

SINGAPORE-SUZHOU WORKSHOP ON QUANTITATIVE FINANCE

12 - 13 July 2015
Suzhou

Jointly organized by:



蘇州大學

SOOCHOW UNIVERSITY



NUS

National University
of Singapore

Table of Contents

PROGRAMME

Organizers	1
Schedule	1

ABSTRACTS

Baojun BIAN	2
Zengjing CHEN	2
Min DAI	2
Shijie DENG	3
Xuezhong HE	3
Steven KOU	4
Duan LI	4
Zhongfei LI	5
Lu LIN	5
Shanjian TANG	6
Jianming XIA	6
Jingping YANG	6
Xingye YUE	7
Chao ZHOU	7

Organizers

Yongluo CAO (Soochow University)

Min DAI (National University of Singapore & NUS (Suzhou) Research Institute)

Weinan E (Princeton University & Peking University)

Steven KOU (National University of Singapore & NUS (Suzhou) Research Institute)

Xingye YUE (Soochow University)

Schedule

Sunday 12 July 2015	Monday 13 July 2015
08:30 – 08:50 Registration	08:30 – 09:00 Registration
08:50 – 09:00 Opening Address	
09:00 – 09:45 Steven KOU	09:00 – 09:45 Zengjing CHEN
09:45 – 10:30 Shijie DENG	09:45 – 10:30 Lu LIN
10:30 – 11:00 Tea Break	10:30 – 11:00 Tea Break
11:00 – 11:45 Duan LI	11:00 – 11:45 Zhongfei LI
11:45 – 12:30 Min DAI	11:45 – 12:30 Baojun BIAN
12:30 – 14:00 Lunch	12:30 – 14:00 Lunch
14:00 – 14:45 Shanjian TANG	14:00 – 14:45 Xuezhong HE
14:45 – 15:30 Jingping YANG	14:45 – 15:30 Chao ZHOU
15:30 – 16:00 Tea Break	15:30 – 15:40 Closing Address
16:00 – 16:45 Jianming XIA	
16:45 – 17:30 Xingye YUE	

Abstracts

Merton Investment and Consumption Problem and Portfolio Turnpike Theorem

Baojun BIAN, Tongji University, China

We consider Merton investment and consumption problem. The duality HJB equation is solved and semi-explicit solution is obtained. The optimal strategy can be studied by this duality representation for solution. We prove also turnpike theorem and convergence rate for long-term investment and consumption problem.

This talk is based on joint works (Bian, Miao, Zheng, 2011, SIAM Journal on Financial Mathematics; Bian, Zheng, 2015, Journal of Economic Dynamics and Control; Bian, Zheng, Preprint).

Limit Theorems under Nonlinear Expectations

Zengjing CHEN, Shandong University, China

Motivated by Ellsberg-type models and problems in mathematical finance, we investigate limit behaviours of two different models: one is the very simple Bernoulli trials with ambiguity (or called Ellsberg-type model), and the other is sub-linear expectations arising from mathematical finance. With a new notion of φ -convolution for random variables, we show that empirical averages obtained from a large number of trials in both models have the same limit distribution. We also investigate the relation between this limit theorem and the weak law of large numbers for nonadditive probability, and show that they are equivalent under the assumption of φ -convolution on random variables. Our results generalize well-known laws of large numbers (LLNs), using the proofs that are completely different from those in the existing literature. Finally, we discuss four models which satisfy the assumptions of our main results.

This is a joint work with Jing CHEN (Shandong University, China).

Keywords: Capacity, Choquet expectation, BSDE, law of large numbers, g -expectation

Singular Stochastic Control in Portfolio Selection with Market Imperfections

Min DAI, National University of Singapore, Singapore

In this talk, I will give a review on two singular stochastic control problems arising from continuous time portfolio selection with market imperfections: one with transaction costs, and the other with capital gains tax.

Pricing and Optimal Exercise of Swing Options under Alternative Stochastic Price Models

Shijie DENG, Georgia Institute of Technology, United States

Swing options are commonly used in the energy industries such as the natural gas and electricity industries for energy marketers and service providers alike to manage their convoluted risk exposure to the fluctuating energy price and the end customers' consumption quantities. We discuss the pricing of several variations of swing options with a variety of underlying spot price models. Discrete and continuous time formulations are illustrated and the respective optimal policies of some quintessential examples from each strain are contrasted to highlight the conventional features of each formulation. We review the prominent valuation approaches based on stochastic dynamic programming, while providing examples in the context of a recent approach, the PROJ method, which applies broadly to exotic option pricing.

Differences in Opinion and Equilibrium Asset Returns in Multi-Asset Market

Xuezhong HE, University of Technology, Sydney, Australia

This paper analyzes the impact of disagreement on equilibrium stock returns in a multi-asset market. Most dynamic models of disagreement focus on a market with a single stock which is a claim on the aggregate consumption. In reality, investors can speculate on the future cash flows of multiple stocks. In a continuous-time pure exchange economy, we assume investors have logarithmic preferences and disagree about future dividends. We show that the effect of disagreement can be very different in a multi-asset market compare to a single-asset market. In a single-asset market, although disagreement affects equilibrium returns, the effect is negligible if the dispersion in beliefs is small. In comparison, when there are multiple assets in the market, investors may have small disagreement about each asset, however, when the number of assets is relatively large (as in the real financial market), the overall level of belief dispersion could be much higher compared to the single-asset market. Consequently, we find that effect of disagreement can lead to a much higher excess volatility and larger time-variation in expected returns in a multi-asset market than in a single-asset market. We also study the effect of correlation in optimism/pessimism between assets. We find that correlation in optimism/pessimism can lead to excess correlation in asset returns even though assets have independent future dividends. Furthermore, we show that when optimism/pessimism are negatively correlated, assets with the same level of belief dispersion can have different excess volatilities and also different expected returns. Lastly, we find that in a multi-asset market, initial run-up in asset prices may not lead any fluctuations in the distribution of consumption shares, thus have no effect of expected asset returns, which is in contrast of Yan (2010)'s finding of price-overshooting and mean-reversion in asset returns.

Information from Options during the Crisis: An Empirical Likelihood Method of Combining Stock and Option Prices

Steven KOU, National University of Singapore, Singapore

As discussed in the finance literature (Lo and Wang, 1995, *J. of Finance*; Ross, 2014, *Journal of Finance*; Hansen and Scheinkman, 2014, Working Paper), option prices may contain information about the dynamics of the underlying asset returns including the drift. This conclusion appears to be surprising because, according to the Black-Scholes formula, only volatility of returns is used in the option pricing formula. In this paper, we confirm this viewpoint by showing that the option information leads to shorter confidence intervals for the parameters of the returns dynamics (e.g. drift, volatility and jump parameters) and more efficient ways to reflect current market information, which is especially useful during financial crises. Our approach is through developing an empirical likelihood based method that can combine the return series and the associated derivative prices for the purpose of estimation. We apply the new method to Standard and Poor's 500 Index and its derivative prices. Our empirical findings suggest that inclusion of option price data provides a more reasonable set of estimates that can reflect the market conditions during the 2009 financial crisis. We also provide theoretical justification by establishing large sample properties of resulting estimators under suitable regularity conditions.

This is a joint work with Tony SIT and Zhiliang YING.

A Planner-Doer Game Framework for Multi-Period Mean-Variance Portfolio Selection

Duan LI, The Chinese University of Hong Kong, Hong Kong

Time inconsistency has been a thorny issue in the multi-period mean-variance portfolio selection. We develop in this research a two-tier planner-doer game model with self-control, in which the planner and doers represent different interests of the same investor at different time instants. In the model, the planner (the willpower to resist short term temptations) can impact preferences of doers through commitment by punishment, while the applied total penalty in turn affects the planner's own preference. Through aligning interests of planner and doers, a degree of internal harmony (measured quantitatively by the expected cost of self-control) can be achieved. We further extend this game framework to general time inconsistent stochastic decision problems.

Optimal Dividend Strategy with Time-Inconsistent Preferences and Costs from Ruin and Transaction

Zhongfei LI, Sun Yat-sen University, China

In this talk we consider the optimal dividend strategy for a company whose surplus follows a general diffusion process. The company's manager has time-inconsistent preferences and decides the optimal dividend strategy, which consists of the optimal times and amounts to pay as dividends, and is subject to constant penalty cost when the company goes bankruptcy and to fixed and proportional transaction costs. We tackle with the optimization problem by assuming that the manager is time-consistent, naive or sophisticated, and obtain analytical solutions respectively. Our results show that, for each case, the optimal strategy is to keep the company's surplus below a constant level and upon reaching this level, to pay out dividends to bring the company's surplus down to a lower constant target. An extensive analysis suggests that manager with time-inconsistent preferences tends to pay out dividends earlier than her time-consistent counterpart and that the sophisticated manager is more inclined to pay out dividends than the naive manager. On the contrary, the penalty cost leads to delay in dividend payments. Finally, we provide several examples to illustrate our results.

Portfolio Selection Model with Estimable Ambiguity and Ambiguity Aversion

Lu LIN, Shandong University, China

In this paper, an upper-lower expectation portfolio model is introduced in the environment of essential distribution-uncertainty. The underlying idea is actually different from those of the classical Bayesian models, multi-priors models and “confidence interval” uncertainty models. The new method does allow the asset returns to follow uncertain distributions or allow the unknown distributions of the asset returns change with financial conditions. The model can be simplified to an uncertain mean-variance framework, consequently, the unknown uncertainty can be estimated via the observation values of asset returns, instead of being subjectively determined. Moreover, the model can simultaneously characterize risk aversion and uncertainty aversion, and can separately deal with the objective mean-variance uncertainty and subjective mean-variance uncertainty aversion. On the other hand, the solution to the portfolio problem has a closed and simple expression. Empirical analysis shows that, compared with portfolios from classical Bayesian models and “confidence interval” uncertainty models, the upper-lower expectation portfolio is more stable over time and delivers a higher out-of sample Sharpe ratio.

This is a joint work with Chen LIN.

Multi-Dimensional Backward Stochastic Differential Equations of Diagonally Quadratic Generators

Shanjian TANG, Fudan University, China

We are concerned with adapted solution of a multi-dimensional BSDE with a “diagonally” quadratic generator, the quadratic part of whose i th component only depends on the i th row of the second unknown variable. Local and global solutions are given. Both John-Nirenberg and reverse Hölder inequalities for BMO martingales play a key role in our arguments.

This is a joint work with Ying HU at University of Rennes 1, France.

Continuous-Time Homothetic Recursive Utilities with Infinite Time Horizon

Jianming XIA, Chinese Academy of Sciences, China

The existence and uniqueness of the infinite time horizon continuous-time homothetic recursive utility are proved in this paper. We also show the comparison theorem, monotonicity, and concavity of the solution to the corresponded infinite time horizon BSDE.

This is a joint work with Huina XIAO.

Composite Bernstein Copulas

Jingping YANG, Peking University, China

Copula function has been widely used in insurance and finance for modeling inter-dependency between risks. Inspired by the Bernstein copula (BC) put forward by Sancetta and Satchell (2004), we introduce a new class of multivariate copulas, the composite Bernstein copula (CBC), generated from a composition of two copulas. This new class of copula functions is able to capture the tail dependence, and it has a reproduction property for the three important dependency structures: comonotonicity, countermonotonicity and independence. We introduce an estimation procedure based on the empirical composite Bernstein copula (ECBC) which incorporates both prior information and data into the estimation. A simulation study and an empirical study on financial data illustrate the advantages of the ECBC estimation method, especially in capturing the tail dependence.

This is a joint work with Zhijin CHEN, Fang WANG and Ruodu WANG.

Reference: A. Sancetta and S. Satchell (2004). The Bernstein copula and its applications to modeling and approximations of multivariate distributions. *Ecometric Theory*, Vol.20, 535-562.

Numerical Study on G-Expectation

Xingye YUE, Soochow University, China

We will present some numerical methods for the G-Heat equation which is a nonlinear partial differential equation related to the G-Expectation or nonlinear expectation, introduced by Peng [1]:

$$u_t - G(D^2u) = 0, (x, t) \in \mathbb{R}^n \times (0, T); \quad u(x, 0) = \phi(x),$$

where $G(A) = \sup_{Q \in \Theta} (\frac{1}{2} \text{tr}(AQ))$, $\Theta \subset S_+(n) = \{BB^t : B \in \mathbb{R}^{n \times n}\}$

Numerous numerical experiments will be carried out to show the efficiency, accuracy and stability of the proposed methods. The effect of the boundary conditions is also numerically investigated. Some numerical analysis is given to show the convergence of the numerical solutions to the viscous solutions of the G-Heat equation.

This is a joint work with Shige PENG and Lihe WANG.

Stochastic Control for a Class of Nonlinear Kernels

Chao ZHOU, National University of Singapore, Singapore

A stochastic control problem for a class of nonlinear stochastic kernels is studied. We prove a dynamic programming principle (DPP) for the value function by a measurable selection argument and consider several applications of the DPP.

This is a joint work with Dylan POSSAMAI and Xiaolu TAN.
