

AustMS Early-Career Workshop

7th December 2020

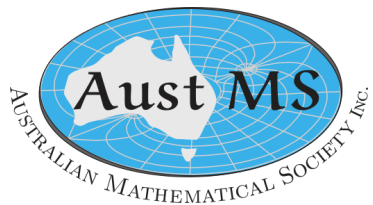
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1 Welcome

Welcome to the AustMS Early-Career Workshop 2020! We hope you will find the mix of talks inspiring and informative, and that you will enjoy interacting (digitally) with your fellow ECRs.

We thank our moral sponsors, AMSI and AustMS, and Thomas Kalinowski from the University of New England for his help in the preliminary planning of this event when it was going to take place offline.

Sophie Calabretto and Luke Bennetts

In the spirit of reconciliation the AustMS ECW 2020 acknowledges the Traditional Custodians of country throughout Australia and their connections to land, sea, and community. We pay our respect to their elders past, present, and emerging, and extend that respect to all Aboriginal and Torres Strait Islander peoples today. They have never ceded sovereignty, and remain strong in their enduring connection to land and culture.

We support the Uluru Statement from the Heart to achieve justice, recognition and respect for First Nations people and a referendum to enshrine a First Nations Voice in the Constitution. We accept the invitation contained in the Statement to walk together with Aboriginal and Torres Strait Islander peoples in a movement of the Australian people for a better future.

2 Workshop Details

The AustMS ECW 2020 will be held online via [Zoom](#). Zoom is available for PC, Mac, iPad, iPhone, or Android.

To download **Zoom Client for Meetings**, or the **Zoom Add-in for Microsoft Outlook**, please visit the [Zoom Download Center](#). Alternatively, the workshop can also be accessed via Zoom online.

Registered attendees will receive a Zoom link and password closer to the date of the workshop.

Unfortunately, neither Closed Captioning nor Auslan interpreting services are able to be provided for this online event.

3 Programme

MONDAY 7TH DECEMBER	
09:30-9:45	Welcome
9:45-10:15	Kerrie Mengersen
10:15-10:45	Jason Sharples
10:45-11:00	15-minute snack interlude*
11:00-11:30	Karen Lamb <i>Maths and Stats Engagement Speaker</i>
11:30-12:00	Chris Rasmussen
12:00-12:30	Q&A with morning workshop speakers
12:30-13:45	(BYO) Lunch break*
13:45-14:15	Robert Van Gorder <i>ECR Speaker</i>
14:15-14:45	Catherine Greenhill
14:45-15:00	15-minute snack interlude*
15:00-15:30	Gem Lloyd <i>Maths IRL Speaker</i>
15:30-16:00	Q&A with afternoon workshop speakers
16:00-16:05	Closing

* Refreshments not provided in online format, you will need to get your own.

4 Speakers



Kerrie Mengersen @KerrieMengersen

Queensland University of Technology

Kerrie Mengersen is a Distinguished Professor of Statistics at the Queensland University of Technology (QUT). She is an alumni of UNE and has also worked in a commercial consulting company (Siromath) and at Bond University, Central Queensland University, the University of Newcastle and Colorado State University (USA). Kerrie is an elected Fellow of the Australian Academy of Science, the Academy of the Social Sciences in Australia, and the Queensland Academy of the Arts and Sciences. She is an ARC Laureate Fellow, Deputy Director of the ARC Centre of Excellence in Mathematical and Statistical Frontiers, and Director of the QUT Centre for Data Science. Her research interests focus on Bayesian statistics, statistical machine learning, and statistical challenges in health, environment and industry.

Riding the Wave: Maths and Stats meet Data Science: The Mathematical Sciences play a fundamental role in a very wide array of theoretical, methodological, computational and applied fields. An emerging discipline that is taking the world by storm is Data Science. This brings together the Mathematical and Computer Sciences, with a focus on data. In this presentation, I will reflect on the profile of Mathematical Sciences in Data Science, and the associated opportunities for new areas of research and practice both within and outside academia. It's an exciting future!

**Jason Sharples***UNSW Canberra*

Jason Sharples is Professor of Bushfire Dynamics at the University of New South Wales, where he works as part of the Applied and Industrial Mathematics Group and the Computational Science Initiative at UNSW Canberra. Jason started his career in mathematical general relativity and geometric analysis before venturing into spatiotemporal climate analysis, mathematical chemistry and combustion theory, and wildfire science. He is currently Lead Chief Investigator on two ARC Discovery Indigenous Projects and a Project Leader with the Bushfire and Natural Hazards CRC's. Jason's current research interests span wildfire behaviour, bushfire risk management and fire meteorology, with a specific focus on extreme and dynamic wildfire propagation and the development of large conflagrations.

Mathematics across disciplines – perspectives from a transdisciplinary researcher: When I started my research career 25 years ago, I was very much a pure mathematician – my areas of interest were differential geometry, partial differential equations and geometric analysis. I spent my time as a PhD student proving abstract existence and uniqueness theorems for a subset of the Einstein field equations in a particular coordinate gauge. However, after completing my PhD, the realities of the job market saw me switch into the far more applied area of climate data analysis, and at the time I thought I had left the rigours of pure mathematics behind forever – I couldn't have been more wrong! Since those early days, my research interests have shifted across a broad range of different research topics, so much so that I now consider myself

a transdisciplinary researcher. The one constant, and the one thing that has underpinned my success, has been my solid foundation in mathematics. In this talk I will provide a brief account of how some of the “ghosts of mathematics past” have revisited me over the years and provided me with the means to tackle problems in a range of areas from the “pan evaporation paradox” to the development of computationally efficient models of dynamic wildfire behaviour.



Karen Lamb @drklamb

University of Melbourne

**Mathematics and Statistics
Engagement Speaker**

Karen is a consultant biostatistician in the School of Population and Global Health at the University of Melbourne. Karen is passionate about statistical communication and gets a real buzz out of helping researchers in other disciplines use statistics to answer research questions. This is often more about successful communication of statistics than it is about the statistics themselves! Karen finds the process of making non-mathematicians comfortable with mathematics to be both challenging and hugely rewarding. As a result, the focus of her research has been as diverse as the people she has been fortunate enough to work with, including doctors, psychologists, epidemiologists, social scientists, biologists and many more!

Life as a consultant biostatistician during a global pandemic:

Never has there been a time in our lifetime in which global interest in health data, biostatistics, and epidemiology has been so great. The pandemic has led to words like exponential growth, reproductive numbers and 14-day rolling case averages become the norm in common discussions. I could never have envisaged a time when my non-statistical family members and friends (i.e., almost all of them!) took such a great interest in my work and knowledge about health data. As a consultant biostatistician, it is my job to respond quickly to the needs of clients undertaking work in public health. I have never been busier than during the global pandemic! In this presentation, I will provide an overview of life as a consultant biostatistician and some of the challenges I have been presented with due to the COVID-19 pandemic.

**Chris Rasmussen***San Diego State University*

Chris Rasmussen is Professor of mathematics education and associate chair in the department of mathematics and statistics at San Diego State University. He received his B.A., M.A. and Ph.D. from the University of Maryland in Mechanical Engineering, Mathematics, and Mathematics Education, respectively. After receiving his undergraduate degree he served as a Peace Corp Volunteer in Sierra Leone, West Africa. He is currently an Editor-in-Chief of the *International Journal of Research in Undergraduate Mathematics Education*. His research investigates inquiry-oriented approaches to the learning and teaching of undergraduate mathematics, focusing on how mathematical ideas are developed through student exploration and teacher-student classroom discourse. His work in differential equations and linear algebra has led to the development of research-based curricula that begin with students' informal or intuitive ideas to progressively build more formal mathematics. He has also been at the forefront of a US national study of successful calculus programs, which identified a number of programmatic features that are common among the programs identified as being more successful than peer institutions. Currently, he is co-PI on two US studies of the introductory mathematics courses for science, engineering, and mathematics students with the goal of better understanding current departmental practices related to these courses, the process of departmental and institutional change, and ways that professional organisations can support and help sustain such change.

Research on Learning and Teaching University Mathematics:
Where we are and where we might go next: In this talk I begin

with a brief overview of what we know about the teaching and learning of calculus in the United States. In particular, I highlight findings from two large US national studies of the precalculus through calculus sequence. Next, I review what we know about the effects and uptake of research-based instructional strategies at the university level. I then reflect on new directions for the broader field of research in university mathematics education. These new directions include expanding the notion of inquiry, research related to departmental and institutional change, and research that centres issues of equity and social justice.



Robert Van Gorder @ravangorder

University of Otago

Early-Career Research Speaker

Robert hails from Florida, and obtained all of his degrees at the University of Central Florida, where he carried out research as a National Science Foundation Graduate Research Fellow. After completing his PhD in 2014, Robert moved to the University of Oxford, where he held a Violette and Samuel Glasstone Research Fellowship in Science. Robert took up a Senior Lectureship at the University of Otago in 2019, in the hopes of “getting away from it all” to focus on his research in the south island of New Zealand. Robert’s research interests primarily involve applying tools from mathematics in order to better understand phenomena arising in various fields of science or engineering, with current work focused on understanding how non-autonomous and spatially heterogeneous structures arise in biology, physics, fluids, and thermodynamics.

Bose–Einstein condensates on bounded space domains: Bose–Einstein condensates (BECs), first predicted theoretically by Bose and Einstein and finally discovered experimentally in the 1990s, continue to motivate theoretical and experimental physics work. Although experiments on BECs are carried out in bounded space domains, theoretical work in the modelling of BECs often involves solving the Gross–Pitaevskii equation on unbounded domains, as the combination of bounded domains and spatial heterogeneity render most existing analytical approaches ineffective. Motivated by a lack of theory for BECs on bounded domains, in this talk I will derive a perturbation theory for both ground and excited stationary states on a given bounded space domain. The shape and curvature of a space domain are shown

to strongly influence BEC structure, and may potentially be used as control mechanisms in experiments. Along the way, I will discuss what got me interested in the problem, and how my views on the problem evolved over time up until the point where I figured out how to properly “solve” the problem.



Photo credit: Mark Graham

Catherine Greenhill @catherinemaths

University of New South Wales

Catherine Greenhill started her academic career as an undergraduate at the University of Queensland, before obtaining a D.Phil. from the University of Oxford (1992). She held postdoctoral positions at the University of Leeds and at the University of Melbourne, then joined UNSW in 2002. Today she is a Professor and head of the Combinatorics group in the School of Mathematics and Statistics, UNSW Sydney. Catherine's research interests lie in asymptotic, probabilistic and algorithmic combinatorics. She was awarded the Christopher Heyde Medal by the Australian Academy of Science in 2015. Her work lies at the interface between discrete mathematics, theoretical computer science and probability, and has been applied by researchers in various areas including physics, computer science and criminology.

Random walks and random graphs: In combinatorics, it can be quite difficult to answer a simple question, like “how many elements does this set contain?”, or “how can I sample a random element from this set?”, or “what does a typical element from this set look like?”. Much of my research aims to answer questions like these, often involving sets of graphs or hypergraphs which satisfy certain conditions. I will tell you about some of my research, and say something about the events and decisions that brought me here.

**Gem Lloyd***Bureau of Meteorology***‘Mathematics in the Real World’
Speaker**

Gem is a reformed pure mathematician – clean now for 11 years! She did her undergrad and PhD at Manchester University, UK before moving halfway around the world in 2010 and settling in Adelaide. There she convinced a tech company to take a chance on her and secured a job as a C++ software engineer. From there, she moved on to the Bureau of Meteorology and Melbourne to study for a Grad Dip in Meteorology and to train to become an operational forecaster in 2016. Always up for a challenge and seeing the opportunity to mix some meteorology and engineering, she took a job in the Research to Operations group in at the Bureau in 2019 and is busy writing code that predicts volcanic ash dispersion, air quality and verification of tropical cyclone bias correction forecasts. Gem is a strong LGBTQIA+ advocate at the Bureau being the inaugural Member Chair of the Bureau’s STORM Pride Network. Her extra-curricular interests include sourdough, pottery and running!

Help! I don’t think research is for me, but I don’t know what to do!: In this talk, Gem aims to allay your fears! There is, in fact, life after research and it doesn’t have to be boring! Come on a journey through Gem’s winding career so far, from the UK to Australia, from maths to computer science to meteorology. . . . She’ll aim to give you tips, some you may know, others you may not. If you don’t care about that, there are sure to be some fun photos.