a certain stochastic differential game with infinitely many players, referred to as a mean-field game. We show how properties of solutions to an infinite-dimensional partial differential equation associated with the mean-field game called the master equation can be used to establish central limit theorems and large deviation principles for the sequence of empirical measures of Nash equilibria in n-player games. (Joint work with Francois Delarue and Dan Lacker)

Steven Shreve (Carnegie Mellon)
A Diffusion Model for Limit-Order Book Evolution

With the movement away from the trading floor to electronic exchanges and the accompanying substantial increase in the volume of order submission has come the need for tractable mathematical models of the evolution of the limit-order book. The problem is inherently high dimensional, and any realistic description of order flows must have them depend on the state of the limit-order book. Poisson process models for the evolution of the limit-order book have been proposed, but the analysis of these is either difficult or impossible. In this talk, we show how diffusion scaling of a simple Poisson model, inspired by queueing theory, can lead to a rich yet tractable diffusion model for the evolution of the limit-order book. We then show how to compute the probability of up and down price moves and the time between price changes in this model. (Joint work with Chris Almost, John Lehoczky and Xiaofeng Yu)

Mete Soner (ETH Zurich)
Viability, Arbitrage and Preferences

Consider a financial market in which all agents are presented a set of contracts that are tradable with no cost and a cloud of possible weak orders among the contracts. A natural notion of viability is the existence of a preference relation that is consistent with this plausible orders so that all contracts are weakly preferred to any position obtained by adding a replicable contract to itself. Hence in an economy populated with agents with this viable preference relation every agent is content to remain at her endowment. This is an equivalent statement of viability defined by Harrison & Kreps in 1979. We will prove in this context that a market is viable if and only if there are no free lunches with vanishing risk. However, this notion also needs to be appropriately redefined. These notions are then shown to be equivalent to the existence of a sublinear expectation consistent with the market. (Joint work with Frank Riedel and Matteo Burzoni)

Josef Teichmann (ETH Zurich)
Bayesian Finance

We consider an abstract two filtration setting to model (large) financial markets: the trader is using information from the smaller filtration whereas the price process is adapted to the larger filtration. We present an FTAP extending seminal work of Kabanov-Stricker in the discrete time setting for small markets. We show that this modeling approach applies to many important real world situations including model uncertainty, non-semimartingale models, Bayesian calibration, randomization, credit risk, etc. (Joint work with Christa Cuchiero and Irene Klein)

Gordan Žitković (University of Texas Austin)

Equilibria in Incomplete Continuous-Time Financial Markets and Systems of BSDEs

The problem of existence of equilibrium prices in incomplete continuous-time financial markets has proved to be one of the most stubborn open problems in financial economics and mathematical finance. While the complete case was settled 30 years ago in the work of Ioannis Karatzas and others, very little is known about what happens when no completeness assumptions are made.

A new approach to this problem – and its positive resolution – in the special case when all agents have exponential utility functions will be presented. It is based on systems of quadratic backward stochastic differential equations (BSDEs) and provides a general existence result for a class of such equations under structural conditions. It is interesting that very similar conditions appear in completely different contexts – e.g, when one tries to construct martingales on Riemannian manifolds or find Nash points of non-zero-sum stochastic games. (Joint work with Hao Xing, and with Hao Xing and Constantinos Kardaras)