

**Quantitative Finance and Risk Management  
School of Mathematics, Jilin University  
JLU-GT Joint Institute for Theoretical Sciences**

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Your registration material should contain:

- A schedule of talks, speakers, titles, and abstracts. A list of registered participants.
- List of local restaurants, on and off campus.

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- Guest accounts for wireless access have been set up for personal computers. Login information is available at the Conference information table.

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# Schedule of Presentations

Monday, July 2

8:00–8:45: Registration ( first lecture hall, mathematical building)

8:45–9:00: Welcome (first lecture hall, mathematical building)

|                     |  |
|---------------------|--|
| <b>Session A1:</b>  | Modeling Complex High Dimensional, Categorical, Corporate Financial and Functional Data                            |
| <b>Organizer:</b>   | Liang Peng   |
| <b>Room:</b>        | first lecture hall   |
| <b>9:00–9:25:</b>   | Jing Wang<br>Simultaneous Confidence Bands for Functional Derivatives  |
| <b>9:25–9:50:</b>   | Yuan Jiang<br>Variable selection with prior information for generalized linear models via the pLasso method        |
| <b>9:50–10:15:</b>  | Kai-Sheng Song<br>Multivariate fractional regression with structural zeros: the case of corporate debt composition |
| <b>10:15–10:35:</b> | Coffee break   |

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|---------------------|---|
| <b>Session A2:</b>  | Portfolio Choice and model uncertainty  |
| <b>Organizer:</b>   | Tiefeng Jiang   |
| <b>Room:</b>        | first lecture hall  |
| <b>10:35–11:00:</b> | Hening Liu<br>Ambiguity Aversion and Underdiversification   |
| <b>11:00–11:25:</b> | Xudong Zeng<br>Optimal Consumption and Portfolio Choice with Life Insurance under Uncertainty and Borrowing Constraints |
| <b>11:25–11:50:</b> | Tiefeng Jiang<br>Distributions of Angles in Random Packing on Spheres   |
| <b>12:00–14:00:</b> | Lunch   |

## Monday, July 2 Continued

|                     |   |
|---------------------|---|
| <b>Session A3:</b>  | Risk Theory, Statistics and Their Applications in Finance   |
| <b>Organizer:</b>   | Rongming Wang   |
| <b>Room:</b>        | first lecture hall  |
| <b>14:00–14:25:</b> | Dingjun Yao<br>Optimal dividend payment-capital injection strategy in the dual jump-diffusion risk model when the dividend rate is restricted |
| <b>14:25–14:50:</b> | Yong Ren<br>Reflected backward stochastic differential equations with time delayed generators   |
| <b>14:50–15:15:</b> | Zhiping Lu<br>Comparison Study of Long Memory Estimation Methods and Its Application in GDP Data  |
| <b>15:15–15:40:</b> | Shijie Wang<br>Precise Large Deviations for Sums of END Random Variables with Two-sided Distributions and Dominated Variation                 |
| <b>15:40–16:00:</b> | Coffee break  |

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| <b>Session A4:</b>  | Nonstandard Models   |
| <b>Organizer:</b>   | Holger Rootzen   |
| <b>Room:</b>        | first lecture hall   |
| <b>16:00–16:25:</b> | Ruodu Wang<br>Bounds for joint portfolio with given marginal distributions           |
| <b>16:25–16:50:</b> | Zongwu Cai<br>Testing Instability of Predictability of Asset Returns                 |
| <b>16:50–17:15:</b> | Holger Rootzen<br>Optimal discrete hedging and approximation of stochastic integrals |
| <b>18:00–</b>       | Reception  |

**Tuesday, July 3**

|                     |   |
|---------------------|---|
| <b>Session B1:</b>  | Numerical Methods, Model Calibration, and Market Behaviour  |
| <b>Organizer:</b>   | Yongmin Zhang   |
| <b>Room:</b>        | first lecture Hall  |
| <b>9:00–9:25:</b>   | Xiaogang Bi<br>Mutual Funds and Corporate Acquisitions: Evidence from China                               |
| <b>9:25–9:50:</b>   | Weian Zheng<br>Research on Calendar Spread Rate Processes of Futures Based on High-Frequency Trading Data |
| <b>9:50–10:15:</b>  | Duo Wang<br>Stock price and market maker inventory dynamics with switching heterogeneous beliefs          |
| <b>10:15–10:35:</b> | Coffee break  |

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| <b>Session B1*:</b> | Maximizing Non-expected utilities in finance and insurance                 |
| <b>Organizer:</b>   | Jianming Xia   |
| <b>Room:</b>        | second lecture Hall  |
| <b>9:00–9:25:</b>   | Zuoquan Xu<br>Portfolio Selection under Duality Index                      |
| <b>9:25–9:50:</b>   | Phillip YAM<br>Risk-Minimizing Insurance Protection For Multivariate Risks |
| <b>9:50–10:15:</b>  | Jianming Xia<br>Arrow-Debreu Equilibria for Rank-Dependent Utilities       |
| <b>10:15–10:35:</b> | Coffee break   |

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|---------------------|--|
| <b>Session B2:</b>  | Numerical Methods, Model Calibration, and Market Behaviour   |
| <b>Organizer:</b>   | Yongmin Zhang  |
| <b>Room:</b>        | first lecture hall   |
| <b>10:35–11:00:</b> | Shuhua Zhang<br>A Front-fixing Finite Element Method for the Valuation of American Options with Regime Switching |
| <b>11:00–11:25:</b> | Hongtao Yang<br>Calibration of the Extended CIR Model and Finite Element Methods for Bond Option Problems        |
| <b>11:25–11:50:</b> | Yongmin Zhang<br>American option pricing models and obstacle problems  |
| <b>12:00–14:00:</b> | Lunch  |

## Tuesday, July 3 Continued

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| <b>Session B2*:</b> | Insurance   |
| <b>Organizer:</b>   | Lihong Zhang  |
| <b>Room:</b>        | second lecture hall   |
| <b>10:35–11:00:</b> | Lin Zhao<br>Quantifying the Impact of Partial Information on Sharpe Ratio Optimization    |
| <b>11:00–11:25:</b> | Baimin Yu<br>Optimal Portfolio Selection and Retirement for an Uncertain lived individual |
| <b>11:25–11:50:</b> | Lihong Zhang<br>Ambiguity and Intellectual Resource Allocation for Insurers               |
| <b>12:00–14:00:</b> | Lunch   |

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| <b>Session B3:</b>  | Financial Statistics   |
| <b>Organizer:</b>   | Bingyi Jing  |
| <b>Room:</b>        | first lecture hall   |
| <b>14:00–14:25:</b> | Guobin Fang<br>Specification and estimation of high dimensional panel data stochastic volatility models                |
| <b>14:25–14:50:</b> | Xinbing Kong<br>A direct estimation approach to risk approximation for vast portfolios under gross-exposure constraint |
| <b>14:50–15:15:</b> | Yuanyuan Lin<br>Marginal models with a resampling method   |
| <b>15:15–15:40:</b> | Cui-Xia Li<br>On integrated volatility of Ito semimartingales when sampling times are endogenous                       |
| <b>15:40–16:00:</b> | Coffee break   |

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|---------------------|---|
| <b>Session B3*:</b> | Regular Variation and Lévy Processes  |
| <b>Organizer:</b>   | Qihe Tang   |
| <b>Room:</b>        | second lecture hall   |
| <b>14:00–14:25:</b> | Xuemiao Hao<br>Finite-time survival probability and Credit Default Swaps Pricing Under geometric Lévy markets             |
| <b>14:25–14:50:</b> | Chengguo Weng<br>Constant Proportion Portfolio Insurance under Regime Switching Exponential Lévy Process                  |
| <b>14:50–15:15:</b> | Yi Zhang<br>Evaluate Multivariate VaR and CVaR for the Aggregate of Heavy-Tailed Risk Vectors by an Asymptotical Approach |
| <b>15:15–15:40:</b> | Qihe Tang<br>Loss Given Default in the Framework of Multivariate Regular Variation  |
| <b>15:40–16:00:</b> | Coffee break  |

**Tuesday, July 3 Continued**

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|---------------------|---|
| <b>Session B4:</b>  | Extract information from financial data for risk management   |
| <b>Organizer:</b>   | Hoi Ying Wong   |
| <b>Room:</b>        | first lecture hall  |
| <b>16:00–16:25:</b> | Chi Chung Siu<br>Credit-Equity Modeling under A Latent Lévy Firm Process                            |
| <b>16:25–16:50:</b> | Chun Yip Yau<br>LASSO for Structural Break Estimation in Time Series                                |
| <b>16:50–17:15:</b> | Ying Chen<br>Regularized Pairwise Estimator of Realized Covariance                                  |
| <b>17:15–17:40:</b> | Hoi Ying Wong<br>Managing Mortality Risk with Longevity Bonds When Mortality Rates Are Cointegrated |
| <b>19:00–</b>       | Dinner  |

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|---------------------|---|
| <b>Session B4*:</b> | Quantitative risk management in actuarial science   |
| <b>Organizer:</b>   | Jun Cai   |
| <b>Room:</b>        | second lecture hall   |
| <b>16:00–16:25:</b> | Tak Kuen (Ken) Siu<br>Functional Ito's Calculus and Dynamic Convex Risk Measures for Derivative Securities  |
| <b>16:25–16:50:</b> | Xiaowen Zhou<br>Lévy Process Theory Applied to Risk Processes   |
| <b>16:50–17:15:</b> | Ming Zhou<br>Optimal Dividend Policy with Transaction Costs and Dividend Rate Constraints   |
| <b>17:15–17:40:</b> | Jun Cai<br>On the expectations of the total discounted operating costs up to ruin times in a two-dimensional risk model with proportional reinsurance |
| <b>19:00–</b>       | Dinner  |



### Wednesday, July 4

|                     |   |
|---------------------|---|
| <b>Session C1:</b>  | Extreme value theory and heavy tailedness   |
| <b>Organizer:</b>   | Zuoxiang Peng   |
| <b>Room:</b>        | first lecture hall  |
| <b>8:30–8:55:</b>   | Deyuan Li<br>Estimation of High Conditional Quantiles for Heavy-tailed Distributions    |
| <b>8:55–9:20:</b>   | Xiaoqian Wang<br>Higher Order General Regularly Varying                                 |
| <b>9:20–9:45:</b>   | Xiaoqing Pan<br>Asymptomatic behavior of tail distortion risk measure for extreme risks |
| <b>9:45–10:10:</b>  | Xin Liao<br>Rates of Convergence of Extremes from Skew Normal Samples                   |
| <b>10:10–10:20:</b> | Coffee break  |

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| <b>Session C2:</b>  | Actuarial Models and applications   |
| <b>Organizer:</b>   | Jingping Yang   |
| <b>Room:</b>        | first lecture hall  |
| <b>10:20–10:45:</b> | Lianzeng Zhang<br>A simple extension of comonotonicity: From independence to comonotonicity     |
| <b>10:45–11:10:</b> | Yefu Kou<br>Disability rate analysis of long term care insurance based on fuzzy sets and system |
| <b>11:10–11:35:</b> | Yanting Zheng<br>Applications of Shuffle of min   |
| <b>11:40–13:00:</b> | Lunch   |
| <b>13:00–</b>       | Tour  |

# Abstracts

## **Mutual funds and corporate acquisitions: evidence from China**

Xiaogang Bi, Nottingham University Business School China

In the developing Chinese capital market which dominated by individual investor and potentially suffer from more behavioural biases, we simultaneously examine the trading and monitoring role of mutual funds (as the largest institutional investor in China) in corporate acquisition activities where there are potential for a wide disparity between institutional investors and controlling shareholders' interests. We find the level of holding by all mutual funds is not a superior indicator of deal quality, there are some evidence that the collective holding by the largest fund holding company relates to the deal quality and they also play the monitoring role in M&A event. Our paper contribute to the existing literature that 'transient investors' can also gain from monitor in the market where institutional investors has less dominant position.

## **On the expectations of the total discounted operating costs up to ruin times in a two-dimensional risk model with proportional reinsurance**

Jun Cai, University of Waterloo

Assume two insurance companies share proportionally the aggregate risk that is modelled by a compound Poisson process. Thus, the surplus processes of the two companies form a two-dimensional dependent risk process. Ruin is said to occur in one company when the surplus of the company falls below zero. In this two-dimensional risk model, we are interested in the following three different ruin times: (1) the first time when ruin occurs in at least one company; (2) the first time when ruin occurs in both of the two companies simultaneously; and (3) the first time when ruin occurs in both of the two companies eventually. For each of the three ruin times, we define the expected total discounted operating cost up to the ruin time as a bivariate function of the initial reserves of the two companies. Such a function includes many interesting ruin-related quantities such as ruin probabilities, the Laplace transforms of the ruin times, the expected discounted penalty functions at the ruin times, the expected numbers of claims up to the ruin times, and so on. We derive explicit expressions of the expected total discounted operating cost up to the ruin times for certain cost functions. As applications, we give the formulas of the Laplace transforms of the ruin times and other ruin-related quantities of interest. This talk is based on a joint work with Wei Wei.

## **Testing Instability of Predictability of Asset Returns**

Zongwu Cai, UNCC and Xiamen University

This study examines the evidence of instability in time-varying coefficient predictive models which can deal with the possible instability of the predictability associated to the linear predictive model. In this paper, an  $L_2$  type of statistic is proposed to check the instability of the coefficient vector, and the asymptotic distributions of the test statistic under the null and alternative hypotheses are developed respectively. Monte Carlo experiments are conducted to evaluate the finite sample performance of the proposed test.

## **Regularized pairwise estimator of realized covariance**

Ying Chen, National University of Singapore

This paper proposes a new methodology to estimate covariance from ultra-high frequency (UHF) data. It is applicable for raw data that are asynchronous and contaminated by microstructure noises, and can guarantee semi-positiveness of the estimator. In particular, a synchronizing technique is developed, which learns from the dependence structure of the raw data and iteratively recovers the underlying synchronous series. Covariance is then pairwise estimated based on the synchronized series. A multi scaling technique is further employed to eliminate the impact of microstructure noises. The pairwise estimator however may not be semi-positive definite, and hence a regularization technique is adopted. The performance and characteristics of the regularized pairwise estimator are investigated in simulation and real data analysis. Numerical results show that the proposed estimator performs well in terms of accuracy and feature. (Joint work with Yingying Li and Vladimir Spokoiny)

## **Specification and estimation of high dimensional panel data stochastic volatility models**

Guobin Fang, Renmin University of China

Excess return of assets influenced by observable market factors and unobservable latent factors. In this paper, we proposed the dynamic factor stochastic volatility models of panel data, the unobservable factors driven by some stochastic volatility. High dimensional panel data stochastic volatility models (PDSVM) include large number parameters and latent factors to be estimated, we introduce Markov chain Monte Carlo method based on Bayesian inference. The stationary posterior distribution of latent volatility specified by proposal priori information. This method solve estimation problem of the high dimensional models effectively. Empirical studies show that PDSVM can better fit the time-varying volatility of return and heteroscedasticity characteristics on stock market, this will be used for portfolio construction and risk management.

## **Finite-time survival probability and Credit Default Swaps pricing under geometric Lévy markets**

Xuemiao Hao, University of Manitoba

We study the first passage time distribution for a general pure-jump subordinator with a negative drift over a fixed level. We prove a closed-form formula for the survival function of the first passage time in terms of only marginal distribution function and density function of the subordinator. Then we apply the formula to calculate finite-time survival probabilities in a structural model of credit risk, in which the asset value process of a company is determined by a geometric Lévy process. By doing this, we provide a closed-form pricing formula for a single-name Credit Default Swap. Particularly, the pricing formula shows that the credit spread as maturity becomes short is determined by the Lévy measure.

## Distributions of Angles in Random Packing on Spheres

Tiefeng Jiang, University of Minnesota

We study the asymptotic behaviors of the pairwise angles among  $n$  randomly and uniformly distributed unit vectors in  $p$ -dimensional spaces as the number of points  $n$  goes to infinity, while the dimension  $p$  is either fixed or growing with  $n$ . For both settings, we derive the limiting empirical distribution of the random angles and the limiting distributions of the extreme angles. The results reveal interesting differences in the two settings and provide a precise characterization of the folklore that “all high-dimensional random vectors are almost always nearly orthogonal to each other”. Applications to statistics and connections with some open problems in physics and mathematics are also discussed. This is a joint work with Tony Cai and Jianqing Fan.

## Variable selection with prior information for generalized linear models via the pLasso method

Yuan Jiang, Oregon State University

Lasso is a popular variable selection tool and is often used in conjunction with generalized linear models. When the number of variables of interest is larger than the sample size, as in many biological/biomedical studies, the power of Lasso can be limited. However, intensive biological/biomedical researches have provided large amount of plausible information about the significance of certain variables. This paper proposes an extension of Lasso, named prior Lasso (pLasso), to incorporate that prior information into penalized generalized linear models. The goal is achieved by further penalizing the Lasso criterion function with a measure of the discrepancy between the prior information and the model. For linear regression, the whole solution path of the pLasso estimator can be found with a procedure similar to Least Angle Regression. Asymptotic theory and simulation results show that pLasso provides significant improvement over Lasso when the prior information is relatively accurate. When the prior information is less reliable, pLasso shows great robustness from being distracted. We illustrate the application of pLasso using a real data set from genome-wide association studies.

## A direct estimation approach to risk approximation for vast portfolios under gross-exposure constraint

Xinbing Kong, Fudan University

It is well known that the traditional estimated risk for the Markowitz mean-variance optimization had been demonstrated to seriously depart from its theoretic optimal risk due to accumulation of input estimation errors. Fan *et al.* (2012) addressed the problem by introducing the gross-exposure constrained mean-variance portfolio selection. In this paper, we present a direct approach to estimating the risk for vast portfolios using high-frequency data. The approach transfers the risk approximation problem for vast portfolios to a problem of estimating the integrated volatility of a one dimensional Ito process. This approach does not accumulate the estimation error of tens of hundreds of integrated volatilities at all, and on the other hand it has the advantage of smoothing away the microstructure noise in

the spatial direction. Based on the simple approach, we obtained a sharper bound of the risk approximation error which is locally dependent on the allocation plan satisfying the gross-exposure constraint. The bound does not require exponential tail of the distribution of the microstructure noise. Finite fourth moment suffices. Our work also demonstrates that the gross-exposure constraint helps in decreasing the mean squared error of the risk estimator by choosing an optimal bandwidth depending on the allocation plan. Our theoretical results are further confirmed by simulations. This greatly enhances the practical uses of the gross-exposure constrained risk minimization procedure using high frequency data.

### **Disability rate analysis of long term care insurance based on fuzzy sets and system**

Yefu Kou, Central University of Finance and Economics

According to the sixth census data of 2010, in China, the aging trend, cost of care rising and changes in family structure are more and more obvious. All of these provide a lot of space for the development of long-term care insurance. This article begins by assuming that the physical condition of the insured vague and divided into health, disability and death of the three states, and their health status should be indicated by triangular fuzzy number. For the different levels of care needs of the insured, the individual is divided into four age groups (0-14, 15-44, 45-64, 65 +); and we assume that the transition probabilities between all ages is homogeneous. By applying theory and methods of fuzzy conditional probability, fuzzy transition probability and Fuzzy-Markov chain, we could calculate the distribution of the insured's physical condition in the future each year at different ages. And according to Chinese data, the distribution of disability could be get at all ages. This paper attempts to adopt Fuzzy set and system theory to analyze the rate of China disability, providing support for the pricing of long-term care insurance.

### **On integrated volatility of Ito semimartingales when sampling times are endogenous**

Cui-Xia Li, Lanzhou University

In this paper, we estimate the integrated volatility of Ito semimartingale when sampling times are endogenous. The estimator is proved to be consistent, and is robust to jumps, regardless of whether they are finite and infinite activity jumps. We also establish a central limit theorem for the estimator in a general endogenous time setting when the jumps have finite variation. Simulation is also included to illustrate the performance of the proposed procedure.

### **Estimation of High Conditional Quantiles for Heavy-tailed Distributions**

Deyuan Li, Fudan University

Estimation of conditional quantiles at very high or low tails is of interest in numerous applications. Quantile regression provides a convenient and natural way of quantifying the impact of covariates at different quantiles of a response distribution. However, high tails are often associated with data sparsity, so quantile regression estimation can suffer from high

variability at tails especially for heavy-tailed distributions. In this paper, we develop new estimation methods for high conditional quantiles by first estimating the intermediate conditional quantiles in a conventional quantile regression framework, and then extrapolating these estimates to the high tails based on reasonable assumptions on tail behaviors. We establish the asymptotic properties of the proposed estimators, and demonstrate through simulation studies that the proposed methods enjoy higher accuracy than the conventional quantile regression estimates. In a real application involving statistical downscaling of daily precipitation in the Chicago area, the proposed methods provide more stable results quantifying the chance of heavy precipitation in the area.

### **Rates of convergence of extremes from skew normal samples**

Xin Liao, Southwest University

One interesting problem in extreme value theory is considering the rates of convergence of the distribution of normalized maximum to its ultimate extreme value distribution if the marginal distribution function belongs to one type of domains of attraction of extreme value distributions. Attentions in this paper are to consider the convergence rates of distribution of normalized maximum from random sample with common skew-normal distribution family  $SN(\lambda)$  proposed by Azzalini (1985). Chang and Genton (2007) proved that distribution function following  $SN(\lambda)$  belongs to the domain of Gumbel extreme distribution by Von-Mises condition. The convergence rates of distribution of maximum from standard normal, i.e.  $SN(0)$ , were studied by Leadbetter et al. (1983), Hall (1979). More informative result was established by Nair (1981). For  $\lambda \neq 0$ , we derive Mills' inequality and Mills' ratio of distribution function following  $SN(\lambda)$ , which implies the tail representation of  $SN(\lambda)$ . Two different convergence rates of distribution of maximum from  $SN(\lambda)$  samples are established under different normalized constants, respectively.

### **Marginal models with a resampling method**

Yuanyuan Lin, Xiamen University

When using marginal models to analyze longitudinal or clustered data, the estimation methods based on each marginal model are often readily available. However, combining them to obtain a more accurate or possibly optimal estimate under certain criterion, could be difficult. The main reason is that the objective functions based on marginal models may be not differentiable. Moreover, the estimating functions based on marginal models might have variances that are difficult to compute or approximate, preventing the direct use of the method of generalized estimating equations. To circumvent these difficulties, a random weighting method is proposed to use. The main advantage of this approach is that it is computationally straightforward even when no particular structure of dependence among marginal models is available. The resulting estimator achieves certain optimality in terms of asymptotic variance. We illustrate the method with median regression, Mann-Whitney-Gehan's estimation, Buckely-James estimation and multivariate proportional hazards model as examples. Supportive empirical evidence is shown in the simulation studies. Application is illustrated with a well-known medical study.

## **Ambiguity aversion and underdiversification**

Hening Liu, University of Manchester

We examine asset allocation decisions under ambiguity aversion when investors have a prior degree of belief in asset pricing models (e.g., the CAPM). Different from the Bayesian portfolio approach, in our model the conditional distribution of returns and the posterior over uncertain parameters cannot be integrated to produce a predictive distribution. This feature is accommodated using the smooth ambiguity model of Klibanoff et al. (2005). We find that from the perspective of U.S. investors, ambiguity aversion can generate strong home bias in their equity holdings. Our results are robust to investors' belief in the domestic CAPM, the degree of risk aversion, sample periods and regime-switching investment opportunities.

## **Comparison study of long memory estimation methods and its application in GDP data**

Zhiping Lu, East China Normal University

In this paper, several semi-parametric memory parameter estimation procedures for the fractionally integrated I(d) process are reviewed. Through the Monte Carlo simulation study in which time series with a linear time trend, occasional structural breaks in levels and heteroscedastic innovations are considered, we cast a light on the finite sample performance of these estimation procedures for the non-stationary I(d) process. Another result of this comparison study is that we provide a bandwidth parameter selection strategy for the Fourier domain estimators and an upper-and-lower scale trimming strategy for the wavelet domain estimators from a practical standpoint. Therefore this paper gives a useful reference for the utilization of memory parameter estimation procedures to practitioners and applied researchers who are interested in the long memory property in time series. Finally, we apply our results to the historical GDP data of 16 OECD countries in Europe and obtain some empirical findings. (With Beijia Zhu and Dominique Guegan)

## **Asymptotic behavior of tail distortion risk measure for extreme risks**

Xiaoqing Pan, University of Science and Technology of China

In this paper, we revisit the first-order asymptotic approximation of the tail distortion risk measure under the assumption of regular variation, and then derive the second-order approximation of the tail distortion risk measure in the framework of the second-order regular variation. The second-order properties of the risk concentration based on the tail distortion risk measure are also investigated.

## **Reflected backward stochastic differential equations with time delayed generators**

Yong Ren, Anhui Normal University

In this talk, I will introduce a class of reflected backward stochastic differential equations with time delayed generator (RBSDEs with time delayed generator, in short) for a sufficiently small Lipschitz constant of the generator and its potential applications in optimal control and finance. (With Zhou Qing)

## **Optimal discrete hedging and approximation of stochastic integrals**

Holger Rootzen, Chalmers University of Technology

This talk discusses strategies for discrete option hedging. The tool is joint convergence of the approximation error for several stochastic integrals with respect to local Brownian semimartingales, for non-equidistant and random grids. The conditions needed for convergence are that the Lebesgue integrals of the integrands tend uniformly to zero and that the squared variation and covariation processes converge. We also provide tools which simplify checking the conditions and extend the range for the results. In particular the talk presents explicit limit theorem for random grid approximations of integrals based on solutions of multidimensional SDE-s, and way to “design” and optimize the distribution of the approximation error.

## **Credit-equity modeling under a latent Lévy firm process**

Chi Chung Siu, Tokyo Metropolitan University

We propose a unified credit-equity modeling by extending the latent structural model originally proposed by Kijima et al. (2009) so as to include jumps and regime switching. As in the original latent model, we treat the actual firm value to be unobservable and one can extract information from the correlated marker process, the equity value, which is actively traded in the market. Default occurs when the actual firm value reaches a default threshold at the first time before the maturity of debt. The purpose of such extension is to capture more realistic credit spreads under different economic environments. We illustrate the application of the model through the pricing of credit default swaps and equity options. Our model can evaluate corporate securities and their derivatives in a unified framework.

## **Functional Ito’s calculus and dynamic convex risk measures for derivative securities**

Tak Kuen (Ken) Siu, Macquarie University

Using the functional Ito’s calculus and forward-backward stochastic differential equations (FBSDEs), a new approach for evaluating dynamic convex risk measures for European-style derivative securities is proposed in a general, continuous-time financial market. The proposed approach can accommodate non-Markovian price processes of underlying risky assets. It consists of two stages. Initially, a dynamic convex risk measure for an unhedged position of derivative securities is represented as the conditional g-expectation which is given by the solution of the backward system in a FBSDE. Then, at the second stage, we use the functional Ito’s calculus, a martingale representation and the unique decomposition of special semimartingales to identify the solution of the backward system in the FBSDE. In particular, the control component in the backward system is identified using functional derivatives. Whereas the first component of the backward system satisfies a functional partial differential equation.



**Multivariate fractional regression with structural zeros:  
the case of corporate debt composition**

Kai-Sheng Song, University of North Texas

There are many problems in finance that involve compositional data: investor asset allocations, corporate liability structures, debt composition, etc. In all of these situations one faces structural zeros. That is, the decision-maker chooses not to invest in a particular asset class or the firm chooses not to use a particular type of debt instrument. The statistical analysis of such problems has proved difficult and published solutions are ad hoc (e.g., add a small number to zero). We propose a new class of multivariate mixed continuous-discrete densities on the simplex. Our approach of combining a discrete choice model with continuous compositional models allows consistent estimation of multivariate fractional regression models with structural zeros based on tractable likelihood functions. To evaluate our approach, we use both Monte Carlo simulations to examine its performance and an application to the analysis of corporate debt composition. Colla, Ippolito, and Li (2012) examine the composition of corporate debt without considering its key compositional features. We examine data on the composition of corporate debt and derive a richer analysis of these data, and so illustrate the need to recognize the features that motivate our statistical model in financial studies involving compositional data.

**Loss Given Default in the Framework of  
Multivariate Regular Variation**

Qihe Tang, University of Iowa

We are interested in an investment portfolio of  $n$  obligors subject to possible default. A new model for the loss given default is introduced. The tail probability of the loss given default is studied within the framework of multivariate regular variation. This talk is based on a joint work with Zhongyi Yuan.

**Stock price and market maker inventory dynamics with  
switching heterogeneous beliefs**

Duo Wang, Peking University

This paper examines the stabilizing role of a market maker who acts as both a liquidity trader and an active investor within the framework of bounded rationality. It does so by developing a market maker inventory and dynamic stock price model with two types of heterogeneous agents' fundamentalists and trend followers who change their beliefs according to the realized profits. It is shown that the stabilizing role of the market maker can be very limited when both types of agents are active strongly. However, as an investor, the market maker may have an incentive to destabilize the market in order to maximize his(her) profit. Numerical analysis of the stochastic model demonstrates that the model is able to generate most of the stylized facts of asset returns and empirical patterns for market maker inventories observed in financial markets. The model sheds light on issues related to market design, regulation and stability.

## **Simultaneous confidence bands for functional derivatives**

Jing Wang, University of Illinois at Chicago

A new procedure is developed to construct simultaneous confidence bands for regression curves in functional data analysis. Specifically polynomial spline estimators are proposed to approximate the derivatives of the mean functions, the covariance functions and the associated eigenfunctions. Desirable statistical properties of the proposed procedure include semiparametrically efficiency of the curve derivatives, and asymptotic consistency of the derivatives of the covariance function and eigenfunctions. The proposed spline confidence bands are shown to be asymptotically efficient as if all random trajectories were observed correctly. The confidence band procedure is illustrated through numerical simulation studies and a real life example. This is a joint work with collaborators, Guanqun Cao, Dr. Li Wang, and Dr. David Totem.

## **Bounds for joint portfolio with given marginal distributions**

Ruodu Wang, University of Waterloo

Let  $S = X_1 + \cdots + X_n$  be a joint portfolio of identically distributed assets  $X_1, \cdots, X_n$ . We consider the bounds for  $S$  when the marginal distribution of  $X_1$  is known but the joint distribution (or copula) of  $(X_1, \cdots, X_n)$  is unknown. Specifically, we investigate two types of problems: (a) the bounds on  $E(f(S))$  where  $f$  is a convex function; (b) the bounds on  $P(S \leq s)$ . The concept of completely mixable (CM) distributions will be used to discuss the two problems which lead to the bounds on the variance, stop-loss premium, European options and VaR associated with  $S$ . Sharp bounds are found in the case when  $X_1$  has a monotone density.

## **Precise large deviations for sums of random variables with two-sided distributions and dominated variation**

Shijie Wang, Anhui University

In this paper, we investigate the lower and upper bounds of precise large deviations for non-random sums and random sums for END (extended negatively dependent) random variables with two-sided distributions and dominated variation. By comparison with Wang et al. (2006), although the dependent assumption of random variables is weakened and the support of random variables is broadened in this paper, we investigate that the upper bounds of precise large deviations are same and the lower bounds of precise large deviations are sharper. Moreover, the lower bounds of precise large deviation in the presented paper are more reasonable and insensitive to END structure. The obtained results also extend the corresponding ones in Liu (2009) and Chen et al. (2011).

## **Higher order general regularly varying functions and their convolutions**

Xiaoqian Wang, Nanjing Normal University

Properties of second order regularly varying function can be characterized by the general regularly varying function. In this paper we consider the convergence rate of the following

general regularly function given by

$$\lim_{t \rightarrow \infty} \frac{f(tx) - f(t)}{a(t)} = \frac{x^\gamma - 1}{\gamma},$$

and concept and some basic properties of higher order regularly varying functions are given. Furthermore, for distributions with higher order regularly varying properties we investigate the asymptotic expansion of their convolutions, which are applied to estimate ruin probability with heavy-tailed distribution.

### **Constant Proportion Portfolio Insurance under Regime Switching Exponential Lévy Process**

Chengguo Weng, University of Waterloo

Constant Proportion Portfolio Insurance (CPPI) is one of the most popular portfolio managing techniques, designed for participation in the potential gains on an upward moving of the equity market while limiting the downside risk. One main concern on the CPPI strategy is the gap risk, which is defined as the risk for the portfolio value possibly to fall below a given protection floor during the investment horizon. In this talk, I will introduce some interesting results regarding the risk-reward profile of the CPPI strategy when the investment asset price follows a regime switching exponential Lévy process. Analytical forms of the shortfall probability, expected shortfall and expected gain of the CPPI strategy are all obtained, and moreover, the characteristic function of the gap risk is also obtained analytically for further exploration on its distribution. Those developed results also illustrate a critical role which the market regime can play in the performance of a CPPI strategy.

### **Managing mortality risk with longevity bonds when mortality rates are cointegrated**

Hoi Ying Wong, Chinese University of Hong Kong

As a hedging vehicle for insurance companies to manage their mortality risks, longevity bonds are linked to a selected mortality index. This paper investigates the dynamic mean-variance hedging problem of an insurer using longevity bonds. Insurance liabilities are modelled by a doubly stochastic compound Poisson process with the mortality rate being correlated and cointegrated with the index mortality rate. We solve this dynamic hedging problem using theory of backward stochastic differential equations. Our theory shows that cointegration materially affects the optimal hedging strategy on top of correlation. The effect of cointegration is independent of the risk preference of insurers. Explicit solutions of the optimal hedging strategy are derived for both cointegrated stochastic mortality models with constant volatilities and with state-dependent volatilities. (Joint work with M.C. Chiu and T.W. Wong)

### **Arrow-Debreu equilibria for rank-dependent utilities**

Jianming Xia, Chinese Academy of Sciences

We provide conditions on a single period, two-date pure exchange economy with rank-dependent utility agents under which Arrow-Debreu equilibria exist. When such an equilibrium exists, we derive the state-price density explicitly, which is a weighted marginal rate of

substitution between initial and end-of-period consumption of a representative agent, while the weight is expressed through the differential of the probability weighting function. A key step in our derivation is to obtain an analytical solution to the individual consumption problem that involves the concave envelope of certain non-concave function. Our results indicate that, under a “weighting-neutral probability” that is an appropriate modification of the original probability measure, assets can be priced in the same way as in an economy with expected utility agents. (This is a joint work with Xun Yu Zhou)

### **Portfolio selection under duality index**

Zuoquan Xu, Hong Kong Polytechnic University

Say that one index satisfies duality axiom if one agent who is uniformly more risk-averse than another agent, accepts a gamble, then latter agent accepts any less risky gamble under the index. Say that one index satisfies homogeneity axiom if a gamble is scaled by a positive scalar, then the index is also scaled by the same scalar. Aumann and Serrano (2008) have shown that only one (positive real-valued) index defined on gambles satisfies both the duality axiom and the positive homogeneity axiom. We call this index as duality index. In this work, we first define the duality index on the set of all random payoffs and show that it is the unique index satisfying both axioms. We will then consider a portfolio selection problem whose target is minimizing the duality index ? risk of the investment. Via linking the problem with a series of Merton’s optimum consumption like problems, the optimal solution and optimal value are explicitly derived. It turns out that if the benchmark level is prior given too high, which is given explicitly, then the investment risk will be beyond any risk-averse agent’s risk tolerance. If the benchmark level is reasonable, then the optimal solution is the same as that of one of the series problems mentioned above, but with a particular value of absolute risk aversion, which in fact is given as a part of the optimal solution.

### **Risk-minimizing insurance protection for multivariate risks**

Phillip Yam, Chinese University of Hong Kong

In the talk, I shall introduce the study of the optimal reinsurance decision problem for multivariate risks whose quantitative analysis in the realm of general law-invariant convex risk measures, to the best of our knowledge, is still absent in the literature. In reality, it is often difficult to determine the actual dependence structure of these risks. Instead of assuming any particular dependence structure, we propose the minimax optimal reinsurance decision formulation, being a nonstandard (non-convex) saddle point problem, in which the worst case scenario is first identified, then we proceed to establish that the stop-loss reinsurances are optimal in the sense that they minimize a general law-invariant convex risk measure of the total retained risk. By using minimax theorem, explicit form of and sufficient condition for (stochastic dominance) ordering the optimal deductibles are also obtained.

### **Numerical Pricing of Interest Rate Derivatives**

Hongtao Yang, University of Nevada at Las Vegas

In this talk, I shall first consider the inverse problem for calibration of the extended CIR model. The solution existence and uniqueness are established by a constructive proof, which

naturally leads to an efficient algorithm to compute the time-dependent parameters and bond prices numerically. In the second part of this talk, I shall consider finite element methods for bond option problems. The problems are reformulated to variational problems with coercive bilinear forms. The stability and weak convergence of their finite element approximations are established. Numerical examples will be presented to examine the proposed numerical methods and to compare the Hull-White model and the extended CIR model.

### **Optimal dividend payment-capital injection strategy in the dual jump-diffusion risk model when the dividend rate is restricted**

Dingjun Yao, Nanjing University of Finance and Economics

In this paper, we consider the optimal dividend payment-capital injection strategies under the dual risk model with diffusion. Our criterion is to maximize the expected present value of the dividends payout minus the discounted costs of capital injections, proportional and fixed transaction costs are involved. Different from Yao et al.(2010,2011) , a ceiling  $l_0$  is imposed for the dividend rate. The optimal strategy happens to be either a dividend threshold strategy without capital injections, or another dividend threshold strategy with forced injections, when the surplus is close to zero, in order to prevent ruin. The choice to inject capital or not and the level of the optimal threshold depend on the parameters of the model. Explicit solutions are obtained when the gain distribution is mixtures of exponentials. Moreover, some light is shed on the limit  $l_0 \rightarrow \infty$ , that is, how value functions and optimal strategies in Yao et al.(2010,2011) can be obtained as limit. Some numerical examples and interesting economics interpretations are presented. (With Rongming Wang and Hailiang Yang)

### **LASSO for structural break estimation in time series**

Chun Yip Yau, Chinese University of Hong Kong

We consider the structural break autoregressive process where a time series has an unknown number of break-points, and the time series follows a stationary AR model in between any two break-points. It is well-known that the estimation of the locations of the break-points involves huge computational challenges. By reformulating the problem in a regression variable selection context, we propose in this paper a group least absolute shrinkage and selection operator (LASSO) procedure to estimate the number and the locations of the break-points, where the computation can be efficiently performed. We show that the number and the locations of the break-points can be consistently estimated from the data. Furthermore, the convergence rate of the breaks is shown to be nearly optimal. Simulation studies are conducted to assess the finite sample performance. Applications to estimating structural breaks in volatility series are investigated. (Joint work with N.H. Chan from CUHK and R. Zhang from Zhejiang U)

### **Optimal Portfolio Selection and Retirement for an Uncertain lived individual**

Baimin Yu, University of International Business and Economics

In this paper, we investigate the impact of longevity risk on consumption/investment by studying optimal retirement and portfolio choice of an uncertain lived individual. Based on

Choi et al(2006)'s model, we introduce the mortality rate. We show that the higher mortality rate results in individual's earlier retirement, more consumption and less investment in risky assets. This illustrates stimulating consumption is more difficult in population-aging society, which is consistent with common intuition. We further do the sensitivity analysis of the parameters, like mortality rate, volatility of risky assets, to the optimal choice. Explicit-formed critical wealth level and the optimal consumption and portfolio policy are obtained for the investor with constant relative risk aversion.

**Optimal consumption and portfolio choice with life insurance  
under uncertainty and borrowing constraints**

Xudong Zeng, Shanghai University of Finance and Economics

We develop a duality approach to study a family's optimal consumption, portfolio choice and life insurance purchase when the family receives deterministic labor income which may be terminated due to premature death or retirement of the family's wage earner. The family faces a borrowing constraint and the wage earner has an uncertain lifetime. We establish the existence of an optimal solution to the optimization problem and solve the problem explicitly for two cases.

**A simple extension of comonotonicity: from independence to comonotonicity**

Lianzeng Zhang, Nankai University

Comonotonicity has become popular in actuarial science and finance. The notion of upper comonotonicity has recently been proposed. Using distributional representation we provide a unified method to extend the notion of comonotonicity further to lower comonotonicity, lower and upper comonotonicity, and interval comonotonicity respectively. Numerical illustrations are provided to make a comparison among the six types of dependence structure: independence, upper comonotonicity, lower comonotonicity, lower and upper comonotonicity, interval comonotonicity, and comonotonicity. The numerical results are related to the sum of two uniform(0,1) random variables, for which we obtain the explicit formula for the density function of the sum in every case. For higher dimension, it becomes complicated to find the corresponding explicit formulas.

**Ambiguity and Intellectual Resource Allocation for Insurers**

Lihong Zhang, Tsinghua University

In this paper, we study how insurance companies make optimal investment policies when accounting explicitly for ambiguity from two sources: one about the risky assets, and the other about the insurance premium income. We show different transmission mechanisms of the two sources of ambiguity to insurers' investment in risky assets, to insurers' welfare resulting from investment and earning insurance premium, and finally to the allocation of intellectual resources into the two fields. Does information about insurance premium income always dominant that about the stock market? In our framework we say this hold mostly, but there are exceptional cases when risky assets are given higher informational priority in certain market environment. Definition of absolute ambiguity aversion is also introduced

in this paper, as a development of classic Arrow-Pratt risk aversion. We show that when the informational precision of insurance premium is high enough and the stock market is sufficiently profitable, the insurer will be more ambiguity averse in risky assets than in premium income, and should further devote more intellectual resources to researches on the attractive stock market.

### **A front-fixing finite element method for the valuation of American options with regime switching**

Shuhua Zhang, Tianjin University of Finance and Economics

American option problems under regime switching model are considered in this paper. The conjectures in Yang (2010) about the position of early exercise prices are proved, which generalize the results in Yi (2008) by allowing the interest rates are different in two states. A front-fixing finite element method for the free boundary problems are proposed and implemented. Its stability is established under reasonable assumptions. Numerical results are given to examine the rate of convergence of our method and compare it with the usual finite element method.

### **Evaluate Multivariate VaR and CVaR for the Aggregate of Heavy-Tailed Risk Vectors by an Asymptotical Approach**

Yi Zhang, Zhejiang University

In this paper, we developed some asymptotic relations for the tail probabilities, the multivariate Risk-at-Value (MVaR) and the multivariate conditional Risk-at-Value (MCVaR) of the multivariate regularly varying (MRV) risks. Our results show that, for a large confidence level associated with the risk measures, the MVaR and MCVaR of the aggregate of the MRV risks can be well approximated by that of the marginal MRV risk via a new upper tail dependence index of the marginal MRV risk vector.

### **American option pricing models and obstacle problems**

Yongmin Zhang, Nottingham University Business School China

We first give a brief overview of American option pricing models and numerical methods. We treat American option models as a special class of obstacle problems. Finite element formulation is introduced together with error analysis of numerical solutions. Some interesting properties about sensitivity of the option price to the payoff function are proved. We also give a criterion for the convergence of numerical free boundaries (optimal exercise boundaries) under mesh refinement. Some future research plans will be discussed

### **Quantifying the Impact of Partial Information on Sharpe Ratio Optimization**

Lin Zhao, Tsinghua University

Motivated by the fact that many investors have limited ability to update the expectation regarding future stock returns with the arrival of new information instantly, this paper provides a continuous-time model to study the performance of passive trading strategies. We derive the true Sharp ratio of the passive strategies in terms of an explicit stochastic process. Based

on this expression, we quantify the impact of partial information by performing a thorough comparative static analysis. Such an analysis provides a rationale for why investors with inaccurate information about stock return behave better in the mean-reverting environment than in the i.i.d. environment and why pessimistic investors can achieve better performance than optimistic ones. As a by-product, we propose an analytical approach to compute the ‘implied’ parameters in stock return predictor for both i.i.d. and mean-reverting dynamics, which seems interesting for future research.

### **Research on calendar spread rate processes of futures based on high-frequency trading data**

Weian Zheng, University of California and East China Normal University

We show an example to use calendar spread rate process for statistical arbitrage. By using high-frequency trading data from Shanghai Futures Exchange (Closing prices per 0.5 second), we establish a nonlinear auto-regression model for the skeleton process of futures calendar spread rate process

$$Y_{\Delta t}(k) = (1 + a_1\Delta t + a_3(\Delta t)^2)Y_{\Delta t}(k - 1) + (-a_2\Delta t + a_4(\Delta t)^2)Y_{\Delta t}^3(k - 1) + \epsilon_{\Delta t}(k),$$

where  $a_1$ ,  $a_3$  and  $a_4$  are three constants,  $a_2$  is a positive constant,  $\{\epsilon_{\Delta t}(k), k = 1, 2, \dots\}$  is a white noise series. When the time-interval between successive samplings of the skeleton process tends to zero (i.e.  $\Delta t \rightarrow 0$ ), the futures calendar spread rate processes satisfy nonlinear stochastic differential equation

$$dX(t) = (a_1X(t) + a_2X^3(t))dt + b_0dW(t)?$$

where  $W(t)$  is a Wiener process,  $a_1$  is a constant,  $a_2$  and  $b_0$  are positive constants.

### **Applications of shuffle of min**

Yanting Zheng, Beijing Technology and Business University

Shuffle of min represents a piece linear dependent structure among its random variables. We will give the probability structure of shuffle of min approximation in terms of random variables. In bivariate case, we show that shuffle of min approximations give sharp upper and lower bound for copula sets. In multivariate case, we find counter examples to show that multivariate shuffle of min approximation cannot give sharp bounds for copulas set. We simulate random numbers of shuffle of min approximation, and use them to approximate random numbers of the original copula. The relative errors caused by the approximation are discussed.

### **Optimal dividend policy with transaction costs and dividend rate constraints**

Ming Zhou, Central University of Finance and Economics

In the dynamic setting of diffusion models, it is shown that the barrier policy is of the optimal form for dividend payments without transaction costs and any restrictions. To incorporate fixed transaction costs for lump sum dividend payments, the optimal dividend policy is



a two-barrier policy, also called  $(S, s)$  policy. In another way, incorporating a maximum bound for dividend payments rate, it leads to a threshold policy. Either the  $(S, s)$  policy or the threshold policy is a generalization of the barrier policy under some more reasonable assumptions. Note that lump sum dividend payments and dividend payments with a limited rate can be operated alternately in practice. Instead of only considering one form of dividend payments, we incorporate these two forms together in a diffusion model in this paper. To maximize the expectation of total discounted dividend payments up to the time of ruin, we show that the optimal form is a combination of threshold policy and  $(S, s)$  policy. This optimal combinational dividend policy operates as follows. If the surplus is in a ‘low’ region, there is no dividend payment; If the surplus goes into a ‘medium’ region, the dividends are paid with a constant rate; Once the surplus attains a ‘high’ level, the dividends are paid in lump sum, and the surplus jumps down to ‘medium’ region. The optimal dividend policy obtained here also gives a good explanation to the consumption problems in mathematical economics.

### **Lévy process theory applied to risk processes**

Xiaowen Zhou, Concordia University

The Lévy processes are stochastic processes with independent and stationary increments. Its fluctuation behavior is well understood when such a process allows only one-sided jumps. In this talk we are going to go over some applications of Lévy process theory to risk models. In particular, we are going to consider three classes of risk processes, the risk processes with dividend barriers, the risk processes with taxes and the risk processes with random observations.