

Applied mathematics researcher with expertise in statistical analysis, machine learning, and deep learning for complex systems modelling. Proficient in Python, R, and Julia, with a proven track record of applying advanced methods to inform national and international policy, including UK COVID-19 response and Global Fund malaria strategies.

PROFESSIONAL EXPERIENCE

Malaria Technical Analyst – Machine Learning & Complex Systems, Imperial College London, U.K., 2023 –

- Directed innovative modelling projects that influenced strategic malaria prevention policies at the Global Fund, focusing on the deployment of novel mosquito nets, directly aligning AI advances with tangible global health outcomes.
- Created and implemented advanced machine learning emulators using PyTorch, significantly accelerating complex agent-based simulations of malaria transmission in Africa. These models have substantially reduced computational requirements, enabling faster and more efficient policy decision-making and resource allocation in malaria control programmes.

Research Software Engineer – Pathogen Epidemiology Review Group, Imperial College London, UK., 2024 –

- Developed and executed software lifecycle management strategies to enhance code quality, maintainability, and efficiency. Led the integration of DevOps practices and quality-of-life features, such as virtual environments, CMD-checks, test-coverage targets, and package managers, to ensure consistent development and version compatibility. Presented project outcomes to multiple organizations, including Médecins Sans Frontières, World Health Organization, Public Health Canada, and data.org.
- Conducted lectures and workshops on programming principles, emphasising code management, test writing, and I/O validation to boost team expertise.
- Established team standards for open-source software practices, overseeing the review and management of pull requests and issues, focusing on bug fixes, performance enhancements, and alignment with research objectives.

Research Scientist – Machine Learning, German Centre for Artificial Intelligence (DFKI), Germany, 2022 – 2023

- Led pioneering cross-disciplinary research utilising advanced Deep Neural Networks, including the development of Deep Neural Universal Differential Equations, to model and predict complex phenomena such as tumour growth, enhancing decision-making in healthcare contexts.
- Adapted the developed predictive frameworks for broader societal applications, including predicting criminal behaviour and the spread of gun violence, demonstrating the versatility and societal relevance of advanced AI tools.
- Integrated robust AI ethics and interpretability principles into model design and deployment, ensuring transparency, safety, and fairness in AI-driven healthcare and public safety applications.

Research Assistant – COVID-19 Real Time Modelling, Imperial College London, U.K., 2021 – 2023

- Achieved the “SPI-M-O Award for Modelling and Data Support” on behalf of SAGE, presented by the UK Government’s Chief Scientific and Medical Officers. Managed the development and testing of our open-source packages (OSS) and led daily and weekly development efforts, ensuring consistency of statistical approaches across our projects and OSS packages.
- Developed weekly comprehensive reports used by UK Government SPI-M-O & SAGE, providing essential statistical support to the UK government’s crisis response during the pandemic.
- Collaborated with Prof. Neil Ferguson to lead the creation and development of deterministic and stochastic models and data pipelines for infectious disease transmission during the COVID-19 crisis, primarily using traditional and particle Markov Chain Monte Carlo (MCMC) methods for Bayesian inference.

TECHNICAL SKILLS & LANGUAGES

- **Machine Learning & Deep Learning:** PyTorch, TensorFlow, Keras, RStan, Julia SciML, TuringLang
- **Programming:** Python, R, Julia, C#/C++, SQL, CUDA, Matlab, SAS, Latex, Bash Shell Scripting (Linux/Unix)
- **High-Performance & Distributed Computing:** HPC Distribution (CPU & GPU environments)
- **Web, API & Cloud Development:** Flask, Postman, OpenAI, Microsoft Azure
- **Versioning & Collaboration:** Git, GitHub, GitLabs
- **Languages:** Fluent in English & Spanish, with working proficiency in French

EDUCATION

- **PhD in Applied Mathematics**, *Imperial College London, U.K.*, January 2025 – December 2027
Thesis: “Accelerating Policy Decision-Making Support in Infectious Disease Dynamics Through Deep Learning Surrogate Modelling and Graph Neural Networks”
- **MSc. Epidemiology (Merit)**, *Imperial College London, U.K.*, 2020 – 2021
- **BSc. (Hons.) Mathematics with Economics (2:1)**, *Aston University, U.K.*, 2015 – 2019

PUBLICATIONS & REFERENCES

Publications:

- Morgenstern, C., et al. (including Cosmo Santoni) “Severe acute respiratory syndrome (SARS) mathematical models and disease parameters: a systematic review and meta-analysis” *The Lancet Microbe*, DOI: <https://doi.org/10.1101/2024.08.13.24311934>
- Imai, N., Rawson, T., et al. (including Cosmo Santoni.) “Quantifying the impact of delaying the second COVID-19 vaccine dose in England: a mathematical modelling study” *The Lancet Public Health*, DOI: [https://doi.org/10.1016/S2468-2667\(22\)00337-1](https://doi.org/10.1016/S2468-2667(22)00337-1)
- Perez-Guzman, P. N., Knock, E., et al. (including Cosmo Santoni.) “Epidemiological drivers of transmissibility and severity of SARS-CoV-2 in England.” *Nature Communications*, DOI: <https://doi.org/10.1038/s41467-023-39661-5>

Manuscripts under Review:

- McCabe, R., et al. (including Cosmo Santoni) “The impact of ambiguously reported epidemiological parameters for infectious disease modelling and recommended best practices” *The Lancet Infectious Disease*
- Cosmo Santoni., et al. “Deep Neural Universal Differential Equations: A Novel Approach for Tumour Volume Growth in Complex Mathematical Systems” *Nature Machine Intelligence*

Published Software & Tools:

- **MINTe**: An advanced machine learning pipeline leveraging PyTorch for end-to-end data processing, training, and emulation enabling user interactions and real-time prevalence time series predictions.
- **Epireview**: A tool to obtain the latest data, figures and tables from the Pathogen Epidemiology Review Group (PERG). PERG is an internationally recognised World Health Organization collaborative collective.
- **Sircovid**: Tools for Bayesian analysis of stochastic models using adaptive Metropolis-Hastings and particle MCMC.
- **Spimalot**: The models in this package can be used to estimate key epidemic parameters and predict the course of the epidemic under different intervention scenarios.
- **MCState**: Parameter inference for stochastic, compartmental models from data, using Monte Carlo methods.

CONFERENCES & PRESENTATIONS

- **Epireview: Hands-on Workshop for Public Health & Epidemiology Researchers**, *Infectious Disease Modelling Conference, Bangkok, Thailand, November 2024*
- **Applying Neural Network Emulation to Assess the Impact of Pyrethroid-Pyrrole Bed Nets on Malaria in Africa**, *9th International Conference on Infectious Disease Dynamics, Bologna, Italy, November 2023*
- **Investigating Parameterisation and Inference Trade-Offs in Stochastic and Deterministic Epidemic Models**, *9th International Conference on Infectious Disease Dynamics, Bologna, Italy, November 2023*

ACADEMIC SERVICE & VOLUNTARY WORK

- **Curator, Amphibian & Malaria Collections**, *Museum of Life Sciences, King's College London, U.K.*, 2025 –
- **Departmental MRC GIDA Seminar Series Co-Organiser**, *Imperial College London, U.K.*, 2023 –
- **MSc. Epidemiology Graduate Teaching Assistant**, *Imperial College London, U.K.*, 2021 – 2022
- **Lay Grant Reviewer**, *University College London & Parkinson's UK, U.K.*, 2019 – 2022
- **BSc. Mathematics Undergraduate Teaching Assistant**, *Aston University, U.K.*, 2017 – 2019