Viral Acharya
Measuring Systemic Risk

Robert Almgren
Option Hedging with Market Impact

We consider the problem of a trader hedging a large options position. We use a realistic proportional market impact cost model, as is commonly used in optimal execution problems, rather than the bid-ask spread model which has been previously used. We also include overnight risk, which is important for an intraday hedge position. Our solutions solve a "pursuit problem", in which the actual hedge position moves smoothly in the direction of the perfect Black-Scholes hedge. We also obtain an expression for the modified volatility of the underlying caused by the hedge activity: if the hedger is long the option then volatility decreases and conversely if he is short.

This talk is based on joint work with Michael Li (Princeton University).

Torben Andersen
Assessing VPIN Measurement of Toxic Order Flow Toxicity via Perfect Trade Classification

The VPIN, or Volume-synchronized Probability of INformed trading, metric is introduced by Easley, Lopez de Prado and O'Hara (ELO) as a real-time indicator of order flow toxicity. They find the measure useful in predicting return volatility and conclude it may help signal impending market turmoil. The VPIN metric involves decomposing volume into active buys and sells. We use the best-bid-offer (BBO) files from the CME Group to construct (near) perfect trade classification measures for the E-mini S&P 500 futures contract. We investigate the accuracy of the ELO Bulk Volume Classification (BVC) scheme and find it inferior to a standard tick rule based on individual transactions. Moreover, when VPIN is constructed from accurate classification, it behaves in a diametrically opposite way to BVC-VPIN. We also find the latter to have forecast power for short-term volatility solely because it generates systematic classification errors that are correlated with trading volume and return volatility. When controlling for trading intensity and volatility, the BVC-VPIN measure has no incremental predictive power for future volatility. We conclude that VPIN is not suitable for measuring order flow imbalances.

This talk is based on joint work with Oleg Bondarenko (University of Illinois at Chicago).

Dorje Brody

Aggregation of Risk Aversion in Heterogeneous Markets

When investors have heterogeneous attitudes towards risk, it is reasonable to assume that each investor has a pricing kernel, and that these individual pricing kernels are aggregated to form a market pricing kernel. The various investors are then buyers or sellers depending on how their individual pricing kernels compare with that of the market. In Brownian-motion-based models, we can represent such heterogeneous attitudes by letting the market price of risk be a random variable, the distribution of which corresponds to the variability of attitude across the market. If the flow of market information is determined by the movements of prices, then neither the Brownian driver nor the market price of risk are directly visible: the filtration is generated by an "information process" given by a combination of the two. We show that the market pricing kernel is then given by the harmonic mean of the individual pricing kernels associated with the various market participants. Remarkably, with an appropriate definition of Lévy information one draws the same conclusion in the case when asset prices can jump. As a consequence, we are led to a rather general scheme for the management of investments in heterogeneous markets subject to jump risk.

This talk is based on joint work with Lane Hughston (Brunel University and University College London).

Igor Cialenco

On Bid-Ask Prices for Dividend Paying Securities

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 (2011). 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. 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). Finally, we link the theory of stochastic backward difference equations to bid-ask prices in the dynamic conic finance framework.

This talk is based on joint work with T.R. Bielecki (Illinois Institute of Technology), I.Iyigunler (Illinois Institute of Technology) and R. Rodriguez (Illinois Institute of Technology).

Laurent Clerc
New Advances in Measuring and Assessing Systemic Risks: a Central Bank Perspective

The presentation will focus on the new advances in measuring and assessing systemic risks stemming in particular from new regulatory requirements (e.g. mandatory OTC derivatives reporting to trade repositories) and the development of network analysis and modeling to better understand the topography and the main features of OTC derivative markets. If times allows, it will also touch upon efforts currently made to develop general equilibrium models factoring in the possibility to default in equilibrium in order to assess macro-prudential policies.

Rama Cont
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Marco Frittelli
Title TBA

Tom Hurd
Illiquidity and Insolvency Cascades in the Interbank Network

The great crisis of 2007-08, followed by the ongoing Euro crisis, have highlighted the need for better mathematical and economic understanding of financial systemic risk. Are there "toy models" of systemic risk that are amenable to an exact probabilistic analysis? How do these models work, how useful are they, and what are some of the conclusions that can be drawn from them? As an illustration of some of the complex issues that can be addressed, I will show how to obtain results on large graph asymptotics for systemic risk in a model in which two kinds of contagion, insolvency and illiquidity, act in opposite directions in the network.

Sebastian Jaimungal
Robust Market Making

Because market makers (MMs) acknowledge that their models are incorrectly specified, in this paper, we allow for ambiguity in their choices to make their models robust to misspecification in (i) the arrival rate of market orders (MOs), (ii) the fill probability of limit orders, and (iii) the dynamics of the fundamental value of the asset they deal. We demonstrate that MMs adjust their quotes to reduce inventory risk and adverse selection costs. Moreover, robust market making increases the Sharpe ratio of market making strategies and allows for the MM to fine tune the tradeoff between the mean and the standard deviation of expected profits. Our framework adopts the robust optimal control

approach of Hansen & Sargent (2007) and we provide analytical solutions for the robust optimal strategies as well as verification theorems.

This talk is based on joint work with Álvaro Cartea (University College London) and Ryan Donnelly (University of Toronto).

Monique Jeanblanc

Non-arbitrage Conditions up to Random Horizon and After Honest Times

We study arbitrages opportunities and no unbounded profit with bounded risk (NUPBR) in a progressive enlargement setting. We are concerned with the case where a martingale representation theorem holds in the reference filtration. Under the hypothesis that there are no arbitrages (and NUPBR holds) in the reference filtration, we give conditions to have arbitrages in a continuous filtration and in a Poisson filtration. We give examples where the arbitrage strategies are explicitly computed. For NUPBR, we study the particular case where the price process is quasi left continuous.

Michael Kupper

On Robust Duality and Superhedging under Model Uncertainty

We focus on the robust representation of convex risk measures when there is no reference probability measure. As an application we discuss the superhedging problem and duality results for supersolutions of BSDEs under model uncertainty.

Alfred Lehar

Why are Banks Highly Interconnected?

We study optimal interconnections between banks in alternative banking systems created using interbank loans and over-the-counter derivatives. Settlements on all interbank payments are rene- gotiated in the event of financial distress of a counterparty. Interconnections in our analysis play a positive role since they serve as a commitment device to facilitate mutual private sector bailouts to lower the need for government bailouts. We show that the renegotiable interbank loans form the optimal interconnection to the joint risk management and asset quality problem faced by banks. In addition, our analysis shows that systemic spillovers and the likelihood of financial crises are severely mismeasured when interbank renegotiations are not considered. The optimality of inter-bank loans is shown to hold in a wide range of institutional settings.

This talk is based on joint work with Alexander David (University of Calgary).

Marcel Nutz

On Model Uncertainty in Discrete Time

We study the problems of arbitrage, superhedging and utility maximization in a nondominated model of a discrete-time financial market. We show that absence of arbitrage in a quasi-sure sense is equivalent to the existence of a suitable family of martingale measures, that a superhedging duality holds, and that optimal strategies for robust utility maximization exist. If time permits, some consequences for martingale theory will also be discussed.

This talk is based on joint work with Mathias Beiglböck (University of Vienna) and Bruno Bouchard (Université Paris-Dauphine).

Anna Obizhaeva

Smooth Trading with Overcondence and Market Power

This paper presents a continuous time model of oligopolistic trading among symmetric traders who agree to disagree concerning the precision of continuous flows of private information. Although traders do not share a common prior, they apply Bayes law consistently. If there is enough disagreement among traders, an equilibrium exists in which prices reveal the average of all traders' signals immediately, but traders continue to trade on their information slowly. The speed with which traders adjust inventories reflects a trade-off between incentives to slow down to reduce market impact costs and incentives to speed up to profit from perishable information. The price impact depends linearly on the changes in the inventories and the changes in the speed of trading. Trading modest quantities much faster than consistent with equilibrium strategies results in flash-crash patterns with price spikes followed by price reversals.

This talk is based on joint work with Albert S. Kyle (University of Maryland) and Yajun Wang (University of Maryland).

Teemu Pennanen

Optimal Investment and Contingent Claim Valuation in Illiquid Markets

We study portfolio optimization and contingent claim valuation in markets where illiquidity may affect the transfer of wealth over time and between investment classes. In addition to classical frictionless markets and markets with transaction costs, our model covers nonlinear illiquidity effects that arise in limit order markets. We extend basic results on arbitrage bounds and attainable claims to illiquid markets and general swap contracts where both claims and premiums may have multiple payout dates. The existence of optimal trading strategies and dual representations are established under conditions that extend the classical no-arbitrage condition in the classical linear market model.

Martijn Pistorius

Optimal Dividend Distribution in the Presence of a Penalty

This talk concerns an optimal dividend distribution problem for an insurance company which risk process evolves as a spectrally negative L´evy process (in the absence of dividend payments). The management of the company is assumed to control timing and size of dividend payments. The objective is to maximize the sum of the expected cumulative discounted dividend payments received until the moment of ruin and a penalty payment at the moment of ruin which is an increasing function of the size of the shortfall at ruin; in addition, there may be a fixed cost for taking out dividends. A solution is presented to the corresponding stochastic control problem. It is established that the value-function is the unique stochastic solution and the pointwise smallest stochastic supersolution of the associated HJB equation. A number of concrete examples are discussed in detail.

Joshua Reed

High Frequency Asymptotics for the Limit Order Book

We study the one-sided limit order book corresponding to limit sell orders and model it as a measure-valued process. Limit orders arrive to the book according to a Poisson process and are placed on the book according to a distribution which varies depending on the current best price. Market orders to buy periodically arrive to the book according to a second, independent Poisson process and remove from the book the order corresponding to the current best price. We consider the above described limit order book in a high frequency regime in which the rate of incoming limit and market orders is large and traders place their limit sell orders close to the current best price. Our first set of results provide weak limits for the unscaled price process and the properly scaled measure-valued limit order book process in the high frequency regime. In particular, we characterize the limiting measure-valued limit order book process as the solution to a measure-valued stochastic differential equation. We then provide an analysis of both the transient and long-run behavior of the limiting limit order book process.

This talk is based on joint work with Peter Lakner (New York University) and Sasha Stoikov (Cornell University).

Halil Mete Soner

Robust Hedging, Duality and No-Arbitrage

We discuss the duality between super-hedging and linear pricing rules in the setting of robust hedging. In this market, one does not assume any structure but allows for static postions in liquid options. The dual elements are martingale measures satisfying constraints that are consistent with the market given option prices. In this talk, we will outline this duality result and several results in this direction. Then, we use the duality to

establish a connection between no-arbitrage and the existence of martingale measures. Several different notions of no-arbitrage will also be discussed.

This talk is based on joint work with Yan Dolinsky (Hebrew University).

Sasha Stoikov

Time is Money: Estimating the Cost of Latency in Trading

We formulate a trading problem at the market microstructure level and solve it using dynamic programming methods. The objective is to sell a single lot of an asset in a very short horizon, while monitoring the limit order book. The solution to this optimal stopping problem divides the state space into a "trade" and "no-trade" region. We investigate shapes of the trade and no-trade regions given different underlying price processes, input parameters and assumptions on the latency of the trade execution. Finally, we calculate the cost of latency per lot traded and demonstrate that the advantage of observing the limit order book can dissipate quickly as latency increases. In the empirical section, we show that our optimal policy significantly outperforms a TWAP algorithm in liquidating on-the-run U.S. treasury bonds, saving on average approximately 1/3 of the spread per share liquidated if trades are executed with low latency (10 milliseconds).

Nizar Touzi

Martingale Optimal Transport and Robust Hedging

The martingale optimal transport problem is motivated by model-independent bounds for the pricing and hedging exotic options.

In the simplest one-period model, the dual formulation of the robust superhedging cost differs from the standard optimal transport problem by the presence of a martingale constraint on the set of coupling measures. The one-dimensional Brenier theorem has a natural extension. However, in the present martingale version, the optimal coupling measure is concentrated on a pair of graphs which can be obtained in explicit form. These explicit extremal probability measures are also characterized as the unique left and right monotone martingale transference plans, and induce an optimal solution of the kantorovitch dual, which coincides with our original robust hedging problem.

By iterating the above construction over n steps, we define a Markov process whose distribution is optimal for the n-periods martingale transport problem corresponding to a convenient class of cost functions. Similarly, the optimal solution of the corresponding robust hedging problem is deduced in explicit form. Finally, by sending the time step to zero, this leads to a continuous-time version of the Brenier theorem in the present martingale context, thus providing a new remarkable example of Peacock, i.e. Processus Croissant pour l'Ordre Convexe. Here again, the corresponding robust hedging strategy is obtained in explicit form.