

Rene Carmona
Princeton University

Title: Market Designs for Emission Trading Schemes

Abstract (joint work with M. Fehr, J. Hinz and A. Porchet):

Emission trading schemes are regulatory frameworks designed to reduce and control pollution levels by creating economic incentives for responsible emission sources. The present work is devoted to the mathematical analysis of the most important lesson learned from the first phase of the European experiment: the relations between carbon and electricity prices. We explain how the prices of goods and pollution permits come out of a competitive equilibrium model of the economy. We prove existence, and we characterize mathematically the price of a pollution permit in equilibrium, and we show that the prices of goods follow a classical merit order. In such an economy, pollution reduction is possible if the regulator can solve an (ill-posed) inverse problem. Using our model, we compare numerically, for a fixed emissions target, the social costs and the windfall profits for three different schemes: a plain tax, a cap-and-trade scheme as implemented by the European Union, and a new cap-and-trade scheme where pollution allowances are granted proportionally to production, and we show that the latter lowers the social costs and the windfall profits.

Peter Carr
New York University

Title: Static Hedging under Zero Drift CEV

Abstract:

We consider an up and in put option written on forward price whose risk neutral dynamics are described by a zero drift CEV process. We show that there exists a perfect static hedge consisting of co-terminal European calls struck above the barrier. We explicitly determine the number of calls to hold at each strike and consider an approximation of this hedge involving a single strike. Finally, we show that the same hedge also works under an unspecified independent time change.

Recovering Credit Portfolio Loss Rates from CDO Tranches:
Solution of an inverse problem by intensity control

Rama Cont (Columbia University)

Joint work with: Andreea MINCA (Ecole Polytechnique)

The calibration of (top-down) pricing models for portfolio credit derivatives such as CDOs involves the construction of a risk-neutral jump intensity for the loss process which is compatible with a set of observations of market spreads for CDO tranches. We propose an efficient and stable algorithm to solve this inverse problem by transforming it into a stochastic control problem. Given a set of observations of market spreads for CDO tranches, we construct a risk-neutral default intensity process for the portfolio underlying the CDO which matches these observations, by looking for the risk neutral loss process verifying the calibration constraints 'closest'

--in the sense of relative entropy-- to a prior loss process. We formalize the problem in terms of minimization of relative entropy with respect to the prior under calibration constraints and use convex duality techniques to solve the problem. The dual problem is shown to be an intensity control problem, characterized in terms of a nonlinear Hamilton Jacobi system of differential equations. We show that the Hamilton Jacobi system can be solved explicitly thus yielding an efficient method for obtaining the calibrated intensity. Our method allows to construct an implied intensity process which leads to CDO tranche spreads consistent with the observations. We illustrate our method ITRAXX index data: our results reveal strong evidence for the dependence of loss transitions rates on the past number of defaults, thus offering quantitative evidence for "contagion effects" in the risk-neutral loss process.

Paolo Guasoni
Boston University

Title: Portfolios and Risk Premia for the Long Run

Abstract:

The problems of portfolio choice and derivatives pricing are studied in an incomplete market with several risky assets, with investment opportunities driven by, and partially correlated with, economic factors following an ergodic diffusion.

For CRRA utility from terminal wealth, long-run optimal portfolios and their implied risk-premia are derived explicitly in terms of the principal eigenfunction of the generator of the factor process. The principal eigenvalue represents the maximal utility growth rate, and sharp bounds on the finite-horizon performance of long-run strategies are provided.

The calculation of the eigenvector-eigenvalue pair is reduced to the solution of a linear ODE in the case of several assets with one economic factor. Several factors lead to a quasilinear PDE, which can be solved explicitly in special cases.

Ken Kim
Columbia University
(Joint work with Paul Glasserman)

Title: Moment Explosions and Stationary Distributions in Affine Diffusion Models

Many of the most widely used models in finance fall within the affine family of diffusion processes. The affine family combines modeling flexibility with substantial tractability, particularly through transform analysis; these models are used both for econometric modeling and for pricing and hedging of derivative securities. We analyze the tail behavior, the range of finite exponential moments, and the convergence to stationarity in affine models, focusing on the class of canonical models defined by Dai and Singleton (JF, 2000). We show that these models have limiting stationary distributions and characterize these limits. We show that the tails of both the transient and stationary distributions of these models are necessarily exponential or Gaussian; in the non-Gaussian case, we characterize the tail decay rate for any linear combination of factors. We also give necessary and sufficient conditions for a linear combination of factors to be Gaussian. Our results follow from an investigation into the stability properties of the systems of ordinary differential equations associated with affine diffusions.

Title: What Is a Good External Risk Measure: Bridging the Gaps between Robustness, Subadditivity, and Insurance Risk Measures

Steve Kou

Columbia University

(Joint work with Chris Heyde and Xian Hua Peng)

Abstract:

Choosing a proper risk measure is of great regulatory importance and is relevant to the interfaces of operations and finance, as exemplified in Basel Accord which uses VaR (or quantiles) in combination with scenario analysis as a preferred risk measure for banking and operational risk. Two main families of axiomatically based risk measures are the coherent risk measures, which assume subadditivity for random variables, and the insurance risk measures, which assume additivity for comonotonic random variables. We propose new, data-based, risk measures, called \textit{natural risk statistics}, that are characterized by a new set of axioms. The new axioms only require subadditivity for comonotonic random variables, consistent with the prospect theory. We point out while many risk measures may be suitable for internal risk management, robustness is an important consideration for external risk measures. Comparing to the previous measures, the natural risk statistics include the tail conditional median which is more robust than the tail conditional expectation suggested by coherent risk measures; and, unlike insurance risk measures, the natural risk statistics can also incorporate scenario analysis. The natural risk statistics includes VaR as a special case and therefore shows that VaR, though simple, is not irrational.

Kasper Larsen
Carnegie Mellon University

Title: Continuity of utility-maximization with respect to preferences

Abstract:

This paper provides an easily verifiable regularity condition under which the investor's utility maximizer depends continuously on the description of her preferences in a general incomplete financial setting. Specifically, we extend the setting of Jouini and Napp (2004) to include noise generated by a general continuous semi-martingale and to the case where the market price of risk process is allowed to be a general adapted process satisfying a mild integrability condition.

This extension allows us to obtain positive results for both the mean-reversion model of Kim and Omberg (1996) and the stochastic volatility model of Heston (1993). Finally, we provide an example set in Samuelson's complete financial model illustrating that without imposing additional regularity, the continuity property of the investor's optimizer can fail.

Dilip B. Madan
Robert H. Smith School of Business
University of Maryland

Title: Equilibrium Asset Pricing with Non-Gaussian Factors and Exponential Utility

Abstract: We analyse the equilibrium asset pricing implications for an economy with single period return exposures to explicit non-Gaussian systematic factors, that may be both skewed and long-tailed, and Gaussian idiosyncratic components. Investors maximize expected exponential utility and equilibrium factor prices are shown to reflect exponentially tilted prices for non-Gaussian factor risk exposures. It is shown that these prices may be directly estimated from the univariate probability law of the factor exposure, given an estimate of average risk aversion in the economy. In addition a residual form of the capital asset pricing model continues to hold and prices the idiosyncratic or Gaussian risks. The theory is illustrated on data for the US economy using independent components analysis to identify the factors and the variance gamma model to describe the probability law of the non-Gaussian factors. It is shown that the residual CAPM accounts for no more than one percent of the pricing of risky assets, while the exponentially tilted systematic factor risk exposures account for the bulk of risky asset pricing.

Alexander Schied
Cornell University

Title: Optimal portfolio liquidation and predatory trading

Abstract:

A variety of circumstances can force a market participant to liquidate an asset position that is so large that selling it will significantly impact the underlying asset price. In this talk, we will review some of the mathematical models that have been proposed to deal with this often nonlinear price impact. We will then discuss the problem of constructing optimized liquidation algorithms that minimize a cost functional or maximize the expected utility of the seller. A particularly interesting situation occurs when competing traders become aware of the seller's intention and try to make a profit out of it. We show by an equilibrium analysis that the optimal strategies of seller and competitors are strongly dependent on the liquidity characteristics of the market and the number of competitors.

Steve Shreve
Carnegie Mellon University

Title: Futures Trading with Transaction Costs

A model for optimal consumption and investment is posed whose solution is provided by the classical Merton analysis when there is zero transaction cost. A probabilistic argument is developed to identify the loss in value when a proportional transaction cost is introduced. There are two sources of this loss.

The first is a loss due to "displacement" that arises because one cannot maintain the optimal portfolio of the zero-transaction-cost problem. The second loss is due to "transaction," a loss in capital that occurs when one adjusts the portfolio. The first of these increases with increasing tolerance for departure from the optimal portfolio in the zero-transaction-cost problem, while the second decreases with increases in this tolerance. This paper balances the marginal costs of these two effects. The probabilistic analysis provided here complements earlier work on a related model that proceeded from a viscosity solution analysis of the associated Hamilton-Jacobi-Bellman equation. This is joint work with Karel Janecek.

Gordan Zitkovic
University of Texas

Title: A perspective on the stochastic equilibrium problem

Abstract: My goal is to convince the audience of the following: the classical general equilibrium problem in the stochastic setting of financial markets generates interesting mathematics. Submitted in evidence: a summary of some of the lines of research generated by it so far, as well as an outline of the future mathematical, financial, statistical and numerical steps necessary for better understanding of this fundamental problem.

Thaleia Zariphopoulou
University of Texas

Title: Stochastic pdes in portfolio choice

Abstract: A new approach to investment performance measurement is introduced via the so-called forward performance processes. A related stochastic pde is derived and analyzed for various cases of utility coefficients. Explicit solutions for the optimal wealth and portfolio processes are given.