Yuanyuan Zhang

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Professional Positions

Research Associate, The Centre for Digital Trust and Society 01/2023 – Present
School of Social Sciences, The University of Manchester, UK.
Member **of the Digital Technologies and Crime Research** Cluster (CDTS)
Project title: **Anomaly and Fraud Detection in Blockchain and Cryptocurrency Networks**

- Secured over **£15,000 as PI** in research funding for this project, 2023-2024.
- Implemented and developed AI and data science techniques to investigate fraud and anomalies in blockchain.
- Enhanced the deep learning model for anomaly detection, comparing algorithms like GATv1, GATv2, VAE, AdaBoost, LGBM, and SVM.
- Created a Python model using OpenAI's LLMs to automate the extraction and analysis of web-based data on blockchain scam.
- Designed R Shiny apps for temporal analysis of blockchain network structures, network statistics, and blockchain forensics.
- Chair and organiser of the conference "Investigating the Blockchain: Forensic Approaches to Digital Crime Analysis", in collaboration with CDTS and MIMS, University of Manchester, September 21, 2024, UK.

Data Scientist (Research Associate), Division of Musculoskeletal & Dermatological Sciences 01/2020 – 01/2023
School of Biological Sciences, The University of Manchester, UK.
Member for the Centre for Epidemiology Versus Arthritis (CfE).

- Designed and developed the Shiny app (interactive data Visualisation dashboard) for cloudy with a chance of pain project/Health intelligence project.
- Involved data request and storage, assessing data quality, creating and developing the data wrangling pipeline, supporting systems to share data and analysis methodology.
- Provided practical data analytics support to research staff working with a range of data sources (mHealth and eHealth data).
- Provided feedback to improve the usability, functionality, and security of medical apps for patient partners through temporal analysis.
- Training researchers, PhD students and medical clinicians in R software programming for Data Science.

Honorary contract with Salford Royal NHS Foundation Trust (***Epidemiological COVID-19 Researcher: Informatics***)

- Performed data visualization and statistical regression models for Covid data.
- Implementing text mining to identify patients who requires shielding for Covid.
- Tested the efficiency, accuracy, and security of the automated shielding process for COVID-19.

Education

Ph.D. in Mathematical Sciences, School of Mathematics 01/2016 – 01/2020
The University of Manchester, UK Supervisor: Dr. Saralees Nadarajah
Research area: **Statistical Methods and Distribution Theory with Applications to Finance and Cryptocurrencies**

- Analyzed the Stylised facts for high frequency cryptocurrency data.
- Proposed new extreme value analysis methods to high frequency Cryptocurrencies.
- Modelled the composition of social networks using heavy tailed distributions.
- Developed new R software packages for over 40 wrapped distributions.

MSc Financial Statistics, School of Mathematics 09/2014 – 09/2015
The University of Manchester, UK

BSc (joint Hons) Applied Mathematics (First Class Honours) 09/2009 – 09/2013
Nanjing University of Science Information and Technology (NUIST), Nanjing, China

Publications

25 publications (9 first author), 537 citations and a h-index of 13 (Google Scholar, 2024).

First author publications:

1. **The adaptive market hypothesis of Decentralized finance (DeFi).** (Zhang, Y., Chan, S & Chu, J). *Applied Economics* (2022), 55 (42), pp.4975-4989.
2. **Exact Distribution of the Max/Min of Two Correlated Random Variables.** (Zhang, Y., & Nadarajah, S). *Wireless Personal Communications* (2021), 116 (3), 1593-1612.
3. **On the Market Efficiency and Liquidity of High-Frequency Cryptocurrencies in a Bull and Bear Market.** (Zhang, Y., Chan, S., Chu, J. & Sulieman, H). *Journal of Risk and Financial Management* (2020), 13, 8. **[41 citations]**
4. **The Generalised hyperbolic distribution and its subclass in the analysis of a new era of cryptocurrencies: Ethereum and its financial risk.** (Y. Zhang., J. Chu., S. Chan. & B. Chan). *Physica A: Statistical Mechanics and its Applications* (2019), 526, 120900.
5. **Extreme value analysis of high-frequency cryptocurrencies.** (Zhang, Y., Chan, S., & Nadarajah, S). *High Frequency* (2019), 2(1), pp.61-69.
6. **Stylised facts for high frequency cryptocurrency data.** (Zhang, Y., Chan, S. & Chu, J). *Physica A: Statistical Mechanics and its Applications* (2019), 513, pp. 598-612. **[64 citations]**
7. **A review of backtesting for Value at Risk.** (Zhang, Y. & Nadarajah, S)**.** *Communications in Statistics – Theory and Methods* (2017), Taylor & Francis Online, 47 (15), pp. 3616-3639. **[60 citations]**
8. **Flexible heavy tailed distributions for big data.** (Zhang, Y. & Nadarajah, S). *Annals of Data Science* (2017), Springer, 13 (4), pp. 1-12.
9. **On partially-truncated distributions.** (Zhang, Y. & Nadarajah, S). *Communications in Statistics – Simulation and Computation* (2017), Taylor & Francis Online, 47 (6), pp. 1623-1631.

Other publications:

10. **Interconnections and contagion among cryptocurrencies, DeFi, NFT and traditional financial assets: Some new evidence from tail risk driven network.** (Liao, X., Li, Q., Chan, S., Chu, J., & Zhang, Y). Physica A: Statistical Mechanics and its Applications, (2024, In Press).
11. **P051 Development and evaluation of a text-analytics algorithm for automated application of the BSR COVID-19 shielding criteria in rheumatology patients** (Jani, M., Alfattni, G., Belousov, M., Zhang, Y., Cheng, M., Webb, K., Kanter, A., Dixon, W., & Nenadic, G). Rheumatology, (2023), 62(Supplement_2), pp.kead104-092.
12. **The epidemiology of Psoriatic Arthritis in the UK: A health intelligence analysis of UK Primary Care Electronic Health Records 1991-2020.** (Druce, K., Zhang, Y., Dixon, W. & McBeth, J). *Rheumatology*, (2023), kead586, https://doi.org/10.1093/rheumatology/kead586
13. **An analysis of the return-volume relationship in decentralised finance (DeFi).** (Chu, J., Chan, S & Zhang, Y). *International Review of Economics & Finance* (2023), 85, pp.236-254. https://doi.org/10.1016/j.iref.2023.01.006.
14. **An extreme value analysis of the tail relationships between returns and volumes for high frequency cryptocurrencies.** (Chan, S., Chu, J., Zhang, Y., & Nadarajah, S). *Research in International Business and Finance* (2022), 59, 101541. **[28 citations]**
15. **Bitcoin versus high-performance technology stocks in diversifying against global stock market indices.** (Chu, J., Chan, S., & Zhang, Y). *Physica A: Statistical Mechanics and its Applications* (2022), 580, 126161.
16. **Count regression models for COVID-19.** (Chan, S., Chu, J., Zhang, Y., & Nadarajah, S). *Physica A: Statistical Mechanics and its Applications* (2021), 563, 125460. **[30 citations]**
17. **Discrete analogues of continuous multivariate probability distributions.** (Wiegand, M., Nadarajah, S. & Zhang, Y). *Annals of Operations Research* (2020), 292, pp.183-190.
18. **Bias reduction in the population size estimation of large data sets.** (Chu, J., Zhang, Y. & Chan, S). *Journal Computational Statistics and Data Analysis* (2020), 145, p.106914.
19. **High frequency momentum trading with cryptocurrencies.** (Chu, J., Chan, S. & Zhang, Y). *Research in International Business and Finance* (2020), 52, 101176. **[39 citations]**
20. **The adaptive market hypothesis in the high frequency cryptocurrency market** (Chu, J., Zhang, Y. & Chan, S). *International Review of Financial Analysis* (2019), 64, pp.221-231. **[106 citations]**
21. **An investigation of effective factors on children's growth failure in Iran using multilevel models.** (Azarbar, A., Zhang, Y. & Nadarajah, S). *Quality & Quantity* (2018), pp. 1-8.
22. **Wrapped: An R Package for Circular Data.** (Nadarajah, S. & Zhang, Y). *Journal of PLOS one* (2017), 12(12), e0188512**.**
23. **On sums of independent generalised Pareto random variables with applications to insurance and CAT bonds.** (Nadarajah, S., Zhang, Y. & Pogany, T). *Probability in the Engineering and Informational Sciences* (2017), Cambridge University Press, 32 (2), pp. 296-305.
24. **Examples of zero correlation not implying independence**. (Nadarajah, S. & Zhang, Y). *The Mathematical Scientist* (2016), Applied Probability Trust, 41 (2).

25. **New bivariate wrapped distributions** (Nadarajah, S. & Zhang, Y)**.** *Journal of Mathematics and Statistics* (2016), Science Publications, 12 (4), pp. 206-212.

Refereed Journal Papers under review:

1. **The interplay between cryptocurrencies and phishing crimes: Ethereum under the microscope** (Zhang, Y., Lord, N., Chan, S., Chu, J. & Zhang, Y) (2024).
2. **Enhancing Security in Blockchain Networks: Anomalies, Frauds, and Advanced Detection Techniques** (Osterrieder, J., Chan, S., Chu, J. and Zhang, Y) (2024). Available at SSRN. https://doi.org/10.48550/arXiv.2402.11231

Books and Books Editor

- **Blockchain and Cryptocurrencies** (Chan, S., Chu, J., Zhang, Y., & Nadarajah, S). *J. Risk Financial Manag*. (2020). https://doi.org/10.3390/books978-3-03943-534-0.

Books Chapters

- **Stylized facts of decentralized finance (**Zhang, Y., Chan, S., Chu, J., Lao, X. and Min, H), in La Torre, D. (ed.) *AI for Finance and Beyond. World Scientific Publishing Europe*, (June 2024). https://doi.org/10.1142/q0449

Software Packages

- Nadarajah, S, Zhang, Y, (2017). R package **"Wrapped",** Computes the probability density function, cumulative distribution function, quantile function and random numbers for 40 univariate wrapped distributions. R package version 1.0. http://cran.r-project.org/web/packages/Wrapped/index.html

Research funding

- **Principle Investigator:** "Blockchain Forensics: Criminal Analysis using R Shiny", Centre for Digital Trust and Society (CDTS) Seedcorn, University of Manchester, UK, 2023-2024. Total Amount Awarded: **£9,000.**
- **Principle Investigator:** "Anomaly and Fraud Detection in Blockchain - Based Networks", University of Manchester Global Scholars Fund, 2023-2024 with Institution partner: Renmin University of China, China. Total Amount Awarded: **£4,000.**
- **Principle Investigator:** "Crafting Anomaly and Fraud Detection Tools for Blockchain Integrity: Building the Path for the UK to Become a Global Blockchain Tech Leader", Campion Grant, Manchester Statistical Society, 2023-2024. Total Amount Awarded: **£2,000.**
- **Principle Investigator: "**Mathematics and data science techniques for detecting anomalies in emerging digital technologies and assets" University of Manchester SoSS Small Grants Competition, 2023 with Institution partner: Bern University of Applied Science, Bern, Switzerland. Total Amount Awarded: **£2,000.**
- **Principle Investigator:** ***"Statistical Methods and Distribution Theory with Applications to Cryptocurrencies and Big Data",*** Henry Lester Trust Ltd Research Grant. 2017-2019. Total Amount Awarded: **£8,000**.
- **Team Member:** "Marie Sklodowska-Curie Action (MSCA) Industrial Doctoral Network on Digital Finance", Marie Sklodowska-Curie Action, 2024-2027, (PI - Osterrieder, J). Total Amount Awarded: **EUR 4,473,972.** https://www.digital-finance-msca.com/blockchain
- **Co-Principle Investigator:** "From Digits to Dollars: The Evolution of Price Impact in Digital Assets", (FRG24-E-S25), American university of Sharjah Research Grant, UAE, 2024-2025, (with Chan, S). Total Amount Awarded: **AED 25,000.**
- **Co-Principle Investigator:** "Research on Detecting Illicit Activity in Digital Cryptocurrency Networks", (IS23126), Beijing National Science Foundation 2023 International Scientists Project, 2023-2025, (with Chu, J). Total Amount Awarded: **RMB 200,000.**
- **Co-Principle Investigator:** "2018 Mathematics for Industry Conference: Blockchain and Cryptocurrencies", University of Manchester, UK, 2023, (with Nadarajah, S). Total Amount Awarded: MI – NET Industrial Workshop Grant, **(€1,000),** Bank of England Research Donation Committee Fund for the Workshop and Conference **(£2500)**, The American Risk and Insurance Associations **($5000)** and The Institute of Mathematics and its Applications (IMA) Small Grant Scheme **(£500).**
- **Co-Principle Investigator:** "*Cryptocurrency and blockchain technology"*, Manchester 2017 Fintech Seedcorn funding, (with Nadarajah, S). Total Amount Awarded: **£4,100.**

Teaching Experience

Instructor - University of Manchester, School of Biological Sciences, Manchester, UK.

- Statistical programming & Data Science (PhD students and medical clinicians), Spring 2020, 2021 & 2022.

Teaching Assistant - University of Manchester, School of Mathematics, Manchester, UK.

Graduate level

- Mathematics 68181 Extreme Values and Financial Risk, Autumn 2016, 2017, 2018, 2019 **(Lead demonstrator)**

Undergraduate level

- Mathematics 19842 OF2 (Probability & Vectors), Spring 2017 **(Lead demonstrator)**
- Mathematics 10141 Probability 1, Autumn 2016, 2017
- Mathematics 20912 Statistical Methods, Spring 2017,2018, 2019
- Mathematics 10282 Introduction to Statistics, Spring 2016, 2017

Supervision

I have co/supervised the following students:

- **Kareem Said Ismai**l, Undergraduate, American University of Sharjah, UAE, (2024-Present), Research Grant Project, Title: Using AI to Monitor Behavioral Changes in Captive Bengal Slow Lorises (Nycticebus bengalensis) with Enrichments.
- **Leen Faraj**, Undergraduate, American University of Sharjah, UAE, (2024-Present), Research Grant Project, Title: Automating Blockchain Scam Detection: LLMs for Data Analysis and R Shiny Forensics.
- **Qixuan Yang**, M.Sc., University of Manchester, UK (2023-Present), Master Project, Title: Deep Learning for Anomaly Detection on Blockchain Networks.
- **Durga Chandrashekhar**, Undergraduate, American University of Sharjah, UAE, (2022-2024), Research Project, Title: Stylized facts of the metaverse and non-fungible tokens **(Under review in Physica A: Statistical Mechanics and its Applications).**
- **Brandon Chan**, M.Sc., University of Warwick, UK (2019), Master Project, Title: Ethereum: Bitcoin 2.0 - taking the road less travelled **(Blockchain research project - Published).**

Invited Talks

- "Empirical Analysis of Illicit Transactions on Blockchain network" (seminar), **Renmin University of China**, School of Statistics, Beijing, China, December 5th 2023.
- "Anomaly and Fraud detection in Blockchain Networks" (seminar), **Hong Kong Laureate Forum**, Hong Kong Science Park, Convention Center, Hong Kong, November 15th 2023.
- "Empirical Analysis of Illicit Transactions on Blockchain network" (seminar), **University of Manchester**, Centre of Digital Trust & Security (CDTS) Digital Tech and Crime, Manchester, UK, October 25th 2023.
- "Anomaly and Fraud detection in Blockchain Networks" (seminar), **Bern University of Applied Sciences**, Business School, Bern, Switzerland, July 27th, 2023.
- "Network transitions in the cryptocurrency market: Evidence from the Russia-Ukraine war" (seminar), **White-collar and Organisational Crime: New ideas, directions and perspectives workshop**, University of Manchester, Manchester, UK, July 6th 2023.
- "Transitions in the cryptocurrency market: Evidence from the Russia-Ukraine war" (seminar), **The Cybersecurity Revolution** (SECREV) 2023, Online, May 10th 2023.
- "Wash trading in the NFT space and Cryptocurrency mixers and tumblers" (seminar), **ACE Sandpit: Future Use of Cryptocurrency by Serious and Organised Crime**, Tintagel House, London, UK, March 27th 2023.
- "Build your own Web Application with R shiny" (seminar). R-thritis Statistical Computing Group, **University of Manchester**, Centre for Epidemiology Versus Arthritis, School of Biological Sciences, UK, May 7th 2021. Seminar slides

Conference Presentations

- "Empirical analysis of illicit transaction on Blockchain network". Royal Statistical Society (RSS) International Conference 2023, Harrogate Convention Centre, Harrogate, UK, September 4th – 7th 2023.
- "Making project management seamless using automated Gantt charts in R Shiny". ShinyConf 2023, Online, March 15th – 17th 2023.
- "Stylised facts for high frequency cryptocurrency data". 2019 IMS China International Conference on Statistics and Probability, Dalian, China, July 6th – 10th 2019. **Awarded the Institute of Mathematical Statistics (IMS) New Researcher Travel Award.**
- "Stylised facts for high frequency cryptocurrency data". 3rd International Conference on Econometrics and Statistics, National Chung Hsing University, Taichung, Taiwan, June 25th - 27th 2019.
- "Ethereum: Bitcoin 2.0 - Taking the Road Less Travelled". 2018 Joint Statistical Meetings (JSM), Vancouver Convention Center, British Columbia, Canada, July 28th-August 2nd 2018. **Awarded the IMS Hannan Travel Award.**
- "On sums of independent generalized Pareto random variables with applications to insurance and CAT bonds"

(Research Poster). 2017 Joint Statistical Meetings (JSM), Baltimore Convention Center, Baltimore, USA, July 29th-August 3rd 2018. **American Statistical Association Award Winner (Poster competition)**

- "On sums of independent generalized Pareto random variables with applications to insurance and CAT bonds" (Research Poster). 1st International Conference on Econometrics and Statistics (EcoSta 2017), Hong Kong University of Science and Technology, Hong Kong, June 15th-17th 2017.
- "On the maximum and minimum for classes of bivariate distributions" (Research Poster). Workshop on "Risk Quantification and Extreme Values in Applications", École polytechnique fédérale de Lausanne (EPFL) Lausanne, Switzerland, February 15th-17th 2017.
- "New bivariate wrapped distributions" (Research Poster), International Conference on Statistical Distributions and Applications, Crown Plaza, Niagara Falls, Canada, October 14th-16th 2016.
- "Flexible heavy tailed distributions for big data" (Research Poster). 2016 Joint Statistical Meetings (JSM), McCormick Place, Chicago, USA, July 30th – August 4th 2016.
- "A new distribution to describe Big Data" (Research Poster), The 4th Institute of Mathematical Statistics Asia Pacific Rim Meeting, Chinese University of Hong Kong, Hong Kong, June 27th- 30th 2016.

Professional Activities

Team Member, Marie Sklodowska-Curie Action (MSCA) Industrial Doctoral Network on Digital Finance", Marie Sklodowska-Curie Action, 2024-2027, (PI - Osterrieder, J). Total Amount Awarded: **EUR 4,473,972.**

- Research Project "Leveraging Data Science and AI for fraud detection in Blockchain Networks". Engaged in comprehensive discussions on methodologies, techniques, and findings. Publications and ongoing academic collaborations with Bern University of Applied Science.

Chair of the Organising/Program Committee, "Investigating the Blockchain: Forensic Approaches to Digital Crime Analysis" Conference, University of Manchester, Manchester September 21st, 2024, UK.

- Successfully secured as PI grants totaling **over £10,000** from the Centre for Digital Trust and Society (**CDTS**) grant and the Manchester Institute for Mathematical Sciences (**MIMS**), to host the conference.

Member of Planning Committee, "Centre for Digital Trust and Society Forum 2024", Circle Square, Oxford Road, Manchester, July 3rd, 2024.

- Coordinated key international partners and experts across six research clusters to explore challenges and opportunities related to trust in digital technologies, and collaboratively co-created an inclusive vision for the future in the UK and beyond.

Organizing Committee Chair, "The 4th International Symposium on Big Data and Artificial Intelligence (ISBDAI)", conference, Hong Kong, December 14th-15th 2024.

Organiser, Bits and Blocks (Blockchain) Workshop 2021, Online, 18th December 2021.

- Joint organiser (with Chan, S. & Chu, J) hosting a small one-day workshop bringing together individuals from academia and industry, to share the latest knowledge, research, and developments in the blockchain, decentralised finance, and digital assets.

Co-organiser, "Mathematics for Industry: Blockchain and Cyptocurrencies" Conference, University of Manchester, Manchester (2018), UK.

- Participated in the planning of the conference schedule; invitation of guest speakers; arrangement of transport, accommodation, and catering for attendees; conference website and publicity.
- Successfully secured multiple grants totaling over £7500 from the European Cooperation in Science and Technology (COST); Bank of England Research Donations Committee; The American Risk and Insurance Association (ARIA); The Institute of Mathematics and its Applications (IMA), to host the conference.

Guest Editor, Two Special Issues:
"Fraud and Anomaly Detection in the Digital Asset Economy**",** Journal of Risk and Financial Management, 2023-2024.
"Smart Cities Research in Enabling Technologies and Tools**"**, Journal of Risk and Financial Management, 2020-2022.

Editor "Frontiers in Blockchain and Cryptocurrencies**"**, Journal of Risk and Financial Management, 2018-2022.

Member of American Statistical Association (ASA), Institute of Mathematical Statistics (IMS) and International Chinese Statistical Association (ICSA).

Honours and Awards

- 2023 European Cooperation in Science and Technology (COST) Travel Grant – Attending the 8th European COST Conference on Artificial Intelligence in Finance, Bern, Switzerland. Total Amount Awarded: **€1000.**
- Selected by the Scientific Review Board of the **Council of the Hong Kong Laureate forum** and the Government of the Hong Kong Special Administrative Region to present (only 200 worldwide selected) at the 2023 Young Scientist Forum on my research blockchain project. https://hklaureateforum.org/en/inaugural-forum/forum-overview
- 2019 **Institute of Mathematical Statistics (IMS)** New Researcher Travel Award – Attending the 2019 IMS China Meeting. **[1 out of 11 worldwide to receive this award, and the only one from the UK to receive this award.]** Total Amount Awarded: **$1300.**
- 2019 European Mathematical Society (EMS) Travel Grant – Visiting Scholars Scheme, to fund a one-week academic visit to Universidad Carlos III de Madrid, Madrid. Total Amount Awarded: **€500.**
- 2018 **Institute of Mathematical Statistics (IMS) Hannan Travel Award** – Attending the 2018 Joint Statistical Meetings, Vancouver. Total Amount Awarded: **USD $750.**
- 2017 University of Manchester Data Science Institute Travel Bursary Fund – Visiting Scholars Scheme. Total Amount Awarded: **£2000.**
- **Best poster Award**, Risk Analysis section in the American Statistical Association at the 2017 Joint statistical Meetings. Total Amount Awarded: **$500.**
- Recipient of the **2017 Manchester Doctoral College (MDC)** PGR Conference Travel Fund.
- Recipient of the **École polytechnique fédérale de Lausanne (EPFL)** grant to present at the Extreme and Application Winter School 2017.
- Successful Applicant to "Manchester Gold" Careers Mentoring scheme, **Alliance Manchester Business School** 2016.
- Awarded the **Canadian Statistical Sciences Institute** grant to attend the ICOSDA conference 2016.
- Awarded University of Manchester "**Top Student Award"** for master dissertation.
- Awarded "Outstanding student" in 2010-2013 Nanjing University.

IT Skills

- Programing: Statistical System R; Python; C; Excel; SPSS; SQL; SAS; Matlab; Minitab; Latex.
- Operating System: Windows; Mac OS X; Unix.

Languages

- Languages: Fluent English
- Chinese - Mandarin (level A) and Teacher's qualification certificate (High Level).