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EDUCATION

Ph.D., Economics, Boston University, Boston MA, May 2021 (expected)
Dissertation Title: *Essays on nonlinear filtering and its application in finance*
Dissertation Committee: Zhongjun Qu, Pierre Perron and Jean-Jacques Forneron

M.S., Economics, University of Wisconsin, Madison, WI, 2015

M.A., Economics, Hitotsubashi University, Tokyo, JAPAN, 2012

B.A., Japanese, Xi'an International Studies University, Xi'an, CHINA, 2008

FIELDS OF INTEREST

Econometrics, Finance

PUBLICATIONS

"Constructing Employment and Compensation Matrices and Measuring Labour Input in China," (with Harry X. Wu, and Ximing Yue) *RIETI Discussion Papers*, 2015, 15-E-005

WORKING PAPERS

"Quasi Monte Carlo Kalman Filter for Nonlinear and Non-Gaussian State-Space Models," *Job Market Paper*, July 2020.

"Pairs Trading with Nonlinear and Non-Gaussian State Space Models," *submitted*, June 2020.

"Hermite Polynomial-Based Valuation of American Options with General Jump-Diffusion Process," (with Li Chen), July 2020.

WORK IN PROGRESS

"Spot-future Arbitrage and Market Efficiency: a Quantamental Approach"

"Generalized Finite Mixture Approximation of the Transition Density of Jump-diffusion Process"

"Generalized Finite Mixture and Option Pricing"

"Maximum Likelihood Estimation and Inference of Discrete Sampled Regime Switching Diffusions: with an Application on Treasury Bill Rates Data," (with Anlong Qin and Li Chen)

"Pricing of American Option under Stochastic Volatility Models Based on Unscented Kalman filter"

"An Ant Colony Optimization Approach to the Valuation of American Option"

"A *k*-means Clustering Estimator for Nonparametric GARCH Models"

PRESENTATIONS

BU-BC Joint Econometrics Workshop, Boston, MA, 2019

FELLOWSHIPS AND AWARDS

Dean's Fellowship and Teaching Fellowship, BU, 2015-2020

WORK EXPERIENCE

Research Assistant for Professor Pierre Perron, Department of Economics, Boston University, Fall 2017 - Spring 2019, Fall 2020

Research Assistant for Professor Zhongjun Qu, Department of Economics, Boston University, Fall 2019 - Spring 2020

TEACHING EXPERIENCE

Teaching Assistant, Department of Economics, BU
- EC303/304 Empirical Economic Analysis (BA level), Spring 2017, Fall 2019
- EC203/204 Empirical Economics (BA level), Fall 2016

LANGUAGES

Mandarin (native)
English (fluent)
Japanese (fluent)

COMPUTER SKILLS: Python, R, C++, JavaScript, MATLAB, Stata, LaTeX

CITIZENSHIP/VISA STATUS: China/F1

REFERENCES

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GUANG ZHANG

Quasi Monte Carlo Kalman Filter for Nonlinear and Non-Gaussian State-Space Models (Job Market Paper)

In this study, we present a new filtering approach for nonlinear and non-Gaussian state space models. This approach builds on the well-established Kalman filter, combined with approximations of least square linearization for nonlinear function and Gaussian mixture for non-Gaussian noises, and applies the quasi Monte Carlo method for numerical integration during computation. We compare our approach with other existing methods using simulated data, and we show the proposed approach can outperform these methods in terms of speed and accuracy. This study also provides analysis on the stability of this new filtering approach. In addition, we propose two methods to estimate the unknown parameters in the model, and show the consistency of the proposed quasi-maximum likelihood estimator under general conditions. To illustrate the proposed approach, we discuss several numerical examples. We also introduce two applications of our approach. The first one is a stochastic volatility model, and we apply it to foreign exchange data between Sterling and Dollar. In the second application, we discuss a jump model, and show the jump size has a Gaussian mixture representation. We use the 3-month T-bill data to estimate the jump probability and investigate the jump sources based on macroeconomic events.

Pairs Trading with Nonlinear and Non-Gaussian State Space Models

This study examines pairs trading using a nonlinear and non-Gaussian state space model framework. We model the spread between the prices of two assets as an unobservable state variable, and assume that it follows a mean-reverting process. This new model has two distinctive features: the (1) non-Gaussianity and heteroscedasticity of the innovations to the spread, and (2) nonlinearity of the mean reversion of the spread. We show how to use the filtered spread to carry out statistical arbitrage. We also propose a new trading strategy and present a Monte Carlo-based approach to select the optimal trading rule. For empirical applications, we first apply our approach to two examples: PEP vs. KO and EWT vs. EWH, and show that the new approach can achieve 21.86% (31.84%) annualized return for the PEP-KO (EWT-EWH) pair. Then, we consider all the possible pairs among the five largest and the five smallest U.S. banks listed on the NYSE. For these pairs, we compare the performance of the proposed approach with that of the existing popular approaches, both in-sample and out-of-sample. We find that our approach can significantly improve the return and the Sharpe ratio.

Hermite Polynomial-Based Valuation of American Options with General Jump-Diffusion Process *(with Li Chen)*

We present a new approximation scheme for both of the price and exercise policy of American options. The scheme is based on Hermite polynomials expansion of the transition density of the underlying asset dynamics and the early exercise premium representation of the American option price. The advantage of the proposed approach is threefold. First, our approach does not require the transition density and characteristic functions of the underlying asset dynamics to be attainable in closed form. Second, our approach is shown to be fast and accurate, while the prices and exercise policy could be jointly produced. Third, our approach has a wide range of application scopes. We show that the proposed approximations of the price and optimal exercise boundary will be convergent to the true ones. We also provide a numerical method based on a step function for the implementation of our proposed approach. Examples such as nonlinear mean-reverting model, double mean-reverting model, Merton's and Kou's jump-diffusion models are presented and discussed.