Renyuan Xu

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POSITIONS

University of Southern California *August 2021 -*
WiSE Gabilan Assistant Professor, Epstein Department of Industrial System Engineering, Los Angeles

University of Oxford
Research Fellow, St Hugh's College, Oxford
September 2019 -
Hooke Research Fellow, Mathematical Institute, Oxford
Mentor: Rama Cont *September 2019 - August 2021*

EXPERIENCE

Institute for Mathematical and Statistical Innovation (IMSI), University of Chicago *March - May 2022, March - May 2023*
Visiting Scholar
Host: Thaleia Zariphopoulou

Quantitative Brokers *June 2017 - August 2017*
Quantitative Researcher Intern

EDUCATIONS

University of California, Berkeley *August 2014 - August 2019*
Ph.D., Industrial Engineering and Operations Research Department
Thesis Title: Stochastic Games: Nash Equilibrium, Pareto Optimality, Price of Anarchy, and Learning
Advisor: Xin Guo

University of Science and Technology of China *August 2010 - June 2014*
B.S. Mathematics
University of Sydney *August 2012 - December 2012*
Exchange Student, Mathematics Department

RESEARCH INTERESTS

- Stochastic Modeling, Control Theory, Stochastic Games and Mean-Field Games
- Mathematical Finance, Market Microstructure and High Frequency Trading
- Machine Learning Theory and Applications
- Reinforcement Learning and Data-driven Decision Making
- Mechanism Design and Information Acquisition

HONORS

- SIAM Financial Mathematics and Engineering Early Career Prize January, 2023
- JP Morgan AI Research Faculty Award July, 2022
- WiSE Gabilan Faculty Fellowship, USC August, 2021

- Research Recognition Award, University of Oxford December, 2020
- Outstanding Graduate Instructor, UC Berkeley March, 2019
- Finalist, INFORMS Applied Probability Society Best Paper Competition November, 2018

FUNDINGS

- JP Morgan AI Research Award (with gift grant of 110k) July, 2022
- WiSE Institute Research Funding (60k) August, 2021

JOURNAL PUBLICATIONS

1. B. Hambly, R. Xu, and H. Yang. "Policy Gradient Methods Find the Nash Equilibrium in N-player General-sum Linear-quadratic Games," *Journal of Machine Learning Research*, 2023.
2. B. Hambly, R. Xu, and H. Yang. "Recent Advances in Reinforcement Learning in Finance," *Mathematical Finance*, 2023.
3. J. Blanchet, R. Xu, and Z. Zhou. "Delay-Adaptive Learning in Generalized Linear Contextual Bandits," *Mathematics of Operations Research*, 2023.
4. X. Guo, A. Hu, R. Xu, and J. Zhang. "General Framework of Learning Mean Field Games," *Mathematics of Operations Research*, 2022.
5. H. Gu, X. Guo, X. Wei, and R. Xu. "Dynamic Programming Principles for Learning Mean-Field Controls," *Operations Research*, 2022.
6. X. Guo, R. Xu, and T. Zariphopoulou. "Entropy Regularization for Mean Field Games with Learning," *Mathematics of Operations Research*, 2022.
7. X. Guo, CA Lehalle, and R. Xu. "Transaction Cost Data Analytics for Corporate Bonds," *Quantitative Finance*, 2022.
8. R. Cont, A. Kotlicki, and R. Xu. "COVID-19 Contagion in England: Heterogeneous Dynamics and Targeted Mitigation Policies," *Royal Society Open Science*, 2021.
9. R. Cont, X. Guo, and R. Xu. "Interbank Lending with Benchmark Rate: Pareto Optima for a Class of Singular Control Games," *Mathematical Finance*, 2021.
10. B. Hambly, R. Xu, and H. Yang, "The Policy Gradient Method Finds the Nash Equilibrium in N-player General-sum Games," *SIAM Journal on Control and Optimization*, 2021.
11. X. Guo, W. Tang, and R. Xu. "A Class of Stochastic Games and Moving Free Boundary Problems," *SIAM Journal on Control and Optimization*, 2021.
12. H. Gu, X. Guo, X. Wei, and R. Xu. "Q-Learning Algorithm for Mean-Field Controls, with Convergence and Complexity Analysis," *SIAM Journal on Mathematics of Data Science*, 2021.
    - Short version accepted by ICML 2020 Workshop on Theory of Reinforcement Learning.
13. X. Guo and R. Xu. "Stochastic Games for Fuel Followers Problem: N vs MFG," *SIAM Journal of Control and Optimization*, 2019.

CONFERENCE PUBLICATIONS

1. J. Ji, R. Xu, and R. Zhu. "Risk-Aware Linear Bandits: Theory and Applications in Smart Order Routing," 3rd ACM International Conference on AI in Finance, 2022.
2. A.S. Cohen, R. Cont, A. Rossier, and R. Xu. "Scaling Properties of Deep Residual Networks," *International Conference on Machine Learning*, 2021.
3. X. Guo, A. Hu, R. Xu, and J. Zhang. "Learning Mean Field Games," *NeurIPS*, 2019.
4. Z. Zhou, R. Xu, and J. Blanchet. "Learning in Generalized Linear Contextual Bandits with Stochastic Delays," *NeurIPS*, 2019.

WORKING PAPERS

1. H. Gu, X. Guo, X. Wei, and R. Xu. "Mean-Field Multi-Agent Reinforcement Learning: A Decentralized Network Approach", Minor Revision, *Mathematics of Operations Research*, 2021.
2. R. Cont, M. Cucuringu, R. Xu, and C. Zhang. "TailGAN: Nonparametric Scenario Generation for Tail Risk Estimation", R&R, *Management Science*, 2022.
3. Y. Han, M. Razaviyayn, and R. Xu. "Policy Gradient Finds Global Optimum of Nearly Linear-quadratic Control Systems", Major Revision to *SIAM Journal on Control and Optimization*, 2022.
    - Short version accepted by *NeuRIPs Workshop on Machine Learning and Optimization*, 2022.
4. A.S. Cohen, R. Cont, A. Rossier, and R. Xu. " Asymptotic Analysis of Deep Residual Networks," Submitted to *Annuals of Applied Probability*, 2022.
5. R. Cont, A. Rossier, and R. Xu. " Implicit Regularization and Convergence of Gradient Descent for Deep Residual Networks," Submitted to *Journal of Machine Learning Research*, 2022.
6. B. Hambly, R. Xu, and H. Yang. " Linear-quadratic Gaussian Games with Asymmetric Information: Belief Corrections Using the Opponents Actions," Submitted to *SIAM Journal on Control and Optimization*, 2023.
7. A. Ananova, R. Cont, and R. Xu. "Model-free Analysis of Dynamic Trading Strategies," Submitted to *SIAM Journal on Financial Mathematics*.
8. Y. Han, M. Razaviyayn, and R. Xu. "Neural Network-based Score Estimation for Diffusion Models: Optimization and Generalization," Submitted to *International Conference on Learning Representations (ICLR)*.
9. R. Xu, L. Zhang, and T. Zariphopoulou. "Reversible and Irreversible Decisions under Costly Information Acquisition," Working Paper.
10. A. Ananova, R. Cont, and R. Xu. "Excursion Risk," Working Paper.
11. Z. Wu and R. Xu. "Risk-sensitive Reinforcement Learning under General Utility Functions," Working Paper.
12. R. Hu and R. Xu. "Proposal-based and Transaction-based Index Rate Designs: from the Perspective of Stochastic Differential Games," Working Paper.

PHD MENTORING

- Yinbin Han (co-advised with Meisam Razaviyayn), 2021-
- Jingwei Ji, 2021-
- Zhengqi Wu, 2021-

THESIS COMMITTEE

- Suyanpeng Zhang (USC ISE), Tianjian Huang (USC ISE), Sina Baharlouei (USC ISE), Julien Yu (USC ISE), Ying Tang (USC Math), Mengxiao Zhang (USC CS), Ke Shen (USC ISE), Peng Dai (USC ISE), Bixing Qiao (USC Math), Thejani Gamage (USC Math)

ORGANIZERS

- Conference Co-chair of the 3rd ACM International Conference on AI in Finance (November 2-4, 2022)
  - Largest conference in AI and Finance with ∼1000 participants
  - Conference with proceedings: 242 submissions and 60 accepted papers
- Co-organizer of the World Online Seminar on Machine Learning in Finance (March 2021 -)
  - Bi-weekly seminars with both senior and junior speakers
  - 1600 subscribers word-wide
- Main organizer for the Oxford Machine Learning Summer School (August 2022, July 2023)
  - 200 participants per year with mixed background from both academia and industry
  - Highly selective with an acceptance rate around 15% for the participants
- Co-organizer of a mini-symposium at SIAM Annual Meeting (July 2022)
- Invited session chair at the Annual Meeting of the Institute of Mathematical Statistics, London (June 2022)
- Session chair at the 15th International Conference on Computational and Financial Economics, King's College, London (December 2021)
- Co-organizer of the Women in AI and Finance Workshop at ICAIF 2021 (November 2021)
- Organizer of the Oxford Mathematical and Computational Finance Seminar (September 2019-June 2021)
- Co-organizer of the Oxford Data Science Seminar (September 2020-June 2021)
- Session (co-)chair at INFORMS Annual Meetings (2019, 2020, 2021,2022)
- Co-organizer of a mini-symposium at SIAM Conference on Financial Mathematics and Engineering (June 2021)
- Panelist Committee for ICML 2020 Workshop on Theory of Reinforcement Learning

REVIEWERS

- Journals: SIAM Journal on Control and Optimization, Annuals of Applied Probability, Operations Research, Mathematics of Operations Research, Management Science, Quantitative Finance, Applied Mathematics and Optimization, Applied Mathematical Finance, Market Microstructure and Liquidity, Journal of Economic Dynamics and Control, SIAM Journal on Applied Mathematics, SIAM Journal on Financial Mathematics, The Proceedings of the National Academy of Sciences (PNAS)
- Conferences: NeurIPS, International Conference on Machine Learning (ICML), International Conference on Learning Representations (ICLR), International Conference on AI in Finance (ICAIF)

OTHER SERVICES

- Co-editor for the special issue on "Machine Learning in Finance" in *Mathematical Finance*, 2023
- NSF Proposal Reviewer, 2022

INVITED TUTORIALS

- Fields Institute Summer School (October 2022)
- Summer School of the Bachelier Finance Society (September 2021)
- Oxford Machine Learning Summer School (September 2021)
- Reinforcement Learning China (RLChina) Summer Camp (August 2022, August 2021, July 2020)

INVITED ACADEMIC TALKS

- Department Seminar, Department of Decision Science, HEC Montreal, Canada (November 2023)
- Financial/Actuarial Mathematics Seminar, University of Michigan (October 2023)
- INFORMS Annual Meeting, Phoenix (October 2023)
- Advanced Financial Technology Laboratory Seminars, Stanford University (October 2023)
- International Council for Industrial and Applied Mathematics (ICIAM'23), Waseda University, Japan (August 2023)
- Advanced Mathematical Methods For Finance Conference (AMaMeF), Bielefeld, Germany (June 2023)
- Machine Learning and Finance Conference, University of Oxford, UK (June 2023)
- Women in Mathematical Finance Conference, Rutgers University (June 2023)
- SIAM Conference on Financial Mathematics and Engineering, Philadelphia (June 2023)
- SIAM Conference on Optimization, Seattle (May 2023)
- Financial and Actuarial Mathematics (IFAM) Seminar, University of Liverpool (April 2023)
- Young Talents in Actuarial Science and Quantitative Finance, University of Waterloo, Canada (April 2023)
- Workshop on "Mathematics, Statistics, and Innovation in Medical and Health Care," IMSI, University of Chicago (March-April 2023)
- Western Conference on Mathematical Finance (WCMF), Berkeley (March 2023)

- Mathematical Finance Seminar, Department of Statistics, Columbia University (March 2023)
- Quantitative Finance Seminar, Fields Institute, University of Toronto, Canada (January 2023)

- Royal Society Statistics Meeting on "Machine Learning and Optimal Control" (October 2022)
- INFORMS Annual Meeting, Indianapolis (October 2022)
- Math Finance Seminar, Princeton University (October 2022)
- CFMAR 2022 Workshop, UCSB, Santa Barbara (September 2022)
- Finance Department Seminar, Boston University (September 2022)
- Quantitative Finance Seminar at Peking University (May 2022)
- Hong Kong - Singapore joint seminar in Financial Mathematics/Engineering (April 2022)
- Royal Statistical Society Workshop on Time Series Generation and Anomaly Detection in High Dimensions (March 2022)
- Online Seminar Series in Actuarial Science and Financial Mathematics, University of Waterloo, Canada (March 2022)
- Actuarial and Financial Mathematics Seminar, Quantact Laboratory (March 2022)
- Math Finance Seminar, UCLA (February 2022)
- Machine Learning Seminar, UBS (February 2022)
- Mathematical Finance Seminar, University of Edinburgh (February 2022)
- Control and Optimization Seminar, University of Connecticut (January 2022)
- Mathematical Finance Colloquium, University of Southern California (January 2022)

- SIAG/FME Virtual Seminars Series (December 2021)
- INFORMS Annual Meeting, Seattle (October 2021)
- Industrial Engineering & Management Sciences Department Seminar, Northwestern University, Evanston, IL, US (October 2021)
- Electrical and Computer Engineering Department Seminar, UCLA, Los Angeles, CA, US (October 2021)
- Probability and Computational Finance Seminars, Carnegie Mellon University, Pittsburgh, PA, US (September 2021)
- Workshop on "Advances in Stochastic Analysis for Handling Risks in Finance and Insurance", CIRM, France (September 2021)
- Berlin Workshop for young Researchers, Virtual (August 2021)
- Bernoulli-IMS 10th World Congress in Probability and Statistics, Virtual (July 2021)
- SIAM Annual Meeting, Virtual (July 2021)
- SIAM Conference on Financial Mathematics and Engineering, Virtual (June 2021)
- Data Science Seminar, National University of Singapore, Virtual (April 2021)
- Optimal Transport and Mean Field Games Online Seminar (March 2021)
- One World Optimal Stopping and Related Topics Online Seminar (March 2021)

- Informs Annual Meeting, Virtual (November 2020)
- Berlin Research Seminar on Stochastic Analysis and Stochastic Finance, Virtual (November 2020)
- Virtual Workshop on New Challenges in the Interplay between Finance and Insurance (October 2020)
- 2020 SIAM-CAIMS 2nd Joint Annual Meeting, Virtual (July 2020)

- Computer Science Department, University College London, UK (June 2020)
- Data Science Lab at MIT, Virtual (June 2020)
- Math Department at UCLA, Virtual (June 2020)
- Computer Science Department, University College London (Jan 2020)

- NeurIPS 2019, Vancouver, Canada (December 2019)
- Joint Risk & Stochastics and Financial Mathematics Seminar, Department of Mathematics, London School of Economics and Political Sciences, UK (December 5, 2019)
- 12th Oxford-Berlin Young Researchers Meeting in Stochastic Analysis, Oxford, UK (December 4, 2019)
- Probability and Financial Mathematics Seminar, School of Mathematics, University of Leeds, UK (November 21, 2019)
- Finance and Stochastics Seminar, Department of Mathematics, Imperial College London, UK (November 20, 2019)
- Warwick Stochastic Finance Seminar, Department of Statistics, Warwick University, UK (November 8, 2019)
- Bielefeld Stochastic Afternoon, Center for Mathematical Economics, Bielefeld University, Germany (October 30, 2019)
- INFORMS Annual Meeting, Seattle, WA, US (October 20-23, 2019)

- 9^{th} Western Conference in Mathematical Finance, University of Southern California, Los Angeles, CA, US (November 2018)
- INFORMS Annual Meeting, Phoenix, AZ, US (November 2018)
    - Selected as one of the four finalists to present in the Applied Probability Society Best Student Paper Competition
- Mathematical Finance Seminars, University of Southern California, Los Angeles, CA, US (September 2018)
- Probability and Computational Finance Seminars, Carnegie Mellon University, Pittsburgh, PA, US (August 2018)
- Berkeley-Stanford Workshop on Mathematical and Computational Finance, Stanford, CA, US (July 2018)
- Berkeley-Columbia Meeting in Engineering and Statistics, Columbia University, New York, NY (April 2018)
- Probability Seminar, University of Science and Technology of China, Hefei, China (December 2017)
- INFORMS Annual Meeting, Houston, TX, US (October 2017)
- Fourth Annual Young Researchers Workshop on Data-driven and Decision Making, Cornell University, Ithaca, NY, US (October 2017)

INVITED INDUSTRY TALKS

- Internal Seminar, Amazon (October 2023)
- Machine Learning Seminar, Amazon A9 (April 2022)
- Machine Learning Seminar, BNY Mellon (April 2022)
- Internal Seminar, JP Morgan, UK (Feb 2020)

AFFILIATED SCIENTIFIC COMMUNITIES

- Member, Institute for Operations Research and the Management Sciences (INFORMS)
- Member, SIAM Activity Group in Financial Mathematics and Engineering
- Member, Applied Probability Society (APS)
- Member, Society for Industrial and Applied Mathematics (SIAM)
- Member, Bachelier Finance Society
- Member, Institute of Mathematical Statistics (IMS)

TEACHING EXPERIENCE

- Instructor at USC:
  - ISE 537: Financial Analytics (Machine Learning in Finance), Fall 2023/Fall 2022/Fall 2021
  - ISE 599: Control Theory and Reinforcement Learning, Fall 2022
- Tutor at University of Oxford:
  - Machine Learning, Hilary Term 2020
  - Statistics and Financial Data Analysis, Michaelmas Term 2019
  - Market Microstructure and Algorithmic Trading, Hilary Term 2020
  - Stochastic Control, Hilary Term 2020