CAI WU

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EDUCATION

Fudan University *Sep 2020 - Jun 2024 (expected)*

4th year undergraduate in Economics, minor in Financial Mathematics; GPA: 3.56/4

Selected courses: Mathematical Finance, Numerical Analysis and Numerical Linear Algebra, Time Series Analysis, Econometrics (Honor), Game Theory (Honor), Mathematical Economics, Investments

University of California, Berkeley *Jan 2023 - May 2023*

Visiting student in BGA program; GPA: 3.92/4

Selected courses: Real Analysis, Stochastic Processes, Financial Engineering, Quantitative Finance Seminar

RESEARCH INTEREST

Domain	Financial Engineering, Stochastic Analysis, Operations Research
Detailed	Option pricing, Market Microstructure, Algorithmic Trading, Stochastic Control and Games, Monte Carlo simulation

PUBLICATIONS AND PREPRINTS

1. Explicit solution to the economic index of riskiness, with Zhenyu Cui and Lingjiong Zhu. *Economics Letters*, Vol. 232, November 2023, 111343.

2. An exact explicit solution to the adjustment coefficient in risk theory, with Zhenyu Cui. Under review at *European Actuarial Journal*.

3. Variance optimality of empirical martingale simulation estimators, with Zhenyu Cui, Yanchu Liu, Ruodu Wang and Lingjiong Zhu. Submitted to *Management Science*.

4. Valuation of VIX derivatives through combined Itô-Taylor expansion and Markov chain approximation, with Zhenyu Cui, Chihoon Lee and Mingzhe Liu. Submimtted to *Journal of Derivatives*.

RESEARCH EXPERIENCE AND ONGOING PROJECTS

Explicit quantile through Fourier cosine expansion and Lagrange inversion

Undergraduate researcher advised by Prof. Zhenyu Cui *Oct 2023 - Present*

· Derived an explicit representation of quantile in terms of the specified probability utilizing Fourier cosine expansion and Lagrange inversion theorem.

· Derived an alternative representation of quantile by a direct expansion of the cumulative density function.

· Implemented a numerical test of normal distribution.

Valuation of VIX derivatives through combined Itô-Taylor expansion and Markov chain approximation

Undergraduate researcher advised by Prof. Zhenyu Cui *Aug 2023 - Present*

· Proposed an analytical method to valuate VIX derivatives under stochastic volatility models based on a closed-form approximation of VIX index through Itô-Taylor expansion and the subsequent continuous-time Markov chain approximation.

· Programmed for the numerical tests implementing the Itô-Taylor expansion to obtain an approximate VIX value under the Heston, CEV, 3/2, 4/2 and α-hypergeometric models and compared with benchmark values obtained from closed-form expressions or Monte Carlo simulations.

· Programmed for the numerical tests implementing the CTMC approximation to obtain an approximate VIX option prices under the aforementioned models and compared with benchmark values obtained from Monte Carlo simulations.

· Carried out the sensitivity analysis of convergence for the Itô-Taylor expansion of VIX in terms of the order of expansion and the CTMC approximation under the aforementioned models with regard to the initial stock price and strike.

· Designed the calibration scheme for both affine and non-affine stochastic volatility models and calibrated the Heston, 3/2 and α-hypergeometric model utilizing VIX options quotes data of 2016 on a weekly scale.

Variance optimality of empirical martingale simulation estimators

Undergraduate researcher advised by Prof. Zhenyu Cui *July 2023 - Present*

- Rigorously provided theoretical foundations of the variance optimality of empirical martingale simulation (EMS) estimator introduced in Duan and Simonato (1998), which is an improvement of Monte Carlo estimator.
- Helped establish the conditions under which the asymptotic variance of the EMS estimator is smaller than that of the standard Monte Carlo estimator, with specific cases where the EMS estimator is not effective in reducing the variance discussed.
- Programmed for the numerical tests of the application of EMS to European option pricing under the Variance gamma process and Heston model, in addition to two extreme cases under Black-Scholes model showing both the dramatic efficiency and possible inefficiency of EMS.

Explicit solution to the economic index of riskiness and the adjustment coefficient in risk theory

Undergraduate researcher advised by Prof. Zhenyu Cui   *July 2023 - Sep 2023*

- Proposed an exact series expansion formula for the economic index of riskiness and the adjustment coefficient in risk theory utilizing Lagrange inversion theorem.
- Derived the explicit expression for three specific riskiness indices, Cramér-Lundberg model (both with and without reinsurance), Sparre-Anderson model, discrete time risk model and a few more types of Lundberg equation.
- Programmed for all the numerical experiments, including Aumann-Serrano index under Gamma distributed gambles, Foster-Hart riskiness index under uniformly and Beta distributed gambles, BCCY riskiness under uniformly distributed gambles and exponential and Erlang(2) claims in the classical Cramér-Lundberg model to verify the accuracy and convergence efficiency of the proposed series expansion.

Adding and subtracting Merton: A new approach for the optimal portfolio problem

Undergraduate researcher advised by Prof. Zhenyu Cui   *May 2023 - Present*

- Proposed a diffusion-operator-integral-expansion-based method to solve optimal investment and consumption problems under several models.
- Programmed for numerical experiments for the application of the proposed method to the optimal investment problem under several stochastic models, including the CEV, Heston, 4/2, SABR model, and optimal investment-consumption problem under the Heston model.

Offline simulation of portfolio default risk under stochastic volatility models   Fudan University

Undergraduate researcher advised by Prof. Yanxi Hou   *Nov 2022 - Present*

- Replicated numerical tests implemented in Jiang et al. (2019) to verify their proposed method to measure the portfolio default risk.
- Combined variance reduction techniques like EMS to the simulation as a modification to the perturbation method.
- Designed and programmed for additional experiments for underlying assets modeled by the 3/2 model, α-hypergeometric model and portfolio including path-dependent products like arithmetic Asian options with floating strike and lookback options to illustrate the accuracy and efficiency of the proposed method.

SKILLS

Coding Languages	Python, MATLAB, LaTeX
Natural Languages	Mandarin (native), Japanese (native), fluent English (TOEFL 108), basic French