GUANG ZHANG

Department of Economics, Boston University
270 Bay State Road
Boston MA 02215 USA
Cell: (857) 205-5326
Email: gzhang46@bu.edu
Web site: https://sites.google.com/view/guang-zhang

EDUCATION

Ph.D., Economics, Boston University, Boston MA, May 2021 (expected)
Dissertation Title: *Essays on nonlinear filtering with applications 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, Empirical 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," Revise and Resubmit, *Quantitative Finance*, October 2020.

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

WORK IN PROGRESS

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

"Generalized Finite Mixture Approximations of Transition Densities of Jump Diffusions"

"Generalized Finite Mixtures and Option Pricing"

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

"Pricing of American Options under Stochastic Volatility Models Using the Unscented Kalman filter"

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

"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

REFEREE EXPERIENCE

Journal of Econometric Method

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

Professor Zhongjun Qu
Department of Economics
Boston University
Phone: (617) 358-5921
Email: qu@bu.edu

Professor Pierre Perron
Department of Economics
Boston University
Phone: (617) 353-3026
Email: perron@bu.edu

Professor Jean-Jacques Forneron
Department of Economics
Boston University
Phone: (617) 353-4824
Email: jjmf@bu.edu

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, featuring a state-dependent least-square linearization of the nonlinear function and a Gaussian-mixture approximation to the error distribution, and it applies the quasi Monte Carlo method for numerical integration during the computation. We compare our approach with other existing methods using simulated data, and we find that 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, and establish the consistency of the proposed quasi-maximum likelihood estimator under general conditions. To illustrate the proposed approach, we discuss several numerical examples. We also consider two empirical applications. The first is a stochastic volatility model for foreign exchange data between Sterling and Dollar. The second is a jump model for the 3-month T-bill rate data, where we show that the jump size has a Gaussian mixture representation. We estimate the jump probability and investigate the jump sources based on macroeconomic events.

Pairs Trading with Nonlinear and Non-Gaussian State Space Models (Revise and Resubmit at *Quantitative Finance*)

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 Processes (with Li Chen)

We present a new approximation scheme for the price and exercise policy of American options. The scheme is based on Hermite polynomial expansions 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 fast and accurate, while the prices and exercise policy can be jointly produced. Third, our approach has a wide range of applications. We show that the proposed approximations of the price and optimal exercise boundary converge to the true ones. We also provide a numerical method based on a step function to implement our proposed approach. Applications to nonlinear mean-reverting models, double mean-reverting models, Merton and Kou’s jump-diffusion models are presented and discussed.