2015 The Third Asian Quantitative Finance Conference (AQFC)

Conference Program

6-8 July, 2015, Hong Kong, China

Conference Schedule

Date / Time	6 July (Mon)	7 July (Tue)	8 July (Wed)
08:00 – 08:30	Registration		
08:35 – 08:45	Remark by Benjamin W. Wah	Registration	Registration
08:45 – 08:55	Remark by Duan Li & Nan Chen		
08:55 – 09:45	**Keynote 1 – Information and Derivatives by Jerome Detemple** **Group Photo**	**Keynote 3 – A Unified Approach to Systemic Risk Measures via Acceptance Sets by Jean-Pierre Fouque**	**Keynote 5 – The Best Time to Leave a Casino by Xunyu Zhou**
09:45 – 10:00	**Tea break, G/F, Yasumoto International Academic Park**		
10:00 – 11:30	**M01 - Credit Risk Modeling** Location: YIA 201 **M02 - Option Pricing (I)** Location: YIA LT4	**T01 - Credit Risk** Location: YIA 201 **T02 - Option Pricing (II)** Location: YIA LT4	**W01 - Computational Methods** Location: YIA 201 **W02 - Time Inconsistency** Location: YIA LT4
11:30 – 12:30	**M03 - Student Paper Competition I** (YIA LT4)	**T03 - Student Paper Competition III** (YIA LT4)	
12:30 – 13:50	**Lunch**		
14:00 – 15:30	**M04 - Risk Measure & Control** Location: YIA 201 **M05 - Optimal Control** Location: YIA LT4	**T04 - Term Structure & Funding Risk** Location: YIA 201 **T05 - Optimal Investment** Location: YIA LT4	**W03 - Trading & Market Microstructure** Location: YIA 201 **W04 - Portfolio Optimization & Control (I)** Location: YIA LT4
15:30 – 15:50	**Tea break, G/F, Yasumoto International Academic Park**		
15:50 – 16:40	**Keynote 2 – Separating Skilled and Unskilled Fund Managers by Contract Design by Steven Kou**	**Keynote 4 – VaR and Expected Shortfall under Sublinear Expectation by Shige Peng**	**Keynote 6 – Dynamics of Order Positions and Related Queues in a Limit Oder Book by Xin Guo**
16:40 – 17:40	**M06 - Student Paper Competition II** (YIA LT4)	**T06 - Dependence Modelling** Location: YIA 201 **T07 - Stochastic Analysis** Location: YIA LT4	**W05 - Optimal Consumption** Location: YIA 201 **W06 - Portfolio Optimization & Control (II)** Location: YIA LT4
19:00 – 21:30		Conference Banquet **Banquet speech -** Demystifying the Chinese Housing Boom by Prof. Wei Xiong **Best Paper Award Ceremony**	

6 July 2015 (Monday)

08:00 – 08:30	Registration, YIA LT4, 2/F, Yasumoto International Academic Park, CUHK
08:30 – 08:45	Remark by Benjamin W. Wah
08:45 – 08:55	Remark by Duan Li & Nan Chen
08:55 – 09:45	Keynote 1 – Information and Derivatives by Jerome Detemple, Chair: Nan Chen (YIA LT4)
09:45 – 10:00	**Group Photo** **Tea break, G/F, Yasumoto International Academic Park, CUHK**

	M01 - Credit Risk Modeling Chair : Takeaki Kariya Venue: YIA 201	**M02 - Option Pricing (I)** Chair : Prof. Jean-Pierre Fouque Venue: YIA LT4
10:00 – 10:30	Pricing Credit Derivatives in a Markov-Modulated Reduced Form Model by Srikanth K. Iyer	Modelling Time-Dependency in Finance: a Time-Change Approach by Lingfei Li
10:30 – 11:00	Measuring Credit Risk of Individual Corporate Bonds in the US Energy Sector By Takeaki Kariya	An Analytical Approximation for Pricing VWAP Options by Masaaki Kijima
11:00 – 11:30	Rare Event Simulation Related to Financial Risks: Efficient Estimation and Sensitivity Analysis By Ankush Agarwal	Pricing Options on Discrete Realized Variance with Partially Exact and Bounded Approximations by Yue Kuen Kwok

	M03 - Student Paper Competition I Judges: Yue Kuen Kwok, Xun Li Venue: YIA LT4
11:30 – 11:50	Margin Calculation of Multi-leg Option Strategies by Yuanyuan Chen
11:50 – 12:10	A New Model for Valuation of a Bond with Multi Credit Rating Migration Risks by Yuan Wu
12:10 – 12:30	Modeling of Stochastic Basis Spread by Cheuk Hang Leung
12:30 – 13:50	**Lunch**

	M04 - Risk Measure & Control Chair: Xianhua Peng Venue: YIA 201	**M05 - Optimal Control** Chair: Kazutoshi Yamazaki Venue: YIA LT4
14:00 – 14:30	Rank-Dependent Utility Maximization with Constrained Risk Exposure by Zuo Quan Xu	Optimality of Refraction Strategies for Spectrally Negative Levy Processes by Kazutoshi Yamazaki
14:30 – 15:00	On the Measurement of Economic Tail Risk by Xianhua Peng	Robust Optimal Control of Excess-of-loss Reinsurance and Investment for an Insurer with Jumps by Yan Zeng
15:00 – 15:30	On Dynamic Mean-Downside Risk Portfolio Optimization by Jianjun Gao	Probabilistic Characterization and Density Expansion of the SABR Model By Nian Yang

15:30 – 15:50	**Tea break, G/F, Yasumoto International Academic Park, CUHK**
15:50 – 16:40	Keynote 2 – Separating Skilled and Unskilled Fund Managers by Contract Design by Steven Kou, Chair: Duan Li (YIA LT4)

	M06 - Student Paper Competition II Judges: Jean-Pierre Fouque, Xunyu Zhou Venue: YIA LT4
16:40 – 17:00	Fracking, Renewables & Mean Field Games by Patrick Chan
17:00 – 17:20	Finite-horizon Optimal Investment under Transaction Cost and Stochastic Volatility by Yidong Dong
17:20 – 17:40	Consistent Modeling of Smile Dynamics by Pui Yin Chan

7 July 2015 (Tuesday)

08:35 – 08:55	Registration, YIA LT4, 2/F, Yasumoto International Academic Park, CUHK
08:55 – 09:45	**Keynote 3 – A Unified Approach to Systemic Risk Measures via Acceptance Sets** by Jean-Pierre Fouque, Chair: Lingfei Li (YIA LT4)
09:45 – 10:00	**Tea break, G/F, Yasumoto International Academic Park, CUHK**

	T01 - Credit Risk Chair : Lingjiong Zhu Venue: YIA 201	**T02 - Option Pricing (II)** Chair : Jiro Akahori Venue: YIA LT4
10:00 – 10:30	Variable Volatility and Financial Failure by Lingjiong Zhu	Asymptotic and Exact Semi-Static Hedges of Barrier Options by Jiro Akahori
10:30 – 11:00	A Generalised Self-exciting Point Process: Exact Simulation and Financial Applications by Hongbiao Zhao	A General Framework for Pricing Asian Options under Markov Processes by Ning Cai
11:00 – 11:30	Systemic Risk: The Dynamics under Central Clearing by Allen Wan-Schwin Cheng	Bivariate GARCH-type Option Pricing Models with Normal-Laplace Innovations by Xundi Diao

	T03 - Student Paper Competition III Judges: Xin Guo, Xuefeng Gao Venue: YIA LT4
11:30 – 11:50	An Optimization View of Financial Systemic Risk Modeling: The Network Effect and the Market Liquidity Effect by Xin Liu
11:50 – 12:10	Empirical Pricing Kernel: An Oscillating Pattern and Its Implications by Jinming Xie
12:10 – 12:30	Saddlepoint Approximations for Conditional Expectations with Applications to Risk Management by Sojung Kim
12:30 – 13:50	**Lunch**

	T04 - Term Structure & Funding Risk Chair: Jerome Detemple Venue: YIA 201	**T05 - Optimal Investment** Chair: Tony Xue Zhong He Venue: YIA LT4
14:00 – 14:30	The Hidden Role of Interest Rate Risk in Carry Trade Return by Qi Wu	When are Investors Better off with Index Funds? A Theoretical Analysis by Tony Xue Zhong He
14:30 – 15:00	A Dual-Curve Market Model for Interest Rate Derivative by Lixin Wu	Optimal Selling Time of a Stock under Capital Gains Taxes by Budhi Arta Surya
15:00 – 15:30	Arbitrage-Free Pricing of XVA by Stephan Sturm	Endogenous Credit Constraints and Household Portfolio Choices by Hyeng Keun Koo

15:30 – 15:50	**Tea break, G/F, Yasumoto International Academic Park, CUHK**
15:50 – 16:40	**Keynote 4 – VaR and Expected Shortfall under Sublinear Expectation** by Shige Peng, Chair: Nan Chen (YIA LT4)

	T06 - Dependence Modelling Chair : Cheng-Der Fuh Venue: YIA 201	**T07 - Stochastic Analysis** Chair : Xunyu Zhou YIA LT4
16:40 – 17:10	Multi-Stage Model for Correlated Defaults by Cheng-Der Fuh	Linear Quadratic Mean-Field-Game (MFG) with Partial Information by Jianhui Huang
17:10 – 17:40	Multivariate Countermonotonicity and the Minimal Copulas by Ka Chun Cheung	Models with Discontinuous Coefficients by Arturo Kohatsu-Higa

19:00 – 21:30	Conference Banquet **Banquet Speech** – Demystifying the Chinese Housing Boom by Wei Xiong **Best Paper Award Ceremony**

8 July 2015 (Wednesday)

08:35 – 08:55	Registration, YIA LT4, 2/F, Yasumoto International Academic Park, CUHK
08:55 – 09:45	Keynote 5 – The Best Time to Leave a Casino by Xunyu Zhou, Chair: Xuefeng Gao (YIA LT4)
09:45 – 10:00	**Tea break, G/F, Yasumoto International Academic Park, CUHK**

	W01 - Computational Methods Chair : Siu Pang Yung Venue: YIA 201	**W02 - Time Inconsistency** Chair : Duan Li YIA LT4
10:00 – 10:30	Time-Inconsistent Stochastic Linear-Quadratic Control: Characterization and Uniqueness of Equilibrium by Ying Hu	Coping with Time Inconsistency in Dynamic Portfolio Selection by Duan Li
10:30 – 11:00	Fast Numerical Algorithms for Ruin Probability by Siu Pang Yung	Optimal Dividend Payments for a Diffusion Process with Time-inconsistent Preferences and Solvency Constraint by Shumin Chen
11:00 – 11:30	An Operator Expansion of Transition Density Function with Application to Maximum-Likelihood Estimation of Multivariate Diffusion by Xiangwei Wan	Competition and Time Inconsistency by Xiangyu Cui
11:30 – 12:00	Splitting Method and its Application to Multidimensional Utility Indifference Valuation by Gechun Liang	Paradoxes in Time Consistency in Mean-Variance Problem? by Phillip Sheung-Chi Yam
12:00 – 13:50	**Lunch**	

	W03 - Trading & Market Microstructure Chair: Xin Guo Venue: YIA 201	**W04 - Portfolio Optimization & Control (I)** Chair: Geetanjali Panda Venue: YIA LT4
14:00 – 14:30	Monopolistic Dealer versus Broker: Impact of Proprietary Trading with Transaction Fees by Yuan Tian	Portfolio Optimization Using Interval Analysis by Geetanjali Panda
14:30 – 15:00	Hydrodynamic Limit of Order Book Dynamics by Xuefeng Gao	Combined Estimation-Optimization (CEO) Approach for High Dimensional Portfolio Selection by Hoi Ying Wong
15:00 – 15:30	Optimal Portfolio Liquidation in Target Zone Models and Catalytic Superprocesses by Eyal Neuman	A Model for Reducing and Trading of Carbon Emissions by Huaying Guo
15:30 – 15:50	**Tea break, G/F, Yasumoto International Academic Park, CUHK**	
15:50 – 16:40	Keynote 6 – Dynamics of Order Positions and Related Queues in a Limit Oder Book by Xin Guo, Chair: Q Wu (YIA LT4)	

	W05 - Optimal Consumption Chair : Harry Zheng Venue: YIA 201	**W06 - Portfolio Optimization & Control (II)** Chair : Min Dai YIA LT4
16:40 – 17:10	An Optimal Job and Consumption/Investment Policy under Borrowing Constraints by Yong Hyun Shin	Optimal Tax Timing with Asymmetric Long-Term/Short-Term Capital Gains Tax by Min Dai
17:10 – 17:40	Merton Investment and Consumption Problem and Portfolio Turnpike Theorem by Baojun Bian	Time Consistent Behavioral Portfolio Policy for Dynamic Mean-Variance Formulation by Xun Li
17:40 – 18:10	Convex Duality Method for Constrained Quadratic Risk Minimization via FBSDEs by Harry Zheng	Relative Time and Stochastic Control with Non-Smooth Features By Xi-Ren Cao

Keynote Presentation

Keynote 1 – Information and Derivatives

Jerome Detemple

Boston University

8:55 – 9:45am, July 6; YIA LT4

Abstract: This paper studies a multi-asset continuous time economy with heterogeneous information and a derivative market. The derivative is written on an underlying stock paying a dividend at a future date. The economy is populated by informed and uninformed investors as well as active unskilled investors with bounded rationality. Informed investors observe private noisy signals about future dividend payments. The noisy rational expectations equilibrium is derived in explicit form. The equilibrium stock price has stochastic volatility, which is affine in the fundamentals and the endogenous information signals. The derivative is a non-redundant asset. Properties of equilibrium, such as informational efficiency, volatility structure and asset holdings behavior are examined.

Bio: Jérôme Detemple is Professor of Finance and Everett W. Lord Distinguished Faculty Scholar at Boston University Questrom School of Business. He holds a PhD in Finance from Wharton, a Doctorat D'État ès Sciences Économiques from Université de Strasbourg, as well as degrees from ESSEC and Université de Paris-Dauphine. He has published over 50 articles in journals, including Econometrica, Journal of Finance, Review of Financial Studies and Mathematical Finance. Detemple is the current Editor-in-Chief of Mathematical Finance and an Associate Editor of the Journal of Financial Engineering. His research focuses on portfolio selection, asset pricing and derivative securities.

Keynote Presentation

Keynote 2 - Separating Skilled and Unskilled Fund Managers

by Contract Design

Steven Kou

National University of Singapore

3:50 – 4:40pm, July 6; YIA LT4

Abstract: Foster and Young (2010, Quarterly Journal of Economics) shows that it is very difficult to design performance fee contracts rewarding skilled fund managers while screening out unskilled fund managers. In particular, none of the standard practices, such as postponing bonuses and claw-back provisions, can separate skilled and unskilled managers. We show that if (1) there is a liquidation boundary, meaning that the fund investors will close the fund immediately if the fund return is bad enough to hit the boundary, and (2) the fund manager has to use his/her own money to set up a deposit to offset the potential losses from the fund investors, then the skilled and unskilled fund managers can be separated. The deposit can be a combination of cash or an equity stake in the fund. A particular version of this type of contracts, called the first-loss scheme, is quite popular in China, and is emerging in U.S. This is a joint paper with Xuedong He and Sang Hu.

Bio: Steven Kou is currently a Provost's Chair Professor of Mathematics and the Director of the Risk Management Institute at National University of Singapore. Previously, he taught at Columbia University, University of Michigan, and Rutgers University. He teaches courses in quantitative finance, stochastic models, and statistics. He has served on editorial boards of Management Science, Mathematical Finance, Advances in Applied Probability, Mathematics of Operations Research, Operations Research Letters, Probability in Engineering and Information Science, Journal of Business and Economics Statistics. He is also the Vice President-Applied Probability for the Financial Service Section of INFORMS. He won the Erlang Prize from INFORMS.

Keynote Presentation

Keynote 3 - A Unified Approach to

Systemic Risk Measures via Acceptance Sets

Jean-Pierre Fouque

University of California, Santa Barbara

8:55 – 9:45am, July 7; YIA LT4

Abstract: The purpose of this paper is to specify a general methodological framework that is flexible enough to cover a wide range of possibilities to design systemic risk measures via multi-dimensional acceptance sets and aggregation functions, and to study corresponding examples. Existing systemic risk measures can usually be interpreted as the minimal amount of cash needed to secure the system *after aggregating* individual risks. In contrast, our approach also includes systemic risk measures that can be interpreted as the minimal amount of cash that secures the aggregated system by allocating capital to the single institutions *before aggregating* the individual risks. This allows for a possible ranking of the institutions in terms of systemic riskiness measured by the optimal allocations. Another important feature of our approach is the possibility of allocating cash according to the future state of the system (scenario-dependent allocation). We illustrate with several examples the advantages of this feature. We also provide conditions that ensure monotonicity, convexity, or quasi-convexity properties of our systemic risk measures.

Joint work with Francesca Biagini, Marco Frittelli, and Thilo Meyer-Brandis.

Bio: Jean-Pierre Fouque, Ph.D. in Mathematics, University Pierre et Marie Curie, Paris 6, 1979.

Jean-Pierre Fouque held positions at the CNRS and at the Ecole Polytechique in France, before joining North Carolina State University in 1998 where he started the Masters of Financial Mathematics.
Since 2006, he is Professor in the department of Statistics and Applied Probability at University of California Santa Barbara and Director of the Center for Financial Mathematics and Actuarial Research (CFMAR).
His research is in the domain of random media with applications ranging from wave propagation phenomena to financial mathematics. He published over ninety research articles and co-authored three books:
"Derivatives in Financial Markets with Stochastic Volatility" (Cambridge University Press, 2000),
"Wave Propagation and Time Reversal in Randomly Layered Media" (Springer, 2007), and
"Multiscale Stochastic Volatility for Equity, Interest-Rate and Credit Derivatives" (Cambridge University Press, 2011).
He co-edited the "Handbook on Systemic Risk" (CUP, 2013), and he is a member of the Advisory Committee of the U.S. Office of Financial Research.
He is Editor-in-Chief of the SIAM Journal on Financial Mathematics.
Jean-Pierre Fouque is a Fellow of the Institute of Mathematical Statistics since 2009 and a SIAM Fellow since 2011.

His web page: www.pstat.ucsb.edu/faculty/fouque

Keynote Presentation

Keynote 4 - VaR and Expected Shortfall under Sublinear Expectation

Shige Peng

3:50 – 4:40pm, July 7; YIA LT4

Abstract: The theory of G-expectation provides a new tool to measure the risk of risky portfolios. On the other hand, it also rise challenging problems, in a very fundamental level, to understand how to estimate parameters of a risk model of distribution. A typical example is the maximal distribution $M([\underline{\mu}; \bar{\mu}])$ and the normal distribution $N(\mu, [\underline{\sigma}; \sigma])$. We have proposed a robust method to calculate the risk of profit/loss essentially based on the uncertainty of distributions. In this talk we will present how to use the parameterized G-normal distribution $N(\mu, [\underline{\sigma}; \sigma])$ and maximal distribution $M_{[\underline{\mu}; \bar{\mu}]}$ in the calculations of VaR with model risk, called GVaR approach. Comparing to the classical historical simulation VaR, actually widely used in financial markets, this approaches are significantly efficient in several typically important empirical testings.

Bio: Shige Peng, Professor of Mathematics at Shandong University, is an Academician of the Chinese Academy of Sciences and a Distinguished Professor of Ministry of Education of China under Cheung Kong Scholarship Program.

His research interests include backward stochastic differential equations, nonlinear expectations and stochastic calculus; option pricing and risk measurement in mathematical finance; theory of stochastic differential controls and games; recursive utilities under risk and uncertainty; stochastic and deterministic partial differential equations. He also initialled and organized many important research programs in mathematical finance in China.

Peng has received awards and honours, which include TAN Kah Kee Science Award, 2008; Prize for Scientific and Technological Progress of Ho Leung Ho Lee Foundation, 2007; Su Buqing Award of Applied Mathematics, 2006; Top Prize of the Science and Technology of Shandong Province, China, 2003; Second Prize of the Natural Science Prize of China. Professor Peng gave a plenary lecture in the 26th ICM (International Congress of mathematicians) in 2010. He was also a plenary speaker of numerous international conferences such as in The First Pacific Rim Mathematical Association (PRIMA) Congress, Sydney, 2009; in International Conference on Stochastic Analysis and Related Fields, 1st to 6th Colloquium on Backward Stochastic Differential Equations. Shige Peng Chaired the Organizing Committee of the program of IMS of NUS "Nonlinear Expectations, Stochastic Calculus under Knightian Uncertainty, and Related Topics" in June, 2013, in Singapore.

Keynote Presentation

Keynote 5 - The Best Time to Leave a Casino

Xunyu Zhou

University of Oxford

8:55 – 9:45am, July 8; YIA LT4

Abstract: We consider the dynamic casino gambling model initially proposed by Barberis (2012) and study the optimal stopping strategy of a pre-committing gambler with cumulative prospect theory (CPT) preferences. We develop a systematic and analytical approach to finding the gambler's optimal strategy. We illustrate how the strategies computed in Barberis (2012) can be strictly improved by reviewing the betting history or by tossing an independent coin, and we explain that the improvement generated by using randomized strategies results from the lack of quasi-convexity of CPT preferences. Finally, we show that any path-dependent strategy is equivalent to a randomization of path-independent strategies. This is a joint work with Xuedong He (Columbia), Sang Hu (NUS) and Jan Obloj (Oxford).

Bio: Xunyu Zhou is Nomura Professor of Mathematical Finance, Director of the Nomura Centre for Mathematical Finance and Director of the Oxford-Nie Financial Big Data Lab at the University of Oxford. He is leading one of the biggest research groups in Quantitative Finance in Europe. His own research areas include mathematical finance/risk management, operations research and stochastic control, and he has recently engaged in the study of behavioural finance. The awards and honours he has received include Royal Society Wolfson Research Award, Humboldt Distinguished Lecturership, IEEE Fellowship, SIAM Outstanding Paper Prize, and Alexander von Humboldt Fellowship. He was an invited speaker at the 2010 International Congress of Mathematicians, and plenary/keynote speaker at numerous conferences including the 7th World Congress of the Bachelier Finance Society. He obtained his PhD degree in 1989 from Fudan University, and had worked in Kobe University, University of Toronto, and Chinese University of Hong Kong prior to joining Oxford.

Keynote Presentation

Keynote 6 – Dynamics of Order Positions and Related Queues in a Limit Oder Book

Xin Guo

University of California, Berkeley

3:50 – 4:40pm, July 8; YIA LT4

Abstract: One of the most rapidly growing research areas in financial mathematics is centered around modeling Limit Order Book (LOB) dynamics and/or minimizing the inventory/execution risk. A critical yet missing piece of the puzzle is the dynamics of an order position in a LOB.

In this talk, we will present some of our recent progress regarding the limiting behavior of the dynamics of order positions in a LOB. As a corollary, we will present some explicit expressions for various quantities of interests, including the distribution of a particular limit order being executed by a given time, its expected value and variance. Joint work with Ruan Zhao and Lingjiong Zhu.

Bio: Dr. Xin Guo is the Coleman Fung Chair professor for financial modeling at UC Berkeley's **Industrial Engineering & Operations Research** department. Her primary research interests are in the general area of stochastic processes and in particular theory of stochastic control, with applications to financial engineering. Before joining UC Berkeley, she was a professor at the school of ORIE, Cornell University. Prior to that, she spent four years at the mathematics department of IBM T. J. Watson research center at Yorktown Heights, where she was the winner of the Herman Goldstein Postdoc Fellowship.

Banquet Speech

Demystifying the Chinese Housing Boom

Wei Xiong

Princeton University

7:00pm, July 7

Abstract: We construct housing price indices for 120 major cities in China in 2003-2013 based on sequential sales of new homes within the same housing developments. By using these indices and detailed information on mortgage borrowers across these cities, we find enormous housing price appreciation during the decade, which was accompanied by equally impressive growth in household income, except in a few first-tier cities. While bottom-income mortgage borrowers endured severe financial burdens by using price-to-income ratios over eight to buy homes, their participation in the housing market remained steady and their mortgage loans were protected by down payments commonly in excess of 35 percent. As such, the housing market is unlikely to trigger an imminent financial crisis in China, even though it may crash with a sudden stop in the Chinese economy and act as an amplifier of the initial shock.

Bio: WEI XIONG is Hugh Leander and Mary Trumbull Adams Professor in Finance and Professor of Economics in the Department of Economics and Bendheim Center for Finance, Princeton University. His research interests center on capital market imperfections and behavioral finance. He has published in top economics and finance journals on a wide range of research topics, such as speculative bubbles, asset pricing with heterogeneous beliefs, asset market contagion, limited investor attention, nonstandard investor preferences, rollover risk and other financing frictions faced by firms. His current research interests focus on financialization of commodity markets, belief distortions in the recent financial crisis, and China's financial markets. He has received various awards, including 2012 Smith Breeden Award (first prize) for the best non-corporate finance paper published in Journal of Finance and 2013 NASDAQ OMX Award for the best asset pricing paper presented in Western Finance Association Meetings. He received his Ph.D. in finance from Duke University in 2001 and B.S. in physics from University of Science and Technology of China in 1993. He is a research associate of the National Bureau of Economic Research and had been the finance editor of Management Science in 2009-2011.

M01 - Monday, 10:00am - 11:30am, YIA 201
- **Credit Risk Modeling**

Chair: Takeaki Kariya, Josai International University

Pricing Credit Derivatives in a Markov-Modulated Reduced Form Model

Srikanth K. Iyer, Indian Institute of Science Bangalore (with Tamal Banerjee, Mrinal K. Ghosh)

Numerous incidents in the financial world have exposed the need for the design and analysis of models for correlated default timings. Some models have been studied in this regard which can capture the feedback in case of a major credit event. We extend the research in the same direction by proposing a new family of models having the feedback phenomena and capturing the effects of regime switching economy on the market. The regime switching economy is modeled by a continuous time Markov chain. The Markov chain may also be interpreted to represent the credit rating of the firm whose bond we seek to price. We model the default intensity in a pool of firms using the Markov chain and a risk factor process. We price some single-name and multi-name credit derivatives in terms of certain transforms of the default and loss processes. These transforms can be calculated explicitly in case the default intensity is modeled as a linear function of a conditionally affine jump diffusion process. In such a case, under suitable technical conditions, the price of credit derivatives are obtained as solutions to a system of ODEs with weak coupling, subject to appropriate terminal conditions. Solving the system of ODEs numerically, we analyze the credit derivative spreads and compare their behavior with the non-switching counterparts. We show that our model can easily incorporate the effects of business cycle. We demonstrate the impact on spreads of the inclusion of rare states that attempt to capture a tight liquidity situation. These states are characterized by low floating interest rate, high default intensity rate and high volatility. We also model the effects of firm restructuring on the credit spread, in case of a default.

Measuring Credit Risk of Individual Corporate Bonds in the US Energy Sector

Takeaki Kariya, Josai International University

In this paper, using the credit risk price spread (CRiPS) and the standardized credit risk price spread (S-CRiPS) associated with Kariya's (2013) corporate bond (KCB) model, we make empirical credit risk analysis on individual corporate bonds (CBs) in the US energy sector. Applying the principal component analysis method to the S-CRiPS, we also categorize individual CBs into three different groups and show the characteristics of the price and S-CRiPS fluctuations in each group. Secondly, using the market credit rating scheme (M-Rating) proposed by Kariya et al. (2014), we make the credit-homogeneous groups of CBs and show that our rating scheme is empirically very useful. Thirdly via KCB model with a set of cross-sectional CB and government bond (GB) price data, we derive a term structure of default probabilities (TSDPs), which reflect the investors' views and perspectives on the future default probabilities implicitly implied by the CB prices for each credit homogeneous group. Throughout this paper we find that our credit risk measure for individual CBs work effectively and can timely provide the market-based information.

Rare Event Simulation Related to Financial Risks: Efficient Estimation and Sensitivity Analysis

Ankush Agarwal, École Polytechnique (with Stefano De Marco, Emmanuel Gobet, Gang Liu)

In this paper, we develop the reversible shaking transformation methods of Gobet and Liu (2014) to estimate the rare event probability arising in different financial risk settings driven by general Gaussian noise. The underlying Markov chains introduced in our approaches take values directly in the path space. We

provide theoretical justification for few key properties of these Markov chains which are required for their ergodicity. Further, using these properties, we prove consistency results for the simulation estimator. The examples in our work cover usual semi-martingale stochastic models (not necessarily Markovian) driven by Brownian motion, and, also fractional Brownian motion based models to address various financial risks. Our approach also handles the important problem of sensitivities of rare event probability. We compare our numerical studies to the already existing results and demonstrate improved computational performance.

M02 - Monday, 10:00am - 11:30am, YIA LT4
- **Option Pricing (I)**

Chair: Jean-Pierre Fouque, University of California Santa Barbara

Modelling Time-Dependency in Finance: a Time-Change Approach

Lingfei Li, The Chinese University of Hong Kong

We show that additive subordination is a useful technique for constructing time-inhomogeneous Markov processes with analytical or computational tractability. This technique is a natural generalization of Bochner's subordination that has proven to be extremely useful in financial modelling. Probabilistically, Bochner's subordination corresponds to a stochastic time change with respect to an independent L\'{e}vy subordinator, while in additive subordination, the L\'{e}vy subordinator is replaced by an additive one. We generalize the classical Phillips Theorem for Bochner's subordination to the additive subordination case, based on which we provide Markov and semimartingale characterizations for a rich class of jump-diffusions and pure jump processes obtained from diffusions through additive subordination, and study equivalent measure changes and obtain spectral decomposition for them. To illustrate the usefulness of additive subordination, we develop 3 new models: (1) an analytically tractable cross commodity model for crack spread option valuation that is able to calibrate the implied volatility surface of each commodity and generate implied correlation patterns that are consistent with market observations and economic intuitions; (2) an analytically tractable model for pricing VIX options that is able to achieve excellent fit to the volatility surface with deep out-of-money call prices; (3) a computationally tractable model for modelling seasonal spikes in electricity spot prices and pricing electricity derivatives.

An Analytical Approximation for Pricing VWAP Options

Masaaki Kijima, Tokyo Metropolitan University (with Hideharu Funahashi)

This paper proposes a unified approximation method for various options whose payoffs depend on the volume weighted average price (VWAP). Despite their popularity in practice, quite few pricing models have been developed in the literature. Also, in previous works, the underlying asset process has been restricted to a geometric Brownian motion. In contrast, our method is applicable to the general class of continuous Markov processes such as local volatility models, stochastic volatility models, and their combinations. Moreover, our method can be used for any type of VWAP options with fixed-strike, floating-strike, continuously sampled, discretely sampled, forward-start, and in-progress transactions.

Pricing Options on Discrete Realized Variance with Partially Exact and Bounded Approximations

Yue Kuen Kwok, The Hong Kong University of Science & Technology (with Wendong Zheng)

We derive efficient and accurate analytic approximation formulas for pricing options on discrete realized variance (DRV) under affine stochastic volatility models with jumps using the partially exact and bounded (PEB) approximations. The PEB method is an enhanced extension of the conditioning variable approach commonly used in deriving analytic approximation formulas for pricing discrete Asian style options. Our numerical tests demonstrate that the PEB approximation formulas provide very good performance for pricing options on DRV under the Heston stochastic volatility model with jumps, without the shortcoming exhibited in other analytic approximation methods where accuracy may deteriorate significantly in pricing options with short maturities. The high level of numerical accuracy is attributed to the adoption of either the normal or gamma approximation of the distribution of DRV conditional on the quadratic variation.

M03 - Monday, 11:30am – 12:30pm, YIA LT4
- **Student Paper Competition I**

Judges: Yue Kuen Kwok, The Hong Kong University of Science and Technology
Xun Li, The Hong Kong Polytechnic University

Margin Calculation of Multi-leg Option Strategies
Yuanyuan Chen, The Chinese University of Hong Kong (with Duan Li)

Margin requirement is common in the practice but often ignored in the portfolio selection models. The margin calculation for option portfolios is more complicated than stocks, since options in the portfolio can offset one another partially in terms of market risk. Motivated by the combinational property of margining option portfolios, we propose an integer margin calculation model based on the strategy-based approach and vector model. Our model is proved to be equivalent to a linear programming and thus tractable. Moreover, there is a concern in the literature that the strategy-based approach is likely to overestimate the market risk in many situations. In this paper, we identify the situation where our model yields the lowest margin with full risk protection. And we also prove that the strategy-based approach with the offsets up to eight-leg will not overestimate the market risk for the portfolio with the same long and short positions of calls/puts, respectively.

A New Model for Valuation of a Bond with Multi Credit Rating Migration Risks
Yuan Wu, Tongji University (with Jin Liang)

In this paper, a new model using free boundary for pricing a corporate bond with multi credit rating migration risks is established and proposed. Properties of the solution and numerical examples are presented.

Modeling of Stochastic Basis Spread
Cheuk Hang Leung, The Chinese University of Hong Kong (with Qi Wu)

We propose a no-arbitrage dual-curve model of discount rate and index rate in single currency setting. Most existing studies model the basis spread via forward rates. In this paper, we choose the modelled quantities as two short rates. The first short rate is for calculating payoff functions referencing to index rate. The second short rate is for discounting cash flows and modeled as the spread between discount rate and index rate. Our specification is general, allowing separate driving factors for funding and referencing as well as stochastic volatilities. Key results of the paper are the derivation of the two yield curves using Mallivian calculus.

M04 - Monday, 2:00pm - 3:30pm, YIA 201

- **Risk Measure & Control**

Chair: Steven Kou, National University of Singapore

Rank-Dependent Utility Maximization with Constrained Risk Exposure

Zuo Quan Xu, The Hong Kong Polytechnic University (with Peizhen Ding)

As risk measure based investment is now emerging as the industry standard by choices and by regulation, in this work we analyze the optimal investment policies of rank-dependent utility maximizing investors who must manage risk exposure using a general law-invariant risk measure such as Value-at-Risk and Average Value-at-Risk. We overcome the difficulties arising from the discontinuity of the probability weighting function and obtain the closed-form optimal solution via the quantile formulation, change of variable technique and relaxation method.

On the Measurement of Economic Tail Risk

Xianhua Peng, The Hong Kong University of Science and Technology (with Steven Kou)

This paper attempts to provide a decision-theoretic foundation for the measurement of economic tail risk, which is not only closely related to utility theory but also relevant to statistical model uncertainty. The main result is that the only risk measures that satisfy a set of economic axioms for the Choquet expected utility and the statistical property of elicitability (i.e. there exists an objective function such that minimizing the expected objective function yields the risk measure) are the mean functional and the median shortfall, which is the median of tail loss distribution. Elicitability is important for backtesting. We also extend the result to address model uncertainty by incorporating multiple scenarios. As an application, we argue that median shortfall is a better alternative than expected shortfall for setting capital requirements in Basel Accords.

On Dynamic Mean-Downside Risk Portfolio Optimization

Jianjun Gao, Shanghai Jiao Tong University

Instead of controlling ``symmetric'' risks measured by central moments of investment, more and more portfolio models have shifted their focus to manage ``asymmetric'' downside risks that the investment return is below certain threshold. In this paper we investigate the dynamic mean-LPM, mean-CVaR and mean-multiple-risks portfolio optimization problems in continuous-time model. Our contributions are two-fold, in both building up tractable formulations and deriving corresponding analytical solutions. By imposing a limit funding level on the terminal wealth, we conquer the ill-posedness exhibited in the class of mean-downside risk portfolio models.For a general market setting, we prove the existence and uniqueness of the Lagrangian multiplies, which is a key step in applying the martingale approach, and establish a theoretical foundation for developing efficient numerical solution approaches. Moreover, for situations where the opportunity set of the market setting is deterministic, the analytical portfolio policies are derived.

M05 - Monday, 2:00pm - 3:30pm, YIA LT4
- **Optimal Control**

Chair: Kazutoshi Yamazaki, Kansai University

Optimality of Refraction Strategies for Spectrally Negative Levy Processes
Kazutoshi Yamazaki, Kansai University (with Daniel Hernandez-Hernandez, Jose-Luis Perez)

We revisit a stochastic control problem of optimally modifying the underlying spectrally negative Levy process. A strategy must be absolutely continuous with respect to the Lebesgue measure, and the objective is to minimize the total costs of the running and controlling costs. Under the assumption that the running cost function is convex, we show the optimality of a refraction strategy. The proof of convergence to the reflection strategy as well as numerical illustrations are also given.

Robust Optimal Control of Excess-of-Loss Reinsurance and Investment for an Insurer with Jumps
Yan Zeng, Lingnan (University) College, Sun Yat-sen University (with Danping Li)

This paper focuses on a robust optimal excess-of-loss reinsurance-investment problem with jumps for an ambiguity-averse insurer, who worries about model misspecification and aims to find the robust optimal strategies. The surplus process of the insurer is assumed to follow an approximation diffusion model. The insurer is allowed to purchase reinsurance and invest in a risk-free asset and a risky asset whose price process is described by a jump-diffusion model. By applying stochastic dynamic programming approach, the optimal strategies and the corresponding value function with constant absolute risk aversion utility are derived. We also analyze the utility loss of the insurer who ignores model uncertainty. Finally, some economic implications of our results and numerical illustrations are presented.

Probabilistic Characterization and Density Expansion of the SABR Model
Nian Yang, Nanjing University (with Nan Chen)

In this paper, we provide an innovative probabilistic approach to derive the asymptotic joint density formula for the SABR model considering the impact of the absorbing boundary at the origin. To the best knowledge of the authors', it is the first time that the absorbing boundary at the origin is considered to avoid an arbitrage opportunity. The impact of the absorbing boundary is quantified by the principle of not feeling the boundary. The principle explains the conditions under which the boundary does not have a great effect. We have derived an asymptotic joint density

M06 - Monday, 4:40pm – 17:40pm, YIA LT4
- ## Student Paper Competition II

Judges: Jean-Pierre Fouque, University of California, Santa Barbara
       Xunyu Zhou, University of Oxford

Fracking, Renewables & Mean Field Games
Patrick Chan, Princeton University (with Ronnie Sircar)

The dramatic decline in oil prices, from around $110 per barrel in June 2014 to less than $50 in January 2015 highlights the importance of competition between different energy sources. Indeed, the price drop has been primarily attributed to OPEC's strategic decision not to curb its oil production in the face of increased supply of shale gas and oil in the US. We study how continuous time Cournot competitions, in which firms producing similar goods compete with one another by setting quantities, can be analyzed as continuum dynamic mean field games. We illustrate how the traditional oil producers may react in counter-intuitive ways in face of competition from alternative energy sources.

Finite-horizon Optimal Investment under Transaction Cost and Stochastic Volatility
Yidong Dong, Princeton University (with Maxim Bichuch, Ronnie Sircar)

It is well known that in optimal investment problems with both risky and risk-free assets, the optimal strategy is governed by a key quantity called the ''Merton'' ratio. When the volatility is stochastic, the optimal strategy will be shifted by a certain amount. When there is proportional transaction cost associated with trading, the optimal strategy is essentially to maintain a non-trade region around the ''Merton'' ratio. To study the joint effect, we consider a finite horizon optimal investment problem with small proportional transaction cost and multi-scale stochastic volatility. We use asymptotic method to derive close-form approximations for the optimal strategy and compare it with some numerical results. We will also discuss some of the existing challenges in this study.

Consistent Modeling of Smile Dynamics
Pui Yin Chan, The Chinese University of Hong Kong (with Qi Wu)

Few existing models produce flexible term structure of volatility smile. The challenge is that volatility processes are usually specified to generate smile effects, rather than to produce maturity consistencies. For this purpose, we propose a parsimonious and tractable multi-vol-factor model whose volatility structure is low-dimensional, structurally-intuitive and degenerates to various market standard models. Essential to the model design is the derivation of general relationship between smile measures (level, skew and curvature) and the parameters of a given model. In particular, we find that the drift of stochastic volatility plays a key role in generating maturity-varying implied volatility for all moneyness. Implied volatility slope and curvature are further controlled through rate-vol correlation and vol-vol correlation.

T01 - Tuesday, 10:00am - 11:30am, YIA 201
▪ **Credit Risk**

Chair: Lingjiong Zhu, University of Minnesota

Variable Volatility and Financial Failure

Lingjiong Zhu, University of Minnesota (with Peter Carr)

Structural models of corporate default, e.g. Merton's model typically impose a rigid parametric specification on the volatility of the firm's assets. We propose a nonparametric structural model whose volatility is a function of the distance to default. We develop closed form formulas which relate RNDP and equity value to this asset volatility function and to asset price. We also show how to explicitly determine the implied RNDP and the implied asset value from the market price of the equity and from the market prices of calls written on the equity. Remarkably, the RNDP formula is independent of both the initial asset level and the debt level. Generalizations to incorporate interest rates, dividend yield, CEV, stochastic volatility into the model will also be discusses.

A Generalised Self-exciting Point Process: Exact Simulation and Financial Applications

Hongbiao Zhao, Xiamen University (with Angelos Dassios)

We introduce a generalised self-exciting point process, and develop an associated efficient Monte Carlo simulation scheme for exactly simulating this process. The underlying model is an extension of the classical Hawkes process which already has a wide application in modelling the arrival of events with clustering or contagion effect in finance, economics and many other fields. We use integral transforms of the joint distributions of the process to derive the transition densities as the basis for the design of simulation algorithm, which involves several classical simulation schemes together: distributional decomposition, transformation and the acceptance/rejection scheme, all in analytic forms. Our algorithm is pretty accurate, efficient and flexible. Some numerical examples (including some unconventional cases that are often hard to be generated by other algorithms in the existing literature) as well as examples of applications to modelling the credit risk are also provided.

Systemic Risk: The Dynamics under Central Clearing

Allen Wan-Schwin Cheng, Johns Hopkins University (with Agostino Capponi and Sriram Rajan)

We develop a tractable model for asset value processes of financial institutions trading with one central clearinghouse. Each institution allocates assets between his loan book and his clearinghouse account. We show that a unique equilibrium allocation profile arises when institutions adjust trading positions to hedge risks stemming from their loan books. The stochastic dynamic equilibrium path shows a buildup of systemic risk manifested through the increase of market concentration. We provide new testable predictions including that, for each institution, the volatility of the traded portfolio can be forecasted by the collective collateral demand of other institutions, and that hedging becomes increasingly costly as his asset value increases.

T02 - Tuesday, 10:00am - 11:30am, YIA LT4

- **Option Pricing (II)**

Chair: Jiro Akahori, Ritsumeikan University

Asymptotic and Exact Semi-Static Hedges of Barrier Options

Jiro Akahori, Ritsumeikan University

I will discuss how a risk associated with a hitting time, such as a barrier option and a defaultable bond, could be hedged by a static portfolio of European options. I will introduce a hedge-framework composed of a hierarchy of semi-static positions, n-th one of which hedges the error by the $(n-1)$-th and so on. In a fairly general situations, the hierarchy is proven to be "exact" in that the hedging error vanishes. Mathematically, it is a kind of parametrix.

A General Framework for Pricing Asian Options under Markov Processes

Ning Cai, The Hong Kong University of Science and Technology

A general framework is proposed for pricing both continuously and discretely monitored Asian options under one-dimensional Markov processes. For each type (continuously monitored or discretely monitored), we derive the double transform of the Asian option price in terms of the unique bounded solution to a related functional equation. In the special case of continuous-time Markov chain (CTMC), the functional equation reduces to a linear system that can be solved analytically via matrix inversion. Thus the Asian option prices under a one-dimensional Markov process can be obtained by first constructing a CTMC to approximate the targeted Markov process model, and then computing the Asian option prices under the approximate CTMC by numerically inverting the double transforms. Numerical experiments indicate that our pricing method is accurate and fast under popular Markov process models, including the CIR model, the CEV model, Merton's jump diffusion model, the double-exponential jump diffusion model, the variance gamma model, and the CGMY model.

Bivariate GARCH-type Option Pricing Models with Normal-Laplace Innovations

Xundi Diao, Shanghai Jiao Tong University (with Bin Tong and Chongfeng Wu)

This paper develops a method for pricing bivariate contingent claims within the framework of the generalized autoregressive conditionally heteroskedastic (GARCH) theory and the copula methodology. Under the historical probability measure, we assume that the dynamics of risky asset return is modelled by GARCH-type models with Normal-Laplace innovations and the pricing kernel is an exponential affine function of the state variables. We then show that the risk-neutral distribution is unique and again implies a Normal-Laplace dynamics with changed parameters. The dependence structure is modelled with both time invariant and time-varying copula functions. The proposed model is applied to better-of-two markets and worse-of-two-markets options. The results show that the Normal-Laplace innovations leads to option prices different from the Gaussian innovations. As for the dependence structure, option prices implied by the Symmetrized Joe-Clayton (SJC) copula and the Gaussian copula also differs substantially.

▪ **Student Paper Competition III**

Judges: Xin Guo, University of California, Berkeley
        Xuefeng Gao, The Chinese University of Hong Kong

An Optimization View of Financial Systemic Risk Modeling:The Network Effect and the Market Liquidity Effect

Xin Liu, The Chinese University of Hong Kong (with Nan Chen, David D.Yao)

Financial institutions are interconnected directly by holding debt claims against each other (the network channel), and they are also bound by market liquidity in selling assets to meet debt liabilities when facing distress (the liquidity channel). The goal of our study is to investigate how these two channels of risk transmission interact to propagate individual defaults to a system-wide catastrophe. We formulate the model as an optimization problem with equilibrium constraints and derive a partition algorithm to solve it. The obtained market-clearing equilibrium enables us to identify two factors, the network multiplier and the liquidity amplifier, to characterize the contributions of these two channels to financial systemic risk, whereby we can acquire a better understanding of the effectiveness of several policy interventions. The analysis behind the algorithm yields estimates for the contagion probability on the basis of the market value of the institutions' net worths, underscoring the importance of equity capital as a cushion against systemic shocks in the presence of the liquidity channel. The optimization formulation also provides more structural insights to allow us to extend the study of systemic risk to a system with debts of different seniorities and meanwhile presents a close connection to the literature of stochastic networks. Finally, we illustrate the impacts of the network and the liquidity channels --- in particular, the significance of the latter --- in the formation of systemic risk with data on the European banking system.

Empirical Pricing Kernel: An Oscillating Pattern and Its Implications

Jinming Xie, The Chinese University of Hong Kong (with Duan Li)

We revisit the empirical pricing kernels (EPK) estimated from the index option and the index prices. Using a much longer sample, we find that the EPKs consistently demonstrate oscillating patterns. These oscillating patterns provide a nonlaboratorial evidence for the Friedman and Savage three-piece utility function, under which the utility function is convex with moderate wealth levels, which further confirms our finding that the EPK is increasing in a subinterval with small magnitude of losses and gains.

Saddlepoint Approximations for Conditional Expectations with Applications to Risk Management

Sojung Kim, Korea Advanced Institute of Science and Technology (with Kyoung-Kuk Kim)

This paper derives saddlepoint appxomiations for $E[X \mid Y = a]$ and $E[X \mid Y > a]$ for a continuous bivariate r.v. (X,Y) whose joint MGF is known. The result is applied to value-at-risk and expected shortfall and their sensitivities. In addition, we obtain risk contribution of asset portfolios and sensitivity of delta-gamma portfolios. Numerical studies illustrate that the new approximations are not only computationally efficient but also very accurate compared to IPA estimators. The extensions to the case where Y is a multivariate random vector are also derived.

▪ **Term Structure & Funding Risk**
Chair: Jerome Detemple, Boston University

The Hidden Role of Interest Rate Risk in Carry Trade Return
Qi Wu, The Chinese University of Hong Kong
This paper studies the role played by interest rates in understanding the forward premium puzzle in currency market. Using three sets of derivative data including currency option, domestic and foreign swaption, and domestic and foreign yield curves, we find that risks associated with funding rate uncertainty and investment rate uncertainty contribute a non-negligible premium to the total carry trade return. Further, it appears that, for premium associated with higher order moments such as skewness and kurtosis, interest rate risks contribute more, if not dominant, than exchange rate risk does. Our finding is based a new international asset pricing model whose specification allows simultaneous calibration of currency option smile, domestic and foreign swaption smile, as well as yield curves. This specification enables separate control of implied risk-neutral distributions across exchange rate, funding currency interest rate, and investment currency interest rate. Therefore, a premium-attribution study can be carried out structurally across exchange rate risk, funding rate risk, investment rate risk once calibrated jointly to relevant combination of derivative data.

A Dual-Curve Market Model for Interest Rate Derivative
Wu Lixin, The Hong Kong University of Science & Technology
Before the 2007-08 financial crisis, forward-rate curves of different tenors almost overlapped, so interest-rate modeling can be carried out with the forward-rate curve of a particular tenor, say, three months. 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 modeled tenor by tenor, giving rise to the so-called multi-curve modeling. While the tenor-dependent modeling 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 "mean-loss rates", and adapt the standard LIBOR market model to the post-crisis reality of interest-rate derivatives markets by jointly modeling a forward-rate curve and a mean-loss rate curve of the same tenor. Through our dual-curve modeling we will demonstrate how the "premium of panel review" causes the basis spreads, which is a belief held by market participants.

Arbitrage-Free Pricing of XVA
Stephan Sturm, Worcester Polytechnic Institute (with Maxim Bichuch, Agostino Capponi)
We introduce a framework for computing the total valuation adjustment (XVA) of an European claim accounting for funding costs, counterparty risk, and collateral mitigation. Based on no-arbitrage arguments, we derive the nonlinear backward stochastic differential equations (BSDEs) associated with the replicating portfolios of long and short positions in the claim. This leads to defining buyer and seller's XVAs which in turn identify a no-arbitrage band. When borrowing and lending rates coincide we provide a fully explicit expression for the uniquely determined price of XVA. When they differ, we derive the semi-linear partial differential equations (PDEs) associated with the non-linear BSDEs. We use them to conduct a numerical analysis showing high sensitivity of the no-arbitrage band and replicating strategies to funding spreads and collateral levels.

T05 - Tuesday, 2:00pm - 3:30pm, YIA LT4

- **Optimal Investment**

Chair: Tony Xue-Zhong He, University of Technology Sydney

When are Investors Better off with Index Funds? A Theoretical Analysis

Tony Xue-Zhong He, University of Technology Sydney (with Lei Shi)

Motivated by the growing popularity of index funds, this paper provides a theoretical framework to examine the conditions under which the investors are better off with passive index funds than actively managed funds. We find that, for an active investor, having a relatively more accurate belief is not sufficient to achieve a better welfare than the index fund investor. One must also take into account the belief correlation between the active investors. Furthermore, when the beliefs are negatively correlated, we find that the index fund can significantly improve investors' welfare.

Optimal Selling Time of a Stock under Capital Gains Taxes

Budhi Arta Surya, Victoria University of Wellington (with christoph Kuhn, Bjorn Ulbricht)

We investigate the impact of capital gains taxes on optimal investment decisions in a quite simple model. Namely, we consider a risk neutral investor who owns one risky stock from which she assumes that it has a lower expected return than the riskless bank account and determine the optimal stopping time at which she sells the stock to invest the proceeds in the bank account up to the maturity date. In the case of linear taxes and a positive riskless interest rate, the problem is nontrivial because at the selling time the investor has to realize book profits which triggers tax payments. We derive a boundary that is continuous and increasing in time and decreasing in the volatility of the stock such that the investor sells the stock at the first time its price is smaller or equal to this boundary.

Endogenous Credit Constraints and Household Portfolio Choices

Hyeng Keun Koo, Ajou University (with Kyoung Jin Choi, Byung Hwa Lim, Jane Yoo)

In this paper we develop a consumption and portfolio selection model for a household with borrowing constraints endogenized by limited enforcement of debt repayment. By using a duality approach, we provide explicit solutions for endogenous credit limits and consumption and portfolio policies according to the limit. We derive several theoretical implications for unsecured credit limits. In particular, we find that the change of the credit limit implies that a better investment opportunity implied by a higher Sharpe ratio increases the shares of investment in risky assets of the rich but decreases those of the poor. We also provide empirical evidences on the change of credit limit and the heterogeneous investment pattern predicted by the model by using the Survey of Consumer Finances.

T06 - Tuesday, 4:40pm - 5:40pm, YIA 201

▪ **Dependence Modelling**

Chair: Cheng-Der Fuh, National Central University

Multi-Stage Model for Correlated Defaults

Cheng-Der Fuh, National Central University (with Chu-Lan Michael Kao)

Correlated defaults for multiple firms are complicated phenomenon in finance, however existing models are either simplified that contain little information, or complex that lose mathematical tractability. In this paper, we propose a structural form default model for multiple firms that preserves the rich information in structural form model, remains mathematical tractability, and captures empirical observed phenomenon. The model is divided into stages that, when any firm defaults, the model evolves into the next stage, where the firms would encounter a new set of default thresholds. By such, we are able to capture `contagion' and other correlated default effects. This stage setting also provides us the mathematical tractability in the sense that, with the help of renewal theorem, we can provide asymptotic approximation for the joint probability of default times, which is critical for risk management. The results could be further applied for n-th to default swap pricing. Numerical results are also given for illustration.

Multivariate Countermonotonicity and the Minimal Copulas

Ka Chun Cheung, The University of Hong Kong (with Woojoo Lee and Jae Youn Ahn)

As the maximum and minimum of bivariate copulas (in concordance order), Frechet-Hoeffding upper and lower bounds play an important role in various bivariate optimization problems. Similarly, as the maximum of multivariate copulas, the Frechet-Hoeffding upper bound is useful in multivariate optimization problems. However, there is no minimum copula available for dimensions $d \geq 3$. When the minimum copula is absent, minimal copulas can be useful for multivariate optimization problems. In this paper, we show that d-countermonotonic copulas defined in Lee and Ahn (2014) are minimal copulas and illustrate their usefulness in the variance minimization problem of the sum of random variables where the marginal distributions are not jointly mixable.

T07 - Tuesday, 4:40pm - 5:40pm, YIA LT4

- **Stochastic Analysis**

Chair: Xunyu Zhou, University of Oxford

Linear Quadratic Mean-Field-Game (MFG) with Partial Information

Jianhui Huang, The Hong Kong Polytechnic University

This talk considers a class of linear-quadratic-Gaussian mean-field games with partial information for individual agents. The decentralized strategies for individual agents are derived and the consistency condition is established which is equivalent to the wellposedness of some forward-backward stochastic differential equation system. The epsilon Nash equilibrium property is also verified.

Models with Discontinuous Coefficients

Arturo Kohatsu-Higa, Ritsumeikan University

In this talk we will introduce a methodology to analyse stochastic differential equations with discontinuous coefficients of a certain type. We will also discuss their applications to switching type models in finance.

Time-Inconsistent Stochastic Linear – Quadratic Control: Characterization and Uniqueness of Equilibrium

Ying Hu, Universite de Rennes1

We study a general time-inconsistent stochastic linear--quadratic (LQ) control problem. We derive a necessary and sufficient condition for equilibrium controls via a flow of forward--backward stochastic differential equations. When the state is one dimensional and the coefficients in the problem are all deterministic, we prove that the explicit equilibrium control is indeed unique. Our proof is based on the derived equivalent condition for equilibria as well as a stochastic version of the Lebesgue differentiation theorem. Finally, we show that the equilibrium strategy is unique for a mean--variance portfolio selection model in a complete financial market where the risk-free rate is a deterministic function of time but all the other market parameters are possibly stochastic processes.

W01 - Wednesday, 10:30am - 12:00noon, YIA 201
- **Computational Methods**

Chair: Siu Pang Yung, The University of Hong Kong

Fast Numerical Algorithms for Ruin Probability
Siu Pang Yung, The University of Hong Kong

In this talk, we shall exhibit some fast numerical schemes for computing ruin probability. Different type of models will also be examined. By using wavelets, the computations can sometime be simplified into a single evaluation of the density funtion.

An Operator Expansion of Transition Density Function with Application to Maximum-Likelihood Estimation of Multivariate Diffusion
Xiangwei Wan, Shanghai Jiao Tong University (with Nan Chen, Nian Yang)

This paper uses an Ito-Taylor expansion to approximate the transition density of multivariate diffusion and arranges the expansion in term of Hermite polynomials. The recursive equation for the coefficients are given explicitly and the uniform convergence of the expansion is proven, which guarantees the associated estimator approximates the true maximum likelihood estimator and shares its asymptotic properties. Numerical performances via Monte Carlo simulation show that the bias of the approximated maximum likelihood estimator is related smal.

Splitting Method and Its Application to Multidimensional Utility Indifference Valuation
Gechun Liang, King's College London

We consider exponential utility indifference pricing for a multidimensional non-traded assets model subject to inter-temporal default risk, and provide a semigroup approximation for the utility indifference price. The key tool is the splitting method, whose convergence is based on Barles-Souganidis monotone scheme and the rate of convergence is based on Krylov's shaking coefficients technique.

W02 - Wednesday, 10:00am - 12:00noon, YIA LT4
- ### Time Inconsistency

Chair: Duan Li, The Chinese University of Hong Kong

Coping with Time Inconsistency in Dynamic Portfolio Selection
Duan Li, The Chinese University of Hong Kong

Time inconsistency has been a thorny issue in many dynamic portfolio selection problems. We present in this talk a review for the state-of-the-art of this subject and discuss possibile future research directions in tackling this challengy.

Optimal Dividend Payments for a Diffusion Process with Time-Inconsistent Preferences and Solvency Constraint
Shumin Chen, Shaoxing University (with Zhongfei Li, Yan Zeng)

In this paper 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 the optimal amounts to pay as dividends. 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 the 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. Finally, we provide several examples to illustrate our results.

Competition and Time Inconsistency
Xiangyu Cui, Shanghai University of Finance and Economics (with Yun Shi)

The salespersons, whose time preferences are described by quasi-hyperbolic discounting functions, tend to evaluate the payoff received in the future with a large discount factor. In the product sales, the salespersons suffer from time inconsistency and prefer exerting relative small effort. Thus, the company may propose a competition scheme between salespersons, in which the winner can receive a marginal profit benefit. We construct the mathematical model for the competition scheme and study its influence on the time inconsistency and the total welfare of the salespersons' group. With detailed analysis, we have shown that the competition scheme with suitable attraction can improve the time inconsistency and the total welfare of the group. However, the competition scheme with large attraction makes the time inconsistency of the group worse. When the difference between the salespersons' time preference is large enough (or small), the competition scheme with large attraction may improve (or worsen) the total welfare of the group.

Paradoxes in Time Consistency in Mean-Variance Problem?
Phillip Sheung-Chi Yam, The Chinese University of Hong Kong (with A. Bensoussan, Ryan K. C. Wong)

In this talk, we shall discuss new conditions, with respect to mean-variance objective functions, under which one can start off his/her constrained (time-consistent) equilibrium strategy at a certain time to beat the unconstrained counterpart. It can be shown that the pure strategy of solely investing on bond can sometimes simultaneously dominate both constrained and unconstrained equilibrium strategies. With

numerical experiments, we also illustrate that the constrained strategy can dominate the unconstrained one at most of the commencement dates (even more than 90\%) over of a prescribed planning horizon.

The source of paradoxes is rooted from the nature of game theoretic approach of time consistency, which purposely seeks for equilibrium solution but not the ultimate maximizer. Our obtained results actually advocate that, to properly implement the concept of time consistency in various financial problems, all economic aspects should be critically taken into account at a time.

W03 - Wednesday, 2:00pm - 3:30pm, YIA 201
- **Trading & Market Microstructure**

Chair: Xin Guo, University of California, Berkeley

Monopolistic Dealer versus Broker: Impact of Proprietary Trading with Transaction Fees
Yuan Tian, Ryukoku University (with Katsumasa Nishide)

In this study, we consider a one-period financial market with a monopolistic dealer/broker and an infinite number of investors. While the dealer who trades on his own account (with proprietary trading) simultaneously sets both the transaction fee and the asset price, the broker who brings investors' orders to the market (with no proprietary trading) sets only the transaction fee, given that the price is determined according to the market-clearing condition among investors. We analyze the impact of proprietary trading on the asset price, transaction fee, trading volume, and the welfare of investors. Results show that proprietary trading increases both the trading volume and the transaction fee, and improves social welfare. Our study effectively demonstrates how proprietary trading affects market equilibrium and welfare of investors.

Hydrodynamic Limit of Order Book Dynamics
Xuefeng Gao, The Chinese University of Hong Kong (with Jim Dai, Ton Dieker, Shijie Deng)

Motivated by optimal trade execution, we study the temporal evolution of the shape of a limit order book over a time horizon that is large compared with the length of time between order book events, with the aim of approximating the transient distribution of the shape. Relying on the stochastic order book model in Cont et al. (2010), we show that when the tick size approaches zero, a pair of measure-valued processes representing the "sell-side shape" and "buy-side shape" of an order book converges to a pair of deterministic measure-valued processes in a certain sense. Moreover, we describe the density profile of the limiting processes through ordinary differential equations which can be solved explicitly. We also perform experiments to test our limiting model against data. The empirical results suggest that the approximation is effective.

Optimal Portfolio Liquidation in Target Zone Models and Catalytic Superprocesses
Eyal Neuman, The Hong Kong University of Science and Technology (with Alexander Schied)

We study optimal buying and selling strategies in target zone models. In these models the price is modeled by a diffusion process which is reflected at one or more barriers. Such models arise for example when a currency exchange rate is kept above a certain threshold due to central bank intervention.
We consider the optimal portfolio liquidation problem for an investor for whom prices are optimal at the barrier and who creates temporary price impact. This problem will be formulated as the minimization of a cost-risk functional over strategies that only trade when the price process is located at the barrier. We solve the corresponding singular stochastic control problem by means of a scaling limit of critical branching particle systems, which is known as a catalytic superprocess. In this setting the catalyst is a set of points which is given by the barriers of the price process. For the cases in which the unaffected price process is a reflected arithmetic or geometric Brownian motion with drift, we moreover give a detailed financial justification of our cost functional by means of an approximation with discrete-time models.

W04 - Wednesday, 2:00 - 3:30pm, YIA LT4

▪ Portfolio Optimization & Control (I)

Chair: Geetanjali Panda, Indian Institute of Technology Kharapur

Portfolio Optimization Using Interval Analysis

Geetanjali Panda, Indian Institute of Technology Kharapur (with Pankaj Kumar, U. C. Gupta)

In the portfolio selection model some parameters such as expected return, risk, proportion of investment, liquidity, etc., are uncertain. These parameters are generally estimated using probability theory or fuzzy set theory or possibility theory etc., for which the distribution function or membership function or possibility distribution, respectively, are to be known in advance. In reality, sometimes identification of such functions becomes burden for the decision maker. However, an investor can state these parameters in the form of intervals, whose lower and upper bound can be found either from historical data or based on the expert's knowledge. This Talk aims at investigating the impact of these facets on the optimization problems and application to portfolio selection. Initial part of the talk is based on the formulation of different single and multi-objective linear/nonlinear portfolio optimization models, In which the objective function(s) and constraints are interval valued functions. Next, one methodology is explained based on the theory of interval analysis, to find an efficient portfolio of these models, followed by application with data from Bombay Stocks Exchange, India.

Combined Estimation-Optimization (CEO) Approach for High Dimensional Portfolio Selection

Hoi Ying Wong, The Chinese University of Hong Kong (with Chi Seng Pun)

We propose a combined estimation-optimization (CEO) approach that directly estimates the optimal trading strategy (optimal control), instead of separating the estimation and optimization procedures. This paper investigates a constrained l1-minimization for estimating the optimal control and applies it to the mean-variance portfolio (MVP) problems under static and dynamic settings when the number of assets (p) is larger than the number of observation times (n). We prove that the classical sample-based MVP strategy makes the probability that the optimal portfolio will outperform the bank account tend to 50% for p>>n and a large n. The CEO approach, however, converges to the true optimal solution. In addition, the CEO scheme automatically filters out unfavorable stocks based on historical data, and works for dynamic portfolio problems and non-Gaussian distributions. Simulations validate the theory and the behavior of the proposed approach. Empirical studies show that the CEO-based portfolios outperform the equal-weight portfolio, the MVP with shrinkage estimators and other competitive approaches.

A Model for Reducing and Trading of Carbon Emissions

Huaying Guo, Tongji University (with Jin Liang)

A Model for reducing and trading of carbon emissions is established, which can turn to a nonlinear HJB equation problem. From the analysying the solution, some results are obtained.

W05 - Wednesday, 4:40pm - 5:40pm, YIA 201
- ▪ **Optimal Consumption**

Chair: Harry Zheng, Imperial College

An Optimal Job and Consumption/Investment Policy under Borrowing Constraints

Yong Hyun Shin, Sookmyung Women's University (with Ho-Seok Lee, Gyoocheol Shim)

We study an optimal job choice and consumption/investment policy of an economic agent under borrowing constraints in a continuous and infinite time horizon. The agent's preference is given by the Cobb-Douglas utility function whose arguments are consumption and leisure, and the jobs have trade-off between labor income and leisure. We obtain the closed-form solution to the optimization problem by using the martingale method. We investigate how the borrowing constraint affects the optimal job choice and consumption/investment policy. An interesting result is that the borrowing constraint in the financial market can lower the effective flexibility in labor market.

Merton Investment and Consumption Problem and Portfolio Turnpike Theorem

Baojun Bian, Tongji University (Bian, Miao, Zheng, 2011, SIAM Journal on Financial Mathematics; Bian, Zheng, 2015, Journal of Economic Dynamics and Control; Bian, Zheng, Preprint)

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.

Convex Duality Method for Constrained Quadratic Risk Minimization via FBSDEs

Harry Zheng, Imperial College (with Yusong Li)

In this paper we study a stochastic control problem arising from mathematical finance. The goal is to minimize a cost function that is quadratic in both the wealth process and portfolio strategy in a continuous time complete market with random market parameters and portfolio constraints. Following a convex duality approach, we adopt the formulation of the primal and dual problem as introduced in Heunis and Labbe (2007). We then prove that the necessary and sufficient conditions for both the primal and dual problems can be written in terms of processes satisfying a system of FBSDEs together with other conditions. This allows us to explicitly characterise the primal control as a function of adjoint process coming from the dual FBSDEs in a dynamic fashion and vice versa. Moreover, we also find that the optimal primal wealth process coincides with the optimal adjoint process of the dual problem and vice versa. Finally, we apply the dual approach to solve both the unconstrained and cone-constrained quadratic risk minimization problems.

W06 - Wednesday, 4:40pm - 5:40pm, YIA LT4
▪ Portfolio Optimization & Control (II)
Chair: Min Dai, National University of Singapore

Optimal Tax Timing with Asymmetric Long-Term/Short-Term Capital Gains Tax
Min Dai, National University of Singapore (with Hong Liu, Chen Yang, Yifei Zhong)

We develop an optimal tax-timing model that takes into account asymmetric long-term and short-term tax rates for positive capital gains and limited tax deductibility of capital losses. In contrast to the existing literature, this model can help explain why many investors not only defer short-term capital losses to long term but also defer large long-term capital gains and losses. Because the benefit of tax deductibility of capital losses increases with the short-term tax rates, effective tax rates can decrease as short-term capital gains tax rates increase.

Time Consistent Behavioral Portfolio Policy for Dynamic Mean-Variance Formulation
Xun Li, The Hong Kong Polytechnic University (with Duan Li, Xun Shi, Xiangyu Cui)

When one considers an optimal portfolio policy under a mean-risk formulation, it is essential to correctly model investors' risk aversion which may be time variant, or even state-dependent. In this work, we propose a behavioral risk aversion model, in which risk aversion is a piecewise linear function of the current wealth level with a reference point at the discounted investment target, to reflect a behavioral pattern with both house money and break even effects. Due to the time inconsistency of the resulting multi-period mean-variance model with adaptive risk aversion, we investigate the time consistent behavioral portfolio policy by solving a nested mean-variance game formulation. We derive a semi-analytical time consistent behavioral portfolio policy which takes a piecewise linear feedback form of the current wealth level with respect to the discounted investment target. Finally, we extend our results on time consistent behavioral portfolio selection to dynamic mean-variance formulation with a cone constraint.

Relative Time and Stochastic Control with Non-Smooth Features
Xi-Ren Cao, Shanghai Jiao Tong University

The stochastic calculus of non-smooth functions indicates that for a continuous semimartingale $X(t)$, the changes of a function $h[X(t)]$ at its semi-smooth point (both rightand left-hand side derivatives exist) $X(t)$ = x in $[t, t + dt]$ is at the scale of the local time of $X(t)$, with a mean of the order $\sqrt{}$ dt in the case of Ito processes. We introduce the relative time which evolves at the scale of local time when the semi-martingale is at a semismooth point of $h(x)$. The change of $h[X(t)]$ in $[t, t + dt]$ can be precisely measured in the scale of relative time, while this change is wrongly ignored with regular time scale dt. The optimal control problem is well defined with the regular time replaced by the relative time; however, dynamic programming does not seem work well for this problem. We apply the direct-comparison-based optimization approach to the control problem formulated in relative time and derive the generalized Hamilton-Jacobi-Bellman (HJB) equations, which consist of two parts, the classical HJB equation for smooth points, and some additional relations for semi-smooth points. The optimal value function is the classical solution to the generalized HJB equations, and viscosity solution is not needed. In addition, we show that the singular control problem can be formulated and solved in the same framework with the relative time.

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