NUS–UPARIS DIDEROT WORKSHOP ON QUANTITATIVE FINANCE

4–5 February 2015

National University of Singapore

Jointly organized by:

NUS National University of Singapore | Centre for Quantitative Finance, Faculty of Science

université PARIS DIDEROT PARIS 7

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09:45 – 10:15 Group Photo & Tea Break	**09:45 – 10:15** Tea Break
10:15 – 11:00 Erhan BAYRAKTAR	**10:15 – 11:00** Aparna GUPTA
11:00 – 11:45 Min DAI	**11:00 – 11:45** Steven KOU
11:45 – 12:30 Claudio FONTANA	**11:45 – 12:30** Noufel FRIKHA
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16:25 – 16:45	**Vilimir YORDANOV** Vienna School of Finance, Austria *Dynamic CDO Pricing and Hedging in a Forward Setting*	Auditorium	Pg 10
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ABSTRACTS

Optimal Control of Pure Jump Markov Processes and Constrained BSDEs with Nonpositive Jumps

Elena BANDINI, Politecnico di Milano, Italy

We consider the stochastic control problem of pure jump Markov processes and we derive a probabilistic representation, known as nonlinear Feynman-Kac formula, for the corresponding value function in terms of backward stochastic differential equations with partially nonpositive jumps. The intuition behind the backward representation formula comes from the *randomization of the control method* introduced in the paper of Kharroubi and Pham. Notice, however, that in the present work we met different peculiar difficulties, essentially due to the complementary nature of our control problem, which looks at the intensity of the state process, rather than at the coefficients of the stochastic differential equation solved by it. Despite that, by a suitable choice of the underlying probability space, we are still able to randomize the control through a Poisson random measure. Moreover, since the corresponding Hamilton-Jacobi-Bellman equation is of first-order, we can write it as an integral equation and deal with a solution more regular than the viscosity one. As a consequence, the link between the backward equation and the dynamic programming equation can be proved relying on more direct arguments. Finally, the control randomization approach allows to prove that the value function of the original non-dominated control problem coincides with the value function of a *dual* control problem, expressed in terms of equivalent changes of probability measures.

This is a joint work with Marco FUHRMAN.

Minimizing the Probability of Lifetime Ruin under Ambiguity Aversion

Erhan BAYRAKTAR, University of Michigan, United States

We determine the optimal robust investment strategy of an individual who targets at a given rate of consumption and seeks to minimize the probability of lifetime ruin when she does not have perfect confidence in the drift of the risky asset. Using stochastic control, we characterize the value function as the unique classical solution of an associated Hamilton-Jacobi-Bellman (HJB) equation, obtain feedback forms for the optimal investment and drift distortion, and discuss their dependence on various model parameters. In analyzing the HJB equation, we establish the existence and uniqueness of viscosity solution using Perron's method, and then upgrade regularity by working with an equivalent convex problem obtained via the Cole-Hopf transformation. We show the original value function may lose convexity for a class of parameters and the Isaacs condition may fail. Numerical examples are also included to illustrate our results.

This is a joint work with my Ph.D. student, Yuchong ZHANG. To appear in the SIAM Journal on Control and Optimization.

Dynamic Programming in Mathematical Finance

Alain BENSOUSSAN, City University of Hong Kong, Hong Kong

Mathematical Finance has introduced new type of stochastic control problems. In this context, the martingale method has been used to solve them. This gives the impression that probabilistic techniques are the only way to obtain a solution. We want to show that purely analytical techniques can be used for the same result. Not only it is useful to have additional techniques, but also analytical techniques allow for more constructive solutions. In particular, one does not need to rely on the martingale representation theorem to construct optimal stochastic controls.

We will discuss the concepts and the main techniques. Two models will be considered, the classical consumer-investor model and a model describing the choice of projects for an entrepreneur. A credit risk problem will be solved in this framework.

Market Models with Optimal Arbitrage

Ngoc Huy CHAU, University Paris Diderot, France

We construct and study market models admitting optimal arbitrage. We say that a model admits optimal arbitrage if it is possible, in a zero-interest rate setting, starting with an initial wealth of 1 and using only positive portfolios, to superreplicate a constant $c > 1$. The optimal arbitrage strategy is the strategy for which this constant has the highest possible value. Our definition of optimal arbitrage is similar to the one in Fernholz and Karatzas (2010), where optimal relative arbitrage with respect to the market portfolio is studied. In this work we present a systematic method to construct market models where the optimal arbitrage strategy exists and is known explicitly. We then develop several new examples of market models with arbitrage, which are based on economic agents' views concerning the impossibility of certain events rather than ad hoc constructions. We also explore the robustness of arbitrage strategies with respect to small perturbations of the price process, and provide new examples of arbitrage models which are robust in this sense.

Key words: Optimal Arbitrage, No Unbounded Profits with Bounded Risk, Strict Local Martingales, Incomplete Markets, Robustness of Arbitrage.

Authors: Ngoc Huy CHAU, University of Padova and University Paris Diderot, France; Peter Tankov, University Paris Diderot, France.

Robust Feedback Switching Control

Andrea COSSO, University Paris Diderot, France

We study a robust switching control problem, where the switcher can only observe the evolution of the state process, and thus uses feedback (closed-loop) switching strategies, a non-standard class of switching controls introduced in this work. The adverse player, which can be interpreted as nature, chooses open-loop controls that represent the so-called Knightian uncertainty, i.e., misspecifications of the model. The (half) game switcher versus nature is then formulated as a two-step (robust) optimization problem. We develop the stochastic Perron method for this control problem, and prove that it provides a viscosity sub and supersolution to a system of Hamilton-Jacobi-Bellman variational inequalities, such that the value function is squeezed between them. Together with a comparison principle, this characterizes the value function of the game as the unique viscosity solution to the Hamilton-Jacobi-Bellman equation, and shows as a byproduct the dynamic programming principle for the robust feedback switching control problem.

This is a joint work with Erhan BAYRAKTAR and Huyên PHAM.

Portfolio Selection with Transaction Costs and Capital Gains Taxes

Min DAI, National University of Singapore, Singapore

We are concerned with the continuous time portfolio selection problem with transaction costs and capital gains taxes. We consider both the full rebate case where a CRRA investor can use all capital losses to offset taxable ordinary income and the full carry-forward case where the investor can only carry forward capital losses to offset future gains. We find that the investor is inclined to defer realization of large capital gains to the end of each fiscal year. Moreover, transaction costs lead the investor to defer realization of even large capital losses.

This is a joint work with Hong LIU and Yaoting LEI.

Insider Information and Arbitrage Profits via Enlargement of Filtrations

Claudio FONTANA, University Paris Diderot, France

In the context of semimartingale financial models, we discuss whether the introduction of additional information allows for arbitrage profits. First, in a continuous semimartingale setting, we consider the additional information associated to an honest time, which is shown to yield different arbitrage possibilities depending on the investment horizon of an insider trader. We shall then study the stability of the absence of arbitrage of the first kind condition under progressive and initial enlargements in a general semimartingale setting.

Based on joint work with B. Acciaio, M. Jeanblanc, C. Kardaras and S. Song.

Multi-level & Richardson Romberg Methods for Stochastic Approximation

Noufel FRIKHA, University Paris Diderot, France

During this presentation we study multi-level stochastic approximation algorithm. Our aim is to extend the scope of the multi-level Monte Carlo method recently introduced by Giles (Giles 2008) to the framework of stochastic optimization by means of stochastic approximation algorithm. We first introduce and study a two-level method, also referred as statistical romberg stochastic approximation algorithm. Then, its extension to multi-level is proposed. We prove a central limit theorem for both methods and describe the possible optimal choices of step size sequence. Numerical results confirm the theoretical analysis and show a significant reduction in the initial computational cost. If time permits I will present how the principle of Richardson-Romberg extrapolation method can be applied to stochastic optimization.

Explanatory Co-movement in Asset Prices with Minimal Dependence Structures

Aparna GUPTA, Rensselaer Polytechnic Institute, United States

In a highly interconnected financial economy, deciphering co-dependencies between asset prices and their time-varying dynamics is challenging and important for sound financial decisions. This paper develops a framework to study dynamic features of a financial network, which incorporates explanatory factors for evaluating the underlying co-dependency structure of asset prices in a minimalist approach. Temporal evolution of the network reveals the relative significance of idiosyncratic versus systematic connections under different economic conditions. The framework can handle hundreds of financial variables to minimally identify interconnections, as well as offers flexibility in the choice of explanatory factors for specific objectives of a study. We demonstrate the application of the framework to few key cases, as well as present an overview of an asset price dynamics investigation developed based on the insights from the framework.

First Passage Times of Two-Dimensional Brownian Motion

Steven KOU, National University of Singapore, Singapore

First passage times of two-dimensional Brownian motion have been used to study correlated defaults under structural models in finance. However, despite various attempts since 1950's, there are few analytical solutions available. By analytically solving a modified Helmholtz equation in an infinite wedge with non-homogenous boundary conditions, we propose a unified approach to obtain analytical solutions to these problems. We also point out a link between the Laplace transforms of the first passage times and a bivariate exponential distribution which is absolute continuous but does not have memoryless property.

This is a joint work with Haowen ZHONG.

Parametrix Approach to the Transition Density of SDEs Driven by α-Stable Process with Hölder Continuous Coefficients

Libo LI, University of New South Wales, Australia

The transition density of stochastic differential equations driven by α-stable Lévy process with Hölder continuous coefficients have been recently studied by Debussche and Fournier, where they showed the existence of the transition density. From a simulation point of view, the drawback is that it is only an existence result. In our work, under some slightly weaker assumptions, we apply the parametrix method originated from theory of PDE, to derive an asymptotic representation of the transition density, in addition, we show that the transition density is jointly continuous and once differentiable with respect to the initial condition.

This is a joint work with Arturo Kohatsu-Higa.

Modeling Sovereign Default Risk

Shanqiu LI, University Paris Diderot, France

We study the European sovereign debt crisis by analyzing the solvency and the sovereign bond yield of some euro area member States, and we propose a hybrid model which combines the structural approach and the reduced-form approach. This model takes into account the movement of the sovereign solvency and the impact of political critical events. The sovereign default time is then decomposed into an accessible part with predictable components and a totally inaccessible part. As a consequence, the probability of default at the time of a predetermined political critical event is nonzero and the conditional survival probability has discontinuous parts. We also study this model in a generalized density framework by extending the so-called density hypothesis, and we explain the jumps in the long-term government bond yield.

Efficient Intraday Counterparty Credit Exposure Calculation

Yue LIU, Nanyang Technological University, Singapore

To meet the actual need from industry to enhance efficiency in real time intraday pre-trade and pre-quote risk analysis, we greatly innovate the traditional way of expected exposure calculation for related risk measures. For one part, EPE (expected positive exposure) is computed by DJS (direct jump simulation) and Quazi Monte Carlo with antithetic method. For another, we utilize Euler Allocation Method to calculate the marginal exposure for sake of intraday exposure increment.

Authors: Jay BHATIA, Bank of America Merrill Lynch, Singapore; Yue LIU, Nanyang Technological University, Singapore.

An Optimal Execution Problem in Intra-day Electricity Markets

Huyên PHAM, University Paris Diderot, France

We consider the problem of optimal trading for a power producer in the context of intra-day electricity markets. The aim is to minimize the imbalance cost induced by the random residual demand in electricity, i.e. the consumption from the clients minus the production from renewable energy. For a simple linear price impact model and a quadratic criterion, we explicitly obtain approximate optimal strategies in the intra-day market and energy production, and exhibit some remarkable properties of the trading rate. Furthermore, we study the case when there are jumps on the demand forecast and on the intra-day price, typically due to error in the prediction of wind power generation. Finally, we solve the problem when taking into account delay constraints in power production.

This is a joint work with René AID (EDF) and Pierre GRUET (Paris Diderot).

Optimal Exit Strategies for Investment Projects

Simone SCOTTI, University Paris Diderot, France

We study the problem of an optimal exit strategy for an investment project which is unprofitable and for which the liquidation costs evolve stochastically. The firm has the option to keep the project going while waiting for a buyer, or liquidating the assets at immediate liquidity and termination costs. The liquidity and termination costs are governed by a mean-reverting stochastic process whereas the rate of arrival of buyers is governed by a regime-shifting Markov process. We formulate this problem as a multidimensional optimal stopping time problem with random maturity. We characterize the objective function as the unique viscosity solution of the associated system of variational Hamilton-Jacobi-Bellman inequalities. We derive explicit solutions and numerical examples in the case of power and logarithmic utility functions when the liquidity premium factor follows a mean-reverting CIR process.

This is a joint work with Etienne CHEVALIER, VATHANA Ly Vath, and Alexandre ROCH.

Keywords: real options, stochastic control, liquidity discount, regime shifting, viscosity solutions, system of variational inequalities.

MSC2000 subject classification: 60G40, 91B70, 93E20.

Utility Maximization with Floor Constraint: A Dual Approach

Jun SEKINE, Osaka University, Japan

The utility maximization from terminal wealth and consumption is studied with floor constraint on the wealth process. A dual approach to the problem is introduced in a Markovian SDE model driven by Brownian motions. The free-boundary problem associated with the differential of the dual HJB equation plays an important role. The dual optimizer is constructed by the solution to an SDE with nonsticky reflection at the free-boundary. Using it, the solution to the primal utility maximization problem is recovered.

The talk is based on a joint work with Salvatore FEDERICO (Univ. of Milano) and Fausto GOZZI (LUISS, Roma).

Superhedging under Ratio Constraint

Jing XU, National University of Singapore, Singapore

We consider superhedging of contingent claims under ratio constraint. It has been widely recognized that the minimum cost of superhedging a contingent claim with certain constraints is equal to the price of a dominating claim without constraints. In terms of the backward stochastic differential equation and the variational inequality equation approach, we revisit this result and provide two counterexamples.

This is a joint work with Yingshan CHEN, Min DAI, and Mingyu XU.

The Level of Risk-free Rate in China: Evidence from the Classification Fund Market

Chen YANG, National University of Singapore, Singapore

One-month SHIBOR rate, three-month fixed deposit rate, and ten-year treasury yield are often employed as a proxy for the risk-free rate in China's market. However, empirical studies show that these rates are too low to reflect the actual level of risk-free rate demanded by China's market. Using the Black-Scholes option pricing theory, we develop an approach to estimating the level of China's risk-free rate in terms of the classification fund, an innovative structured product that is capable of capturing the characteristics of both the bond market and the equity market. We find that the level of the risk-free rate implied from the classification fund market is uniformly higher than the commonly used risk free rates, which confirms the presence of a downward bias in the level of risk-free rate.

This is a joint work with Min DAI, Steven KOU, and Zhenfei YE.

Dynamic CDO Pricing and Hedging in a Forward Setting

Vilimir YORDANOV, Vienna School of Finance, Austria

Dynamic CDO modeling became a hot topic prior to the crisis. The latter, however, showed clearly the inadequacy of static models based on Gaussian copula for pricing, hedging, and risk management. Further, the financial innovation in the market fueled a demand for dynamic models that can capture in a consistent way the default, spread, correlation, contagion, diversification, and recovery effects arising in the basket credit derivatives segment. Encompassing all of them in a tractable arbitrage free model happened to be a highly non-trivial task and posed a big challenge both to practitioners and academics. The purpose of the paper is to address the open problems from the maturity of the post-crisis environment and provide a possible analytic toolkit with a view towards the expected new development of the credit correlation segment. Employing the general HJM forward abstract setting of Sidenius, Piterbarg, and Andersen (2008) as a workhorse, we modify and upgrade it appropriately so that all of the above mentioned effects are incorporated. Then the focus is turned to pricing and hedging. Formal pricing rules are derived and different hedging strategies are discussed. The model is calibrated to market data and its hedging performance is analyzed.

Keywords: CDO, tranche, dependence, forward rate, hedging

Authors: Vilimir YORDANOV, Vienna School of Finance, Austria; Markus HÖCHSTÖTTER and Vilimir YORDANOV, Karlsruhe Institute of Technology, Germany.

Second Order BSDEs with Jumps

Chao ZHOU, National University of Singapore, Singapore

We first provide a wellposedness result of second order backward stochastic differential equations with jumps. We then prove a nonlinear Feynman-Kac formula and give a probabilistic representation for some fully nonlinear partial integro-differential equations.

This talk is based on joint works with Nabil KAZI-TANI and Dylan POSSAMAI.

INFORMATION

Committee | Logistics | General

Committee & Sponsors

ORGANIZING COMMITTEE

- Min DAI (National University of Singapore, Singapore)
- Steven KOU (National University of Singapore, Singapore)
- Huyên PHAM (University Paris Diderot, France)
- Peter TANKOV (University Paris Diderot, France)
- Chao ZHOU (National University of Singapore, Singapore)

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Logistics

MEALS

Tea breaks and lunches, served buffet-style are catered from a Halal-certified supplier. Usually some of the food items would be suitable for vegetarians. Dinners are not included.

Tea breaks and lunches will be served at the outdoor balcony of IMS house 4.

General

PUBLIC TRANSPORTATION

The public transport network in Singapore consists of bus, MRT (Mass Rapid Transit), LRT (Light Rail Transit) and taxi. Buses and MRTs are the most affordable modes of public transport with standard fares ranging from S$1.00 to S$2.20 (depending on distance). Bus fares are charged on board by tapping a stored-value card or paying the exact fare in Singapore currency to the driver. Bus and MRT fares can be calculated using the Fare Calculator on the Public Transport website (http://www.publictransport.sg), under eservices.

MRT fare is paid by tapping a Stored Value Card or a Standard Ticket at the gantry. The Standard Ticket can be used up to six times within 30 days from the date of purchase. The purchase price includes a deposit of 10 cents which will be automatically returned through an off-set against the passenger's fare on the third trip. A user also enjoys a 10-cent discount on the sixth trip. The Standard Ticket can be purchased at the General Ticketing Machine (GTM) at all MRT and LRT stations. LRTs are only available in selected residential neighbourhoods and operate similarly as MRTs.

Typically, the first bus and train starts running at 5.30am and the last service is 11.30pm daily. Special night bus services with specific routes that charge a flat rate of S$4.50 are available from 11.30pm to 4.35am on Fridays, Saturdays and eves of Public Holidays.

Taxis can be flagged down 24 hours a day on most roads or at taxi-stands outside most major shopping centres and hotels. There is no need to bargain for prices as the taxis are all metered. The basic fare consists of a flag-down fare and a metered fare. The flag-down fare for the first kilometer or less is between S$3.00 and S$5.00, depending on the type of taxi (regular or premium). The metered fare after the first kilometer is based on the distance and waiting times during the journey. Additional charges may also be incurred depending on the time of travel and origin of the journey. A detailed rates guide is posted on the rear door of each taxi for reference.

GETTING TO THE AIRPORT

The easiest way to get to the airport is by taxi. For reference, the journey from NUS with smooth traffic would take about 30 minutes and cost about S$25.00 without surcharge. Surcharges may be incurred depending on time of travel and if the taxi was pre-booked via phone.

To get to the airport by MRT (Mass Rapid Transit), connect to the East-West line (green line) going in the direction of Pasir Ris/Changi Airport. The Changi Airport MRT station is located under Terminals 2 and 3 which are connected to Terminal 1 by sky train. A one-way MRT fare from Kent Ridge station is about S$2.30 (using the Standard Ticket) and takes approximately 57 minutes. More Information on MRT Network Map and fare can be found at: http://www.smrt.com.sg/Trains/NetworkMap.aspx.

FOOD & SHOPPING

Food centres and food courts serving local, Asian and sometimes international cuisine at affordable prices are commonly found in neighbourhoods and shopping malls. There would usually be at least one each of Halal and vegetarian stalls in most establishments. Operating hours of the stalls vary but most of them open by 10am and close by 9pm.

Restaurants and cafes are usually found in shopping malls and bigger neighbourhoods. Operating hours depend on the types of meals served but most would be open between 11.00am and 9.00pm.

Most shopping malls in Singapore operate from 11.00am to 10.00pm every day.

BANK SERVICES & FOREIGN EXCHANGE

Participants may use major credit cards to withdraw cash using the Auto Teller Machines, which can be found in various locations on campus. Alternatively, the local banks offer regular banking services including processing foreign exchange and traveler's cheques. The nearest branches are:

DBS (Holland Village Branch)
Address: 257 Holland Avenue, Singapore 278984
Operating hours: 8.30am – 4.30pm (Monday – Friday)
8.30am - 1.00pm (Saturday)

DBS/POSB (NUS Remix Branch)
Address: 31 Lower Kent Ridge Road, #01-02 Yusof Ishak House, Singapore 119078
Operating hours: 8.30 AM - 4.30 PM (Monday to Friday)
8.30 AM - 1.00 PM (Saturday)
Only Personal Banking Services are available. Demand Draft and Remittance services are not available. All cash transactions must be made at Automated Teller Machines.

POSB (Buona Vista Branch)
Address: Blk 43 Holland Drive #01-59, Singapore 270043
Operating hours: 8.30am – 4.30pm (Monday – Friday)
8.30am - 1.00pm (Saturday)

UOB (Holland Village Branch)
Address: 211 Holland Avenue, #01-12 Holland Road Shopping Centre, Singapore 278967
Operating hours: 9.30am – 4.00pm (Monday – Friday)
9.00am - 12.30pm (Saturday)

USEFUL PHONE NUMBERS

Taxi (for current and advanced booking):

Company	Telephone	Colour of vehicle
CityCab	65521111	Yellow
Comfort Taxi	65521111	Blue
Premier Taxis	63636888	Silver
Prime Taxis	67780808	Copper (regular service); Blue (limousine service)
SMRT Taxis	65558888	White
Trans Cab	65553333	Red
Yellow Top Taxis	62935545	Yellow top with black body

Local Emergency Services for Credit Cards:

American Express	1800-6299-1997
Diner's Club Singapore	64160800(during office hours); 64160900 (after office hours)
MasterCard	800-1100-113
Visa	800-4481-250
JCB	001-800-3865-5486

Others:

Tourist Information	1800-7362000
24-hour Flight Enquiry (Changi Airport)	1800-5424422
Buona Vista Neighbourhood Police Post	1800-7779999
Police Emergency	999
Non-emergency Ambulance	1777
Fire Engine/Ambulance	995