Risk & Stochastics and Financial Mathematics Joint Seminar in 2013

Seminars are listed in reverse chronological order, most recent first.

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9 December - Igor Evstigneev (Manchester)
Modelling Dynamics and Equilibrium of Asset Markets: A Behavioral Approach

Conventional models of dynamic equilibrium in asset markets are based on the principles of General Equilibrium theory (Walras, Arrow, Debreu, Radner and others). This theory in its classical form assumes that market participants are fully rational and their goals can be described in terms of the maximization of utilities subject to budget constraints. The objective of this work is to develop an alternative modelling approach admitting that market participants may have a whole variety of other patterns of behavior determined by their individual psychology, not necessarily reducible to fully rational utility maximization. The models developed do not rely upon restrictive hypotheses (perfect foresight) and avoid using unobservable agents' characteristics such as individual utilities and beliefs, which makes them amenable to quantitative practical applications. The results obtained are concerned with fundamental questions and problems in Financial Economics such as equilibrium asset pricing and portfolio selection. The modelling frameworks combine stochastic dynamic games and evolutionary game theory. The methods employed are based on the stochastic stability analysis of nonlinear random dynamical systems.

Joint work with Rabah Amir (University of Iowa), Thorsten Hens (University of Zurich) and Klaus R. Schenk-Hoppé (University of Leeds).

2 December - Johannes Muhle-Karbe (ETH Zurich)
Optimal Liquidity Provision in Limit Order Markets

A small investor provides liquidity at the best bid and ask prices of a limit order market. For small spreads and frequent orders of other market participants, we explicitly determine the investor's optimal policy and welfare. In doing so, we allow for general dynamics of the mid price, the spread, and the order flow, as well as arbitrary preferences of the liquidity provider under consideration.
Joint work with Christoph Kühn.

25 November - Giorgia Callegaro (Universita Degli Studi di Padova)
An application to credit risk of a hybrid Monte Carlo–optimal quantization method

In this paper, we use a hybrid Monte Carlo-Optimal quantization method to approximate the conditional survival probabilities of a firm, given a structural model for its credit default, under partial information.

We consider the case when the firm's value is a non-observable stochastic process ${(V_t)}_{t \ge 0}$ and investors in the market have access to a process ${(S_t)}_{t \ge 0}$, whose value at each time t is related to $(V_s, 0 \le s \le t)$.
We are interested in the computation of the conditional survival probabilities of the firm given the ``investor's information''.

As an application, we analyze the shape of the credit spread curve for zero coupon bonds in two examples. Calibration to available market data is also analysed.

18 November - Martin Larsson (EPFL)
Polynomial preserving diffusions and models of the term structure

Polynomial preserving processes are multivariate Markov processes that extend the important class of affine processes. They are defined by the property that the semigroup leaves the space of polynomials of degree at most n invariant, for each n, which lends significant tractability to models based on these processes. In this talk I will discuss existence and uniqueness of polynomial preserving diffusions, a task which is made nontrivial due to degenerate and non-Lipschitz diffusion coefficients, as well as a complicated geometric structure of the state space. I will then discuss how polynomial preserving processes can be used to build term structure models that accommodate three features that are otherwise difficult to combine: nonnegative short rates, tractable swaption pricing, and unspanned factors affecting volatility and risk premia.

11 November 2013 -Claudio Fontana (INRIA Paris)
On honest times and arbitrage possibilities

In the context of a general continuous financial market model, we study whether the additional information associated with an honest time T gives rise to arbitrage profits. By relying on the theory of progressive enlargement of filtrations, we explicitly show that arbitrage profits can never be realised strictly before T, while classical arbitrage opportunities can be realised exactly at T as well as after T. Moreover, arbitrages of the first kind can only be obtained by starting to trade as soon as T occurs. We carefully study the behavior of local martingale deflators and consider no-arbitrage-type conditions weaker than no free lunch with vanishing risk. Finally, we discuss extensions of the theory to the case of general semi martingale models.

7 November 2013 - Kostas Kardaras (LSE)
Equilibrium in risk-sharing games

A market is considered with several acting financial agents, whose aim is to increase their utility by efficiently sharing their random endowments. Given the endogenously derived optimal sharing rules, we consider the situation where agents do not reveal their true endowments, but instead report as endowments the random quantities that maximise their utility when the sharing rules are applied. Under exponential utilities (coinciding with entropic risk measures), an analysis of Nash equilibrium is carried out, where it is shown in particular that the optimal contract of each agent possesses endogenous bounds only depending on the agents' risk tolerance, and not on their random endowment. Existence and uniqueness of Nash equilibrium for the 2-player game is obtained. Furthermore, it is discussed how such an equilibrium benefits extremely high risk tolerance agents and results in risk-sharing inefficiency.

Joint work with M. Antropelos.

24 October - Budhi Arta Surya (SBM ITB)
Optimal Capital Structure with Scale Effects under Spectrally Negative Levy Models

The optimal capital structure model with endogenous bankruptcy was first studied by Leland (1994) and Leland and Toft (1996), and was later extended to the spectrally negative Levy model by Hilberink and Rogers (2002) and Kyprianou and Surya (2007). This paper incorporates the scale effects by allowing the values of bankruptcy costs and tax benefits dependent on the firm's asset value. These effects have been empirically shown, among others, in Warner (1976), Ang et al. (1982), and Graham and Smith (1999). By using the fluctuation identities for the spectrally negative Levy process, we obtain a candidate bankruptcy level as well as a sufficient condition for optimality. The optimality holds in particular when, monotonically in the asset value, the value of tax benefits is increasing, the loss amount at bankruptcy is increasing, and its proportion relative to the asset value is decreasing. The solution admits a semi-explicit form, and this allows for instant computation of the optimal bankruptcy levels, equity/debt/firm values and optimal leverage ratios. A series of numerical studies are given to analyze the impacts of scale effects on the default strategy and the optimal capital structure.

Joint work with Kazutoshi Yamazaki

30 May - Mikhail Urusov (Duisburg-Essen)
On The Boundary Behaviour of Diffusions and the Martingale Property of the Associated Local Martingales

Abstract. Let ψ_r denote the increasing r-harmonic function ($r > 0$) associated with a regular one-dimensional diffusion X with the state space $[\alpha, \beta] \subseteq [-\infty, \infty]$. We give several different necessary and sufficient conditions for the local martingale $(e^{-rt}\psi_r(X_t))_{t\geq 0}$ to be a true martingale when the boundary β is inaccessible (if β is accessible, there is nothing to study). One of them is that β should be a natural boundary. In particular, the property of interest does not depend on $r > 0$, and the boundary behaviour of X at α does not play any role. Clearly, the result has its analogue for the decreasing r-harmonic function φ_r. The functions ψ_r and φ_r and their properties are important in optimal stopping. The counterpart of the property of interest for $r = 0$, namely the property of the local martingale $(p(X_{t\wedge\zeta}))_{t\geq 0}$ to be a true martingale (p is the scale function, ζ is the hitting time of $\{\alpha, \beta\}$), turns out to have a different characterisation, where the boundary behaviour of X both at α and at β plays a role.

This is a joint work with Mihail Zervos.

15 May - Michael Schröder (Vrije Universiteit Amsterdam)
Mechanisms for no-arbitrage term-structure modelling, with applications to interest-rates and realized-variance

Suppose that the sentiment is changing in some financial market, or that conditions have changed recently. Examples include volatility levels which are expected to change, or interest-rates expected to be adjusted.
How do we quantify the effects of these changes on derivatives positions?
We will discuss mechanisms for the construction of `no-arbitrage' term structures which enable this; these retain tractability in valuing derivatives and comply with stylized facts like mean-reversion and positivity of rates. This will be illustrated in a paradigm valuation of typical fixed-income derivatives.

20 March - Mikhail Zhitlukhin (Manchester and Steklov Mathematical Institute Moscow)
General Bayesian changepoint detection problems for Brownian motion

We consider changepoint detection problems for Brownian motion in a general Bayesian setting. A changepoint (another name - "disorder") is an unknown moment of time when the drift of an observable Brownian motion changes. The goal is to find a stopping time which is close as possible to the moment of disorder. We solve the problem for a wide class of penalty functions and prior distributions of the moment of disorder. Using the results obtained we also study optimal stopping problems for a Brownian motion and a geometric Brownian motion with a

changepoint. The latter result can be used to model asset price processes with changing trend. In the last part of the talk we apply the method to real financial data and show it gives comparatively good results.