Siyi LYU

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EDUCATION

University of Oxford Oxfordshire, United Kingdom
Master of Science in Mathematical Sciences, Mathematical Institute Oct. 2024 - Present

- **Core modules:** *Stochastic Differential Equations, Probability and Statistics for Network Analysis, Advanced Simulation Methods, Bayes Methods, Continuous Optimisation, Random Matrix Theory, Graphical Models, Advanced Topics in Statistical Machine Learning, Optimal Control, Uncertainty in Deep Learning.*

University of Reading & Nanjing University of Information Science and Technology China
Bachelor of Science in Mathematics & Applied Mathematics, Reading Academy Sept. 2020 - Jun. 2024

- **CGPA**: First class, 87.40/100 (UoR); 88.644/100 (NUIST)
- **Math-related modules GPA:** 86.29/100 (UoR); 94.48/100 (NUIST)
- **Ranking within cohort:** 2/82, top 2.4% (UoR); 3/82, top 3.6% (NUIST)
- **Core courses include:** *Differential Equations 1, Differential Equations II, Calculus, Numerical Analysis 1, Numerical Analysis 2* (*Python*), *Vector Calculus, Mathematical Modelling, Algebra, Mathematical Physics, Probability and Statistics, Complex Analysis, Mathematical Programming, Linear Algebra, Applied Stochastic Process.*

PUBLICATIONS

- Georgiev, S.G., Darvish, V., **Lyu, S.Y.** (2024). *Fractional Inequalities for Strongly r-Convex Functions on Time Scales.* To be submitted to *The Journal of Analysis*.
- **Lyu, S.Y.** (2024) 'Research on Quantitative Evaluation of Financial Investment Risk Based on the GARCH Model', ***Mathematics*** (submitted).
- **Lyu, S.Y.** Wu Wenhui, Ma Xinmei, Hu Fei (2023) 'Global Temperature Prediction Based on SARIMA+LSTM Model', *2023 3rd International Conference on Applied Mathematics, Modelling and Intelligent Computing (CAMMIC 2023)*, ***Conference Proceedings*** (accepted for conference communications).
- **Lyu, S.Y.** & Zhou, Z.Q. (2023). 'Analysis of Green GDP and Global Temperature Forecast Based on Time Series Model', *Proceedings of the 2023 3rd International Conference on Public Management and Intelligent Society (PMIS 2023)*, DOI: 10.2991/978-94-6463-200-2_116.
- **Lyu, S.Y.** & Gao, J.Y. (2023). 'Study of the Scheme and Risk of Shanghai Copper Futures Arbitrage Trading', *The 2nd International Conference on Creative Industries and Knowledge Economy (CIKE 2023)*, ***SHS Web of Conferences*** (ISSN: 2261-2424), (accepted for conference communications).

PATENTS & COPYRIGHTS

- **Lyu, S.Y.** (2024). Patent for Invention of Practical Design: Experimental apparatus for mathematical application of solid geometry, *Patent Number: 202422481082.8*, *Publication Number: 2024101401055000*, Intellectual Property Search and Consultation Centre of CHINA.
- **Lyu, S.Y.** (2023). Software Copyright: Internet-Based Mathematical Model Design System V1.0, *Register Number: 2023SR0035213*, *Certificate Number: R.Z.D.Z. No. 10622384*, Original Acquisition, All Rights, Computer Software Copyright Registration Certificate, National Copyright Administration of the People's Republic of China, 2023.
- **Lyu, S.Y.** (2022). Patent for Invention of Practical Design: Multi-Functional Math Teaching AIDS, *Patent Number: 202223137348.4, Publication Number: 2022112501370580*, Intellectual Property Search and Consultation Centre of CHINA, 2022.

HONOURS & AWARDS

- ***Institute of Mathematical Statistics (IMS), Student Member*** 2024
- ***Academic Funding Award, LMH Grants and Student Support Committee, Oxford*** (top 5%) 2024
  - Awarded £200 for financial support towards an academic language course, Lady Margaret Hall
- ***Optiver Foundation Scholarships (studentship), Oxford*** 2024
  - Awarded to only 6 recipients worldwide every year, with me being the sole recipient from Asia
  - Awarded for women from low- and middle-income countries who performed well and committed to contributing to STEM
  - Full scholarship covering approx. £58,000 in total, with £36,000 for tuition fees and £22,000 grant for living costs
- ***Outstanding Graduate, Class of 2024, NUIST*** (top 3%) 2024
- ***Merit Student & First-Class Scholarship Winner, Four Times, NUIST*** (top 5%) 2021-2024
- ***Teaching Assistant Scholarship, Four Times, NUIST*** (top 3%) 2021-2024
- ***Outstanding Student Leader, Class of 2024, NUIST*** (top 3%) 2022 - 2023
- ***First Prize***, 12th Asia Pacific Mathematical Contest in Modelling (APMCM) (top 2%) 2023
- ***Honourable Mention Prize***, 39th Interdisciplinary Contest in Modelling (ICM) (top 8%) 2023
- ***First Prize***, 8th 'Huichuang Youth' Cultural Creative Works Exhibition Activity for College Students (top 1%) 2023
- ***Provincial First Prize***, 'Challenge Cup' National College Students Extracurricular Academic Science and Technology Works Competition (top 5%) 2023

- ***Provincial First Prize***, 'Higher Education Cup' China Undergraduate Mathematical Contest in Modelling (top 3%) 2022
- ***First Prize***, National Finale of the National College Students Innovation Ability Competition (top 1%) 2022

RESEARCH EXPERIENCE

Dissertation: Analysis and Algorithms in Randomised Numerical Linear Algebra Oct. 2024 – Present

Thesis Researcher | Supervisor: Professor Yuji Nakatsukasa, Mathematical Institute, University of Oxford

- **Anticipated Contribution**: Develop novel methodologies and theoretical insights in randomized numerical linear algebra, addressing computational challenges in large-scale matrix problems. Key topics include the Column Subset Selection Problem, randomized algorithms for eigenvalue and SVD computations, trace estimation, and matrix perturbation theory.
- **Anticipated Methodology**: Employ and refine randomized techniques such as leverage score sampling, uniform sampling, and QR-based pivoting, integrating concepts from random matrix theory and numerical analysis. Derive error bounds and evaluated the impact of matrix properties like coherence and sparsity on algorithm performance.
- **Anticipated Results**: Explore practical implementations in feature selection, dimensionality reduction, and data compression for machine learning and resource-constrained systems, providing insights into algorithm design for uncertain and large-scale data environments. **Resulting paper is currently in preparation.**

High-Frequency Market Making via Avellaneda-Stoikov Framework Oct. 2024 – Jan. 2025

Independent Researcher | Supervisor: Professor Marcel F. Nutz, Department of Statistics, Columbia University

- **Anticipated Contribution**: Optimize high-frequency trading (HFT) strategies by implementing the Hamilton-Jacobi-Bellman (HJB) equation, addressing challenges in dynamic bid-ask pricing, inventory risk management, and market volatility, providing key insights into the application of SDEs and control theory to model market microstructure and mitigate uncertainties in HFT environments.
- **Anticipated Methodology**: Develop a Python-based numerical implementation of the Avellaneda-Stoikov framework, iteratively calibrating drift and diffusion parameters using historical market data to model price dynamics. Incorporate parameterized volatility estimates and liquidity measures to simulate diverse market conditions and integrate dynamic inventory adjustments into the SDE framework to capture stochastic behavior.
- **Anticipated Results**: Achieve significant improvements in the adaptability and predictive accuracy of the model by conducting sensitivity analyses on critical parameters, including order arrival rates and market volatility. Design and teste a risk management framework leveraging stochastic control theory, enabling the dynamic adjustment of stop-loss mechanisms and position sizes in response to real-time market conditions. **Resulting paper is currently in preparation.**

Graduate Thesis: Probabilistic Patterns and Influences on Island Avian Distribution Nov. 2023 - Jun. 2024

Thesis Researcher | Supervisor: Professor Abhishek Pal Majumder, Department of Statistics, University of Reading

- **Contribution**: Applied Sequential Importance Sampling to analyze 0-1 contingency tables with fixed marginal conditions, explore species patterns across different islands. Introduced a statistical framework for studying ecological distribution and randomness, providing deeper insights into species-environment interactions on island ecosystems.
- **Implementation**: Developed and optimized an SIS algorithm that used conditional Poisson distributions for efficient column sampling, weight updating, and resampling. Integrated Effective Sample Size to monitor sampling validity and performance.
- **Results**: Conducted extensive numerical experiments demonstrating the robustness of the SIS method. Achieved faster convergence, improved sampling efficiency, more precise p-value estimates, and the sample generated by SIS method matches the actual observed sample to a higher degree when compared it to traditional MCMC methods.

Advanced Granger Causality Analysis via Structured Deep Learning Nov. 2023 - Feb. 2024

Research Student | Supervisor: Associate Professor Xunfa Lu, School of Management Science and Engineering, NUIST

- **Contribution**: Assisted in exploring structured deep learning methods for Granger causality analysis, focusing on improving interpretability and accuracy compared to traditional approaches.
- **Neural Network Paradigm**: Supported the evaluation of neural network-based models, including MLPs, RNNs, and LSTMs, incorporating sparsity-inducing regularization such as group lasso to enhance causal inference.
- **Neural Network Configurations**: Participated in testing different lag selection strategies and weight penalization techniques, assessing their impact on model interpretability and performance in nonlinear Granger causality detection.

Risk Quantification in Financial Investments Using Enhanced GARCH Techniques May. 2023 - Oct. 2023

Research Student | Supervisor: Associate Professor Xunfa Lu, School of Management Science and Engineering, NUIST

- **Contribution**: Assisted in establishing an advanced risk assessment framework by integrating enhanced GARCH models with multi-dimensional sensitivity and volatility analyses. This contribution augmented the precision of financial risk management systems.
- **Methodological Advancement in Commodities Volatility Analysis:** Assisted in refining the application of GARCH models specifically for commodities trading, focusing on the LME copper and aluminum markets. Extensive parameter optimization to better capture market fluctuations and developing a more detailed articulation of risk profiles.
- **Comprehensive Volatility Pattern Analysis:** Conducted an exhaustive analysis of volatility patterns in LME copper and aluminum trading by leveraging the improved GARCH model. Identified intricate risk factors and developed tailored investment strategies, thereby bridging the gap between theoretical models and practical financial applications.

Fractional Inequalities for Strongly r-Convex Functions on Time Scales Feb. 2023 - Jun. 2023

Research Assistant | Supervisor: Professor Vahid Darvish, Department of Mathematics, University of Reading

- **Contribution**: Assisted in refining mathematical proofs and verifying theoretical results for theorems related to strongly r-convex functions on time scales, contributing to the advancement of fractional calculus and dynamic inequalities.
- **Dynamic Calculus on Time Scales**: Conducted an in-depth study of time scale calculus, focusing on the development of fractional inequalities for strongly r-convex functions as presented in the research.
- **Fractional Integral Bounds:** Investigated properties of delta-Riemann-Liouville fractional integrals and their associated inequalities to establish upper bounds, extending classical results to the time scale framework and bridging discrete-continuous systems.

Shanghai Copper Futures: Arbitrage Trading Mechanisms and Risk Assessment Nov. 2022 - Mar. 2023

Project Co-Leader | Supervisor: Associate Professor Xunfa Lu, School of Management Science and Engineering, NUIST

- **Contribution**: Provided empirical evidence for arbitrage trading in the Shanghai copper futures market, enabling companies to save on financing costs by predicting market yields.
- **Arbitrage Theory and Cost-Risk Modeling**: Explored arbitrage theory and conceptualized a robust arbitrage strategy using advanced probabilistic models and Monte Carlo simulations to delineate risk profiles for Shanghai copper futures.
- **Risk Assessment Algorithm**: Developed a proprietary algorithm incorporating a risk matrix, demonstrating profitability in simulated trading. Additionally, combined ARIMA with macroeconomic variables to predict bond yield volatility.

Analysis of Green GDP and Global Temperature Forecast Based on Time Series Model May 2022 - Sep. 2022

Main Researcher | Supervisor: Professor Wenjun Liu, School of Mathematics and Statistics, NUIST

- **Contribution**: Offered actionable insights into the relationship between climate change and economic activity, supporting policymaking with tools for analyzing Green GDP (GGDP) and environmental factors.
- **Ecological Sustainability in Economic Modeling**: Integrated ecological metrics into a refined GGDP framework using principal component and cluster analysis, blending machine learning and deep learning with numerical techniques, providing a more comprehensive view of economic activity and environmental sustainability.
- **Hybrid Time Series Model**: Developed an ARIMA-LSTM ensemble model to analyze causal relationships between economic activities, ecological factors, and global temperature trends.

TEACHING EXPERIENCE

Nanjing University of Information Science and Technology Nanjing, China

NUIST Reading Academy, School of Mathematics and Statistics

- Mathematical Analysis I — Prof. Chao Wang — Sept. 2021 – Dec. 2021
- Mathematical Analysis II — Prof. Chao Wang — Feb. 2022 – Jul. 2022
- Mathematical Programming — Prof. Riaz Ahmad — Feb. 2023 – Jul. 2023
- Differential Equations II — Prof. Vahid Darvish — Feb. 2023 – Jul. 2023
- Mathematical Modeling — Prof. Riaz Ahmad — Feb. 2024 – Jul.2024
- Facilitated the academic success of 300+ students by pioneering an interactive learning module that was incorporated into the university's curriculum, reflecting a novel approach to teaching complex mathematical concepts.

VISITING EXPERIENCE

University of Oxford Oxfordshire, United Kindom

Oxford Prospects Programmes Visiting Student, Saïd Business School Jan. 2024 - Feb. 2024

- **BFM module**: Completed the BFM module (Business, Finance, and Management) as part of an interdisciplinary academic visitation program, earning a Programme Certificate and an A+ Transcript Report (top 5%).
- **Core courses:** Core courses included Econometric Analysis, Corporate Investment Management, Game Theory and Economic Behavior, Innovation Management, Labor Economics, Global Business, and Political Economy.

PROFESSIONAL EXPERIENCE

SDIC Securities Co., Ltd. *Bond Underwriting Intern* May 2024 – Oct. 2024

- **Risk evaluation**: Innovated risk management by creating a risk evaluation matrix for quasi-REIT and ABS projects, reducing potential risks and ensuring regulatory compliance.
- **Document optimization**: Streamlined document preparation processes by introducing automated templates, cutting document processing time by 20% and improving bond issuance success rates by 15%.
- **Data analytics**: Used Excel VBA to enhance market research efficiency, analyzing over 100 companies across various industries, leading to insights that supported 10+ high-value client transactions.
- **Fixed-income products**: Contributed to the execution and underwriting of fixed-income products (corporate bonds, ABS, quasi-REITs), producing 16 industry research reports that informed strategic decision-making.

Kaiyuan Securities Co., Ltd. *Investment Banking Intern* Sept. 2023 - Dec. 2023

- **Analytical reports**: Researched and prepared presentations that identify and explain trends within our dedicated sectors. Produced over 10 analytical reports on market segments, enhancing the firm's knowledge.
- **Digital transformation**: Involvement in the pitching process – collating materials and undertaking research and analysis. Aggregated and analysed financial data from 50+ companies, influencing five high-value client investment decisions.
- **Valuation model**: Improved transactional models and equity valuation models that was adopted firm-wide, enhancing investment assessment accuracy for a portfolio exceeding 500 million Yuan.

Alibaba Group *Data Analysis Intern* Apr. 2023 - Jun. 2023

- **Market expansion**: Conducted a comprehensive advertising project, analyzing over 1,000,000 data points to identify emerging market trends, resulting in a 20% increase in market reach through strategic decisions.
- **Predictive modeling**: Developed a predictive model for customer behavior in a hotel management project, enhancing business forecasting accuracy by 25% and optimizing marketing strategies.
- **Operational efficiency**: Increased operational efficiency by 15% by creating user profiles and refining push algorithms, contributing to a 4% quarter-over-quarter growth in business performance.

Industrial and Commercial Bank of China *Finance Intern* Dec. 2022 - Feb. 2023

- **Investment strategy**: Collaborated with fund managers on refining investment strategies, increasing portfolio yields by 10% in one fiscal quarter.
- **Trading algorithm**: Contributed to the development of a proprietary trading algorithm, enhancing transaction efficiency and being piloted for high-frequency trading operations.

Nanjing Pack-Age Co., Ltd. *Operations Director* Feb. 2022 - Dec. 2022

- **Viral marketing**: Spearheaded a viral marketing campaign on WeChat, achieving 10,000 views on a single post, resulting in a 25% increase in product inquiries and a 15% boost in sales.
- **Content strategy**: Implemented a data-driven content strategy that increased user engagement by 150% and improved customer satisfaction by 40% across digital platforms.

LEADERSHIP & EXTRACURRICULAR ACTIVITIES

The Mirzakhani Society *Event Coordinator* Oct. 2024 - Present

- Assisted in organizing weekly meetings, fostering an inclusive environment for women and non-binary students in mathematics to engage in problem-solving and discussions over tea and cake.
- Collaborated with team members to coordinate guest speaker events and socials, enhancing the society's outreach and creating opportunities for academic and personal development.

Fushun City, Liaoning; Nanjing City, Jiangsu *COVID-19 Pandemic Response* Jan. 2022 - Dec. 2022

- Assisted in distributing essential supplies to low-income families, ensuring efficient and equitable allocation to community members most in need.
- Helped manage and coordinate vaccine administration sites, overseeing crowd control, safety protocols, and appointment scheduling to maintain smooth operations.
- Worked collaboratively with health officials and other volunteers, contributing to an organized, safe, and community-focused vaccination effort.

Arts Troupe *Secretary* Oct. 2020 - Oct. 2021

- Orchestrated the logistical and creative aspects of 10 comprehensive training workshops, successfully steering six multidisciplinary projects to fruition, elevating operational efficiency by an unprecedented 150%
- Championed the organisation’s digital presence by authoring eight compelling news articles for the university's official social media channels, significantly enhancing community engagement and visibility

Student Union, Reading Academy *Deputy Head of Publicity Department* Oct. 2020 - Oct. 2021

- Oversaw the strategic planning and execution of publicity campaigns and conducted meticulous post-event analyses; engaged with and secured sponsorship deals totalling, directly contributing to the financial viability of critical departmental initiatives
- Demonstrated proficiency in digital content creation by designing ten visually appealing posters with PS, editing promotional videos with PR, and crafting informative leaflets and brochures for five major institutional events**.**

SKILLS & CERTIFICATES

Language Proficiency: Mandarin (native); English (fluent; IELTS 7.0; GRE: Verbal Reasoning: 166, Quantitative Reasoning: 170, Analytical Writing: 5.5); Japanese (fluent, N2)

Professional Organizations Membership: Institute of Mathematical Statistics (IMS), Student Member.

IT Skills: Proficient in Python (NumPy, Pandas, Matplotlib, Seaborn, Sklearn, Pytorch), R (ggplot, faraway, leaps, MASS, tidyverse, lmtest, caret, glmnet, randomForest), MATLAB, LaTeX, SAS, SPSS, Amos, Tableau; MySQL, Power BI, Wind, Choice, iFinD, Microsoft Office (Visio, Access, Word, Excel, PowerPoint)

Certificates: Certificate of Professional Skills in Data Analytics; National Market Research and Analytics Specialized Skills Certificate; Certificate for Business Translation Competence