Milena Vuletić

Christ Church, Oxford, United Kingdom OX1 1DP |Google Scholar| GitHub| *LinkedIn*

EDUCATION

2021-(2025) **DPhil in Mathematics of Random Systems: Analysis, Modelling and Algorithms**,
Mathematical Institute, University of Oxford, Christ Church (https://www.randomsystems-cdt.ac.uk/)
Supervised by **Prof. Rama Cont** and **Prof. Mihai Cucuringu**
Thesis: Mathematical and data-driven modelling of multi-asset markets
Courses taken: Foundations of Stochastic Analysis; Foundations of Data Science; Function Spaces and Distribution Theory; Theories of Deep Learning; Advanced Topics in Stochastic Analysis; Advanced Topics Stochastic Processes; Simulation Methods and Stochastic Algorithms; Optimisation (MCF); Market Microstructure and Algorithmic Trading (MCF); Random Matrix Theory; Stochastic Analysis and Partial Differential Equations; Signatures and Rough Paths in Machine Learning

2017-2021 **MMath in Mathematics and Statistics**, University of Oxford, Wadham College
Master's part of the course (Part C): **Distinction (**Second highest result in the cohort)
Bachelor's part of the degree (Prelims, Part A, Part B): **First Class Honours**
Dissertation: Financial time series forecasting via generative adversarial networks
Supervised by Prof. Mihai Cucuringu
Relevant Courses Taken (Parts A,B and C): Statistical Machine Learning, Foundations of Statistical Inference, Applied Statistics, Computational Statistics, Applied Probability, Mathematical Models of Financial Derivatives; Probability, Measure and Martingales; Continuous Martingales and Stochastic Calculus, Simulation and Statistical Programming, Statistics, Probability, Integration and Measure Theory, Algorithmic Foundations of Learning, Theories of Deep Learning, Bayes Methods, Advanced Topics in Statistical Machine Learning, Probability and Statistics for Network Analysis, Advanced Simulation Methods, Stochastic Differential Equations, Networks

2013-2017 **Mathematical Grammar School**, Belgrade, Serbia
Maximum GPA in every year. Graduation paper on Numerical Integration.

PAPERS

Cont, Rama, and Milena Vuletić. 2023. "Simulation of Arbitrage-Free Implied Volatility Surfaces." *Applied Mathematical Finance* 30 (2): 94–121 DOI: 10.1080/1350486X.2023.2277960.

- We present a computationally tractable method for simulating arbitrage-free implied volatility surfaces. We illustrate how our method may be combined with a data-driven model based on historical SPX implied volatility data to generate dynamic scenarios for arbitrage-free implied volatility surfaces. Our approach conciliates static arbitrage constraints with a realistic representation of statistical properties of implied volatility co-movements.

Milena Vuletić, Felix Prenzel & Mihai Cucuringu (2024) "Fin-GAN: forecasting and classifying financial time series via generative adversarial networks", Quantitative Finance, 24:2, 175-199, DOI: 10.1080/14697688.2023.2299466

- We investigate the use of Generative Adversarial Networks (GANs) for probabilistic forecasting of financial time series. To this end, we introduce a novel economics-driven loss function for the generator. This newly designed loss function renders GANs more suitable for a classification task, and places them into a supervised learning setting, whilst producing full conditional probability distributions of price returns given previous historical values. Our approach moves beyond the point estimates traditionally employed in the forecasting literature, and allows for uncertainty estimates. Numerical experiments on equity data showcase the effectiveness of our proposed methodology, which achieves higher Sharpe Ratios compared to classical supervised learning models, such as LSTMs and ARIMA.

Vuletić, Milena, and Rama Cont. "VolGAN: a generative model for arbitrage-free implied volatility surfaces.", Applied Mathematical Finance, to appear

- We introduce VolGAN, a generative model for arbitrage-free implied volatility surfaces. The model is trained on time series of implied volatility surfaces and underlying prices and is capable of generating realistic scenarios for joint dynamics of the implied volatility surface and the underlying asset. We illustrate the performance of the model by training it on SPX implied volatility time series and show that it is able to learn the covariance structure of the co-movements in implied volatilities and generate realistic dynamics for the (VIX) volatility index. In particular, the generative model is capable of simulating scenarios with non-Gaussian distributions of increments for state variables as well as time-varying correlations.

- Finally, we illustrate the use of VolGAN to construct data-driven hedging strategies for option portfolios, and show that these strategies outperform Black-Scholes Delta and Delta-Vega hedging.

WORK EXPERIENCE

Jun 2024- Aug 2024 **G-Research,** *Intern (Summer Research Programme),* Signal Research
- Spent 10 weeks in a Signal Research team. Forecasting equity returns from alternative and fundamental data.

Jul 2020- Aug 2020 **Bloomberg,** *Summer Intern,* Global Data, London (online)
- 7 weeks long internship with DCM Automation team. Individual project brought some very useful insights into the bonds data as well as some new approaches and findings that should help improve one of the key Fixed Income products. Made a presentation on using statistical diagnostic plots to generate inference from data. Group project resulted in an FFM article on green Covid-19 recovery.

Aug 2019 **MozzartBet,** *Summer Intern,* Analytics , Belgrade
- Learned about the mathematics behind sports betting, different gambling strategies, and games of chance. Spotted places for improvement in the internal systems. Utilised data analysis algorithms and machine learning techniques for mini projects.

Apr 2019 **Goldman Sachs,** *Spring Intern,* Securities Division, London
- Spent two weeks in Sales and Trading, meeting 45 different teams and learning about what they to. Had group trading exercises and quizzes. Presented a final stock pitch on Tesla (long for a year).

Jul 2018- Aug 2018 **National Bank of Serbia,** *Intern,* Directorate for Economic Research and Statistics
- Wrote a paper on extracting inflation expectations from financial derivatives and proposed a new approximation model to the yield curve (a term was added to the Nelson-Siegel model). This model is very likely to be taken into consideration when preparing the Inflation Reports and the project was awarded the best internship project, which resulted in a recommendation from the governor herself. I was their youngest intern ever (they usually only take final year students).

TEACHING

Oct 2021- March 2024 **University of Oxford,** *Teaching Assistant and Class Tutor*
- Teaching Assistant:
  - B8.1 Probability, Measure, Martingales (Part B, MT 2021)
  - B8.2 Continuous Martingales and Stochastic Calculus (Part B, HT 2022)
  - Foundations of Data Science (CDT in Mathematics of Random Systems, MT 2023)
- Tutor (and Teaching Assistant):
  - Statistics and Financial Data Analysis (MSc in Mathematical and Computational Finance, MT2021 and MT 2022)
  - Advanced Volatility Modelling (MSc in Mathematical and Computational Finance, HT 2023 and HT 2023)
  - Asset Pricing (MSc in Mathematical and Computational Finance, HT2023)
  - Quantitative Risk Management (MSc in Mathematical and Computational Finance, HT 2023)
- Assisting with Mathematics and Joint Schools undergraduate interviews for admissions at Exeter College (2022 admissions)

AWARDS AND SCHOLARSHIPS

Nov 2024 **Rising Star in Quantitative Finance**, Risk.net
- Won the award for my work on VolGAN. The selection committee consisted of 20 leading academics and industry quants. The papers were judged based on originality, correctness, relevance, and applicability.

2021-2025 **Doctoral Scholarship by BNP Paribas**, University of Oxford
A full DPhil scholarship awarded by BNP Paribas through the Random Systems CDT.

2021 **Woodhouse Prize in Mathematics,** Wadham College, University of Oxford
Awarded for the best performance in Mathematics options by a 3rd or 4th year Wadham student taking Mathematics or a related Joint School.

2018-2021 **Examination Prize,** Wadham College, University of Oxford
Awarded for achieving equivalents of First Class results in Prelims, Part A, Part B and Part C.

2017-2021 **Reach Oxford Scholarship**, University of Oxford
A full scholarship awarded to 2-3 non-EU students per year by the University of Oxford.

2013-2016 **National Competitions in Serbia**

- National Competition in **Mathematics**: one first, one second and two third prizes
- National Competition in **Physics**: two second prizes
- National Competition in **Informatics**: one first and two third prizes (attended the Team Selection Test for the JBOI for the first time at the age of 12, and I was often the only female competitor)
- Junior Serbian Olympiad in Informatics (the Team Selection Test for the JBOI): third prize

2015 **The Most Innovative Android Application**, *Team Competition,* Mt:s
An app designed to help children safely use Android devices. Included NFC technology.

INVITED TALKS AND PRESENTATIONS

2025

- (27.03.2025) Data-Driven Hedging with Generative Models, *Société Générale Quantitative Finance Seminar 2025*, La Clusaz, France
- (20.03.2025) Data-Driven Hedging with Generative Models, *UBS Quantitative Conference 2025*, London
- (06.02.2025) Data-Driven Hedging with Generative Models, *J.P. Morgan 2025 Macro Quantitative & Derivatives Conference 2025*, London
- (10.01.2025.) VolGAN: A Generative Model for Simulating Arbitrage-Free Implied Volatility Surfaces, *London-Oxford-Warwick Conference*, Oxford

2024

- **21.11.2024.** Data-Driven Hedging with Generative Models, *QuantMinds 2024,* London
- **14.11.2024.** Generative Modelling in Finance, *Xantium Group,* London
- **10.09.2024** – VolGAN: A Generative Model for Simulating Arbitrage-Free Implied Volatility Surfaces, *Berlin-Oxford Summer School in Mathematics of Random Systems 2024*, Oxford
- **20.04.2024** – VolGAN: A Generative Model for Simulating Arbitrage-Free Implied Volatility Surfaces, *13th Oxford-Princeton Workshop,* Princeton
- **03.04.2024** – VolGAN: A Generative Model for Simulating Arbitrage-Free Implied Volatility Surfaces, *11th Oxford-ETH Workshop*, Zurich
- **02.04.2024** – VolGAN: A Generative Model for Simulating Arbitrage-Free Implied Volatility Surfaces, *World Online Seminars on Machine Learning in Finance*, Online
- **19.03.2024** – VolGAN: A Generative Model for Simulating Arbitrage-Free Implied Volatility Surfaces, *17th Financial Risks International Forum on Big Data & Algorithmic Finance*, Paris
- **19.01.2024** – VolGAN: A Generative Model for Simulating Arbitrage-Free Implied Volatility Surfaces, *OMI Student Presentations at the 17th Financial Risks International Forum*, Oxford

2023

- **22.12.2023** – Simulation of Arbitrage-Free Implied Volatility Surfaces, *Student Seminar at the Mathematical Institute of the Serbian Academy of Sciences and Arts*, Belgrade
- **06.12.2023** – VolGAN: A Generative Model for Simulating Arbitrage-Free Implied Volatility Surfaces, *Quant Summit Europe*, London
- **16.11.2023** – VolGAN: A Generative Model for Simulating Arbitrage-Free Implied Volatility Surfaces, *QuantMinds 2023*, London
- **19.10.2023** – VolGAN: A Generative Model for Simulating Arbitrage-Free Implied Volatility Surfaces, *BNP Paribas PhD Days*, Paris
- **04.10.2023** – Fin-GAN: Forecasting and Classifying Financial Time Series via Generative Adversarial Networks, *Balyasny Asset Management*, Online
- **26.06.2023** – Simulation of Arbitrage-Free Implied Volatility Surfaces, *10th Oxford-ETH Workshop*, Oxford
- **20.06.2023** – Simulation of Arbitrage-Free Implied Volatility Surfaces, *Random Systems CDT Workshop*, Oxford
- **02.06.2023** – Simulation of Arbitrage-Free Implied Volatility Surfaces, *SIAM UKIE National Student Chapter Conference*, Oxford
- **18.04.2023** – Fin-GAN: Forecasting and Classifying Financial Time Series via Generative Adversarial Networks, *Probability and Statistics Seminar, Faculty of Mathematics, University of Belgrade*, Belgrade
- **22.03.2023** – Fin-GAN: Forecasting and Classifying Financial Time Series via Generative Adversarial Networks, *Man Group*, London

2022

- **09.12.2022** – Simulation of Arbitrage-Free Implied Volatility Surfaces, *Bank of America Merrill Lynch*, London
- **08.12.2022** – Simulation of Arbitrage-Free Implied Volatility Surfaces, *Oxford-Berlin Workshop*, Oxford
- **17.09.2022** – Simulation of Arbitrage-Free Implied Volatility Surfaces, *Oxford Mathematical and Computational Finance Seminar*, Oxford

- **07.09.2022** – Simulation of Arbitrage-Free Implied Volatility Surfaces, *QuantMinds 2022*, Barcelona
- **19.07.2022** – Financial Time Series Forecasting via GANs, *OMI Crossroads Seminar*, Oxford
- **21.06.2022** – Financial Time Series Forecasting via GANs, *9th Oxford-ETH Workshop*, ETH
- **24.01.2022** – Financial Time Series Forecasting via GANs, *Statistics and Machine Learning in Finance Seminar*, Oxford

PEER-REVIEWING ACTIVITY

Journals: Quantitative Finance, Applied Mathematical Finance, Mathematical Finance, SIAM Journal of Financial Mathematics
Conferences: ACM International Conference on AI in Finance

COMPUTER SKILLS

Advanced: Python (deep learning package of choice: PyTorch), Canva, LaTeX, R
Intermediate: SQL, Bloomberg Terminal, Microsoft Office (Excel, Word, Power Point, Access), C#, Pascal, Prezi, MATLab
Basic: Haskell, Prolog, C++, Java, Stata

LANGUAGES

English (Certificate in Advanced English, grade A, score 203/210), **Serbian** (native speaker), Italian (beginner)

EXTRACURRICULAR ACTIVITIES

Sept 2018-2021 **The Oxford Guild Society, President, Co-President** *(since July 2019, past: Executive Officer)*

- Europe's and World's largest university society of any type as of 2015, according to Forbes, The Times, Milkround and the BBC. Won 10 national best university society awards against 1000+ societies in UK in last few years and regularly host high profile speakers from celebrities to major CEOs, founders, politicians and Nobel Prize winners.
- In charge of sponsorships, partnerships and managing people. Organised the Global Fintech and Blockchain Conference and founded the Global Female Leadership Conference. Founded Female and STEM Arms.
- Organised a 600-person inter-university ball in London (2019). Introduced welfare events such as alpaca visits.
- Organised and assisted a machine learning workshops for beginners in collaboration with the Oxford Foundry.

Oct 2018-2021 **Collegium Global Network,** *Director*

- Collegium is a global network for connecting the most talented and ambitious young people. The University arm seeks to connect the very top societies at the leading Universities around the planet and builds upon the National Union of Student Business Societies, a national network for over 24 Russell Group societies nationwide that was founded in 2012 under the Oxford Guild. The Young Professionals arms aim to connect the top under 30s around the globe from each sector per region with each other so that they can work together and benefit from each other's contacts and skills.

Oct 2019- Jun 2021 **Oxford Foundry,** *Student Fellow and Advisory Board Member*

- Oxford Foundry Student Fellow and Advisory Board Member 2019/20 and 2020/21 – Responsible for co-creating entrepreneurial programmes and initiatives with the Oxford Foundry.

Jun 2018-March 2019 **The Quant Conference,** *Co-Organiser,* London (https://www.thequantconference.com)

- Europe's largest conference of its kind whose aim is to bridge the gap between the industry and academia and showcase the recent development in algorithmic trading, risk management and cryptocurrency investing. Managed the whole team. Involved with every aspect of organisation, from talking to potential speakers and sponsors, reaching out to different student and professionals groups to logistics. Secured key partnerships, sponsorships, speakers and advisors personally. Held meetings and worked on different strategies.

May 2016- Jun 2017 **Champions of the Heart**, *Co-Founder,* Mathematical Grammar School
The very first philanthropic society of high school students in Serbia. Organised various charity events.

Feb 2015-present **Tutoring and Volunteering**, Mathematical Grammar School

- Prepared younger students in Mathematical Grammar School for National Competitions in Mathematics for two years, organised mock competitions for them and proposed genuine problems. Organising lectures on applied mathematics during my university breaks.