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<th>Date</th>
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<th>Event Details</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) Heston-Type Stochastic Volatility with a Markov Switching Regime -- 1360 East Hall</td>
</tr>
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<td>Wednesday, September 09, 2015</td>
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<td>Financial/Actuarial Mathematics -- Yavor Stoiev (UM) Equilibrium with imbalance of the derivative market -- 1360 East Hall</td>
</tr>
<tr>
<td>Wednesday, September 23, 2015</td>
<td>4:00pm-5:00pm</td>
<td>Financial/Actuarial Mathematics -- Johannes Muhle-Karbe (ETH and UM) Information and Inventories in High-Frequency Trading -- 1360 East Hall</td>
</tr>
<tr>
<td>Wednesday, September 30, 2015</td>
<td>4:00pm-5:00pm</td>
<td>Financial/Actuarial Mathematics -- Christian Keller (UM) Pathwise classical and viscosity solutions of fully nonlinear SPDEs -- 1360 East Hall</td>
</tr>
<tr>
<td>Wednesday, October 14, 2015</td>
<td>4:00pm-5:00pm</td>
<td>Financial/Actuarial Mathematics -- Andrea Cosso (Paris 7 (Diderot), LPMA) Randomization method for optimal control of partially observed path-dependent SDEs -- 1360 East Hall</td>
</tr>
<tr>
<td>Thursday, October 15, 2015</td>
<td>3:00pm-4:00pm</td>
<td>Financial/Actuarial Mathematics -- Jiro Akahori (Ritsumeikan University, Kusatsu, Japan) Hedging Error as a Timing Risk and its Static Hedge -- 1360 East Hall</td>
</tr>
<tr>
<td>Wednesday, October 21, 2015</td>
<td>4:00pm-5:00pm</td>
<td>Financial/Actuarial Mathematics -- Leonard Wong (University of Washington) Geometry and Optimization of Relative Arbitrage -- 1360 East Hall</td>
</tr>
<tr>
<td>Wednesday, November 11, 2015</td>
<td>4:00pm-5:00pm</td>
<td>Financial/Actuarial Mathematics -- Bahman Angoshtari (UM) Predictable Investment Preferences -- 1360 East Hall</td>
</tr>
<tr>
<td>Tuesday, November 17, 2015</td>
<td>3:00pm-4:00pm</td>
<td>Financial/Actuarial Mathematics -- Daniel Lacker (Brown University) Liquidity, risk measures, and concentration of measure -- 1360 East Hall</td>
</tr>
<tr>
<td>Wednesday, November 18, 2015</td>
<td>4:00pm-5:00pm</td>
<td>Financial/Actuarial Mathematics -- Daniel Lacker (Brown University) Mean field limits for stochastic differential games -- 1360 East Hall</td>
</tr>
<tr>
<td>Wednesday, December 02, 2015</td>
<td>4:00pm-5:00pm</td>
<td>Financial/Actuarial Mathematics -- Alex Cox (University of Bath, UK) Model-independent bounds for Asian options: a dynamic programming approach -- 1360 East Hall</td>
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<td>Wednesday, December 09, 2015</td>
<td>4:00pm-5:00pm</td>
<td>Financial/Actuarial Mathematics -- Song Yao (University of Pittsburgh) Robust Dynkin games -- 1360 East Hall</td>
</tr>
<tr>
<td>Wednesday, December 16, 2015</td>
<td>3:00pm-4:00pm</td>
<td>Financial/Actuarial Mathematics -- Sergey Nadtochiy (UM) Endogenous Formation of Limit Order Books: the Effects of Trading Frequency -- 1068 East Hall</td>
</tr>
<tr>
<td>Wednesday, January 13, 2016</td>
<td>4:00pm-5:00pm</td>
<td>Financial/Actuarial Mathematics -- Johannes Muhle-Karbe (UM) Equilibrium Models with Small Frictions -- 1360 East Hall</td>
</tr>
<tr>
<td>Wednesday, February 03, 2016</td>
<td>4:00pm-5:00pm</td>
<td>Financial/Actuarial Mathematics -- Rohini Kumar (Wayne State University) Small-time asymptotics for fast mean-reverting stochastic volatility models -- 1360 East Hall</td>
</tr>
<tr>
<td>Wednesday, February 10, 2016</td>
<td>4:00pm-5:00pm</td>
<td>Financial/Actuarial Mathematics -- Dylan Possamai (Paris Dauphine) Dynamic Programming Approach to Principal-Agent Problems -- 1360 East Hall</td>
</tr>
<tr>
<td>Friday, February 12, 2016</td>
<td>4:00pm-5:00pm</td>
<td>Financial/Actuarial Mathematics -- Sebastian Hermann (ETH) Model Uncertainty, Recalibration, and the Emergence of Delta-Vega Hedging -- 1360 East Hall</td>
</tr>
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<td>Financial/Actuarial Mathematics -- Yavor Stoev (UM) quickest change-point detection problems for multidimensional Wiener processes -- 3088 East Hall</td>
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<td>Financial/Actuarial Mathematics -- Abhinav Sinha (EECS, UM) Network Mechanism Design -- 1360 East Hall</td>
</tr>
<tr>
<td>Wednesday, February 24, 2016</td>
<td>3:00pm-4:00pm</td>
<td>Financial/Actuarial Mathematics -- Asaf Cohen (UM) Risk Sensitive Control of the Lifetime Ruin Problem -- 4096 East Hall</td>
</tr>
<tr>
<td>Wednesday, March 09, 2016</td>
<td>4:00pm-5:00pm</td>
<td>Financial/Actuarial Mathematics -- Chris Miller (UC Berkeley) Optimal Control of Conditional Value-at-Risk in Continuous Time -- 1360 East Hall</td>
</tr>
<tr>
<td>Wednesday, March 16, 2016</td>
<td>3:00pm-4:00pm</td>
<td>Financial/Actuarial Mathematics -- Jinniao Qiu (UM) Weak Solution for Fully Nonlinear Stochastic Hamilton-Jacobi-Bellman Equations and its Applications -- 3088 East Hall</td>
</tr>
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<td>4:00pm-5:00pm</td>
<td>Financial/Actuarial Mathematics -- Matin Herdegen (ETH) Sensitivity of Optimal Consumption Streams -- 1360 East Hall</td>
</tr>
</tbody>
</table>
Wednesday, March 23, 2016
4:00pm-5:00pm  Financial/Actuarial Mathematics -- Gustavo Schwenkler (Boston University)  The Systemic Effects of Benchmarking -- 1360 East Hall

Wednesday, March 30, 2016
4:00pm-5:00pm  Financial/Actuarial Mathematics -- Christian Keller (UM)  TBA -- 1360 East Hall

Wednesday, April 06, 2016
4:00pm-5:00pm  Financial/Actuarial Mathematics -- Tom Bielecki (IIT)  Dependence between components of multivariate conditional Markov chains: Markov consistency and Markov Copulae -- 1360 East Hall

Wednesday, April 13, 2016
4:00pm-5:00pm  Financial/Actuarial Mathematics -- Vadim Linetsky (Northwestern)  Long Forward Measure, Recovery, and the Term Structure of Bond Risk Premiums -- 1360 East Hall
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.
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.

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.

http://www.math.lsa.umich.edu/seminars_events/ - Page 6/17
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 $\rho(\lambda X)$ for $\lambda \ge 0$, where $\rho$ is a convex risk measure and $X$ a financial position (a random variable), and we call such a curve a 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 $\rho(\lambda X) \le \gamma(\lambda)$ for all $\lambda \ge 0$. 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 $\mathcal{P}$ 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 $\mathcal{P}$ is weakly compact, one can even find an optimal triple $(\mathcal{P}_*, \tau_*, \gamma_*)$ 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.
How would the introduction of a small trading friction such as a transaction tax affect financial markets? To answer questions of this kind, one needs to consider equilibrium models, where prices are determined endogenously. Indeed, taxes change agents' individual decision making, which in turn affects the market prices determined by their interactions. The new market environment then again alters the agents' behavior, leading to a notoriously intractable fixed point problem.

In this talk we report on recent progress using asymptotic techniques for small trading frictions. In this practically relevant limiting regime, explicit solutions become available for many of the arising singular control problems, bringing analytical results for the equilibrium problem within reach.

(The talk is based on joint works with Martin Herdegen and Jan Killeen)

We use stochastic volatility models, with fast mean-reverting volatility, to price out-of-the-money (OTM) European call options near maturity. The regime of interest is when time to maturity is small, but large compared to the mean-reversion time of the stochastic volatility. The different time scales of mean-reversion and time to maturity makes this a multi-scale problem. To obtain asymptotics of the OTM option price and the corresponding implied volatility, we first prove a large deviation principle for stock price, as time to maturity approaches zero. The large deviation principle is obtained by PDE techniques rather than probabilistic methods. Due to the multi-scale nature of the problem, the PDE techniques involve averaging viscosity solutions of nonlinear PDEs.

This is joint work with Jean-Pierre Fouque, Jin Feng and Lea Popovic.
Financial/Actuarial Mathematics  
Wednesday, February 10, 2016, 4:00pm-5:00pm  
1360 East Hall  
Dylan Possamai (Paris Dauphine)  
*Dynamic Programming Approach to Principal-Agent Problems*

Abstract: We consider a general formulation of the Principal-Agent problem from Contract Theory, on a finite horizon. We show how to reduce the problem to a stochastic control problem which may be analyzed by the standard tools of control theory. In particular, Agent's value function appears naturally as a controlled state variable for the Principal's problem. Our argument relies on the Backward Stochastic Differential Equations approach to non-Markovian stochastic control, and more specifically, on the most recent extensions to the second order case.

This is a joint work with Jaksa Cvitanic and Nizar Touzi.

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Financial/Actuarial Mathematics  
Friday, February 12, 2016, 4:00pm-5:00pm  
1360 East Hall  
Sebastian Hermann (ETH)  
*Model Uncertainty, Recalibration, and the Emergence of Delta-Vega Hedging*

We study option pricing and hedging with uncertainty about a Black-Scholes reference model which is dynamically recalibrated to the market price of a liquidly traded vanilla option. For dynamic trading in the underlying asset and this vanilla option, delta-vega hedging is asymptotically optimal in the limit for small uncertainty aversion. The corresponding indifference price corrections are determined by the disparity between the vega, gammas, vannas, and volgas of the non-traded and the liquidly traded options.

This is joint work with Johannes Muhle-Karbe.
Quickest change-point detection problems for multidimensional Wiener processes

We study the quickest change-point detection problems for the correlated components of a multidimensional Wiener process changing their drift rates at certain random times. These problems seek to determine the times of alarm which are as close as possible to the unknown change-point (disorder) times at which some of the components have changed their drift rates. The optimal times of alarm are shown to be the first times at which the appropriate posterior probability processes exit certain regions restricted by the stopping boundaries. We characterize the value functions and optimal boundaries as unique solutions of the associated free boundary problems for partial differential equations. We provide estimates for the value functions and boundaries which are solutions to the appropriately constructed ordinary differential free boundary problems.

Network Mechanism Design

Mechanism Design is a widely used design framework for resource allocation problems involving strategic agents. Decentralization of information is one of the main issues that mechanism design deals with. Recently, this approach has been studied for problems on networked systems where for instance efficient distribution of bandwidth among Internet users is to be achieved. Full implementation is a refinement of mechanism design and is generally more robust in achieving efficient allocations.

In this talk, I will begin by describing the Hurwicz-Reiter model for Mechanism Design and the relevant resource allocation problems for various networks like unicast, multi-rate/multicast and wireless network. Owing to the nuances of these networked problems like restrictions on complexity and hard system constraints on allocation, I will propose restrictions to the mechanism design framework which network problem ought to adhere to. Finally I will present a set of mechanisms that achieve full implementation for the various networks. As we shall see, dual optimization approach plays a key role in designing such mechanisms.
We study a risk sensitive control version of the lifetime ruin probability problem. We consider a sequence of investments problems in Black-Scholes market that includes a risky asset and a riskless asset. We present a differential game that governs the limit behavior. We solve it explicitly and use it in order to find an asymptotically optimal policy.

Joint work with Erhan Bayraktar.

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We consider continuous-time stochastic optimal control problems featuring Conditional Value-at-Risk (CVaR) in the objective. The major difficulty in these problems arises from time-inconsistency, which prevents us from directly using dynamic programming. To resolve this challenge, we convert to an equivalent bilevel optimization problem in which the inner optimization problem is standard stochastic control. Furthermore, we provide conditions under which the outer objective function is convex and differentiable. We compute the outer objective's value via a Hamilton-Jacobi-Bellman equation and its gradient via the viscosity solution of a linear parabolic equation, which allows us to perform gradient descent. The significance of this result is that we provide an efficient dynamic programming-based algorithm for optimal control of CVaR without lifting the state-space. To broaden the applicability of the proposed algorithm, we provide convergent approximation schemes in cases where our key assumptions do not hold and characterize relevant suboptimality bounds. In addition, we extend our method to a more general class of risk metrics, which includes mean-variance and median-deviation. We also demonstrate a concrete application to portfolio optimization under CVaR constraints. Our results contribute an efficient framework for solving time-inconsistent CVaR-based dynamic optimization.

This is a joint work with Insoon Yang.
Financial/Actuarial Mathematics
Wednesday, March 16, 2016, 3:00pm-4:00pm
3088 East Hall
Jinniao Qiu (UM)

Weak Solution for Fully Nonlinear Stochastic Hamilton-Jacobi-Bellman Equations and its Applications

This talk is concerned with the stochastic Hamilton-Jacobi-Bellman (HJB) equation with controlled leading coefficients, which is a type of fully nonlinear stochastic partial differential equation (SPDE). In order to formulate the weak solution for such kind of SPDEs, a class of regular random parabolic potentials are introduced in the stochastic framework. The existence and uniqueness of weak solution is proved, which seems new even for the classical HJB equations. For the partially non-Markovian case, we obtain the associated gradient estimate. The applications in finance and economics will be discussed as well if time allows.

Financial/Actuarial Mathematics
Wednesday, March 16, 2016, 4:00pm-5:00pm
1360 East Hall
Matin Herdegen (ETH)

Sensitivity of Optimal Consumption Streams

We study the sensitivity of optimal consumption streams with respect to perturbations of the random endowment. At the leading order, the consumption adjustment does not matter: any choice that matches the budget constraint simply shifts the original utility by the marginal value of the perturbation. Nontrivial results obtain at the next-to-leading order. Here, one first solves the problem for a deterministic perturbation, which leads to a "prognosis measure". The desired consumption adjustment for a general endowment perturbation is in turn given by the conditional expectation of the latter, computed under this measure and appropriately weighted with the conditional expectations of the remaining risk-tolerance. As an interesting application, we consider the problem of optimal consumption with small transaction costs.

The talk is based on joint work with Johannes Muhle-Karbe (University of Michigan).
We show that the competitive pressure to beat a benchmark may induce institutional trading behavior that exposes retail investors to tail risk. In our model, institutional investors are different from a retail investor because they derive higher utility when their benchmark outperforms. This forces institutional investors to take on leverage to overinvest in the benchmark. Institutional investors execute fire sales when the benchmark experiences shock. This behavior increases market volatility, raising the tail risk exposure of the retail investor. Ex post, tail risk is only short lived. All investors survive in the long run under standard conditions, and the most patient investor dominates. Ex ante, however, benchmarking is welfare reducing for the retail investor, and beneficial only to the impatient institutional investor.
Dependence between components of multivariate conditional Markov chains: Markov consistency and Markov Copulae

Modeling of evolution of dependence between processes occurring in financial markets is important. Typically, one can identify marginal statistical properties of individual processes, and then one is confronted with the task of modeling dependence between these individual processes so that the marginal properties are obeyed. We have been advocating, for some time now, to address this modeling problem via the theory of Markov consistency and Markov copulae.

In this talk we shall examine the problem of existence and construction of a non-trivial multivariate conditional Markov chain with components that are given conditional Markov chains. In this regard we shall give sufficient and necessary conditions, in terms of relevant conditional expectations, for a component of a multivariate Markov chain to be a Markov chain in the filtration of the entire chain - a property called strong Markov consistency, as well as in its own filtration - a property called weak Markov consistency. These characterization results are proved via analysis of the semi-martingale structure of the chain.

Several financial applications will be indicated.