11th European Summer School in Financial Mathematics

27 - 31 August 2018

Paris, France

http://www.cmap.polytechnique.fr/∼euroschoolmathfi18/index.html

Campus of Saclay

Ecole Polytechnique and ENSAE
Route de Saclay, 91128 Palaiseau, France

Programme Overview

All the courses, talks and the practitioners session will take place at ENSAE, 5 Avenue Le Chatelier, 91120 Palaiseau, France.

Lunches will be given at École Polytechnique.

The welcome cocktail is planed Monday at 19:00 near the lake of Polytechnique.

The conference dinner is planed Tuesday at 20:00. The address of the restaurant is Bouillon Racine, 3 Rue Racine, 75006 Paris, France.

Lecture PA: Contract Theory: incentive policy and applications to financial regulation. By Dylan Possamaï and Stéphane Villeneuve.

Lecture AP: New advances in affine process: simulations and rough models. By Aurélien Alfonsi and Sergio Pulido.

	Monday	Tuesday	Wednesday	Thursday	Friday
8:45 - 9:00	Opening				
9:00 - 10:30	Lecture PA	Lecture PA	Lecture PA	Lecture AP	Lecture AP
10:30 -11:00	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break (10:30-10:50)
11:00 - 12:40	HERNANDEZ Nicolas FARHAT Heythem GÜMBEL Sandrine FEUNOU Victor HUANG Shuo	HU Kaitong HERNANDEZ Camilo WIESEL Johannes OLIVEIRA Carlos MEHALLA Sophian	Lecture PA	ABI JABER Eduardo COSKUN Sema KREMER Jonas VAHID DASTGERDI Maryam YANSORI Sina	BABAEI KHEZERLOO Ismael GERSTENECKER Christoph WANG Yuan ZHANG Yufei MBAYE Cheikh
12:45 - 14:15	Lunch	Lunch	Lunch	Lunch	Lunch (12:30-14:00)
14:15 - 15:45	Lecture PA	Lecture PA	Lecture AP	Lecture AP	Lecture AP (14:00-15:30)
15:45 - 16:15	Coffee Break		Coffee Break	Coffee Break	
16:15-	BENCHEIKH Oumaima SÁNCHEZ BETANCOURT Leandro SOJMARK Andreas NORGILAS Dominykas MUSCAT Jonathan SUN Haodong	Free afternoon	Lecture AP : 16:00-17:30	Practitioners session : 16:15-18:00	
	Welcome cocktail - 19:00	Dinner in Paris : “Bouillon Racine”, 20:00			

Monday, August 27

= 08:45 - 09:00 Opening =

9:00 - 10:30 **Lecture Principal-Agent (1)**
Stéphane VILLENEUVE

= 10:30 - 11:00 Coffee Break =

11:00 - 11:15	**HERNANDEZ Nicolas**	Moral hazard in a VUCA world.
11:20 - 11:35	**FARHAT Heythem**	A Principal-Agent approach for Capacities Market design.
11:40 - 11:55	**GÜMBEL Sandrine**	Towards general multiple yield curve models.
12:00 - 12:15	**FEUNOU Victor Nzengang**	Stability of the utility maximization problem.
12:20 - 12:35	**HUANG Shuo**	A Hopf-Lax splitting approximation for semi-linear parabolic PDEs with convex and quadratic growth gradients.

= 12:45 - 14:15 Lunch =

14:15 - 15:45 **Lecture Principal-Agent (2)**
Stéphane VILLENEUVE

= 15:45 - 16:15 Coffee Break =

16:15 - 16:30	**BENCHEIKH Oumaima**	Bias behaviour in particle approximations of SDEs nonlinear in the sense of McKean
16:35 - 16:50	**SÁNCHEZ BETANCOURT Leandro**	Improving Fill Ratios in FX Markets with Latency, Volatility and Model Ambiguity
16:55 - 17:10	**SOJMARK Andreas**	An SPDE Model for Systemic Risk with Endogenous Contagion
17:15 - 17:30	**NORGILAS Dominykas**	Robust bounds for the American Put
17:35 - 17:50	**MUSCAT Jonathan**	Partial Liquidation and Reference Dependent Preferences.
17:55 - 18:10	**SUN Haodong**	Dynkin games with Poisson random intervention times

Welcome cocktail - 19:00

Tuesday, August 28

09:00 - 10:30	**Lecture Principal-Agent (3)** Stéphane VILLENEUVE	

= **10:30 - 11:00 Coffee Break** =

11:00 - 11:15	**HU Kaitong**	Continuous-time Principal-Agent Problem in a Linear Partially Observed System.
11:20 - 11:35	**HERNANDEZ Camilo**	A General Theory of Non Markovian Time Inconsistent Stochastic Control in Continuous Time: A BSDEs approach.
11:40 - 11:55	**WIESEL Johannes**	A unified framework to robust modelling of financial markets in discrte time.
12:00 - 12:15	**OLIVEIRA Carlos**	Optimal Investment Decision Under Switching Regimes of Subsidy Support.
12:20 - 12:35	**MEHALLA Sophian**	Fast calibration of the Libor Market Model with Jacobi Stochastic Volatility.

= **12:45 - 14:15 Lunch** =

14:15 - 15:45	**Lecture Principal-Agent (4)** Dylan POSSAMAÏ	

Free afternoon in Paris then Dinner at *Bouillon Racine* - 20:00

Wednesday, August 29

09:00 - 10:30	**Lecture Principal-Agent (5)** Dylan POSSAMAÏ

= 10:30 - 11:00 Coffee Break =

11:00 - 12:30	**Lecture Principal-Agent (6)** Dylan POSSAMAÏ

= 12:30 - 14:15 Lunch =

14:15 - 15:45	**Lecture Affine Processes (1)** Aurélien ALFONSI

= 15:45 - 16:15 Coffee Break =

16:15 - 17:45	**Lecture Affine Processes (2)** Aurélien ALFONSI

Thursday, August 30

09:00 - 10:30	**Lecture Affine Processes (3)**	Aurélien ALFONSI

= 10:30 - 11:00 Coffee Break =

11:00 - 11:15	**ABI JABER Eduardo**	Lifting the Heston model.
11:20 - 11:35	**COSKUN Sema**	Pricing Barrier Options in the Heston Model using the Heath-Platen Estimator.
11:40 - 11:55	**KREMER Jonas**	Stationarity of affine processes on the canonical state space.
12:00 - 12:15	**VAHID DASTGERDI Maryam**	A Stable Numerical Method for Pricing and Calibration under Rough Heston Model.
12:20 - 12:35	**YANSORI Sina**	Log-optimal deflator and portfolio under random horizon

= 12:45 - 14:15 Lunch =

14:15- 15:45	**Lecture Affine Processes (4)**	Sergio PULIDO

= 15:45 - 16:15 Coffee Break =

16:15 - 18:00	**Practitioners talks**	Clémence ALASSAEUR, Clara BALARDY, Pierre HENRY-LABORDERE.

Friday, August 31

09:00 - 10:30	**Lecture Affine Processes (5)** Sergio PULIDO	

= 10:30 - 10:50 Coffee Break =

10:50 - 11:05	**BABAEI KHEZERLOO Esmaeil**	Capital growth in financial markets with frictions: Von Neumann-Gale model.
11:10 - 11:25	**GERSTENECKER Christoph**	Moment explosions in the rough Heston model.
11:30 - 11:45	**WANG Yuan**	An Indefinite Stochastic Linear-Quadratic Optimal Control Problem with Delay and Related Forward-Backward Stochastic Differential Equations.
11:50 - 12:05	**ZHANG Yufei**	Approximation schemes for mixed optimal stopping and control problems with nonlinear expectations and jumps.
12:10 - 12:25	**MBAYE Cheikh**	Time-changed affine models: fitting interest-rates and CDS term-structures without shift.

= 12:30 - 14:00 Lunch =

14:00 - 15:30	**Lecture Affine Processes (6)** Sergio PULIDO

Lectures

Dylan Possamaï (Columbia University)
and
Stéphane Villeneuve (Toulouse School of Economics)

Contract Theory: incentive policy and applications to financial regulation.

Since the celebrated Modigliani-Miller theorem, it is well-known that in the absence of frictions, the value of a company is independent of its capital structure, i.e. the proportion of debt and equity in the liability side of the balance sheet. In other words, corporate finance decisions are irrelevant in a perfect capital market. Several types of financial frictions have been introduced to understand the corporate financial and managerial decisions observed in practice. In this course, we will focus on two majors frictions, cost of issuing new securities (chapter 1) and agency problem (chapter 2). Chapter 1 introduces the problem of optimal liquidity management where issuing costs are so high that companies use their cash reserves as precautionary savings. It has to be viewed as a general introduction. From a methodical point of view, the manager is facing challenging singular control problems. Chapter 2 introduces principal-agent frictions in a continuous-time stationary setting. The workhorse of this literature is a simple model with one principal with funds but lack of expertise makes a take-it-or-leave-it offer to a single agent with outside reservation utility to steer a project. If the contract is accepted, the agent then chooses an action which will affect an outcome and which is not observable by the principal. The main objective of the principal is to establish a contract that will incentivize the agent to align his effort with the principal's interest. Although these agency frictions are different from the cost of issuance (even if the presence of these costs can be justified by agency problems), the methodology is very similar to chapter 1 and involves singular control problems.
The second part of this lecture will consists in an overview of recent progresses made in contracting theory, using the so-called dynamic programming approach. The basic situation is that of a Principal wanting to hire an Agent to do a task on his behalf, and who has to be properly incentivized. We will show how this general framework allows to treat volatility control problems arising for instance in delegated portfolio management, in electricity pricing, or in central clearing houses. If time permit, we will also analyze the situation of a Principal hiring a finite number of Agents who can interact with each other, as well as the associated mean-field problem. The theory will be mostly illustrated by examples ranging from finance and insurance applications to regulation issues.

Aurélien Alfonsi (École des ponts)
and
Sergio Pulido (ENSIIE)

New advances in affine processes: simulations and rough models.

Affine processes are widely used in mathematical finance. The most famous examples of affine models include the Cox-Ingersoll-Ross model (1985) for interest rates and the Heston stochastic volatility model (1993) for equity. In this first lecture, we will start by characterizing the one-dimensional affine diffusions and presenting the main properties of affine processes. We will present several models (including Heston model) based on affine processes for different financial applications, and explain why the affine property is convenient. A particular attention will be given to Wishart processes, that are affine diffusions on the set of positive semidefinite matrices. Last, we will study in detail how to simulate and approximate affine diffusions to run Monte-Carlo methods, starting with the simulation of the CIR process.
The second part of this lecture will focus on a self-contained introduction to the class of Affine

Volterra Processes. Classical affine diffusions constitute a special case, but affine Volterra processes are neither semimartingales, nor Markov processes in general. For specific state spaces, we will prove existence, uniqueness, and invariance properties of solutions of the corresponding stochastic convolution equations. We will provide exponential-affine representations of the Fourier-Laplace functional in terms of the solution of an associated system of deterministic integral equations, extending well-known formulas for classical affine diffusions. Our arguments will avoid infinite-dimensional stochastic analysis as well as stochastic integration with respect to non-semimartingales, relying instead on tools from the theory of finite-dimensional deterministic convolution equations. At the end of the mini-course we will establish connections between our findings and related results from the theory of Stochastic Partial Differential Equations (SPDEs) and infinite dimensional affine processes. The motivation to study affine Volterra processes comes from applications in financial modelling. A growing body of empirical research indicates that volatility fluctuates more rapidly than Brownian motion, which is inconsistent with standard semimartingale models. Fractional volatility models have emerged as compelling alternatives, although tractability can be a challenge for these non-Markovian, non-semimartingales models. Some of these models, such as the rough Heston model, are of the affine Volterra type involving singular kernels. Our framework subsumes and extends these examples. The mini course will be structured as follows: 1. Motivation from rough volatility modelling: The rough Heston model 2. Theory of convolution equations: Existence and invariance properties of solutions of deterministic and stochastic convolution equations 3. Definition of Affine Volterra Processes and the Fourier-Laplace transform formula 4. Connections to SPDEs and infinite dimensional affine processes 5. Future lines of research: numerical and theoretical challenges.

Practitioners

Clémence ALASSEUR (EDF-FIME)

An adverse selection approach to power pricing

Clara BALARDY (EPEX SPOT)

TBA

Pierre HENRY-LABORDERE (Société Générale)

TBA

Titles and abstracts

ABI JABER Eduardo

Université Paris Dauphine

Lifting the Heston model
Abstract: How to reconcile the classical Heston model with its rough counterpart? We introduce a lifted version of the Heston model with n multifactors sharing the same Brownian motion but mean reverting at different speeds. Our model nests as extreme cases the classical Heston model (when n=1) and the rough Heston model (when n goes to infinity). We show that the lifted model enjoys the best of both worlds: markovianity and satisfactory fitting of implied volatility smiles for short maturities. Further, our approach speeds up the calibration time and opens the door to time-efficient simulation schemes.

BABAEI KHEZERLOO Esmaeil

The University of Manchester

Capital growth in financial markets with frictions: Von Neumann-Gale model.
Abstract: The aim of this work is to extend the classical capital growth theory to models of asset market with frictions (transaction costs and portfolio constraints). A natural generalization of the notion of a benchmark investment strategy (numeraire portfolio) is proposed, and it is shown how such portfolios can be used for the analysis of growth-optimal investment strategies. The analysis is based on the classical von Neumann-Gale model of economic dynamics, a stochastic version of which is used in this study as a framework for the modeling of financial markets with frictions.

BENCHEIKH Oumaima

CERMICS - Ecole des Ponts ParisTech

Bias behaviour in particle approximations of SDEs nonlinear in the sense of McKean.
Abstract: We prove that the weak error between a stochastic differential equation with nonlinearity in the sense of McKean given by moments and its approximation by the Euler discretization with time-step h of a system of N interacting particles is O(1/N +h). We also show that for systems of particles with mean-field rank based interaction in the drift coefficient, the bias behaves in O(1/N) (without the time discretization in this case). We provide numerical experiments confirming both of the behaviors."

COSKUN Sema

University of Kaiserslautern

Pricing Barrier Options in the Heston Model using the Heath-Platen Estimator
Abstract: Both barrier options and the Heston stochastic volatility model are omnipresent in real-life applications of financial mathematics. Therefore, we apply the Heath-Platen (HP) estimator (as first introduced in D. Heath and E. Platen (2002) A variance reduction technique based on integral representations. Quantitative Finance, 2(5):362–369) to price barrier options in the Heston model setting as an alternative to conventional Monte Carlo methods and PDE based methods. We demonstrate the superior performance of the HP estimator via numerical examples and explain this performance by a detailed look at the underlying theoretical concept of the HP estimator. * Based on the article Pricing Barrier Options in the Heston Model using the Heath-Platen Estimator, Monte Carlo Methods and Applications, 24(1):29-41, 2018. DOI: https://doi.org/10.1515/mcma-2018-0004

FARHAT Heythem

Ecole Polytechnique

A Principal-Agent approach for Capacities Market design
Abstract: We propose a Principal-Agent approach for Capacities Market design. Principal is the electricity consumer, subject to the risk of blackout, and Agent is electricity supplier, who needs to satisfy consumer's demand. Following the methodology of Cvitanic et al., we solve the problem for both parties. Numerical results and comparison with current pricing of capacities market provide insight on the necessity of a capacity compensation in electricity market.

FEUNOU Victor Nzengang

University of Freiburg

Stability of the utility maximization problem.
Abstract: We consider the utility maximization problem in the framework of continuous market models for the stock price process and for utility functions defined on the positive real line. Under a mild BMO assumption on the market price of risk, we present stability results for the optimal wealth process and optimal trading strategy w.r.t. misspecifications in the risk preference and initial capital. This talk is based on a joint work with Peter Imkeller.

GERSTENECKER Christoph

Vienna University of Technology

Moment explosions in the rough Heston model
Abstract: We show that the moment explosion time in the rough Heston model [El Euch, Rosenbaum 2016, arXiv:1609.02108] is finite if and only if it is finite for the classical Heston model. Upper and lower bounds for the explosion time are established, as well as an algorithm to compute the explosion time (under some restrictions). This algorithm is then applied to computing the critical moments, which are shown to be finite for all maturities.

GÜMBEL Sandrine

University of Freiburg

Towards general multiple yield curve models
Abstract: Extending the HJM-theory to allow stochastic discontinuities we develop a general treatment of dynamic term-structure models with semi-martingale drivers. This has important applications to multiple yield curve models. We propose a forward rate representation of the term structure of forward rate agreements (FRAs). Stochastic discontinuities have an important motivation in markets with multiple curves, as for example the movements of the term-structures around the Brexit vote shows. We study absence of arbitrage in these markets by means of NAFLVR. (Joint work with Claudio Fontana, Zorana Grbac and Thorsten Schmidt)

HERNÁNDEZ SANTIBÁNEZ Nicolas

University of Michigan

Moral hazard in a VUCA world
Abstract: In this paper we investigate a Principal-Agent problem with moral hazard under Knightian uncertainty. We extend the seminal framework of Holmström and Milgrom by combining a Stackelberg equilibrium with a worst-case approach. We investigate a general model and we show that optimal contracts depend on the output and its quadratic variation.

We characterize the best reaction effort of the agent through the solution to a second order BSDE and we show that the value of the problem of the Principal is the viscosity solution of an Hamilton-Jacobi-Bellman-Isaacs equation, without needing a dynamic programming principle, by using stochastic Perron's method.

HERNÁNDEZ Camilo

IEOR Department. Columbia University

A General Theory of Non Markovian Time Inconsistent Stochastic Control in Continuous Time: A BSDEs approach

Abstract: In this paper we develop a self-contained theory for continuous time non Markovian stochastic control problems which are time inconsistent. The distinguishing feature of these problems is that the classical Bellman optimality principle no longer holds. We adopt a game theoretic framework to study such problems meaning that we seek for subgame perfect Nash equilibrium points. As a first novelty of this work, we introduce and motivate a new definition of equilibrium which exclude pathological cases allowed in the current literature. Our problem is cast within the framework of a controlled forward SDE and a general objective functional as in the classical, meaning time consistent, framework. To motivate ideas we consider both Markovian and non Markovian settings. In the same spirit as in the classical theory we first prove a extended Dynamic Programming Principle. In the Markovian setting we derive a extended Hamilton-Jacobi-Bellman equation, namely a system of non-linear PDEs. This system consistent with results in existing literature. Likewise, to address the non Markovian setting we derive a system of BSDEs. As a final step we provide a verification theorem in both settings. Next a series of applications of the previous models are discussed. Finally we present some conclusions and ongoing extensions.

HU Kaitong

École Polytechnique

Continuous-time Principal-Agent Problem in a Linear Partially Observed System

Abstract: In this presentation, we are going to consider the Principal-Agent problem in a linear partially observed system, namely, a linear output process one part of which is non-observable neither by Principal nor the Agent. Firstly, we shall demonstrate that the solvability of the Agent's optimization problem can be reduced to the solvability of the system of strongly coupled FBSDEs using variational calculus in weak formulation and then a corresponding sufficient condition of the problem will be given as well. At last, we will compute the optimal contract for the Principal's problem.

KHOSRAWI-SARDROUDI Wahid

University of Freiburg

The Calibration Problem from a Machine Learning point of view

Abstract: We present a novel approach to the calibration problem of financial models using machine learning techniques. This change of paradigm leads to a different understanding of what should be considered tractability of a problem as the main part of the calibration workload can be set offline. We present numerical results for a particular stochastic local volatility problem and discuss further applications. Joint work with: Christa Cuchiero, Josef Teichmann, Andres Hernandez

KREMER Jonas

University of Wuppertal

Stationarity of affine processes on the canonical state space
Abstract: We consider conservative affine processes on the canonical state space $\mathbb{R}^m_{\geqslant 0} \times \mathbb{R}^n$, where m, $n \in \mathbb{Z}_{\geqslant 0}$ with $m+n > 0$, and provide sufficient conditions for the existence of stationary distributions for these processes. Our main theorem extends and unifies some known results for OU-type processes on $\mathbb{R}^n$ and one-dimensional CBI processes (with state space $\mathbb{R}_{\geqslant 0}$). To prove our result, we combine analytical and probabilistic techniques; in particular, the stability theory for ODEs plays an important role. This is a joint work with Dr. Peng Jin and Prof. Dr. Barbara Rüdiger.

MBAYE Cheikh

Université catholique de Louvain

Time-changed affine models: fitting interest-rates and CDS term-structures without shift
Abstract: The class of affine short-rate or intensity models are very popular in finance for tractability reasons. For instance, time-homogeneous models like Vasicek, CIR and JCIR are clearly the most popular models to describe short-rate or default intensity dynamics. However, they are too scarce to allow for a perfect fit to a specified term-structure. In this paper, we propose a method based on change of times. By speeding up or slowing down the clock, we can make sure to fit any valid zero-coupon bond or CDS curves without affecting the range of the initial time-homogeneous model.

MEHALLA Sophian

CERMICS - Ecole des Ponts ParisTech

Fast calibration of the Libor Market Model with Jacobi Stochastic Volatility
Abstract: Since the work of Devineau et al. (2017), the numerical efficiency of density expansions has been shown for calibrating the Libor Market Model with Stochastic Volatility and Displaced Diffusion (DD-SV-LMM), in which the stochastic volatility is a CIR process. In this previous work, the affine property of the so-called "freezing approximation" of the DD-SV-LMM, which reduces to an Heston-type model as studied by Wu and Zhang (2006), is used to derive analytical formulas for the moments computation which are at the core of density expansion techniques. In this talk, we propose an extension of the density approximation techniques to the Libor Market Model where the stochastic volatility follows a Jacobi process. This framework is well suited to Gram-Charlier approximations as the convergence of the related series can be proved in this context. Such dynamics driven by the Jacobi process, which approximates the original one driven by the CIR process, is not affine and belongs to the class of polynomial dynamics whose moments calculation is tractable. In this setting, the presentation will be dedicated to a theoretical and numerical study related to the efficiency and accuracy of the calibration procedure based on Gram-Charlier type approximations, as well as the error analysis related to the density expansion itself, and regarding the difference from the standard Libor Market Model with CIR volatility.

MUSCAT Jonathan

University of Warwick

Partial Liquidation and Reference Dependent Preferences
Abstract: We propose a multiple optimal stopping model whereby an investor can sell a divisible asset position at times of her choosing. Investors have S-shaped reference-dependent preferences whereby utility is defined to be concave over gains and convex over losses. For a price process following a time-homogeneous diffusion, we employ the constructive potential-theoretic methods developed by Dayanik and Karatzas (2003). As an example we also revisit the optimal stopping model of Kyle, Ou-Yang and Xiong (2006) to allow for partial liquidation. In contrast to the

extant literature, we find that the investor may partially liquidate the asset at distinct price thresholds.

NORGILAS Dominykas

University of Warwick

Robust bounds for the American Put
Abstract: We consider the problem of finding a model-free upper bound on the price of an American put given the prices of a family of European puts on the same underlying asset. Specifically we assume that the American put must be exercised at either time-1 or time-2 and that we know the prices of all vanilla European puts with these maturities. In this setting we find a model which is consistent with European put prices and an associated exercise time, for which the price of the American put is maximal. Moreover we derive a cheapest superhedge. The model associated with the highest price of the American put is constructed from the left-curtain martingale transport.

OLIVEIRA Carlos

University of Libon

Optimal Investment Decision Under Switching Regimes of Subsidy Support
Abstract: We address the problem of making a managerial decision when the investment project is subsidized, which results in the resolution of an infinite-horizon optimal stopping problem of a switching diffusion driven by either an homogeneous or an inhomogeneous continuous-time Markov chain. We provide a characterization of the value function (and optimal strategy) of the optimal stopping problem. On the one hand, broadly, we can prove that the value function is the unique viscosity solution to a system of HJB equations. On the other hand, when the Markov chain is homogeneous and the switching diffusion is one-dimensional, we obtain stronger results: the value function is the difference between two convex functions.

SÁNCHEZ BETANCOURT Leandro

University of Oxford

Improving Fill Ratios in FX Markets with Latency, Volatility and Model Ambiguity
Abstract: Latency is the time between the exchange streaming the market data to the client, the client's decision to trade, and the exchange receiving the signal from the trader. Latency affects the prices and fill ratios (FRs) obtained by traders who take liquidity from the top of the book. We develop a model that maximises FRs whilst minimising how deep the marketable orders can walk the FX exchange's limit order book. We employ a proprietary data set to show the performance of our proposed dynamic trading strategy. The applications of the proposed framework ranges from understanding the trade-off between cost and fill rates, to a better comparison between firm-liquidity and last look venues in terms of fill ratios.

HUANG Shuo

University of Warwick

A Hopf-Lax splitting approximation for semilinear parabolic PDEs with convex and quadratic growth gradients
Abstract: We propose a new splitting algorithm to solve a class of semilinear parabolic PDEs with con- vex and quadratic growth gradients. By splitting the original equation into a linear parabolic equation and a Hamilton-Jacobi equation, we are able to solve both equations explicitly. In particular, we solve the associated Hamilton-Jacobi equation by the Hopf-Lax formula, and in-

terpret the splitting algorithm as a Hopf-Lax splitting approximation of the semilinear parabolic PDE. We prove that the numerical solution of the splitting scheme will converge to the viscosity solution of the equation, obtaining its convergence rate via Krylov's shaking coefficients technique and Barles-Jakobsen's optimal switching approximation.

SOJMARK Andreas

University of Oxford

An SPDE Model for Systemic Risk with Endogenous Contagion

Abstract: We propose a dynamic model for systemic risk in a large financial system, which we formulate as a system of interacting diffusions on the positive half-line with an absorbing boundary at zero. These diffusions represent the distances-to-default of the financial institutions. As a way of modelling correlated exposures and herd behaviour, we consider a common source of noise and a form of mean-reversion in the drift. Moreover, we introduce an endogenous contagion mechanism whereby the default of one institution can cause a drop in the distances-to-default of the other institutions. In order to have a general model for systemic (or macroscopic) events, we show that the system converges to a unique mean field limit, characterized by a nonlinear SPDE on the half-line (with a Dirichlet boundary condition), which governs the conditional law of a 'conditional McKean-Vlasov' type diffusion. Depending on the realizations of the common noise and the strength of the mean reversion, the SPDE can exhibit rapid accelerations in the loss of mass at the boundary. In other words, sparked by a devaluation of the common exposures, there are events of small probability that, through amplification by herd behaviour, can give rise to systemic default cascades.

SUN Haodong

University of Warwick

Dynkin games with Poisson random intervention times

Abstract: This paper introduces a new class of Dynkin games, where the two players are allowed to make their stopping decisions at a sequence of exogenous Poisson arrival times. The value function and the associated optimal stopping strategy are characterized by the solution of a backward stochastic differential equation. The paper further applies the model to study the optimal conversion and calling strategies of convertible bonds, and their asymptotics when the Poisson intensity goes to infinity.

VAHID DASTGERDI Maryam

Institute for Advanced Studies in Basic Sciences

A Stable Numerical Method for Pricing and Calibration under Rough Heston Model

Abstract: During recent years, the Rough Heston Model of Gatheral and his coworkers has got a great attention among researchers and finance practitioners. This model preserves the basic structure of the classical Heston model while having interpretative and descriptive capabilities in terms of micro structural foundations of the market. In this respect, devising efficient and reliable numerical tools for pricing and calibration under this model have become a crucial issue in computational finance. The main point in this approach is the solution of a nonlinear fractional Riccati differential equation appearing in the characteristic function of the log-price which is very sensitive to the parameters of the model. In this talk, we present a numerical method based on Newton-Kantorovich quasi-linearization to deal with the non-linearity of the problem in conjunction with using poly-fractonomials to approximate the fractional derivatives in an accurate and fast manner. The efficiency of the proposed method is demonstrated by comparing the pricing and calibration results using this method and the predictor-corrector fractional Adams method.

WANG YUAN

University of Warwick

An Indefinite Stochastic Linear-Quadratic Optimal Control Problem with Delay and Related Forward-Backward Stochastic Differential Equations

Abstract: we will study an indefinite stochastic linear-quadratic optimal control problem, where the controlled system is described by a stochastic differential equation with delay. By introducing the relaxed compensator as a novel method, we obtain the well-posedness of this linear-quadratic problem for indefinite case. And then, we discuss the uniqueness and existence of the solutions for a kind of anticipated forward-backward stochastic differential delayed equations. Based on this, we derive the solvability of the corresponding stochastic Hamiltonian systems, and give the explicit representation of the optimal control for the linear-quadratic problem with delay in an open-loop form. The theoretical results are validated as well on the control problems of engineering and economics under indefinite condition.

WIESEL Johannes

University of Oxford

A unified framework to robust modelling of financial markets in discrte time

Abstract: We prove a Fundamental Theorem of Asset Pricing as well as a Superhedging Theorem in discrete time, which comprises the pathwise and quasisure formulation of [BN15] and [BFH+16]. Furthermore we explain how to extend an M-quasisure superhedging duality result on a set Ω to a pathwise duality without changing the superhedging price.

YANSORI Sina

University of Alberta

Log-optimal deflator and portfolio under random horizon

Abstract: This talk is about investigation and measure the impact of a random horizon on the optimal investment/portfolio. This random horizon, T, is a general random time that might represent the default time of a firm, the death time of an insured, or more generally an occurrence time of an event that might impact the market somehow. We consider a market model resulting from progressively enlarging an initial market model with a random time. Herein, in this setting, we address the numeraire portfolio, the utility optimization problem. In this setting, we consider the following questions: How one can measure the impact of T on the optimal deflator/investment/numeraire portfolio? Can we describe the set of all deflators for the new informational model? how one can get the dynamics for optimal portfolio in this model? Answers of these questions, lie in explicitly describing the set of all deflators for a model stopped at a random time T. Once the set of all deflators is completely and explicitly parametrized, we address the minimization problem over the set of these deflators to solve the dual problem. Then we solve the optimal investment under random horizon for this economic model. This talk is based on joint work with Tahir Choulli (UofA).

ZHANG Yufei

University of Oxford

Approximation schemes for mixed optimal stopping and control problems with nonlinear expectations and jumps

Abstract: We propose a class of numerical schemes for solving mixed optimal stopping and control problems with nonlinear expectations and jumps. By exploiting an approximation with switching systems, piecewise constant policy timestepping reduces the problem to independent

nonlocal semi-linear equations with different control parameters over individual time steps, which we solve by fully implicit monotone approximations to the controlled diffusion and the nonlocal term, and specifically the Lax-Friedrichs scheme for the nonlinearity in the gradient. We establish a comparison principle for the switching system and demonstrate convergence of the schemes, which subsequently gives a constructive proof for the existence of a solution to the switching system. Numerical experiments are presented for a recursive utility maximization problem to demonstrate the adaptability and effectiveness of the new schemes.

Sponsors

The Eleventh European Summer School is supported by:

- The Labex of the Institut Louis Bachelier, sponsored by the ANR for the program "Investissements d'Avenir"
- the Chaire Risques financiers, sponsored by Société Génerale and Fondation du Risque,
- the Chaire Analytics and models for regulation, sponsored by Friends of Ecole Polytechnique,
- the Chaire Finance et développement durable, sponsored by EDF and Crédit Agricole CIB,
- the ERC STAQAMOF, Project ID: 679836 ,
- the ANR PACMAN, Projet ID ANR-16-CE05-0027,
- the lab FIME.

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