LUKE HARDCASTLE

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EMPLOYMENT

Research Associate *Oct. 2025 -*
MRC Biostatistics Unit, University of Cambridge

Working on methods for Bayesian causal inference using observational time series data. In particular utilising tools from factor analysis, tensor decompositions, generalised Bayesian inference and modern Markov Chain Monte Carlo methods to develop and implement novel models for Bayesian causal inference.

EDUCATION

PhD Statistical Science *Sept. 2021 - Sept. 2025*
Dept. of Statistical Science, University College London
Supervisors: Dr Samuel Livingstone & Prof. Gianluca Baio
Thesis title: New approaches to survival extrapolation with inference using piecewise deterministic Monte Carlo

Piecewise exponential models, discretised diffusion priors and PDMPs
Combining inferences from observed data with long-term prior information is a challenging problem when analysing immature survival data. In this project I proposed a new prior structure for the piecewise exponential model based on an underlying diffusion for the local hazard function and a Poisson point process prior for the location of knots. Transparent prior information about the long-term behaviour of the hazard can be encoded in the diffusion, while the prior on the knots allows for a smooth posterior hazard function to be inferred. Posterior sampling is based on Piecewise Deterministic Markov Processes (PDMPs), where I extend existing methods for sampling from spike and slab priors to allow for sampling over the space of knots. We show that the mixing time of the sampler is dependent on the method used for discretising the diffusion prior, and that the sampler exhibits improved efficiency relative to existing reversible jump samplers.

Averaging polyhazard models using Piecewise Deterministic Monte Carlo
Polyhazard models are a popular choice of model for extrapolating survival curves beyond final observed event times. A large space of potential models, and lack of understanding of the role of prior assumptions has, however, limited their application beyond simple datasets. In this project I developed a novel prior specification and efficient sampling methodology to address these issues through Bayesian model averaging. Posterior sampling is achieved using PDMPs. I have developed new methodology to incorporate transdimensional jump moves into these samplers and extended existing methods for generating the PDMP event rate to ensure efficient sampling. I developed guidelines for prior specification to ensure model identifiability and the methods were used to derive new findings on survival in stroke survivors and kidney transplant patients.

MSc Statistics (Medical Statistics), Distinction *Sept. 2020 - Sept. 2021*
Dept. of Statistical Science, University College London
Sessional prize for best overall performance, Project prize for best dissertation

A Bayesian hierarchical model for predicting rates of oxygen consumption in mechanically ventilated intensive care patients
Supervisor: Dr Samuel Livingstone
For my MSc dissertation I worked with clinicians from University College Hospital to develop a Bayesian Hierarchical model for predicting rates of $\dot{V}O_2$ in ICU patients undergoing exercise rehabilitation, based on high frequency physiological time series data.

BSc (Hons) Mathematics and Statistics, First Class *Sept. 2015 - June 2018*
Department of Statistics, University of Warwick

PUBLICATIONS

Hardcastle, L., Livingstone, S., & Baio, G. (2025). Averaging polyhazard models using Piecewise deterministic Monte Carlo with applications to data with long-term survivors. The Annals of Applied Statistics, 19(4), 3179-3202.

Hardcastle, L., Livingstone, S., & Baio, G. Diffusion piecewise exponential models for survival extrapolation using Piecewise Deterministic Monte Carlo. 2025, URL: https://arxiv.org/abs/2505.05932

Hardcastle, L., Livingstone, S., Black, C., Ricciardi, F., & Baio, G. (2024). A Bayesian hierarchical model for predicting rates of oxygen consumption in mechanically ventilated intensive care patients. Statistical Modelling, 1471082X241238810.

Hardcastle, L., Kamatani, K, Shiba, H. (2026+, In preparation). Sticky manifold Piecewise Deterministic Markov Processes

Hardcastle, L., Roy, A., Samartsidis, P. (2026+, In preparation). Bayesian latent factor models with tensor decomposed time-varying loadings for causal inference with unobserved confounding

SELECTED PRESENTATIONS

Poster (upcoming): *Information Geometry, Privacy and Monte Carlo*, Tokyo, Japan *July 2026*
Poster (upcoming): *2026 ISBA World Meeting*, Nagoya, Japan *June 2026*
Contributed talk (upcoming): *Bayesian Young Statisticians Meeting*, Chiba, Japan *June 2026*
Poster (upcoming): *European Causal Inference Meeting*, Oxford, UK *April 2026*
Invited talk: *CFE-CMStatistics 2025*, London, UK, *December 2025*
Invited talk: *Bayescomp 2025*, Singapore, **Session organiser** *June 2025*
Invited talk: *University of Bristol Statistics seminar*, University of Bristol, UK *March 2025*
Invited talk: Isaac Newton Institute, University of Cambridge, UK, *December 2024*
Poster: Isaac Newton Institute, University of Cambridge, UK, *November 2024*
Invited talk: *Warwick Algorithms & Computationally Intensive Inference seminars,* *October 2024*
University of Warwick, UK
Poster: *Greek Stochastics ξ'*, Folegandros, Greece *July 2024*
Poster: *2024 ISBA world meeting*, Venice, Italy *July 2024*
Talk: *London meeting on Computational Statistics*, London, UK *June 2024*
Talk: *UCL Statistical Science PhD seminar*, London, UK *January 2024*
Long talk: *Bayesian Young Statisticians Meeting (j-ISBA)*, Online *November 2023*
Contributed talk: *Greek Stochastics ν'*, Naxos, Greece *July 2023*
Poster: *Bayescomp 2023*, Levi, Finland, **Poster prize winner** *March 2023*
Poster: *UCL Statistical Science Departmental Poster session*, **Book prize winner** *October 2022*
Poster: *International Workshop on Statistical Modelling (IWSM) 2022*, Trieste, Italy *July 2022*

AWARDS & FUNDING

International Internship Program, Institute of Statistical Mathematics, Japan *May 2025*
Programme participant, Isaac Newton Institute *Aug. - Dec. 2024*
Deepti Jayawardena Wilkinson Award for service, UCL Statistical Science *Sept. 2024*
Alan Turing Institute Enrichment Scheme *Sept. 2023 - July 2024*
Poster prize winner, Bayescomp 2023 *March 2023*
Book prize winner, UCL Statistical Science Departmental poster session *October 2022*
Fully funded 4 year EPSRC PhD scholarship *Sept. 2021 - Sept. 2025*
Sessional prize for excellent overall performance (MSc) *Sept. 2021*
Project prize for excellent performance (MSc) *Sept. 2021*
BBSRC funded Research Experience Placement, University of Warwick *July 2017*

SERVICE & OTHER ACTIVITIES

Reviewing: Advances in Applied Probability, Biometrika, Computational Statistics and Data Analysis, UAI 2025

UCL Statistical Science PhD seminar, organiser — *Nov. 2023 - Dec. 2024*

Bayesian methods reading group, Alan Turing institute, organiser — *Oct. 2023 - June 2024*

UCL Data Detectives outreach activity, mentor — *July 2022*

Informal talks and participation in reading groups on optimal transport; Convex optimisation; Markov chain convergence; Generalised Bayesian Inference — *Various*

TEACHING

Project supervision: Masahiro Jimbo, Bayesian factor analysis (Summer 2025)

Tutorials & Demonstrating: Introduction to Probability and Statistics (STAT0002, UCL); Computing for Practical Statistics (STAT0023, UCL); Bayesian Statistics (Population Health MPhil, University of Cambridge).

Marking: Introduction to Probability and Statistics (STAT0002, UCL), Regression modelling (STAT0006, UCL), Optimisation and operations research (STAT0025, UCL), Statistical computing (STAT0030, UCL).

ADDITIONAL EXPERIENCE

Advanced Analytics Associate - Intern — *Dec. 2022 - Sept. 2023*

Parexel

Responsibilities: Analysed clinical trial survival data using parametric and semi-parametric modeling techniques and prepared documents for approval to European regulatory bodies. Conducted literature reviews of state-of-the-art survival analysis techniques and presented results to academic and non-academic stakeholders. Supported development of an Rshiny app for cost-effectiveness analysis based on multi-state survival models.

Research Assistant — *July 2017 - Aug. 2017*

Hebenstreit lab, School of life sciences, University of Warwick

Responsibilities: Analysed high-dimensional Hi-C data to investigate the role of gene looping in transcriptional noise.