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국가수리과학연구소
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Time Table

session	4.24		4.25		session	4.26	
plenary I 9:00-9:40	Shige Peng (Auditorium 2)		Min Dai (Auditorium 2)		plenary 9:00-9:40	Eckhard Platen (Auditorium 2)	
morning 10:00-11:30	Systemic Risk (Auditorium 2)	FE: Pricing (Room 2)	Risk Manageement (Auditorium 2)	Portfolio Opt (Room 2)	morning 10:00-11:30	FE: Stoch Vol (Auditorium 2)	Portfolio Opt (Room 2)
	Katsumasa Nishide	Lixin Wu	Qi Wu	Byung Hwa Lim		Jaehyuk Choi	Yong Hyun Shin
	Jiro Akahori	Hailiang Yang	Duan Li	Zhongfei Li		Chenxu Li	Philip Yam
	Nan Chen	Siu Pang Yung	Liyuan Chen	Alex Tse		Nian Yang	Seyoung Park
	Li-Hsien Sun	Jianqiang Hu	Dawei Zhang	Xiangwei Wan		Kazuhiro Yasuda	Xiang Yu
plenary II 11:40-12:20	Paul Glasserman (Auditorium 2)		Rama Cont (Auditorium 2)		lunch 11:30-1:00		
lunch 12:30-2:00					afternoon I 1:00-2:30	FE: Information (Room 3)	FE: Risk and Strategy (Room 4)
afternoon I 2:00-3:10	Economics (Auditorium 2)	FE: Pricing (Room 2)	Credit risk (Auditorium 2)	Portfolio Opt (Room 2)		Kiseop Lee	Mei Choi Chiu
	Xuedong He	Lingfei Li	Kazutoshi Yamazaki	Bong-Gyu Jang		Xiangyu Cui	Hyungbin Park
	Steven Kou	Ning Cai	Xianhua Peng	Jian-Jun Gao		Haejun Jeon	Wing Fung Chong
	Takanori Adachi	Chao Zhou	Hyun Jin Jang	Youcheng Lou		Michi Nishihara	
afternoon II 3:40-4:50	FE: Math (Auditorium 2)	Portfolio Opt (Room 2)	FE: Pricing (Auditorium 2)	FE: Optimization (Room 2)	afternoon II 3:00-4:30	FE: Market & Equil (Room 3)	FE: Pricing (Room 4)
	Qingshuo Song	Jun Sekine	Junbeom Lee	Chiaki Hara		Shuenn Jyi Sheu	Chao Shi
	Tongseok Lim	Jussi Keppo	Pai-Ta Shih	Minsuk Kwak		Jin Hyuk Choi	Shidong Cui
	Doobae Jun	Michael Wong	Akhlaque Ahmad	Xuefeng Gao		Jun Maeda	Huiming Zhang
plenary III 5:00-5:40	Hyeng Keun Koo (Auditorium 2)		Hideo Nagai (Auditorium 2)				
			banquet 6:00-8:00				

session	4.24 (Mon)	
plenary I 9:00-9:40	Shige Peng "Data Based Quantitative Analysis and Calculation Data under Nonlinear Expectations" (Auditorium 2)	
break 9:40~10:00		
morning 10:00-11:30	**Systemic Risk** (Auditorium 2) Katsumasa Nishide (Hitotsubashi University) "Default Contagion and Systemic Risk in the Presence of Credit Default Swaps" Jiro Akahori (Ritsumeikan University) "A Structural Model for Default Contagion" Nan Chen (The Chinese University of Hong Kong) "Law of the Few: Economics of the Tipping Point" Li-Hsien Sun (National Central University) "Systemc Risk and Interbank Lending"	**Financial Engineering: Pricing** (Room 2) Lixin Wu (Hong Kong University of Science and Technology) "Replication Pricing of XVA and the Asset-Liability Symmetryt-Liability Symmetry" Hailiang Yang (The University of Hong Kong) "Geometric Stopping of a Random Walk and Its Applications to Valuing Equity-linked Death Benefits" Siu Pang Yung (The University of Hong Kong) "Computing Ruin Probabilities via Wavelets Schemes" Jianqiang Hu (Fudan University) "Pricing of Stock Index Futures under Trading Restrictions"
plenary II 11:40-12:20	Paul Glasserman "Market Efficiency with Micro and Macro Information" (Auditorium 2)	
lunch 12:30-2:00		
afternoon I 2:00-3:10	**Economics** (Auditorium 2) Xuedong He (The Chinese University of Hong Kong) "Recursive Utility with Narrow Framing: Existence and Uniqueness" Steven Kou (National University of Singapore) "Exhaustible Resources with Production Adjustment Costs" Takanori Adachi (Ritsumeikan University) "A Category of Probability Spaces and Monetary Value Measures"	**Financial Engineering: Pricing** (Room 2) Lingfei Li (The Chinese University of Hong Kong) "Analysis of Markov Chain Approximations for Option Pricing and Hedging" Ning Cai (Hong Kong University of Science and Technology) "A Unified Framework for Option Pricing under Regime Switching Models" Chao Zhou (National University of Singapore) "The Sustainable Black-Scholes Equations"
break 3:10~3:40		
afternoon II 3:40-4:50	**Financial Engineering: Mathematics** (Auditorium 2) Qingshuo Song (City University of Hong Kong) "Solvability of Dirichlet Problem with Fractional Differential Operator" Tongseok Lim (University of Oxford) "Multi-Martingale Optimal Transport" Doobae Jun (Gyeongsang National University) "Analytic Solution for American Barrier Options with Two Barriers"	**Portfolio Optimization** (Room 2) Jun Sekine (Osaka University) "Optimal Investment and Consumption in an Infinite Dimensional Factor Model with Delay" Jussi Keppo (National University of Singapore) "Data Analytics and Investments" Michael Wong (The Chinese University of Hong Kong) "High-Dimensional Portfolio Selection with Simulation"
plenary III 5:00-5:40	Hyeng Keun Koo "Optimal contracting and Optimal Consumption/Portfolio Selection with Limited Commitment" (Auditorium 2)	

session	4.25 (Tue)	
plenary I **9:00-9:40**	Min Dai TBA (Auditorium 2)	
break **9:40~10:00**		
	Risk Management (Auditorium 2)	**Portfolio Optimization** (Room 2)
morning **10:00-11:30**	Qi Wu (The Chinese University of Hong Kong) "Persistence and Procyclicality in Margin Requirements" Duan Li (The Chinese University of Hong Kong) "Dynamic Mean-CVaR Portfolio Selection and Time-Consistency Induced Term Structure of CVaR" Liyuan Chen (University of York) "Estimation of VaR and CVaR for Oil Prices via SV-ALD Model: A Bayesian Approach Using Scale Mixture of Uniform Distribution" Dawei Zhang (Hong Kong University of Science and Technology) "Wrong Way Risk and Right Way Risk"	Byung Hwa Lim (The University of Suwon) "Optimal Labor Supply under Inflation Risk" Zhongfei Li (Sun Yat-sen University) "Dynamic Asset Allocation with Loss Aversion and Illiquid Asset in a DC Pension Plan" Alex Tse (University of Cambridge) "Optimal Consumption and Investment under Transaction Costs" Xiangwei Wan (Shanghai Jiao Tong University) "Goal-Reaching Problem with Borrowing and Short-Sale Constraints"
plenary II **11:40-12:20**	Rama Cont TBA (Auditorium 2)	
lunch **12:30-2:00**		
	Credit risk (Auditorium 2)	**Portfolio Optimization** (Room 2)
afternoon I **2:00-3:10**	Kazutoshi Yamazaki (Kansai University) "Parisian Reflection and Applications in Insurance and Credit Risk" Xianhua Peng (Hong Kong University of Science and Technology) "Default Clustering and Valuation of Collateralized Debt Obligations" Hyun Jin Jang (Ulsan National Institute of Science and Technology) "Contingent Convertible Bonds with the Default Risk Premium"	Bong-Gyu Jang (Pohang University of Science and Technology) "How Should Individuals Make a Retirement Plan in the Presence of Mortality Risks and Consumption Constraints?" Jian-Jun Gao (Shanghai University of Finance and Economics) "Dynamic Portfolio Optimization with Loss Aversion Preference in Mean-Reverting Market" Youcheng Lou (The Chinese University of Hong Kong) "Optimal Solutions of a Behavioral Portfolio Choice Optimization Problem"
break **3:10~3:40**		
	Financial Engineering: Pricing (Auditorium 2)	**Financial Engineering: Optimization** (Room 2)
afternoon II **3:40-4:50**	Junbeom Lee (National University of Singapore) "Recovering Linear Equations of XVA in Bilateral Contracts" Pai-Ta Shih (National Taiwan University) "Semi-Static Hedging of American Floating Lookback Options" Akhlaque Ahmad (National Institute of Securities Markets) "Pricing Options Using Machine Learning Methods"	Chiaki Hara (Kyoto University) "Risk and Ambiguity in Asset Returns" Minsuk Kwak (Hankuk University of Foreign Studies) "Demand for Life Insurance of a Family with Working Couple" Xuefeng Gao (The Chinese University of Hong Kong) "Optimal Order Exposure in a Limit Order Book"
plenary III **5:00-5:40**	Hideo Nagai TBA (Auditorium 2)	
	banquet **6:00 ~ 8:00**	

session	4.26 (Wed)	
plenary 9:00-9:40	Eckhard Platen "Long-Term Risk of Well-Diversified Equity Indexes" (Auditorium 2)	
break 9:40~10:00		
morning 10:00-11:30	**Financial Engineering: Stochastic Volatility** **(Auditorium 2)** Jaehyuk Choi (Peking University HSBC Business School) "On a class of normal stochastic volatility model" Chenxu Li (Guanghua School of Management, Peking University) "Closed-form Implied Volatility Surface: Dissecting Specifications of Stochastic Volatility" Nian Yang (Nanjing University) "Approximate Arbitrage-Free Option Pricing under the SABR Model" Kazuhiro Yasuda (Hosei university) "Expected Exponential Utility Maximization of Insurers with a Linear Gaussian Stochastic Factor Model"	**Portfolio Optimization** **(Room 2)** Yong Hyun Shin (Sookmyung Women's University) "An Optimal Consumption, Gift, Investment, and Voluntary Retirement Choice Problem with Quadratic and HARA Utility" Philip Yam (The Chinese University of Hong Kong) "Utility-Risk Portfolio Selection" Seyoung Park (National University of Singapore) "Life-Cycle Consumption, Investment, and Voluntary Retirement with Cointegration between the Stock and Labor Markets" Xiang Yu (The Hong Kong Polytechnic University) "Optimal Consumption under Non-Addictive Habit Formation in Incomplete Semimartingale Markets"
lunch 11:30-1:00		
afternoon I 1:00-2:30	**Financial Engineering: Information** **(Room 3)** Kiseop Lee (Purdue University) "Informed Traders' Hedging with News Arrivals" Xiangyu Cui (Shanghai University of Finance and Economics) "Statistical Inference for Unified GARCH-Ito Models with Implied Information" Haejun Jeon (Osaka University) "Patent Protection and R&D Subsidy under Asymmetric Information" Michi Nishihara (Osaka University) "Bankruptcy Decision under Asymmetric Information"	**Financial Engineering: Risk and Strategy** **(Room 4)** Mei Choi Chiu (The Education University of Hong Kong) "Robust Dynamic Pairs Trading with Cointegration" Hyungbin Park (Worcester Polytechnic Institute) "Sensitivity Analysis of Long-Term Cash Flows" Wing Fung Chong (The University of Hong Kong; King's College London) "An Ergodic BSDE Approach to Forward Entropic Risk Measures: Representation and Large-Maturity Behavior"
break 2:30~3:00		
afternoon session 3:00-4:30	**Financial Engineering: Market and Equilibrium** **(Room 3)** Shuenn Jyi Sheu (National Central University) "Updating the Market Completion in Incomplete Market and Its Convergence" Jin Hyuk Choi (Ulsan National Institute of Science and Technology) "Dynamic Equilibrium Framework in Cyber-Security Game" Jun Maeda (University of Warwick) "A Market Driver Volatility Model via Policy Improvement Algorithm"	**Financial Engineering: Pricing** **(Room 4)** Chao Shi (Shanghai University of Finance and Economics) "Asymptotic Expansions of Discretely Monitored Barrier Options under Stochastic Volatility Models" Shidong Cui (Hong Kong University of Science and Technology) "Post-crisis Dual Curve Market Model for Interest Rate Derivatives Pricing" Huiming Zhang (Waseda University) "The Modified Model-Free Implied Volatility in the Chinese Option Market"

4.24 Monday, Plenary I

(9:00AM ~ 9:40AM)

Data based Quantitative Analysis and Calculation Data under Nonlinear Expectations

Shige Peng
Shandong University

Traditionally, a real random data sample is often treated as an i.i.d. sequence, or as a linear and/or nonlinear regression model driven by an i.i.d. sequence. But in many situations this modeling is not true. We must take into account the uncertainty essentially hidden inside a random sequence in practice activity. We have to introduce a robust nonlinear expectation to quantitatively measure and calculate this type of uncertainty. The corresponding basic concept of `nonlinear i.i.d' is introduced to describe a very large type of the randomness of our real world. A robust and simple algorithm called `phi-max-mean' which can be used to measure such type of uncertainties. In fact, it has provided an asymptotically optimal unbiased estimator to the corresponding nonlinear distribution.

4.24 Monday, Morning

(10:00AM ~ 11:30AM)

■ Systemic Risk (Auditorium 2)

Default Contagion and Systemic Risk in the Presence of Credit Default Swaps

Katsumasa Nishide
Hitotsubashi University

We consider a clearing system of an interbank market in the case cross-ownerships of credit default swaps among banks are present, and investigate the effect of CDSs on financial stability. The existence of a clearing payment vector is proved under the assumption of the fictitious default algorithm with financial covenants, which reflects technical defaults often observed in actual financial markets. Some numerical results are presented to illustrate how a cross-ownership structure along with default costs affects the market stability.

A Structural Model for Default Contagion

Jiro Akahori
Ritsumeikan University

The present paper introduces a structural framework to model dependent defaults, with a particular interest in their contagion. This may be a stochastic calculus approach to a Bayesian network structure. This is a joint work with Pham Hai Ha.

Law of the Few: Economics of the Tipping Point

Nan Chen
Chinese University of Hong Kong

Large regime switch due to social interaction, known as the tipping point, is of great interest in sociology and economics. Two empirical features related to the tipping point phenomenon are: (1) Local conformity/global diversity, i.e. one tends to find significant conformity within a given community while different, but in other separate communities the same issue is approached by different ways. (2) Punctuated equilibrium effect, meaning that the dynamics of a given community tend to have a long period of the dominance of one opinion, punctuated by bursts in which the opinion shifts quickly.

In this paper we propose a simple, analytically tractable, stochastic model to incorporate the

above two features in a rigorous way. By doing so, the model provides a foundation for better understanding of the economics of the tipping point. In particular, it demonstrates how social interaction interplays with choice stickiness and context impact to drive the dynamics of a population's aggregate behaviors. Through some tools borrowed from the large deviation theory, we also show that our results can be extended beyond the case of binary choice that a majority of literature focuses. Finally, we discuss how to disrupt the persistence of a social norm by employing the influence of opinion leaders. This is a joint work with Steven Kou from NUS and Yan Wang from CUHK.

Systemic Risk and Interbank Lending

Li-Hsien Sun
National Central University

We propose a simple model of inter-bank lending and borrowing incorporating a game feature where the evolution of monetary reserve is described by a system of coupled Feller diffusions. The optimization subject to the quadratic cost not only reflects the desire of each bank to borrow from or lend to a central bank through manipulating its lending preference but also to intend to leave deposits in a central bank in order to control the volatility for cost minimization. We observe that the adding liquidity creates the effect of flocking leading to stability or systemic risk according to the level of the growth rate. The deposit rate brings about a large number of bank defaults by diminishing the growth of the system. A central bank acts as a central deposit corporation. In addition, the corresponding Mean Field Game in the case of the number of banks N large and the stochastic game on the infinite horizon with the discount factor are also discussed.

■ FE: Pricing (Room 2)

Replication Pricing of XVA and the Asset-Liability Symmetry-Liability Symmetry

Lixin Wu
Hong Kong University of Science and Technology

In the literature, XVAs is defined as a collection of valuation adjustments to the classical risk-neutral valuation of derivatives. In this article, we first uncover the hedging strategy implied by the risk-neutral pricing measure, and then price XVAs as the risk-neutral valuation of various idiosyncratic risks, funding risk in particular, which cannot be eliminated by trading. We justify that the fair price of a derivative should be the no-default value adjusted by the bilateral CVA and the funding cost associated to market funding risk premium, and argue that the rest of XVAs should be excluded from both fair-value pricing and fair-value accounting. For more effective management of the funding risk and other idiosyncratic risks, we call for the adoption of risk measures like VaR or CVaR.

Geometric Stopping of a Random Walk and Its Applications to Valuing Equity-linked Death Benefits

Hailiang Yang
University of Hong Kong

We study discrete-time models in which death benefits can depend on a stock price index, the logarithm of which is modeled as a random walk. Examples of such benefit payments include put and call options, barrier options, and lookback options. Because the distribution of the curtate-future-lifetime can be approximated by a linear combination of geometric distributions, it suffices to consider curtate-future-lifetimes with

a geometric distribution. In binomial and trinomial tree models, closed-form expressions for the expectations of the discounted benefit payment are obtained for a series of options. They are based on results concerning geometric stopping of a random walk, in particular also on a version of the Wiener-Hopf factorization. This is a joint paper with Hans U. Gerber and Elias S.W. Shiu.

Computing Ruin Probabilities via Wavelets Schemes

Siu Pang Yung
University of Hong Kong

Wavelets are function bases that are very effective in reproducing local behaviors due to their compact supports. There is also a fast numerical algorithm in computing the wavelets coefficients. In this talk, we shall describe how wavelets can be used to compute ruin probabilities efficiently. Both infinite time horizon and finite time horizon ruin probabilities are covered. A more general case formulated by the Gerber-Shui function can also be treated. This enable us to compute various moments of the ruin and the surplus before ruin, among others.

Pricing of Stock Index Futures under Trading Restrictions

Jianqiang Hu
Fudan University

Under the assumption of no arbitrage opportunities, the price of stock index futures should be equal to the spot price of the corresponding stock index, excluding capital costs, dividends, and trading costs. However, since the introduction of stock index futures in Chinese stock markets in 2010, the prices of stock index futures have consistently deviated from their theoretical values in a very significant way, especially in recent years. By using an equilibrium model, we show that this deviation is mainly due to various trading restrictions (including short-sell restriction and margin requirements) and it may not lead to any arbitrage opportunity.

4.24 Monday, Plenary II

(11:40AM ~ 12:20PM)

Market Efficiency with Micro and Macro Information

Paul Glasserman
Columbia University

We propose a tractable, multi-security model in which investors choose to acquire information about macro or micro fundamentals or remain uninformed. The model is solvable in closed form and yields a rich set of empirical predictions. Primary among these is an endogenous bias toward micro efficiency. A positive fraction of agents will always choose to be micro informed, but in some cases no agent will choose to be macro informed. Furthermore, for most reasonable choices of parameter values, prices will be more informative about micro than macro fundamentals. The key friction in our model is the assumption that uninformed investors cannot make costless inferences from individual stock prices. We explore the model's implications for the cyclicality of investor information choices, for systematic and idiosyncratic return volatility, and for excess covariance and volatility. This is joint work with Harry Mamaysky.

4.24 Monday, Afternoon I

(2:00PM ~ 3:10PM)

■ Economics (Auditorium 2)

Recursive Utility with Narrow Framing: Existence and Uniqueness

Xuedong He
Chinese University of Hong Kong

We study the total utility of an agent in a model of narrow framing with constant elasticity of intertemporal substitution and relative risk aversion degree and with infinite time horizon. In a finite-state Markovian setting, we prove that the total utility uniquely exists when the agent derives nonnegative utility of gains and losses incurred by holding risky assets and that the total utility can be non-existent or non-unique otherwise. Moreover, we prove that the utility, when uniquely exists, can be computed by a recursive algorithm with any starting point. We then consider a portfolio selection problem with narrow framing and solve it by proving that the corresponding dynamic programming equation has a unique solution. Finally, we propose a new model of narrow framing in which the agent's total utility uniquely exists in general.

Exhaustible Resources with Production Adjustment Costs

Steven Kou
National University of Singapore

We develop a general equilibrium model of exhaustible resources with production adjustment costs based on singular control, and show that the classical Hotelling's rule, which states that the prices of the exhaustible resources should grow at the risk-free rate, does not hold in the presence of adjustment costs; indeed, the adjustment costs can lead to a U-shaped price profile, while will significantly prolong the period of price staying at the bottom. This can help us to understand why the prices of some commodity, e.g. oil, can be quite low for a long period. In addition, our model can explain empirical phenomena observed in futures markets, such as backwardation and contango. This is a joint work with Min Dai and Cong Qin.

A Category of Probability Spaces and Monetary Value Measures

Takanori Adachi
Ritsumeikan University

We introduce a category Prob of probability spaces whose objects are all probability spaces and arrows are corresponding to measurable functions satisfying an absolutely continuous requirement. We can consider a Prob-arrow as an evolving direction of information with a way of its interpretation. We introduce a contravariant functor E from Prob to Set, the category of sets. The functor E provides conditional expectations along arrows in Prob, which are generalizations of the classical conditional expectations. For a Prob-arrow f−, we introduce two concepts f−-measurability and f−-independence and investigate their interaction with conditional expectations along f−. As an application of the category Prob, we define monetary value measures as contravariant functors from Prob to Set.

■ FE: Pricing (Room 2)

Analysis of Markov Chain Approximations for Option Pricing and Hedging

Lingfei Li
Chinese University of Hong Kong

Mijatovic and Pistorius (Math. Finance, 2013) proposed an efficient Markov chain approximation method for pricing European and barrier options in general one-dimensional Markovian models, however sharp convergence rates of this method for realistic financial payoffs which are non-smooth are rarely available. In this paper, we solve this problem for general one-dimensional diffusion models, which play a fundamental role in financial applications. For such models, the Markov chain approximation method is equivalent to the method of lines using central difference. Our analysis is based on the spectral representation of the exact solution and the approximate solution. By establishing the convergence rate for the eigenvalues and the eigenfunctions, we obtain sharp convergence rates for the transition density and the price of options with non-smooth payoffs. In particular, we have shown that for call/put-type payoffs, convergence is second order, while for digital-type payoffs, convergence is only first order in general. Furthermore, we provide theoretical justification for two well-known smoothing techniques that can restore second order convergence for digital-type payoffs and explain oscillations observed in the convergence for options with non-smooth payoffs. We also show that using finite difference with Markov chain approximation is a reliable method for computing option delta and gamma and prove that their convergence rates are the same as the rate for the option price. As an extension, we establish sharp convergence rates for European options in a rich class of Markovian jump models constructed from diffusions via subordination. The theoretical estimates are confirmed by numerical examples.

A Unified Framework for Option Pricing under Regime Switching Models

Ning Cai
Hong Kong University of Science and Technology

Regime changes are prevalent in financial markets, but it is usually challenging to price options in the presence of regime switching. In this paper, we provide a unified framework for option pricing (including European, barrier, lookback, and Asian options) under a wide class of regime switching models. Numerical examples indicate that our pricing methods are accurate and efficient. Moreover, based on our framework, we study the effects of regime switching through several finance problems. This is joint work with Yingda Song and Steven Kou.

The Sustainable Black-Scholes Equations

Chao Zhou
National University of Singapore

In incomplete markets, a basic Black-Scholes perspective has to be complemented by the valuation of market imperfections. In this paper we consider the sustainable Black-Scholes equations that arise for a portfolio of options if one adds to their trade additive Black-Scholes price, on top of a nonlinear funding cost, the cost of remunerating at a hurdle rate the residual risk left by imperfect hedging. We assess the impact of model uncertainty in this setup. This is a joint work with Yannick Armenti and Stéphane Crépey.

4.24 Monday, Afternoon II

(3:30PM ~ 4:40PM)

■ FE: Mathematics (Auditorium 2)

Solvability of Dirichlet Problem with Fractional Differential Operator

Qingshuo Song
City University of Hong Kong

This paper studies the solvability of a class of Dirichlet problem associated with a non-linear integro-differential operator. The main ingredient is the use of Perron's method together with the probabilistic construction of continuous supersolution via the identification of the continuity set of the exit time operators in the path space under Skorohod topology.

Multi-Martingale Optimal Transport

Tongseok Lim
University of Oxford

Beiglbock-Juillet [On a problem of optimal transport under marginal martingale constraints, Ann. Probab.], Beiglbock-Nutz-Touzi [Complete duality for martingale optimal transport on the line, Ann. Probab.] showed that the duality is attained in a suitable sense for the martingale optimal transport problem on the real line, that is, when there is one underlying martingale process. We generalize the duality result to the setting of d-underlying martingales which are coupled through a cost functional on R^d. We then exploit the duality to characterize the geometry of the support of the optimal martingale measures. In particular, we show that their conditional distributions are supported on certain extremal sets on R^d for the strictly convex norm costs.

Analytic Solution for American Barrier

Options with Two Barriers

Doobae Jun
Gyeongsang National University

This paper concerns American barrier options with two barriers. Standard American Options are difficult to price but there exist good numerical or analytical approximation methods. The situation is different for American barrier options. These options cease to exist or come into being if some price barrier is hit during the option's life. The paper studies analytic valuation of American barrier options with two barriers where the barriers become active by turns. In this paper, analytic valuation formulas for these options are derived by using both constant and exponential barriers for optimal early exercise policies.

■ Portfolio Optimization (Room 2)

Optimal Investment and Consumption in an Infinite Dimensional Factor Model with Delay

Jun Sekine
Osaka University

The optimal investment and consumption problem is studied in a financial market model governed by a stochastic factor, which lives in a Hilbert space and obeys to a stochastic functional differential equation. Important examples of such stochastic factors are a forward interest rate curve model with delay and a forward/future price curve model with delay. We are lead to solve a stochastic optimal control problem in infinite dimension: Employing a duality method, the dual value function is characterized as a unique strict solution of the associated dual HJB

equation. Using it, the primal value function and the feedback-form optimal strategy are constructed. The talk is based on a joint work with Fausto Gozzi and Cecilia Prosdocimi (LUISS, Rome).

Data Analytics and Investments

Jussi Keppo
National University of Singapore

We study how the cost of data analytics and the characteristics of investors and investment opportunities affect investment decisions and the demand for data analytics. We show that lower data analytics cost raises leverage, financially constrained or highly risk-averse investors have a low demand for data analytics, the demand is highest with mediocre investment opportunities and the demand is lowest with a high expected return or low risk opportunities.

High-Dimensional Portfolio Selection with Simulation

Michael Wong
Chinese University of Hong Kong

Realistic portfolio optimization problems should observe many practical constraints and apply to a vast of risky assets, including derivatives securities. Simulation-based approach is usually adopted to solve this kind of problem with constraints. However, the backward recursive algorithm becomes less feasible for high-dimensional portfolios. The estimation error in the least-squared simulation may destroy the convergence of the algorithm. This project proposes an improved simulation-based approach to the constrained high-dimensional mean-variance optimization problem, which applies variable selection techniques to deal with the high-dimensional issue and improve the estimation accuracy. Numerical analysis

compares the performance of this improved algorithm with that of the backward recursive algorithm. We show that this new approach significantly outperforms the original one. We also discuss the convergence of the new algorithm to the true optimal solution and its application in optioned portfolios. This research is supported by Hong Kong Research Grants Council via GRF. This is a joint work with Zhongyu LI.

4.24 Monday, Plenary III

(5:00PM ~ 5:40PM)

Optimal contracting and Optimal Consumption/Portfolio Selection with Limited Commitment

Hyeng Keun Koo
Ajou University

Recently there has been a steady growth of literature on optimal contracting/equilibrium with limited commitment. In particular, there is now a newly emerging literature on contracting theory with limited commitment in continuous-time. There has also been a literature on consumption/portfolio selection with liquidity (or borrowing constraints). I will explain the connection between the two strands of literature and discuss new results relevant to the two strands of literature.

4.25 Tuesday, Plenary I

(9:00AM ~ 9:40AM)

Min Dai (TBA)

4.25 Tuesday, Morning (10:00AM ~ 11:30AM)

■ Risk Management (Auditorium 2)

Persistence and Procyclicality in Margin Requirements

Qi Wu
Chinese University of Hong Kong

Margin requirements for derivative contracts serve as a buffer against the transmission of losses through the financial system by protecting one party to a contract against default by the other party. However, if margin levels are proportional to volatility, then a spike in volatility leads to potentially destabilizing margin calls in times of market stress. Risk-sensitive margin requirements are thus procyclical in the sense that they amplify shocks. We use a GARCH model of volatility and a combination of theoretical and empirical results to analyze how much higher margin levels need to be to avoid procyclicality while reducing counterparty credit risk. Our analysis compares the tail decay of conditional and unconditional loss distributions to compare stable and risk-sensitive margin requirements. Greater persistence and burstiness in volatility leads to a slower decay in the tail of the unconditional distribution and a higher buffer needed to avoid procyclicality. The tail decay drives other measures of procyclicality as well. Our analysis points to important features of price time series that should inform "anti-procyclicality" measures but are missing from current rules. This is a joint work with Paul Glasserman.

Dynamic Mean-CVaR Portfolio Selection and Time-Consistency Induced Term Structure of CVaR

Duan Li
Chinese University of Hong Kong

Recent years have witnessed higher and higher attention to down-side risk measures in financial engineering. For long investment horizons, optimal dynamic mean-CVaR strategy is indispensable to achieve high investment performance in terms of the expected return and risk control. While a few research works emerge recently on optimal dynamic mean-CVaR portfolio policy for continuous-time complete markets, we derive in this research optimal dynamic mean-CVaR portfolio policy for general incomplete discrete-time markets. As the dynamic mean-CVaR problem formulation is time inconsistent, how to update investor's VaR level and the trade-off between the mean and CVaR measures dynamically and adaptively is an important issue to address. We provide a complete answer to this question by deriving analytically the time-consistency induced term structure of CVaR in this research.

Estimation of VaR and CVaR for Oil Prices via SV-ALD Model: A Bayesian Approach Using Scale Mixture of Uniform Distribution

Liyuan Chen
University of York

The world crude oil markets have been quite volatile and risky in the past few decades due to the large fluctuations of oil prices and this unstable volatility of oil prices may lead to return uncertainties. Also, it is evident that large fluctuations of crude oil prices can be caused by aggregate demand and supply shocks. From

those points of view, this paper proposes a new parametric approach to estimate market risks of crude oil prices by adopting Value at Risk (VaR) and Conditional Value at Risk (CVaR) from both perspectives of oil supplier and consumer. Specifically, to capture potential heavy-tailed and leptokurtic features of return series, asymmetric Laplace distribution (ALD) is used to model extreme tail risks. A standard discrete stochastic volatility (SV) model, where the latent volatility is modeled by an unobservable stochastic process, is considered to characterize the behavior of return volatility with extension of adopting ALD for return error distribution. Thus, a SV-ALD model is constructed based on which the closed form expressions of VaR and CVaR for both oil supplier and demander are correspondingly derived to quantify oil market tail risks. Considering the intractable likelihood function of volatilities in SV-ALD model when doing statistical inference, the traditional maximum likelihood method, i.e. MLE can be cumbersome. The Bayesian approach, which uses a simulation-based Markov Chain Monte Carlo (MCMC) algorithm, is thus employed in this paper for model estimation.

However, a key problem in dealing the SV-ALD model is to implement it as in the framework of Bayesian inference via MCMC algorithm, the full conditional posterior distributions are of non-closed forms. Hence, this paper proposed a new scale mixture of uniform (SMU) representation for the AL density to overcome this problem. The use of SMU for scaled AL density is a data augmentation technique and its advantage is that some of the full conditional posterior distributions can be reduced to standard forms hence facilitating an efficient Gibbs sampling algorithm in the Bayesian MCMC framework. With this SUM representation, the SV-ALD model can be straightforwardly implemented. In the empirical practice, the market risks of two major crude oil markets WTI and Brent are investigated using SV-ALD model, along with validity tests for VaR and CVaR approach. Besides, a model comparison study from Bayesian statistical perspectives is conducted between SV-ALD model and classical SV normal model to test model fitting abilities for target oil return series.

Wrong Way Risk and Right Way Risk

Dawei Zhang
Hong Kong University of Science and Technology

When building CVA framework, market is complete by shares and CDS, and thus delta risk can be hedged by shares through repo and counterparty default risk can be hedged by CDS. The hedge position is through dynamically rolling over fix-rate par CDS of a short maturity. The CDS premium therefore is stochastic. Using this framework, we introduce the concept of wrong way risk/right way risk through couples of SDE. We define wrong way risk/right way risk, and provide numerical method to compute corresponding CVA adjustment.

■ Portfolio Optimization (Room 2)

Optimal Labor Supply under Inflation Risk

Byung Hwa Lim
University of Suwon

We investigate how the inflation risk affects the labor supply of an investor who wants to maximize the expected utility by choosing consumption, leisure, investment, life-insurance, and retirement time under inflation risk. To hedge the inflation risk, we introduce an

inflation-linked index bond and derive the closed-form solutions by applying martingale method. The effects of the variations of the inflation rate on the optimal policies are analyzed and it is shown that the inflation risk has a significant impact on the leisure choice.

Dynamic Asset Allocation with Loss Aversion and Illiquid Asset in a DC Pension Plan

Zhongfei Li
Sun Yat-sen University

We solve an optimal investment problem of a defined-contribution (DC) pension plan with a loss-averse member. The member is assumed to have a stochastic labor income and be able to hold a fixed position in an illiquid asset which is only traded at time 0. We provide an analytical characterization of the optimal investment strategy using the martingale approach. The S-shaped utility complicates our optimization problem and we guarantee our model to be well-posed. In addition, some sensitivity analyses are provided to show the effects of loss aversion and illiquid asset trading, which may have some important implications for the management of the DC pension plan.

Optimal Consumption and Investment under Transaction Costs

Alex Tse
University of Cambridge

We begin with the Merton problem in a market with a single risky asset and proportional transaction costs. We give a complete solution of the problem up to the solution of a free-boundary problem for a first-order differential equation, and find that the form of the solution (whether the problem is well-posed, whether the

problem is well-posed only for large transaction costs, whether the no-transaction wedge lies in the first, second or fourth quadrants) depends only on a quadratic whose coefficients are functions of the parameters of the problem. The techniques developed can be carried over to a multi-asset version of the problem with one risky liquid asset and one risky illiquid asset. Important properties of the problem such as well-posedness conditions can be derived analytically. This is a joint work with David Hobson and Yeqi Zhu.

Goal-Reaching Problem with Borrowing and Short-Sale Constraints

Xiangwei Wan
Shanghai Jiao Tong University

The Kelly criterion is successfully used in real financial markets for quantitative money management in the long run. However, many active portfolio managers are usually judged over a finite horizon, and thus interested in beating a goal in the short run. In this paper, we consider the problem of maximizing the probability of goal-reaching by a finite deadline with borrowing and short-sale constraints. To maximize the probability of goal-reaching, the managers can bear the possibility of big loss by increasing the exposure to risky assets. Specially, as the deadline approaches, either the borrowing constraint or the short-sale constraint is binding to bet on the fluctuation of the risky asset, if the wealth is still far from the goal. Numerical results show that the optimal strategy outperforms the Kelly criterion for beating the goal.

4.25 Tuesday, Plenary II

(11:40AM ~ 12:20PM)

Rama Cont (TBA)

4.25 Tuesday, Afternoon I

(2:00PM ~ 3:10PM)

■ Credit risk (Auditorium 2)

Parisian Reflection and Applications in Insurance and Credit Risk

Kazutoshi Yamazaki
Kansai University

We consider a company that receives capital injections so as to avoid ruin. Differently from the classical bail-out settings where the underlying process is restricted to stay at or above zero, we study the case bail-out can only be made at independent Poisson times. Namely, we study a version of the reflected process that is pushed up to zero only on Poisson observation times at which the process is below zero. We also study the case with additional classical reflection above so as to model a company that pays dividends according to a barrier strategy. Focusing on the spectrally one-sided Levy case, we compute, using the scale function, various fluctuation identities including capital injections and dividends.

Default Clustering and Valuation of Collateralized Debt Obligations

Xianhua Peng
Hong Kong University of Science and Technology

The financial turmoil started in 2007 has witnessed the impact of the default clustering effect (i.e., one default event tends to trigger more default events in the future and cross-sectionally), especially on the market of collateralized debt obligations (CDOs). We first present empirical evidences on default clustering via an observed common market intensity factor. Then, to price CDOs with the default clustering effects, we show the dynamic prices of CDOs can be decomposed into two parts, one part is related to observed single-name credit securities, such as credit default swaps (CDS), and the other the common market factors. We propose to use a simple affine jump diffusion process to capture the default clustering effect. By construction, the model exactly calibrates to the individual name CDS spreads observed in the market. More importantly, with only 7 parameters, the model provides good calibration to the time series data of monthly observation of CDX NA IG tranche spreads observed during the 2007 financial crisis period. This is a joint work with Steven Kou.

Contingent Convertible Bonds with the Default Risk Premium

Hyun Jin Jang
Ulsan National Institute of Science and Technology

Contingent convertible bonds (CoCos) are hybrid instruments which are characterized by both features debt and equity. CoCos are automatically converted into equities or written down the principal when a capital-ratio of an issuing bank falls below a contractual threshold. This paper studies new methodology for pricing CoCos with a capital-ratio trigger, and develops how to quantify issuing bank's default risk which can happen in a post-conversion period for pricing CoCos. We model an equity price as a geometric Brownian motion, and set a risk-weighted asset level as a single random variable

which reveals only at time of conversion, but its distribution can be progressively estimated at issuance. Under the framework, we quantify post-conversion risk by measuring probability of banks' default in the post-conversion as occuring the moment of which a capital-ratio hits a regulatory default threshold. We formulate the default risk premium caused by post-conversion risk of equity-conversion CoCos. In numerical simulations, semi-analytic results are compared with those from Monte Carlo methods, and sensitivity analysis of CoCos is conducted for risk management. The empirical tests show that equity-conversion CoCo market prices have been reflecting the default risk premium. This is a joint work with Young Hoon Na (KAIST), Harry Zheng (Imperial College)

■ Portfolio Optimization (Room 2)

How Should Individuals Make a Retirement Plan in the Presence of Mortality Risks and Consumption Constraints?

Bong-Gyu Jang
Pohang University of Science and Technology

This paper investigates optimal retirement planning when investors desire to maintain a certain minimum level of consumption, which can be achieved only by a guaranteed income stream after retirement. Our model incorporates the subsistence level in consumption and social securities and defined-contribution retirement pensions, all of which are necessary to guarantee an income stream. Our model shows that the movements of the optimal risky investments might dramatically change with the subsistence level in consumption. Our numerical results show that the risky investment rate in the retirement pension can increase with the risk-free gross return rate and with the risk aversion

level when the low risk-free rate and risk aversion level are both low. Furthermore, the risky investment rate in the retirement pension can decrease even when the market condition is favorable. This is a joint work with Taeyong Kim, Seungkyu Lee, and Hyeon-Wuk Tae.

Dynamic Portfolio Optimization with Loss Aversion Preference in Mean Reverting Market

Jian-Jun Gao
Shanghai University of Finance and Economics

In this work, we study the portfolio optimization problem with loss aversion utility function in mean-reverting market. Particularly, we use Kahneman and Tversky's 'S' shape utility function to characterize investor's preference and adopt CRI type of model to capture the mean-reverting phenomena of the stock return. We develop the semi-analytical portfolio policy of such a problem by using the martingale approach. Furthermore, numerical approach is proposed to compute the optimal wealth process and portfolio policy. The revealed portfolio policy is different from the one derived from the traditional CRRA utility model under mean-reverting market setting and also different from the one derived from portfolio optimization model with S-shape utility function and deterministic opportunity set. This result helps to explain some irrational behavior of the investor when the stock return exhibits mean-reverting pattern.

Optimal Solutions of a Behavioral Portfolio Choice Optimization Problem

Youcheng Lou
Chinese University of Hong Kong

We consider a behavioral portfolio choice optimization problem in a financial market with one risky asset and one risk-free account under the framework of Kahneman and Tversky's cumulative prospect theory. In our model, the utility is power-type, the reference point is general and short-selling is allowed. We first establish the piecewise linearity of the optimal investment strategy of the behavioral portfolio choice problem, and then derive the market conditions for optimally longing or shorting the risky asset. An interesting finding different from the classical result in expected utility theory is that maybe it is optimal for the investor to short the risky asset even though the actual market is good in terms of the mean of the excess return.

4.25 Tuesday, Afternoon II

(3:30PM ~ 4:40PM)

■ FE: Pricing (Auditorium 2)

Recovering Linear Equations of XVA in Bilateral Contracts

Junbeom Lee
National University of Singapore

We investigate conditions to represent derivative price under XVA explicitly. As long as we consider different borrowing/lending rates, XVA problem becomes a non-linear equation and this makes finding explicit solution of XVA difficult. It is shown that the associated valuation problem is actually linear under some proper conditions so that we can have the same complexity in pricing as classical pricing theory. Moreover, the conditions mentioned above is mild in the sense that it can be obtained by choosing adequate covenants between the investor and counterparty.

Semi-Static Hedging of American Floating Lookback Options

Pai-Ta Shih
National Taiwan University

Although many methods have been developed to price American floating lookback options, however replication of American floating lookback options in reality is still an important yet difficult problem in the finance research even under Black-Scholes model. This project first applies the static hedge portfolio (SHP) approach of Derman, Ergener, and Kani (1995) and Carr, Ellis, and Gupta (1998) to price American floating lookback options by constructing a static hedge portfolio to match the complicated boundary conditions of American floating lookback options. In particular, the recalculation of the option prices and hedge ratios under the proposed method is much easier and quicker than the tree methods. Especially when the stock price and/or time to maturity change, the recalculation of the prices for various American options is easier and faster. However, it should be emphasized that the component options used here are hypothetic European options and it is not possible to only use the European options for static replication of American floating lookback options because The payoff of a lookback option depends on the realized maximum or minimum of the underlying asset and the stock price over a specified time. Therefore, second, we will propose a semi-static hedging approach for American floating lookback options based on the portfolio of the hypothetic European options. We will investigate if the semi-static hedging portfolio is far less risky than the dynamic delta-hedged portfolio by detailed analyses of the profit and loss distributions. This project not

only offers another new approach to price American floating lookback options but also first develops a semi-static hedging approach for replicating American floating lookback options in reality.

Pricing Options Using Machine Learning Methods

Akhlaque Ahmad

National Institute of Securities Markets

Machine learning option pricing methods have attracted a lot of attention by researchers and practitioners the last decade. These methods typically include highly data-intensive model free approaches that complement traditional parametric methods. One characteristic of such methods is their independence of the assumptions of continuous finance theory. In this paper, we employ two machine-learning methods, Dynamic Neural Networks (DNN) and Support Vector Machines (SVM) to predict option prices. We design and implement Time Delay Neural Network (TDNN) and Nonlinear Auto-Regressive Exogenous (NARX) models on Indian market data. We also use the nonlinear Support Vector Regression (SVR) to model and predict option prices using the same set of data. This choice of models and methods is based purely on the observations of data. We evaluate forecasts given by SVM, ANN using the Diebold-Marino test. The forecasts are statistically different and ANN outperforms the SVM models on Indian derivative market data. Also, we applied the Diebold-Marino test to establish the equivalence of the two models and find that, forecasts are statistically the same and but NARX models outperform the TDNN model. We also compare forecasts by both machine learning methods with Black-Scholes-Merton (BSM) model. Machine learning methods outperform

BSM model out of sample and on different moneyness criteria.

■ FE: Optimization (Room 2)

Risk and Ambiguity in Asset Returns

Chiaki Hara

Kyoto University

We study the optimal portfolio choice problem for an ambiguity-averse investor having a utility function of the form of Klibanoff, Marinacci, and Mukerji (2005) and Maccheroni, arinacci, and Rufino (2013) in an ambiguity-inclusive CARA-normal setup. We characterize its solution and show, based on the empirical data of Fama and French's portfolios, that the market portfolio is optimal only if the investor is strictly ambiguity-averse. We then ask whether the degree of ambiguity aversion that is necessary for the market portfolio to be optimal is plausible. Exploring the beta-like expression for the expected excess return for each asset, we decompose the expected excess return into the part that can be attributed to risk and the part that can be attributed to ambiguity. Based on this decomposition, we assess whether the degree of ambiguity aversion that is necessary for the market portfolio to be optimal is plausible.

Demand for Life Insurance of a Family with Working Couple

Minsuk Kwak

Hankuk University of Foreign Studies

We investigate an optimal consumption, investment, and life insurance decision of a family with a working couple. Both of them have deterministic labor income and they decide their consumptions separately, although they share their financial wealth. Since the life times of the

working couple are uncertain, life insurance contracts for both of them are necessary to hedge their mortality risk. The objective of the family is to maximize the weighted average of the utilities of the couple and the bequest function. We obtain analytic solution and the properties of the solution are analyzed with focus on the demand for life insurance.

Optimal Order Exposure in a Limit Order Book

Xuefeng Gao
Chinese University of Hong Kong

Hidden orders are offered by many lit venues for participants to hide the true size of their orders. We propose a multi-stage dynamic programming model to determine the optimal choice of limit and hidden orders in a limit order market. We obtain analytical solutions for this model under certain assumptions. We use order-message data from NASDAQ to estimate the model and demonstrate the generality of our assumptions. Our analytical solutions together with numerical experiments suggest that participants should submit hidden orders at early stages, possibly turn to a mixture of limit and hidden orders later, and use limit orders only when the deadline is approaching. This is a joint work with Yuanyuan Chen and Duan Li.

4.25 Tuesday, Plenary III

(5:00AM ~ 5:40PM)

Hideo Nagai (TBA)

4.26 Wednesday, Plenary

(9:00AM ~ 9:40AM)

Long-term Risk of Well-diversified Equity Indexes

Eckhard Platen
University of Technology Sydney

This paper derives the long-term dynamics of well-diversified equity indexes. It is based on the theoretical insight that these indexes can be interpreted as proxy of the respective growth optimal portfolio, and the fact that the variance of the increments of diversified aggregate wealth is proportional to the wealth itself. A normalized index value follows then, in some market time, a square root process of dimension four. The derivative of market time is modelled proportional to a moving average of the square of the derivative of a moving average of the square root of the normalized index. This multi-component index model fits extremely well historical data and explains parsimoniously the index dynamics also over long time periods. It leads beyond classical no-arbitrage modelling and is derived under the benchmark approach. A novel, higher-order path wise inference method permits estimating its single parameter and extracting its single driving Brownian motion. This is a joint work with Renata Rendek.

4.26 Wednesday, Morning

(10:00AM ~ 11:30AM)

■ **FE: Stochastic Vol** (Auditorium 2)

On a Class of Normal Stochastic Volatility Model

Jaehyuk Choi

Peking University HSBC Business School

Normal, as opposed to lognormal, distribution is often suitable for modeling some financial observables which allow negative values. This study concerns a class of normal stochastic volatility model which includes the zero beta case of the popular Stochastic-Alpha-Beta-Rho (SABR) model. We provide an exact one-step simulation method and an efficient integration method for vanilla option pricing. A special case of the class admits a closed-form distribution, which can be used for modeling and simulating leptokurtic distributions.

Closed-form Implied Volatility Surface: Dissecting Specifications of Stochastic Volatility

Chenxu Li
Peking University

To transparently assess and understand whether an arbitrary stochastic volatility model for option pricing is capable of generating observable patterns of implied volatility surfaces dynamics, explicit knowledge about the corresponding evolution of implied volatility surface in terms of observable geometric features plays an important role. For this purpose, we propose and implement new closed-form bivariate-expansion approximations of implied volatility as well as its sensitivities with respect to log-moneyness and time-to-maturity. These approximations hinge on closed-form formulas of the sensitivities evaluated at the money and as the time-to-maturity shrinking to zero, which can be calculated via an iteration method. Our formulas and approximations permit crucial convenience and flexibility for disentangling relations between stochastic volatility and implied volatility. Accordingly, we are allowed to

conduct substantial comparative and empirical studies on dissecting a wide variety of stochastic volatility models and establishing an indispensable enhancement via a parsimonious multi-factor specification of the log-linear type incorporating stochastic leverage effect, in order to reconcile a set of stylized facts on the dynamics of S&P 500 index's implied volatility surface and to attain superior performance of fitting to data.

Approximate Arbitrage-Free Option Pricing under the SABR Model

Nian Yang
Nanjing University

The stochastic-alpha-beta-rho (SABR) model introduced by Hagan et al. (2002) is widely used in interest rate and foreign exchange markets. A problem is that the underlying process can hit zero with positive probability resulting in arbitrage opportunities. Closed-form, arbitrage-free, vanilla option pricing is useful in practice because it allows for fast calibration, pricing, and hedging. However, it is still an open question under the SABR model because existing research does not provide any analytical pricing formulas for vanilla options without arbitrage. In this paper, we resolve this issue by providing an analytical formula to approximate the arbitrage-free vanilla option price. Numerical experiments illustrate the accuracy and efficiency of our formula. This is a joint work with Nan Chen, Yanchu Liu, Xiangwei Wan.

Expected Exponential Utility Maximization of Insurers with a Linear Gaussian Stochastic Factor Model

Kazuhiro Yasuda
Hosei University

We consider the expected exponential utility

maximization problem for insurance companies who invest their surplus to risky assets and the risk-free asset. In our talk, we consider a stochastic factor model for the risky assets, namely the factors follow a linear Gaussian process and the mean returns of the risky assets and the intensity for the number of claims depend on economic factors. With this setting, we derive a Hamilton-Jacobi-Bellman (HJB) equation, obtain its explicit representation and construct the optimal strategy explicitly. Finally, we present some numerical results related to the value function and the ruin probability using the optimal strategy.

■ Portfolio Optimization (Room 2)

An Optimal Consumption, Gift, Investment, and Voluntary Retirement Choice Problem with Quadratic and HARA Utility

Yong Hyun Shin
Sookmyung Women's University

We study an optimal consumption, gift, investment, and voluntary retirement choice model of an agent who has a motive for giving by using a utility function. The utility function in the objective function is given by the weighted sum of a quadratic utility function and a HARA utility function. We use the martingale method to derive a closed form solution for optimal consumption, gift and investment. We also give some numerical implications. This is a joint work with Prof. Hyeng Keun Koo (Ajou University) and Prof. Kum-Hwan Roh (Hannam University)

Utility-Risk Portfolio Selection

Philip Yam
Hong Kong University of Science
and Technology

By considering the first-order optimality conditions, Nonlinear Moment Problem, a static one that includes a variational inequality and some constraints on nonlinear moments, is obtained to characterize the optimal terminal payoff. Under mild assumptions on utility, the existence of the optimal solutions for both utility- downside-risk and utility-strictly-convex-risk problems can be established. Particularly, as an example, our claim on the existence of an optimal solution for utility-semivariance problem is in contrast to the nonexistence result in well-known mean-downside-risk model. Consequently, our study advocates that the semivariance could still serve as a reasonably good risk measure in portfolio optimization. This is a joint work, to appear in SICON, with Kwok Chuen Wong (Dublin City University) and Harry Zheng (Imperial College London).

Life-Cycle Consumption, Investment, and Voluntary Retirement with Cointegration between the Stock and Labor Markets

Seyoung Park
National University of Singapore

We present an optimal life-cycle consumption, investment, and voluntary retirement model for a borrowing and short sale constrained investor who faces cointegration between the stock and labor markets. With reasonable parameter values, there exists a target wealth-to-income ratio under which the investor does not participate in the stock market at all, whereas above which the investor increases the proportion of financial wealth invested in the stock market as she accumulates wealth. We analyze the effects on investment of retirement flexibility with and without cointegration. We also isolate the effects on retirement of risk aversion with and without uninsurable income risks. The model presented

here predicts that early retirement is economically plausible in the stock market booms, like those observed in the late 1990's.

Optimal Consumption under Non-Addictive Habit Formation in Incomplete Semimartingale Markets

Xiang Yu
Hong Kong Polytechnic University

This project studies the optimal consumption under the non-addictive habit formation preference in general semimartingale markets. Our utility function is defined on the whole real line which allows the non-negative consumption to fall below the habit formation level. To avoid the path-dependent structure in our optimization problem, we propose to work on a set of auxiliary processes. However, the non-negative consumption constraint becomes a path-dependent constraint on auxiliary primal elements. In the corresponding dual problem, the stochastic Lagrange multipliers appear. It is revealed in this paper that the optimal consumption can be obtained by the construction of a special stochastic Lagrange multiplier using the optimal dual solution to the auxiliary unconstrained problem. An endogenous stopping time τ^* is provided such that the it is optimal for the individual to forgo consumption completely before τ^*. After the stopping time τ^*, the path-dependent constraint on the auxiliary process ceases to bind which implies that our optimal non-negative consumption can be constructed using the optimal solution of the auxiliary unconstrained utility maximization problem.

4.26 Wednesday, Afternoon I

(1:00PM ~ 2:30PM)

■ FE: Information (Room 3)

Informed Traders' Hedging with News Arrivals

Kiseop Lee
Purdue University

We study a hedging and pricing problem of a market with jumps, where both the jump size and the timing are affected by exclusive information available only to informed traders. The exclusive information process is a continuous time stochastic process, but affects the price process only at discrete times. This model is an extension of Lee and Song(2007), where the exclusive information affects only the jump timing, and Kang and Lee(2012), where the exclusive information affects only the jump size. We find the local risk minimization hedging strategy of informed traders.

Statistical Inference for Unified GARCH-Ito Models with Implied Information

Xiangyu Cui
Shanghai University of Finance and Economics

In financial market, the volatility information of an underlying asset is contained in the historical data of the asset and the corresponding derivatives. Combining the high-frequency and low-frequency historical data of the asset and the implied information of its options, we may achieve a better estimation for the volatility of the asset. In this paper, we construct a unified GARCH-Ito model with implied information, analyze the statistical inference problem for the proposed model and conduct empirical study.

Patent Protection and R&D Subsidy under Asymmetric Information

Haejun Jeon
Osaka University

We examine a license contract problem in vertically separated market under asymmetric information. When the upstream firm develops new technology that can save the downstream firm's running costs, perfect patent protection is optimal under symmetric information. Yet, if the downstream cannot identify the technology's quality and the upstream firm's R&D cost efficiency, perfect protection rather harms social welfare. Furthermore, it is shown that social welfare under asymmetric information is higher than that under symmetric information for most level of patent protection. In the presence of optimal policy for each regime, however, the latter dominates the former. R&D subsidy is found to be suboptimal under symmetric information, whereas it can be optimal given information asymmetry. This feature can be adopted to make optimal policies for multiple industries, and we derive the combination of patent protection and R&D subsidy that yields the first-best results in multiple industries at the same time.

Bankruptcy Decision under Asymmetric Information

Michi Nishihara
Osaka University

We develop a dynamic model in which a distressed firm optimizes the bankruptcy choice and its timing. When shareholders of the distressed firm sell the assets, they are better informed about the asset value than the market. We show that this asymmetric information can delay the firm's distressed sales to signal the asset value to the market. When the signaling cost in the sales is high, the firm changes the bankruptcy choice from selling out to default. Most notably, through the distortion in the bankruptcy choice, asymmetric information can increase the low-cost firm's debt value, as well as the market debt value, beyond the face value of debt as the firm approaches bankruptcy. The model can also account for a lot of types of debt and equity market reactions.

■ FE: Risk and Strategy (Room 4)

Robust Dynamic Pairs Trading with Cointegration

Mei Choi Chiu
Education University of Hong Kong

This paper investigates the robust optimal pairs trading using the concept of equivalent probability measures and a penalty function associated with the confidence in parameter estimates when the parameters in the drift term of the continuous-time cointegration model are estimated with errors. A closed-form solution is derived for the robust pairs trading rule. We compare the robust pairs trading rule against its non-robust counterpart using simulations and real data. The robust strategy is empirically more stable and less volatile.

Sensitivity Analysis of Long-Term Cash Flows

Hyungbin Park
Worcester Polytechnic Institute

This talk discusses a sensitivity analysis of long-term cash flows. The cash flow is given as a pricing operator of a Markov diffusion process. We employ the Hansen-Scheinkman decomposition, which is a technique expressing

the cash flow by the eigenvalue and eigenfunction of the pricing operator. By combining the results of Fournie et al., we conclude that the sensitivities of long-term cash flows can be represented in simple forms of the eigenvalue and the eigenfunction.

An Ergodic BSDE Approach to Forward Entropic Risk Measures: Representation and Large-Maturity Behavior

Wing Fung Chong
University of Hong Kong
King's College London

Using elements from the theory of ergodic backward stochastic differential equations, we study the behavior of forward entropic risk measures. We provide a general representation result and examine their behavior for risk positions of large maturities. We also compare them with their classical counterparts and derive a parity result.

4.26 Wednesday, Afternoon II

(2:50PM ~ 4:20PM)

■ FE: Market & Equilibrium (Room 3)

Updating the Market Completion in Incomplete Market and Its Convergence

Shuenn Jyi Sheu
National Central University

Merton-type optimal consumption problems are classical portfolio optimization problems. When the market is complete, the problem can be solved by martingale method using duality from convex analysis. When the market is incomplete, we can complete the market using the idea of "fictitious completion" developed by Karatzas-Lehoczky-Shreve-Xu(1991). The solution in each "fictitious" complete market will give an upper estimate for the original market. This idea is used to obtain an approximation of the optimal consumption problem in Haugh-Kogan-Wang(2006), Rogers- Zaczkowski(2013). This raises an interesting question about how to update the market completion to obtain a better approximation. In this note we discuss an updating scheme suggested by HJB equation from control theory. We also give analysis how the exponential convergence of this updating scheme can be proved. The discussion is based on a joint work with W.H. Fleming and H. Nagai.

Dynamic Equilibrium Framework in Cyber-Security Game

Jin Hyuk Choi
Ulsan National Institute of Science
and Technology

Motivated by cyber-warfare, we develop an attacker-defender game in the continuous time framework. The attacker(hacker) tries to maximize the expected total profit by malicious activities until she is blocked by the defender, and the defender's role is to estimate the threat level by filtering and to optimally choose the blocking-threshold. We describe the unique equilibrium strategies of the players. Model implications for Internet regulation and cyber-insurance business will be discussed.

A Market Driver Volatility Model via Policy Improvement Algorithm

Jun Maeda
University of Warwick

In the over-the-counter market in derivatives, we

sometimes see large numbers of traders taking the same position and risk. When there is this kind of concentration in the market, the position impacts the pricings of all other derivatives and changes the behaviour of the underlying volatility in a nonlinear way. We model this effect using Heston's stochastic volatility model modified to take into account the impact. The impact can be incorporated into the model using a special product called a market driver, potentially with a large face value, affecting the underlying volatility itself. We derive a revised version of Heston's partial differential equation which is to be satisfied by arbitrary derivatives products in the market. This enables us to obtain valuations that reflect the actual market and helps traders identify the risks and hold appropriate assets to correctly hedge against the impact of the market driver. If time permits, I will further show numerical results when the market driver is of exotic type. This is a joint work with Professor Saul D. Jacka.

https://arxiv.org/abs/1612.00780

■ **FE: Pricing** (Room 4)

Asymptotic Expansions of Discretely Monitored Barrier Options under Stochastic Volatility Models

Chao Shi
Shanghai University of Finance and Economics

We propose an expansion algorithm for pricing discretely monitored barrier options under stochastic volatility models. It turns out that the celebrated Hilbert transform recursion algorithm proposed by Feng and Linetsky (2008) becomes the leading term and building block in our expansion formula under stochastic volatility models. Our expansions are automatic and fast. Numerical results show that our algorithm is efficient and robust.

Post-crisis Dual Curve Market Model for Interest Rate Derivatives Pricing

Shidong Cui
Hong Kong University of Science and Technology

Before the 2007-08 financial crisis, forward-rate curves of different tenors almost overlapped, so interest-rate modelling can be carried out with a single forward-rate curve. Things changed over the crisis. Nowadays, the differences among the forward rates of various tenors are too significant to ignore, and forward-rate dynamics is modelled tenor by tenor, giving rise to the so-called multi-curve modelling. While the tenor-dependent modelling approach encourages sector segmentation, and it is also well-known to be inconsistent with the stylized pattern of basis-spread curves for swap rates. In this talk, we will introduce the term structure of "expected-loss rates", and adapt the standard LIBOR market model to the post-crisis reality of interest-rate derivatives markets by jointly modelling a forward-rate curve and a expected loss rate curve of the same tenor. Through our dual-curve modelling we will demonstrate how the "reshuffle premium" causes the basis spreads, which is a belief shared by market participants. This extension of the market model can 1) explain the existence of the multiple forward-rate curves, 2) the pattern of basis spread curve, and 3) break the barriers in the pricing and hedging for LIBOR derivatives which depends on various tenors. Also, we apply the heat kernel expansion method to our SABR/LMM-like dual-curve model in order to propose a fast method of market calibration. All the numerical results will be presented at the end of the talk.

The Modified Model-Free Implied Volatility in the Chinese Option Market

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Volatility is an effective measure of asset risk, which stimulates a wide range of research interest due to the fundamental impact of asset risk and earnings. However, future volatility is unobservable. The traditional way is based on the option pricing model, such as B-S model, which allows direct calculation of the implied volatility. But the B-S model have very strict and unrealistic assumptions, the use of such model will add a lot of noise which affect the forecast accuracy.

Derived by Britten Jones and Neu-berger(2000), Jiang and Tian(2005) proposed a general model-free method for calculating implied volatility only based on non-arbitrage conditions, Including volatility. The idea is that in the risk of the neutral world, the volatility of the underlying asset is the call option price on the exercise price of some form of integral. The model-free method is independent of the existing option pricing model on the market. The required conditions are relatively simple and have become an important indicator in the market and are used by the Chicago option market as an implied volatility "VIX".

Because of the existence of arbitrage of Chinese options market, this article proposes a new way to calculate the model-free implied volatility. This paper offers a modified method by adding the arbitrage difference delta parameter in the theoretical option equation, meanwhile based on the assumption that delta spreads remained relatively stable over a period of time and use the rolling time window regression to predict the next time delta, then calculate the implied volatility. For solving the problems on fewer and sparse options price points due to China option market is an emerging market, this paper uses the data filling method of the sensor network, and use the improved Markov distance filling algorithm to fill and process the data.