$(YOU)^{us}$

YOU TO THE POWER OF *us*
CAN MAKE MODELS MORE MEANINGFUL

Department of Mathematics and Statistics

The Department of Mathematics and Statistics was formed in mid 2018 through the merger of the Departments of Mathematics and Statistics. The Department is one of Australia's leading mathematical sciences department. We are recognised for our outstanding teaching and high-quality research excellence. Our graduates are recognised for the depth and breadth of their mathematical and statistical knowledge and for their ability to adapt to the challenges they will face in the future. The Department provides leadership in engagement with the education sector, and has strong and lasting relationships with industry partners.

ABOUT US

Through the Department of Mathematics and Statistics, Macquarie University has a long and proud tradition of research in Mathematical Sciences. Members of the Department have held many prestigious research fellowships and have made significant contributions to the health and vitality of the Australasian Mathematics and Statistics community. We have a strong community of higher degree research students, with many students coming from leading international schools to study with us. We have state-of-the-art computational facilities and a rich and broad seminar program, attracting many leading national and international mathematicians and statisticians.

Our research is recognised as above world standard in the Mathematical Sciences, well above world standard in Pure Mathematics and world standard in Applied Mathematics. Our researchers have won multiple awards, most recently the 2017 Medal of the Australian Mathematical Society and the 2017 ABC Radio National/UNSW Top 5 Under 40 science communicator award.

Our staff 's research interests cover many of the important and diverse areas of mathematical sciences such as harmonic analysis, biostatistics, bioinformatics, category theory, applied dynamical systems, flexible regression modelling, fluid mechanics, image and signal processing, mathematical modelling, optimisation and optimal control, statistical education and stochastic modelling and time-series analysis. We produce world-class research in statistical methodology and theory, and actively collaborate on multi-disciplinary research in a broad range of fields. The Department is an active member of the Biostatistics Collaboration of Australia, a consortium of five universities across Australia which offers a postgraduate program in Biostatistics. Members of the Department have strong collaborative links with many leading research organisations, including NHMRC centres in Sydney, and with epidemiologists in South East Asia.

PURPOSE

Our vision is to be recognised as one of the leading Mathematics and Statistics departments in Australia for our outstanding teaching and research excellence in the mathematical sciences. Our graduates will be recognised for the depth and breadth of their mathematical and statistical knowledge and their ability to adapt to those challenges they will face in the future. We will provide leadership in engagement with the education sector, and will develop strong and lasting relationships with industry partners. The Department of Mathematics and Statistics' mission is to provide the highest quality undergraduate and postgraduate training in the Mathematical and Statistical Sciences and to conduct world class research in Applied Mathematics, Pure Mathematics and Statistics.

RESEARCH CENTRE

The Department home to the Centre of Australian Category Theory (CoACT). CoACT is one of the world's oldest and most distinguished research groups in category theory. Category theory is a branch of mathematics that identifies patterns and structures occurring across diverse areas of mathematical discourse, and distils them down to their essential nature. CoACT members are pioneers of monoidal, enriched, and higher-dimensional category theory, areas which is increasingly fundamental to modern algebraic geometry, representation theory, and mathematical physics. Other fields that CoACT research has influenced include lowdimensional topology, programming language semantics, symbolic logic, and quantum groups.

APPLIED MATHEMATICS

DAVID ARNOLD
LECTURER
E: david.arnold@mq.edu.au

- Modelling real-world processes using differential equations, with specific applications in fluid mechanics and human movement in steep terrain
- Experimental and theoretical study of the flow of particle-laden fluids

SOPHIE CALABRETTO
SENIOR LECTURER
E: sophie.calabretto@mq.edu.au

- The unsteady flow of rotating fluids, with a specific focus on the dynamics resulting from impulsive changes in rotation rate, including the formation of boundary layers, their subsequent evolution, and the formation of instabilities, as well as separation and transition to turbulence.
- The identification of rotational coherence in three-dimensional turbulent flows

JIM DENIER
PROFESSOR
E: jim.denier@mq.edu.au

- Fluids mechanics with a particular focus on high-speed flows, non-Newtonian flows and applications of fluid mechanics to physiology

VLADIMIR GAITSGORY
PROFESSOR
E: vladimir.gaitsgory@mq.edu.au

- The development of mathematical apparatus for analytical and numerical analysis of the families of optimisation problems known as singularly perturbed, with a particular focus on problems of optimal control of dynamical systems that evolve on different times scales

CHRISTOPHER GREEN
LECTURER
AUSTRALIAN RESEARCH COUNCIL
DECRA FELLOW
E: christopher.c.green@mq.edu.au

- The solving of problems arising in ideal fluid mechanics in multiple connected domains
- Vortex dynamics, fingers and bubbles in Hele-Shaw cells, and potential flows on different types of curved surfaces
- Utilsation of the Schottky-Klein prime function, little used by mathematicians until relatively recently, but now increasingly recognised as the natural object to consider when solving problems in geometrically complicated domains

STUART HAWKINS
SENIOR LECTURER
E: stuart.hawkins@mq.edu.au

- The development and analysis of numerical methods for solving PDEs modelling propagation of waves in bounded and unbounded media and associated inverse problems
- Uncertainty quantification for wave propagation in stochastic media
- Efficient high-order algorithms and reduced-order models

LYNDON KOENS
LECTURER
E: lyndon.koens@mq.edu.au

- The dynamics of microscopic objects in fluids to improve our understanding of bacterial swimming, colloids, active matter and the dynamics of micro-machines
- The utilisation of analytical approximations and simple numerical techniques to explore the effect of geometry on dynamics and to develop simple models for recent experimental systems

CHRISTOPHER LUSTRI
LECTURER
E: christopher.lustri@mq.edu.au

- Approximation methods for singularly perturbed systems
- Studying connections between discrete and continuous systems
- Waves in linear and nonlinear systems arising in fluid mechanics and particle dynamics

CATHERINE PENINGTON
LECTURER
E: catherine.penington@mq.edu.au

- The spread (both movement and reproduction) of groups of biological cells, whether those cells are cancer cells in humans or bacteria, using both individual-based stochastic models and population-level partial differential equations to understand the biological questions involved

JUSTIN TZOU
LECTURER
E: justin.tzou@mq.edu.au

- Developing and applying mathematical methods for obtaining quantitative descriptions of diffusive processes
- Narrow escape problems, which seek the average capture time of random walkers by small targets
- The stability and dynamics of patterns in reaction-diffusion systems on curved surfaces

ELENA VYNOGRADOVA
LECTURER
E: elena.vynogradova@mq.edu.au

- Potential theory
- Acoustic and electromagnetic fields and waves: radiation, scattering and propagation
- Analytical-numerical techniques for accurately determining diffraction from various classes of canonical scatterers and from more general and arbitrarily shaped open scatterers, which possess edges and other complex features

PURE MATHEMATICS

PAUL BRYAN
LECTURER
AUSTRALIAN RESEARCH COUNCIL
DECRA FELLOW
E: paul.bryan@mq.edu.au

- Geometric evolution equations, such as the Ricci Flow and the Mean Curvature Flow, where one deforms a geometric structure via a gradient flow to decrease an energy in the fastest way possible

THE ANH BUI
LECTURER
E: the.bui@mq.edu.au

- The development of the study of singular integrals on function spaces beyond the Calderón-Zygmund theory and the investigation of applications to partial differential equations

XUAN DUONG
PROFESSOR
E: xuan.duong@mq.edu.au

- Harmonic analysis on singular integrals with rough kernels and function spaces associated to operators
- The utilisation of harmonic analysis techniques to study the existence and regularity of solutions to large classes of linear and non-linear partial differential equations with non-smooth coefficients on rough domains

RICHARD GARNER
SENIOR LECTURER
AUSTRALIAN RESEARCH COUNCIL
FUTURE FELLOW
E: richard.garner@mq.edu.au

- Category theory and its links to computer science, logic and combinatorics
- Enriched categories and their applications in novel areas such as differential geometry, model theory and higher representation theory
- Homotopical algebra as exemplified by Quillen's model categories
- Abstract approaches to inverse semigroups and operator algebra

- Homotopy type theory
- Topos theory

JI LI
SENIOR LECTURER
E: ji.li@mq.edu.au

- Harmonic analysis and the applications to complex analysis and partial differential equations, such as singular integrals and the related function spaces on domains arisen in the complex setting

STEVE LACK
ASSOCIATE PROFESSOR
E: steve.lack@mq.edu.au

- Category theory, especially monoidal, enriched, and higher-dimensional category theory; and its applications to algebra, topology, theoretical computer science and other areas

ROSS MOORE
SENIOR LECTURER
E: ross.moore@mq.edu.au

- Extending the LaTeX typesetting system to be able to produce fully 'tagged' PDF output, simultaneously in conformance with both ISO:19005 (PDF/A) standards for archivability and ISO:14289 (PDF/UA) standards for accessibility

ADAM SIKORA
ASSOCIATE PROFESSOR
E: adam.sikora@mq.edu.au

- Partial differential equations, harmonic analysis, mathematical physics and analysis on Lie groups.
- Singular integrals, spectral and Fourier multiplier theorems, Bochner-Riesz summability, restriction type theorems, functional calculi, and spectral analysis of elliptic and sub-elliptic differential operators, degenerate elliptic operators, Riesz transforms, semi-groups of operators and heat kernels, wave equation, Schrödinger propagators, non-linear heat and wave equations

STATISTICS

KEN BEATH
LECTURER
E: ken.beath@mq.edu.au

- Infant growth modeling
- Robustness and outlier detection through application of mixture models
- Latent trajectory modeling and rare event meta-analysis

AYSE BILGIN
ASSOCIATE PROFESSOR
E: ayse.bilgin@mq.edu.au

- The statistical analysis and design of studies in health and statistics education.
- Health research is focused on orthodontics, adolescent health and studies related to breast cancer, MS and Alzheimer's disease
- Education research is focused on learning approaches in statistics and the impact of learning spaces on students' learning

DAVID BULGER
SENIOR LECTURER
E: david.bulger@mq.edu.au

- Applied statistics
- Optimisation (theory and applications)
- Mathematical musicology
- Statistics education
- Quantum algorithms

HASSAN DOOSTI
LECTURER
E: hassan.doosti@mq.edu.au

- Parametric statistics, particularly the development of diverse models with application in medical sciences
- Spatial point processes and species distribution modeling
- The estimation of unknown curves, eg density function, quantile function, regression function, intensity function and spatial temporal models

THOMAS FUNG
SENIOR LECTURER
E: thomas.fung@mq.edu.au

- Integer-valued time series analysis
- Extreme value theory
- Financial modelling
- Multivariate analysis

GILLIAN HELLER
PROFESSOR
E: gillian.heller@mq.edu.au

- Flexible regression modelling, in particular Generalized Additive Models for Location, Scale and Shape (GAMLSS)
- heavy-tailed count distributions, with applications in biostatistics and insurance

NINO KORDZAKHIA
SENIOR LECTURER
E: nino.kordzakhia@mq.edu.au

- Estimation of parameters in irregular statistical experiments
- Weighted Kolmogorov-Smirnov distributions in Gene Set Enrichment Analysis
- Risk management: Energy Markets; Carbon Emission Trading
- Statistical modelling of seismic risk
- Bayesian inference for Inverse Problems

JUN MA
ASSOCIATE PROFESSOR
E: jun.ma@mq.edu.au

- Semiparametric regression models for survival analysis, particularly Cox models, additive hazard models and accelerated failure time models where survival data include event times as well as left-, right- or interval-censored times.
- Imaging processing/reconstruction asso model selection
- Empirical likelihood methods
- Measurement errors in regression models

MAURIZIO MANUGUERRA
SENIOR LECTURER
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- Continuous ordinal regression, which is relevant when the outcome of interest is continuous and non-linear in nature, eg continuous ordinal. Applications can be found in studies in which continuous scales are used to measure the perception of quantities like quality of life or pain
- Transformation models, which continuous ordinal regression is a special case of
- Penalised likelihood methods and additive mixed models in survival analysis and competing risks

TANIA PRVAN
SENIOR LECTURER
E: tania.prvan@mq.edu.au

- Nonparametric and computational statistics (generalised soothing splines, robust estimation)
- Applied statistics (in the areas of biostatistics, sports nutrition, dietetics, medical statistics and audiology)
- Statistics education

GEORGY SOFRONOV
SENIOR LECTURER
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- Computational statistical methods such as Markov chain Monte Carlo samplers and the Cross-Entropy algorithm
- Multiple change-point detection
- Optimal stopping rules when data are sequentially collected over time, and it's necessary to make decisions based on already obtained information while future observations are not known yet

At Macquarie, we know that research is the key to unlocking a secure future. It's central to everything we do. And everything we do is for the benefit of humanity and life. Our research is influenced by the big picture: finding solutions to critical global challenges – such as health, safety, climate crisis, and food and water security.

Ranked in the top one per cent of universities around the world*, we are home to leading researchers – a community of accomplished academics that unites collective thinking and expertise across all disciplines and areas of study.

As a researcher, research student or collaborator, you'll work alongside world-leading experts, and have access to world-class facilities and partnerships. We encourage you to find out more about our research priorities and projects.

*QS World University Rankings, 2019

FIND OUT MORE
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department-of-mathematics-and-statistics**