Natalie Karavarsamis, PhD

Statistician | Statistical Modelling, Inference & Data Science | Computational & Applied Statistics
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https://natalie-karavarsamis.github.io
Location: Melbourne, Australia

RESEARCH PROFILE

Statistician specialising in statistical modelling and inference for complex data, with expertise in likelihood-based methods (including conditional/composite/partial likelihood), imperfect detection, complex and structured data, Bayesian methods, machine learning methods, data mining methods, complex experimental design, GAMs/mixed models, and computational statistics. My work develops principled inferential methods and simulation-based approaches for complex, high-dimensional and structured data across theoretical and applied settings, with robust implementations in R across statistical ecology, epidemiology, agriculture, and precision medicine.

I have authored 20+ peer-reviewed publications, reports, and contributed methodological advances including two-stage likelihood approaches for presence–absence data under imperfect detection. My research emphasises reproducibility, transparent uncertainty quantification, and translation of methodology into practice.

Over 25 years of experience across academia, government, and international research collaborations. Specialist in likelihood-based statistical modelling, longitudinal and registry data analysis, Bayesian and multilevel inference, and quantitative risk assessment for complex real-world systems.

Led national biosecurity risk modelling projects for Australian Government agencies, contributed to WHO microbial risk assessment guidelines, and collaborated internationally on precision medicine research (Harvard University / Boston Children's Hospital). Experienced educator, research leader, and R software developer with a strong record of methodological innovation, reproducible analytical workflows, and evidence-based decision support.

Now fully available for senior research, statistical leadership, and quantitative risk roles in academic, government, or applied research environments.

RESEARCH INTERESTS

- Likelihood-based inference; composite/partial likelihood
- Imperfect detection and occupancy modelling
- High dimensional data; longitudinal, cohort, and registry data
- Bayesian hierarchical modelling

- Simulation-based methods and computational statistics
- Statistical ecology; epidemiology; complex observational systems
- AI; AGI; machine learning; neural networks

ACADEMIC APPOINTMENTS

Senior Research Statistician (Biometrician)
Centre for Crop Health, Research & Innovation Division
University of Southern Queensland (Remote) | 2024–2025

- Led statistical design and analysis of national agricultural and plant health studies.
- Applied mixed models and GAMs to complex crop health datasets.
- Provided strategic statistical guidance to multidisciplinary research teams.
- Developed reproducible R workflows for agricultural resilience and biosecurity projects.

Independent Research & Professional Development (International)
2021–2024

- Maintained engagement with research and academic networks.
- Undertook advanced technical and professional development, writing, and collaboration scoping.
- Provided full-time carer support during this period.

Lecturer in Statistics
La Trobe University | 2018–2021

- Designed and delivered UG/PG courses in statistical modelling, probability, applied statistics, and R programming.
- Supervised Honours and PhD students; mentored AMSI Scholars.
- Co-chaired Research School on Statistics and Data Science (RSSDS 2019); co-edited Springer CCIS 1150 proceedings.
- Secured travel funding for invited collaboration with Harvard University and Boston Children's Hospital.

Lecturer & Research Fellow
University of Melbourne | 2016–2018

- Conducted methodological and applied research in computational statistics and statistical ecology.
- Awarded Early Researcher Establishment Grant (2016).
- Presented methodological work at ISEC 2018 (St Andrews).

Postdoctoral Research Fellow
University of Melbourne / RMIT University | 2015–2016

- Developed statistical methods and software for ecological and biological data.

- Led collaborative modelling projects with Parks Victoria.

EARLIER PROFESSIONAL EXPERIENCE (SELECTED)

- **Research Fellow** — developed microbial risk assessment models adopted in WHO water reuse guidelines.
- **Biometrician (Statistician), Department of Primary Industries (Victoria)** — national biosecurity risk analysis; experimental design; international collaborations with UNEP/TEAP.
- **Statistician / Epidemiologist, Cancer Council Victoria** — Victorian Cancer Registry and Melbourne Collaborative Cohort Study analyses; survival estimation; nutritional epidemiology software.

SIGNATURE CONTRIBUTIONS & IMPACT

National Biosecurity & Trade Risk Modelling

- Led quantitative risk analyses informing Australian agricultural importation policies.
- Designed simulation-based and likelihood-based modelling frameworks to quantify uncertainty in trade and biosecurity decisions.

International Policy & Guideline Contributions

- Developed microbial risk assessment models adopted in WHO water reuse guidelines.
- Contributed to international pesticide alternatives research (TEAP/UNEP), collaborating with European agencies.

Registry & Longitudinal Health Data Analysis

- Analysed Victorian Cancer Registry and Melbourne Collaborative Cohort Study data.
- Produced survival estimates and risk analyses informing public health reporting.
- Developed nutrient-analysis programs and statistical pipelines for large-scale epidemiological datasets.

Methodological Innovation

- PhD research: two-stage likelihood methods for presence–absence data under imperfect detection.
- Developed and applied likelihood-based and computational statistical methods across ecology, medicine, defence, and demographics.
- Published 20+ peer-reviewed journal and technical papers.

Precision Medicine & Bayesian Modelling

- Applied Bayesian hierarchical models to high-dimensional zebrafish data in collaboration with Harvard University and Boston Children's Hospital.
- Fulbright Research Fellow Finalist (2019).

Reproducible Statistical Computing

- Advanced R programmer and package developer.
- Designed reproducible analysis workflows for multidisciplinary teams.
- Experienced in algorithm development, simulation studies, and robust data pipelines.

EDUCATION

PhD in Statistics, University of Melbourne (2015)
Thesis: *Methods for Occupancy — Two-stage likelihood methods for presence–absence data under imperfect detection.*

BSc (Honours, First Class) – Statistics, University of Melbourne
BSc – Mathematics and Statistics, University of Melbourne

SELECTED PUBLICATIONS

(Full list available via Google Scholar / GitHub)

Inference for likelihood methods / statistical ecology / occupancy / inference

- **Karavarsamis, N.**, Guillera-Arroita, G., Huggins, R.M., and Morgan, B. (2020). *How can the score test be consistent?.* Australian and New Zealand Journal of Statistics, 62(1):94--115. (https://dx.doi.org/10.1111/anzs.12288).

Two-stage likelihood methods for presence–absence data under imperfect detection / computational statistics / inference

- **Karavarsamis, N.** and Huggins, R.M. (2019). *A two-stage approach to the analysis of occupancy data I. The Homogeneous case.* Communications in Statistics - Theory and Methods. (https://dx.doi.org/10.1080/03610926.2019.1607385).
- **Karavarsamis, N.** and Huggins, R.M. (2019). *A two-stage approach to the analysis of occupancy data II. The Heterogeneous case.* Computational Statistics and Data Analysis, 133:195–207. (https://dx.doi.org/10.1016/j.csda.2018.09.009).

Machine learning theory

- Bagnall, J., Jones A., **Karavarsamis, N.**, and Nguyen H. (2019). *The Fully-Visible Boltzmann Machine and the Senate of the 45th Australian Parliament in 2016.* Journal of Computational Social Science. (https://dx.doi.org/10.2139/ssrn.3287903).

Bootstrap / simulations / occupancy

- **Karavarsamis, N.**, Robinson, A. P., Hepworth, G., Hamilton, A.J., and Heard, G.W. (2013). *Comparison of four bootstrap-based interval estimators of species occupancy and detection probabilities.* Australian and New Zealand Journal of Statistics, 55(3):235--252.

Environment / world health / public health / risk analysis / Bayesian analysis

- **Karavarsamis, N.** and Hamilton, A.J. (2010). *Estimators of Annual Probability of Infection for quantitative microbial risk assessment.* Journal of Water and Health, 8(2):365--373.
- Porter, I.J., Trinder, L., Partington, D., Banks, J., Smith, S., Hannah, M., and **Karavarsamis, N.** (2006). *Special report validating the yield performance of alternatives to Methyl Bromide for pre-plant fumigation.* TEAP/MBTOC Special Report, UNEP Nairobi.

Government / importation/ risk analysis / agriculture

- **Karavarsamis, N.** (2004). *Submission (to Australian Government) for the Revised Draft Import Risk Analysis Report for Apples from New Zealand.*

Longitudinal studies / registry and survival analysis / cancer statistics / epidemiology.

- Giles, G., English, D., **Karavarsamis, N.**, Thursfield, V. (2003). *Cancer Survival in Victoria -- Relative survival for selected cancers diagnosed from 1982 to 1997 with follow-up to 2000.* Cancer Council Monographs.

- **Editor**: RSSDS 2019 Proceedings, Springer CCIS 1150.

GRANTS, FUNDING & AWARDS

- Early Researcher Establishment Grant, University of Melbourne (2016)
- Fulbright Research Fellow Finalist (2019)
- Denise Lievesley Award for Young Statisticians (IBS-AR)
- Competitive travel funding for international collaboration with Harvard University and Boston Children's Hospital

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TEACHING & SUPERVISION

- Course design and delivery in statistical modelling, probability, applied statistics, and R programming (undergraduate and postgraduate)
- Supervision of Honours, PhD, and AMSI Summer Scholar students

- Research-led teaching with emphasis on reproducible workflows and applied problem-solving

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SOFTWARE & REPRODUCIBILITY

- Advanced R programming; package development and reproducible analysis pipelines
- Experience with Stata, Genstat, WinBUGS, MATLAB, Mathematica; working familiarity with Python
- Strong emphasis on transparent, version-controlled workflows and simulation studies

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PROFESSIONAL SERVICE

- Technical Sub-Editor, *Australian and New Zealand Journal of Statistics* (since 2018)
- Reviewer for *Biometrics*, *JABES*, *Austral Ecology*, and *Journal of Pediatric Rehabilitation Medicine*
- Member, Statistical Society of Australia

INVITED TALKS & COLLABORATIONS (SELECTED)

Harvard University and Boston Children's Hospital — Bayesian hierarchical modelling for precision medicine/big data/biological data modelling/CRISPR

- Harvard University (Department of Neuroscience) and Boston Children's Hospital — Bayesian hierarchical modelling for precision medicine/big data/biological data modelling/CRISPR

  Karavarsamis, N. (2019). Circular statistics and data mining for Zebrafish models. (Invited Speaker)

- INRIA Seminar Series. Grenoble, France.
- La Trobe University (Australia) —Kyushu University (Japan) Joint Seminar Series
- National and International collaborations with European agencies through UNEP/TEAP (global pesticide alternatives), WHO (microbial risk models), Parks Vicotria (ecological monitoring)
- Conference presentations including ISEC (St Andrews)

OUTPUTS

20+ publications | Software development (commercial and research) | Reports for government and international bodies