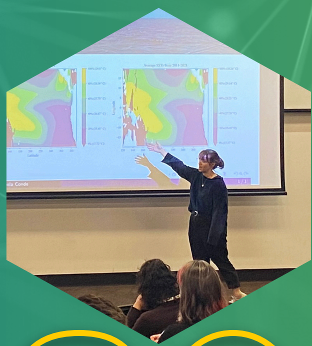
UNSW SYDNEY

School of Mathematics and Statistics

Postgraduate Conference

Book of Abstracts

Welcome to the
11th Annual Postgraduate Conference



2024

Thursday 8 August, 2024

UNSW Colombo Theatres

Welcome to our celebration of postgraduate research!

On behalf of the organising committee (Muhammad Afifurrahman, Siddharth Iyer, Joshua Connor and I) and the School of Mathematics and Statistics at UNSW, Sydney, I welcome you to our 11th annual Postgraduate Conference.

This event is a great opportunity for students to present their work in the fields of Pure and Applied Maths and in Statistics. For many it is their first opportunity to attend a conference and present live.

Our school has over 70 higher degree research (PhD and MRes) students. Considering most are engaged with research full time, it is through our HDR cohort that most of our school's research is done. Having a day to come together and celebrate this group and their work is really important.

This year we will have plenary sessions where representatives of pure, applied and stats, who are towards the end of their degrees, will present their latest findings to the whole cohort. There will also be a welcome session where each of the HDRs that have joined us in the last year will give us a 1-minute introduction.

We hope you will use the morning and afternoon tea, lunch, and evening reception to get to know each other and discuss ways to improve the HDR experience in our school.

As usual there will be awards for the best talks from the three departments. Secret judges have been chosen to judge the best talk from each department and look out for a link to vote for the People's Choice Award!

We hope you enjoy the day!

Jan Zika
Postgraduate Coordinator (Candidature and Examination)
School of Mathematics and Statistics, UNSW

List of Presenters

We would like to thank all presenters from our Higher-Degree Research students in the School of Mathematics and Statistics UNSW, as follows:

Applied Mathematics

Josef Bisits, Isabela Conde, Joshua Connor, Reg Dowse, Hecong Gao, Boris Huang, Kevin Felipe Kühl Oliveira, Yat Long Lee, Lincan Li, Hongzhi Liao, Nick Peters, Brock Sherlock, Agus Soenjaya, Noah Vinod, Qi (Wenky) Wang.

Pure Mathematics

Muhammad Afifurrahman, Christian Bagshaw, Aayush Bhattacharya, Chip Corrigan, Daniel Czapski, Christian De Nicola Larsen, Daniel Dunmore, David Farrell, Tasman Fell, Joshua Graham, Joshua Ham, Michael Harm, Eva-Maria Hekkelman, Siddharth Iyer, Yerlan Nessipbayev, Ryan Seelig, Hopein Christofen Tang, Dilshan Wijesena, Victor Zhang.

Statistics

Mehreen Afzaal, Mst Bithi Akter, Zelong Bi, Daniel Chee, Saman Forouzandeh, Shenghan Gao, Peter Hanna, Amuchechukwu Ibenegbu, Hakiim Jamaluddin, Qian Jin, Arpit Kapoor, Samudra Lamahewage, Jason Lambe, Yiyi Ma, Ben Maslen, Hanwen Xuan, Shuo (Andrew) Zhang, Jenny Zhao.

Plenary Session Abstracts

Counting points on elliptic curves in small boxes

Pure Mathematics

Christian Bagshaw (c.bagshaw@unsw.edu.au)

Elliptic curves have garnered significant attention over the last several decades, finding applications in cryptography and playing a central role in the proof of Fermat's Last Theorem. In this talk, we will provide a very gentle introduction to elliptic curves over finite fields, and discuss some new results regarding counting points on them which lie within small boxes.

Keyword(s): number theory, elliptic curves

Supervisor(s): Igor Shparlinski, Bryce Kerr, Alina Ostafe

About the speaker: As I approach the end of my degree, I am excited to speak at the Postgraduate Conference once more! While I love number theory, I also enjoy getting outside. I love being here in Sydney where I can jump in the ocean, and when I'm back home in Canada you might find me climbing in the Rockies.

Generalized Partial Least Square in Neural Network

Qian Jin (qian.jin@unsw.edu.au)

While deep learning has shown exceptional performance in many applications, the model's mathematical understanding, model designing, and model interpretation are still new areas. Combining the two cultures of deep and statistical learning can provide insight into model interpretation and high-dimensional data applications. This work focuses on combining deep learning with generalised partial least square estimation. In particular, Bilodeau et al. (2015) proposed a generalized regression with the orthogonal components (GROC) model, which is more flexible than the standard partial least square (PLS), because it may involve a more complex structure of dependence and the use of the generalized additive model (GAM) instead of linear regression. Based on all the latent variable models we considered, we proposed a general latent variable predictive model structure. Additionally, we propose a deep-GROC (DGROC) model, which allows for different measures of dependence to be used and shows a high prediction accuracy. Hyperparameter selection and transfer learning in the training loop are included to boost model performance. The superiority of the proposed method is demonstrated on simulations and real datasets, which show that our method achieves competitive performance compared to GROC, PLS and traditional Neural Networks. The Bayesian neural network and bootstrap are considered for the model inference. With the benefit of the general model structure, future inference work lead to the potential of providing a new framework for Partial Least Square model inference.

Keyword(s): neural network, generalized regression

Supervisor(s): Pierre Lafaye De Micheaux; Clara Grazian

About the speaker: Hi, my name is Qian Jin, come from Shanghai, China. I'm currently a 3rd year PhD student in statistics. My main research area is computational statistics and machine learning. In my spare time, I enjoy travelling, reading and discovering all the good food in Sydney.

Numerical analysis of certain models in micromagnetics at elevated temperatures

Applied Mathematics

Agus Soenjaya (a.soenjaya@unsw.edu.au)

The Landau–Lifshitz equation is commonly used in micromagnetics to model the effects of magnetic field on ferromagnetic materials. It is known that this equation is essentially valid only at very low temperature, since it completely ignores contributions from high-frequency spin waves responsible for longitudinal magnetisation fluctuation. To rectify this problem, the Landau–Lifshitz–Baryakhtar (LLBar) and the Landau–Lifshitz–Bloch (LLBloch) equations have been proposed in the literature. These nonlinear vector-valued PDEs take into account longitudinal relaxation and long-range interactions, which are important for applications in heat-assisted magnetic recording devices.

In this talk, I will discuss some fully-discrete numerical schemes to solve the LLBar and the LLBloch equations. One method is a finite element scheme based on certain mixed formulation of the equations. Another scheme is specifically tailored to the LLBloch equation, which involves a regularisation procedure. In all cases, assuming certain regularity of the exact solution, an optimal order of convergence to the solution is obtained. This is further corroborated by several numerical simulations. As by-product of the analysis, various analytical properties of the models are obtained, including the convergence of solution of the LLBar equation to that of the LLBloch equation at high temperatures, the exponential convergence to zero magnetisation above the critical temperature, and the uniqueness of solution to the LLBloch equation, among others.

Partly based on joint work with Ben Goldys (Sydney), Ngan Le (Monash), and Thanh Tran (UNSW).

Keyword(s): micromagnetics, finite element, Landau–Lifshitz, Landau–Lifshitz–Bloch, Landau–Lifshitz–Baryakhtar

Supervisor(s): Thanh Tran (UNSW), Ben Goldys (U. Sydney)

About the speaker: I'm a second year PhD student from Indonesia. I pursued my undergraduate degree in Singapore and my masters degree in the United States. I enjoy drinking coffee while working on my research and spending my leisure time listening to instrumental music or playing video games.

Regular Session Abstracts

Counting rational matrices with bounded entries

Pure Mathematics

Muhammad Afifurrahman (m.afifurrahman@unsw.edu.au)

Consider the set of matrices whose entries are rational numbers, whose absolute values of the numerator and denominator are bounded above by H. How many matrices in this set has a given determinant? How many of them has a given characteristic polynomial? Or rank?

This talk will discuss and give some approach over these families of problems. Some parts of this talk came from a joint work with Vivian Kuperberg (ETH Zürich), Alina Ostafe, and Igor Shparlinski.

Keyword(s): matrices, number theory

Supervisor(s): Alina Ostafe, Igor Shparlinski

About the speaker: Afif is currently a second-year PhD student, claimed to be in analytic number theory. He is raised in the Kalimantan/Borneo Island, and previously studied in Indonesia.

Outside of doing mathematics, he also helps managing the community of Indonesian PhD students in UNSW. He has also written an an illustrated popular mathematics books in Bahasa Indonesia. In his spare time, he likes distributing memes, listening to old Indonesian pop and binging on Japanese animated media.

Finding a Presentation for the q-Schur Algebra of Type B

Aayush Bhattacharya (a.bhattacharya@unsw.edu.au)

The Schur-Weyl Hecke Duality has historically been significant to the study of Quantum Groups and other non-commutative algebra. One result of this duality has been finding presentation of the Schur algebra, both on a classical semi-simple level and on a quantum level. Doty and Giaquinto have found such presentations, and Beilinsion, Lusztig and McPhersons have provided a geometric context to this presentation, in the type A quantum case. Recently, Bao and Wang have established a duality involving the type B q-Schur algebra and the new i-quantum groups. Du and Wu have used this duality to provide a map from the i-quantum group onto the q-Schur algebra, which we use to explore the Doty-Giaquinto type quotient algebra and attempt to find further relations to present the q-Schur algebra.

Keyword(s): Schur algebra

Supervisor(s): Jie Du

About the speaker: I am a 3rd year PhD candidate working in the field of Quantum Groups. I did my honours in the applications of Quantum Groups to Knot and Link invariants. I am also interested in the applications to physics and computer science, though by no means am I knowledgeable in either field.

Non-linear processes trigger and drive convective mixing in Direct Numerical Simulations

Applied Mathematics

Josef Bisits (z5131023@ad.unsw.edu.au)

At constant pressure, a mixture of water parcels with equal density but differing temperature and salinity will be denser than the parent water parcels. The densification of the mixed water is known as cabbeling Witte (1902) and is a consequence of the non-linear equation of state for seawater density. With a source of turbulent vertical mixing, cabbeling has the potential to create an instability in a gravitationally stable water column which may lead to convection. The effects of cabbeling on marginally stable profiles has not been fully explored. Here we investgate how non-linear processes influence mixing, and the energetics of mixing, in stably stratified closed two layer systems using Direct Numerical Simulations. We find that cabbeling can trigger convection in an initially gravitationally stable two layer configuration where relatively cold/fresh water sits atop warm/salty water. We show that the maximum density of the mixed water (i.e. the mixture of the cold/fresh warm/salty water) can be predicted and that non-linear effects have a strong influence on mixing until one of the layers is eroded. Estimates of the effective vertical diffusivity reveal that cabbeling greatly enhances local mixing rates over the parameterised molecular diffusion values. We also find that non-linearities create a reversible exchange between the available and background potential energy reservoirs which is not the case with a linear equation of state. Our results show that due to mixing and non-linear processes, instabilities may form in temperature inverted, gravitationally stable water columns consequently triggering and driving enhanced turbulent mixing.

Keyword(s): Convection, non-linear processes, Direct Numerical Simulations

Supervisor(s): A/Prof. Jan Zika

About the speaker: I am currently in the final year of my PhD under supervision of A/Prof. Jan Zika at the University of New South Wales, Australia. I initially trained as a musician at the Sydney conservatorium and continue to work as a freelance musician. I returned to university to study mathematics and during my honours year I worked on isopycnal mixing with my current PhD supervisor (Jan Zika). This led me to take on a PhD which to date has been good fun! In my spare time I play tennis and spend time with my family.

Optimal stopping problems: A Shannon entropy regularization approach

Statistics

Daniel Chee (z5209546@ad.unsw.edu.au)

In this work, we propose an entropy regularization approach to incorporate reinforcement learning into the computation of optimal stopping problems. We first examine the Bermudan option and a related relaxed control problem to introduce an entropy-regularized BSDEs. Convergence results are discussed. This approach is extended to American options by regularizing a penalization scheme associated with a reflected BSDE. We show that the resulting limit of this regularized penalization scheme is a reflected BSDE with a non-Lipschitz generator.

Keyword(s): optimal stopping problems, Shannon entropy, stochastic analysis

Supervisor(s): Dr Libo Li

About the speaker: I am local student and completed my undergraduate degree at UNSW in 2023. I am currently in second year my PhD. I enjoy playing sports.

Investigating Biases in CMIP5/6 Models: Insights Using a Cold-Warm Temperature Gradient

Applied Mathematics

Isabela Conde (i.conde@unsw.edu.au)

Tropical Pacific sea surface temperature (SST) exerts a substantial influence on regional and global climate-shaping large-scale atmospheric circulation. Trade winds, which flow westward, maintain a SST gradient across the Pacific with warmer waters generally in the west and cooler waters in the east. This gradient is a dominant mode of variability in the climate system, mostly caused by El Nino-Southern Oscillation (ENSO); due to this drastic change in east-west temperature gradient during different ENSO phases, we see the distribution of El Nino and La Nina events affecting the long-term trend of SSTs. Yet, the disparity of ENSO events means the typical warming or cooling may not be occurring within prescribed east/west boxes, we instead use an alternate warm-cold temperature gradient which we find is able to capture the effects of varying ENSO events. We determine that by utilising a cold-warm metric rather than east-west, there is a significant reduction in the spread of ensemble members within multiple CMIP5/6 models between 1982-2020, leading to more definitive results. Additionally, we see that the trend in the coldest waters is not captured by models, our results show that the observational trend in the coldest 10% does not lie within this studies model spread. Previous literature has shown that, over the recent historical period, CMIP5/6 models have not been congruent with observations—our results reinforce the idea that there are fundamental biases within the models as we see a dramatic reduction in the likelihood that observations fall within our model spread with a p-value of 2.6×10^{-12} using cold-warm metric and 4.5×10^{-4} for east-west temperature gradient.

Keyword(s): SST, CMIP5/6 biases, cold-warm temperature gradient

Supervisor(s): Jan Zika

About the speaker: I'm currently in my second year of a PhD in applied mathematics with a focus on physical oceanography and I completed my Honours in Mathematics from UQ. I aim to understand the drivers and impacts of variability in the tropical sea surface temperature distribution, using both mathematical modeling and statistical approaches. In Sydney I enjoy nice weather by going on hikes and being at the beach.

Experimental and numerical study of internal waves generated by moving submerged sources

Applied Mathematics

Joshua Connor (joshua.connor@student.unsw.edu.au)

Submerged vessels moving through a stratified fluid create a wake in the interior of the fluid known as an internal gravity wave. Internal gravity waves are gravity driven waves that exist on the density interfaces between stratified layers of fluid. Knowledge of this wake is important to manufacturers, owners, and observers of submerged vessels. In this talk, we present preliminaries for a numerical and experimental study of internal gravity waves generated by moving submerged vessels. This study utilises a spectral solver that represents solid object using a novel volume penalty method.

Keyword(s): Fluid dynamics, volume penalty method

Supervisor(s): Shane Keating, Scott Sisson, Chris Lustri

About the speaker: Josh is a PhD student in the School of Mathematics who enjoys looking at bodies of water and thinking very hard before diving in.

A large sieve inequality for moduli generated by a quadratic

Chip Corrigan (c.corrigan@student.unsw.edu.au)

Inequalities of large sieve type have many applications in the analytic theory of L-functions. In this talk, we present a large sieve inequality pertaining to moduli in the range of a polynomial of degree two.

Keyword(s): large sieve, number theory

Supervisor(s): Lee Zhao

About the speaker: Currently, I am interested in topics in the analytic theory of L-functions. More specifically, I am interested in studying the mean-values and distribution of zeros for L-functions belonging to certain well-structured families. Previously, I completed honours at UNSW under the supervision of my current H.D.R. supervisor, Dr. Lee Zhao.

Freeing Kruglov's operator: non-commutative independence in finite von Neumann algebras

Pure Mathematics

Daniel Czapski (d.czapski@unsw.edu.au)

The Kruglov operator is, in essence, a stochastic integral with respect to a Poisson process with parameter 1 and defined on integrable random variables. Introduced in the 1990's by S. Astashkin and F. Sukochev in their study of sums of independent random variables, within two decades it had been used to greatly improve and generalise bounds on the norms of such sums in a large class of symmetric Banach function spaces — those with the so-called Kruglov property. In the non-commutative realm, probability theory takes a different but not-unfamiliar form: the commutative von Neumann algebra L^∞ and expectation functional $\mathbb{E}$ are replaced by a potentially non-commutative von Neumann algebra $\mathcal{M}$ equipped with a faithful, normal, tracial state τ. Equipped with the highly non-commutative "free" independence of D. Voiculescu, we seek to define a "free" Kruglov operator on trace-class, measurable operators which is a direct analogue of its classical cousin, and in doing so attempt to answer a question posed by R. Speicher on such an operator on semifinite von Neumann algebras. In this talk, I will give a brief overview of the relevant background and the progress made so far.

Keyword(s): probability theory; non-commutative probability theory; free independence; free probability; measure theory; functional analysis; non-commutative analysis;

Supervisor(s): Dr. Dmitriy Zanin (primary), Prof. Fedor Sukochev

About the speaker: Daniel finished their Bachelor of Advanced Science in 2022 with first class honours in pure mathematics and a major in physics, after taking far too long. They began their PhD at the start of 2023 under the supervision of Dr. Dmitriy Zanin. They are currently in their second year, and has the dubious honour of having lost a contest for their dog's affection to a small flock of sheep.

Jones' Technology and the Haagerup Property

Christian De Nicola Larsen (c.denicolalarsen@unsw.edu.au)

Richard Thompson's groups encode the process of splitting something in half repeatedly, then shuffling and rescaling the pieces. In the late 1960s, they provided the first examples of finitely presented simple groups. Despite intense study, many questions about them remain open, especially about their analytic properties.

A decade ago, Vaughan Jones developed a powerful technology for constructing objects that Thompson's groups act on. When the objects are Hilbert spaces we get unitary representations, which are useful for studying analytic properties. We will discuss how these representations lead to a new analytic proof that Thompson's group V has the Haagerup property (first proven geometrically by Farley in 2003), and how it adapts to other Thompson-like groups.

This talk contains joint work with Ryan Seelig and Dilshan Wijesena.

Keyword(s): discrete groups, unitary representations, Haagerup property

Supervisor(s): Pinhas Grossman, Arnaud Brothier, Ian Doust

About the speaker: I'm in the final stretch of my PhD, so I'm challenging myself to explore postdoc opportunities. In between all of this, I play Oztag and touch footy.

Hidden Symmetries of Differential Operators

David Farrell (david.farrell@unsw.edu.au)

In the study of differential operators on $\mathbb{R}^n$, two key properties are *translation invariance* and *homogeneity*. Indeed, the study of a homogeneous, translation invariant operator (such as the Laplacian Δ) reduces largely to the study of a single function defined on $\mathbb{S}^{n-1}$, the so-called *convolutional kernel* of the operator. In the absence of these properties however, not all is lost. Some operators of interest, while not necessarily homogeneous or translation invariant in the usual sense, satisfy translation invariance or homogeneity with respect to alternative vector space-like structures on $\mathbb{R}^n$. This talk will give a brief introduction to these vector space-like structures, some motivation for why to do analysis there, and a cursory description of my research in the area.

Keyword(s): analysis, harmonic analysis, differential operators, lie groups

Supervisor(s): Dmitriy Zanin

About the speaker: I'm a kiwi, I did my undergrad at the University of Auckland, and I came over to Sydney to do my PhD. Fun facts: I was actually born in Australia. I did half of a PhD in category theory at Mcquarie university before dropping out and coming to UNSW to do analysis. I play the bass, I've never had a green bean casserole, and I haven't stubbed my toe in at least 6 weeks.

Diagrammatics of the Spherical Category

Tasman Fell (t.fell@unsw.edu.au)

The category of Soergel Bimodules categories the Hecke algebra, an important algebra in representation theory. The morphisms in this category can be represented diagrammatically, allowing computations to be made much more easily. My project is to construct the diagrammatics for a similar category, called the spherical category.

Keyword(s): Representation Theory, Soergel Bimodules, Diagrammatics.

Supervisor(s): Anna Romanov (UNSW), Geordie Williamson (USyd)

About the speaker: I did my undergrad in the U.S., before completing an honours year at UNSW. I am in my second year of a research masters, and will begin a PhD at Usyd in representation theory at the beginning of next year. I spend my free time making music, climbing, and buying too many books.

Multi-View Graph Dual Attention and Contrastive Learning for Multi-Criteria Recommender Systems

Statistics

Saman Forouzandeh (s.forouzandeh@unsw.edu.au)

Recommender systems leveraging deep learning models have been crucial for assisting users in selecting items aligned with their preferences and interests. However, a significant challenge persists in single-criteria recommender systems, which often overlook the diverse attributes of items has been addressed by Multi-Criteria Recommender Systems (MCRS). Shared embedding vector for multi-criteria item ratings but have struggled to capture the nuanced relationships between users and items based on specific criteria. Furthermore, contrastive learning (CL) selects anchor points through augmentation matrices, which can involve stochastic augmentations such as node or edge modifications, making them susceptible to noise perturbations. In this study, we present a novel representation for Multi-Criteria Recommender Systems (MCRS) based on a multi-edge bipartite graph, where each edge represents one criterion rating of items by users, and Multi-View Dual Graph Attention Networks (MDGAT). Employing MDGAT is beneficial and important for adequately considering all relations between users and items, given the presence of both local (criterion-based) and global (multi-criteria) relations. Additionally, we define anchor points in each view based on similarity and employ local and global contrastive learning to distinguish between positive and negative samples across each view and the entire graph. We evaluate the proposed method on three real-world datasets and assess its performance based on item rating predictions. The results demonstrate that our approach achieves higher accuracy compared to baseline algorithms, using MAE and RMSE metrics for predicting item ratings. Our dual attention and dual contrastive learning methods effectively capture the local and global impact of neighbors and the similarity between nodes.

Keyword(s): Multi-Criteria Recommender System; Multi-View Graph Attention Network; Contrastive Learning.

Supervisor(s): Dr. Pavel Krivitsky and Dr. Rohitash Chandra

About the speaker: I'm from Iran and currently in my third year of PhD studies at UNSW. I hope to complete my PhD by the end of this year. I waited around two years to come to Sydney because the border was closed due to the COVID-19 pandemic. However, I have really enjoyed living here and have gained valuable experience by studying at UNSW. It has significantly changed my views on research, and I am very grateful for the opportunity to live here.

On the convergence of discontinuous Galerkin methods for integral-algebraic equations of index 1

Applied Mathematics

Hecong Gao (hecong.gao@student.unsw.edu.au)

The integral-algebraic equation (IAE) of index 1 is a mixed system of first-kind and second-kind Volterra integral equations (VIEs). In this paper, the discontinuous Galerkin (DG) method is proposed to solve the index-1 IAE, and the optimal global convergence order is obtained. The iterated DG method is introduced in order to improve the numerical accuracy, and the global superconvergence of the iterated DG solution is derived. However, due to the lack of the local superconvergence of the DG residual for first-kind VIEs, there is no local superconvergence for the mixed IAE system of first-kind and second-kind VIEs, and the numerical experiments also verify this. Some numerical experiments are given to illustrate the obtained theoretical results.

Keyword(s): integral-algebraic equation, index-1, discontinuous Galerkin method, convergence, superconvergence

Supervisor(s): William McLean (UNSW), Hui Liang (Harbin Institute of Technology, Shenzhen, China)

About the speaker: Hecong Gao is a third-year PhD student at the Harbin Institute of Technology (HIT) in Shenzhen, China. Currently, she is a visiting PhD student at the University of New South Wales (UNSW) for a one-year research exchange. Hecong's research focuses on numerical analysis for integral-algebraic equations and time-fractional diffusion equations.

Eilenberg Maclane Spaces for RO(G)-graded cohomology

Joshua Graham (joshua.graham@unsw.edu.au)

The Dold-Thom theorem states that for a "nice" pointed topological space X and discrete abelian group A, reduced homology $H_n(X, x; A)$ is given by the homotopy groups of the infinite symmetric product $\pi_n(\mathrm{SP}(X) \otimes A)$, where $\mathrm{SP}(X)$ denotes the free abelian group on X, modulo its basepoint.

This theorem also helps us compute cohomology by the Brown-representability theorem, and we can find $H^n(X, x; A) = [X, \mathrm{SP}(S^n) \otimes A]$ where $[X, Y]$ denotes based-homotopy classes of continuous maps $X \to Y$, and we call $\mathrm{SP}(S^n) \otimes A$ an *Eilenberg-Maclane space* $K(n, A)$ in that it represents n-th cohomology with coefficients in A.

When X has symmetry arising from a finite group action G on X, the (co)homology theories of interest become more interesting as well as complex, being indexed by the real-orthogonal representation ring $RO(G)$ as well as having coefficients in a broad class of objects called *Mackey functors.* As such results speaking to the existence of these Eilenberg-Maclane spaces (i.e., spaces representing cohomology) abound, but simple explicit constructions are relatively few and far between.

I will describe one simple such construction, as well as recent work by myself in using this construction to define $RO(G)$-graded motivic cohomology with Mackey functor coefficients.

Keyword(s): Algebraic Geometry, Algebraic Topology, Group Theory

Supervisor(s): Mircea Voineagu, Daniel Chan

About the speaker: I'm a South African born Australian PhD student who first came to UNSW as an undergrad in 2018. Outside of research, I enjoy teaching first year mathematics and in my spare time I'm usually spending time with my wife at home or learning to speedrun Nintendo games.

Equivariant motivic cell structures

Joshua Ham (z5298408@ad.unsw.edu.au)

In the classical context, cellular objects provide a standard method for doing homotopy theory. In particular, CW complexes up to homotopy can model the homotopy category of topological spaces and, moreover, CW complexes admit a Kunneth theorem in cohomology. The notion of cellularity was generalised by Dugger and Isaksen to arbitrary pointed model categories; in particular to motivic homotopy theory (which has two elementary spheres). I apply their methods to the context of Bredon motivic homotopy theory (which has four elementary spheres). This leads firstly to questions as to which C_2-schemes are (finitely) cellular; secondly it suggests a conjectural penta-graded Kunneth spectral sequence which applies to such schemes.

Keyword(s): homotopy, equivariant, motivic

Supervisor(s): Mircea Voineagu, Jie Du

About the speaker: I am currently a third year PhD candidate working in motivic homotopy theory. I completed my master by coursework at UNSW in 2021, writing my thesis on the philosophy of mathematics. Outside of my interests in maths and philosophy, I am currently making efforts to learn Mandarin and latin dance.

Nonparametric Density Estimation using Bernstein Polynomials

Peter Hanna (peter.hanna@unsw.edu.au)

In this presentation, the application of Bernstein Polynomials in the realm of nonparametric density estimation will be explored. An estimation method using the sup norm is proposed and compared with both an existing Bernstein-based approach and a representative of the popular kernel density estimation method.

Keyword(s): Bernstein Polynomials, density estimation, nonparametric, statistics

Supervisor(s): Zdravko Botev, Spiridon Penev

About the speaker: Currently in my second year of the PhD program at UNSW. I grew up in Sydney where I also completed my previous studies (all at UNSW).

The Goldbach-Vinogradov theorem with restricted primes

Michael Harm (m.harm@unsw.edu.au)

Let N denote a sufficiently large integer. We prove an asymptotic formula for the number of ways in which N can be represented as the sum of three primes, one of which is smaller than $N^{1/2+\varepsilon}$, for any $\varepsilon > 0$. Results of this type can be viewed as an approximation to the still widely open Binary Goldbach Problem.

Keyword(s): primes, circle method

Supervisor(s): Igor Shparlinski and Bryce Kerr

About the speaker: I'm a second year PhD student from Germany. I took the opportunity to visit a conference in Canada and am (as of writing) enjoying summer in the northern hemisphere. I'm now obligated to return to Sydney because I have flaked on my Trivia team for too long.

A quick guide to pseudodifferential operators

Eva-Maria Hekkelman (e.hekkelman@unsw.edu.au)

In these 20 minutes, I hope to provide a crash course on pseudodifferential operators: what are they good for, what is 'pseudo' about them, and what does it mean for an operator to be elliptic? If time permits I hope to touch on an abstract theory of pseudodifferential operators which is important in the field of noncommutative geometry and show one of the key results in my research: a functional calculus for abstract pseudodifferential operators.

Keyword(s): pseudodifferential operators, functional calculus, functional analysis

Supervisor(s): Fedor Sukochev, Edward McDonald (Penn State), Dmitriy Zanin

About the speaker: I'm Eva-Maria, at the end of my third year, and I'm in denial about how much time I have left to write my thesis (heaps right??). To distract myself I like playing the cello, and recently learned how to rollerskate.

The compounded Sibuya random walk and the fractional Laplacian

Applied Mathematics

Boris Huang (b.huang@unsw.edu.au)

Models for anomalous super diffusion, with mean squared displacement scaling faster than linearly in time, often involve non-local operators, such as the fractional order Laplacian. Due to their relevence in modelling phenomena like the motion of particles and cells, random walks have become a common approach in deriving these models.

We will show how the fractional order Laplacian can arise by considering a compound (continuous time) random walk on a lattice. This surprisingly neat result arises from a connection between the generalised binomial theorem and the Sibuya distribution, a heavy tailed discrete distribution. We will address some of the computational challenges in simulating these random walks as well as generalisations.

Keyword(s): fractional Laplacian, random walks, anomalous diffusion

Supervisor(s): Christopher Angstmann

About the speaker: I am currently in my first year of my PhD. I enjoy mathematics.

On the distribution of real sequences modulo one.

Siddharth Iyer (Siddharth.Iyer@unsw.edu.au)

We make two contributions in the study of fractional parts.

1) It is shown that rationals with denominators made of digits 0 and 1 in base b well approximate real numbers.

2) We improve upon a result by Steinerberger (2024) by showing that for $\alpha \in \mathbb{R}$, there exist integers $1 \leq b_1, \ldots, b_k \leq n$ such that:

$$\left\| \sum_{j=1}^{k} \sqrt{b_j} - \alpha \right\| = O(n^{-\gamma_k}),$$

where $\gamma_k \geq \frac{k-1}{4}$ and $\gamma_k = k/2$ when $k = 2^m - 1$, $m = 1, 2, \ldots$.

Keyword(s): Number Theory, Diophantine Approximation, Sums of Square roots

Supervisor(s): Igor Shparlinski

About the speaker: I am a second year PhD student interested in Number Theory. My hobbies include watching TV shows and playing video games.

Bayesian mixture models via histograms

Hakiim Jamaluddin (a.jamaluddin@unsw.edu.au)

Gaussian Mixture Models (GMMs) are widely used due to their flexibility in modelling complex data distributions. However, parameter estimation in GMMs often encounters numerical challenges. A promising strategy to mitigate these issues involves incorporating missing data structures via auxiliary variables. Both frequentist methods, such as the Expectation-Maximisation (EM) algorithm, and Bayesian techniques, like Markov Chain Monte Carlo (MCMC) methods, can leverage auxiliary variables. Nevertheless, large datasets pose significant computational challenges for these approaches. To address this, classical data can be transformed into aggregated forms, such as histogram-valued data, facilitating more manageable representations while retaining essential statistical properties. Despite this, ensuring the auxiliary variables' distribution adheres to within-group distributions in histogram-valued data remains complex. Efficient MCMC algorithms tailored for GMMs with histogram-valued data and missing structures are crucial for advancing research in this domain.

Keyword(s): Mixture model, histogram, symbolic data analysis

Supervisor(s): Scott Sisson and Boris Beranger

About the speaker: I am a final year PhD student and later I have to return home to serve the bond teaching at Universiti Putra Malaysia, Malaysia. I will miss Sydney, some people and Katana. Apart from PhD and casual work, I work out, swim and run in the evening. This year, I will join the Sydney Marathon!

Neural Operator Approach for Gain Function Approximation in the Feedback Particle Filter

Statistics

Arpit Kapoor (arpit.kapoor@unsw.edu.au)

A feedback particle filter (FPF) is a numerical algorithm designed to approximate the solution of the nonlinear filtering problem in continuous-time settings. A significant challenge in implementing the FPF algorithm is the accurate approximation of the gain function, which is the gradient of the solution to a Poisson equation involving a probability-weighted Laplacian Δ_ρ. We present a neural operator-based method for gain function approximation. Neural operators have emerged as an effective data-driven alternative to numerical methods for learning the solution operator of partial differential equations.

We present a Fourier neural operator approach for learning a direct mapping between the probability density function and the gain function for the FPF. This method is independent of the probability density, providing a faster and more flexible solution for the underlying partial differential equation across various probability densities. Unlike the diffusion map-based methods, which rely on intermediate steps and are subject to bias and variance due to finite sample sizes, our neural operator-based approach mitigates these issues by learning the underlying solution operator from data.

We conduct numerical experiments to demonstrate the efficiency, accuracy, and scalability of our proposed method. These experiments reveal that our neural network-based approach provides a fast and accurate emulator for gain function, particularly in high-dimensional settings. The flexibility and speed of our method make it a superior alternative for solving complex filtering problems.

Keyword(s): Fourier Neural Operator, Feedback Particle Filter, Partial Differential Equation

Supervisor(s): Rohitash Chandra, Sahani Pathiraja, and Lucy Marshall (Faculty of Science and Engineering, Macquarie University, Sydney)

About the speaker: I am a second-year PhD candidate at the School of Mathematics and Statistics, UNSW, focusing on developing deep learning methods for modelling physical processes in environment and hydrology. I am also fascinated by robotics and I spent considerable time contributing to the humanoid robotics research at my university (in India) during my undergraduate studies. Outside of research, I like to spend my off-time travelling and exploring the countryside.

Mixed integer linear programming and non-cooperative game theoretic models in closed-loop supply chain network designing.

Samudra Lamahewage (s.lamahewage@unsw.edu.au)

Non-cooperative game theoretic models allow us to consider the conflicting objectives and strategic interactions among decision-makers. In contrast, mixed integer linear programming (MILP) modeling focuses on a single decision problem from the perspective of a particular decision-maker. Hence, the investigation of these modeling techniques is crucial in Closed-Loop Supply Chain (CLSC) network designing. In this study, the MILP model obtains location and allocation decisions of the CLSC network with the objective of profit maximization from the perspective of the hybrid plant. Stackelberg's game theoretic modeling is considered to account for the leader and multi-followers' decision-making, and then the bilevel decision model is solved to obtain Stackelberg equilibria. However, the Stackelberg model doesn't capture the dependency between followers. Hence, this study develops the Nash-Cournot quantity competition model to deal with this limitation as well as to consider the simultaneous movement of supply chain members, and then the Linear Generalized Nash Equilibrium Problem (LGNEP) is solved to obtain Nash equilibria based on Karush Kuhn Tucker(KKT) Conditions. However, both of these models apply only to the optimal structure obtained via the MILP model. Hence, this study developed the improved Nash-Cournot quantity competition model to make both structure selection and quantity transformation decisions through quantity transformation decisions. However, it is challenging and time-consuming to solve when the number of players and strategies increases. Therefore, this study proposes the potential game theoretic model to make both structure selection and quantity transformation decisions. This potential game theoretic model results in a MILP model. Finally, these modeling approaches are applied to illustrate the results of the tire CLSC network in the region of the Greater Toronto Area in Ontario, Canada. The results indicate that optimal solutions of MILP modeling are equivalent to the optimal strategies of Stackelberg game theoretic modeling. The Nash-Cournot quantity competition model demonstrates that there is a non-unique Nash equilibrium due to the existence of a singular matrix. Hence, we have imposed further constraints to obtain the unique Nash Equilibrium. The optimal solutions of the game theoretic models illustrate better overall profits and lower losses than the MILP model.

Keyword(s): Optimization, Game Theory

Supervisor(s): Sahani Pathiraja, Scott Sisson, Edward Cripps (University of Western Australia), Lucy Marshall (Macquarie University)

About the speaker: I am a PhD candidate in the School of Mathematics and Statistics, UNSW, and the ARC-funded Industrial Transformation Training Centre in Data Analytics for Resources and Environments (DARE). I completed the MSc degree in Industrial Mathematics at the University of Sri Jayewardenepura and the BSc degree in Statistics and Operations Research at the University of Peradeniya, Sri Lanka. During my sparse time, I love to travel.

The dynamic Laplacian and the harmonic mean metric

Applied Mathematics

Yat Long Lee (z5321396@ad,unsw.edu.au)

Froyland introduces the dynamic Laplacian for the study of the dynamic isoperimetric problem. Since then, many interesting questions have been posed. One of them is whether the dynamic Laplacian is a Laplace-Beltrami operator. In this talk, I will explain that the harmonic mean metric is the Riemannian metric such that the dynamic Laplacian is a Laplace-Beltrami operator.

Keyword(s): dynamic Laplacian

Supervisor(s): Gary Froyland, Upanshu Sharma

About the speaker: Hi, I am Yat Long Lee, you can call me Luca. I am a PhD student from Hong Kong supervised by Prof Gary Froyland. I did my MPhil in Hong Kong working in complex differential geometry, and now working in dynamical systems with settings from differential geometry. I love taking pictures and eating. Let me know if you have any good recommendations.

Finite Convergence of Circumcentered-Reflection Method on Closed Polyhedral Cones in Euclidean Space

Applied Mathematics

Hongzhi Liao (hongzhi.liao@unsw.edu.au)

We study the finite convergence performance of circumcentered-reflection method (CRM) for the case of intersection of two closed convex cones in $\mathbb{R}^3$. We apply this result to prove the finite convergence for two polyhedral sets in $\mathbb{R}^2$.

Keyword(s): Circumcentered-reflection method, Closed convex cones, Finite convergence, Polyhedral sets

Supervisor(s): Vera Roshchina, Mareike Dressler

About the speaker: I am currently in my third year of PhD studies at UNSW. Before enrolling in UNSW, I did my undergraduate studies in Beijing (BJUT), Canberra (ANU), and Singapore (NTU, exchange). Half of my honours year was under the pandemic in Canberra (fortunately survived!). To refresh my head, I would like to train for rock climbing in my spare time. I also believe I may gain some ideas for the research during the sport!

GNN-based parameter inference for Max-Infinitely Divisible Processes

Statistics

Yiyi Ma (yiyi.ma1@unsw.edu.au)

As one of the most famous spatial extreme models, max-stable processes have reached their limits, especially in capturing the weakened dependence at the tail of the distribution. Researchers have started to look for more flexible and generalised processes. The max-infinitely divisible processes (max-id) have emerged as a promising choice. However, inferring the parameters of the model in the traditional parametric way can be computationally expensive due to their complex construction. Likelihood-free inference (LFI) methods fit perfectly in this situation, which, instead, learn an implicit relationship using purely simulated data and produce the estimations that minimise the training objective without involving a closed-formed likelihood. As a new LFI family member, the Neural Bayes estimator is a type of Graphical Neural Network (GNN)-based point estimator. It allows us not only to learn the spatial extreme models on regular grids but also on irregular graphs of different sizes. Based on this robust estimator, we developed a two-step parameter inference scheme for max-id processes: first, classify whether the observations are from a max-stable or a max-id process by a trained GNN classifier; second, apply a trained Neural Bayes estimator accordingly for parameter inference. By achieving good results in simulation case studies, GNN-based methods have shown their potential to be an easy, quick, and reliable solution for max-id parameter inference tasks. Also, the GNN-based classifier provides us with a simple idea of distinguishing the two processes according to the observations, which can be a convenient guide for model selection.

Keyword(s): max-stable processes, max-infinitely divisible processes, likelihood-free inference, graphical neural network, extreme-value model,

Supervisor(s): Sahani Pathiraja, Scott Sisson

About the speaker: It's my third year of PhD studies. I'm interested in applying data-driven methods to environmental problems. Before Sydney, I spent six years in Wales and London for high school and college. Recently, I started playing the ukelele simply because it's the easiest and cheapest instrument I can get.

The Motion Picture: Leveraging Movement to Enhance AI Object Detection in Ecology

Ben Maslen (b.maslen@unsw.edu.au)

With the rise of camera traps and monitoring video cameras, capturing image and video data of wildlife has never been easier for Ecologists. This is vital in managing wildlife populations and our impact on to them as a non-invasive and relatively inexpensive sampling method. However. these methods are being held back by the vast amount of time it takes to analyse and categorise the footage. Methods currently exist to automate this procedure using computer vision algorithms on individual frames from the video, however they struggle to detect occluded, camouflaged, blurred or schooling species. We propose a relatively simple means to include movement information in the detection pipeline to attempt to solve these issues. Automating taxa identification for every frame in an hour of in monitoring video footage produces 200,000 predictions for multiple taxa at individual points in time. We will also assess the usefulness of various statistics that can summarise this information and make it useful for ecologists.

Keyword(s): Ecology, image detection

Supervisor(s): David Warton, Gordana Popovic, Dadong Wang

About the speaker: I am a third year PhD student, studying ecological statistics. I have a passion for the underwater world (even playing a weird sport called underwater rugby), which is why I have tailored my research to help improve the monitoring and analysis of the marine environment.

On non-complemented subspaces of Banach spaces.

Yerlan Nessipbayev (y.nessipbayev@unsw.edu.au)

The complemented subspace problem seeks to determine the closed subspaces M of a Banach space E for which there exists a closed subspace N of E such that $E = M \oplus N$ (that is, $E = M + N$ and $M \cap N = \{0\}$). Equivalently, there is a continuous linear (idempotent) projection from E onto M. We show that an order continuous (separable) part E^{oc} of a Banach function space E is not complemented in E under some natural conditions.

Keyword(s): complemented subspace, order continuous norm

Supervisor(s): Fedor Sukochev, Dmitriy Zanin

About the speaker: I got my bachelor's in Kazakhstan and my master's in the US. Now I'm living the dream, working with Fedor Sukochev's research team and teaching at UNSW. When I'm not crunching numbers, you'll find me kicking a football, smashing a table tennis ball once-twice a year, chatting with friends, or squeezing in some practice time. Life's a balancing act.

Simple groups with no piecewise linear actions

Ryan Seelig (r.seelig@unsw.edu.au)

In a monumental effort spanning decades, the finite simple groups were completely classified. On the other hand, infinite discrete simple groups remain mysterious, so much so that the first finitely presented examples were discovered in 1965, long after the advent of group theory. One of these first examples was Thompson's group T, which consists of piecewise linear homeomorphisms of the circle. Most examples of finitely presented simple groups acting on the circle can be viewed as generalisations of T, though only one such group, constructed by Lodha in 2019, cannot act on the circle by piecewise linear homeomorphisms. In this talk we construct infinitely many new finitely presented simple groups that act on the circle, but never in a piecewise linear way. Our examples all arise as forest-skein groups, introduced by Brothier in 2022. These groups can be viewed as a mixture of Thompson's groups with Jones' planar algebra.

Keyword(s): Thompson's groups, finitely presented simple groups

Supervisor(s): Arnaud Brothier and Pinhas Grossman

About the speaker: Hi! I'm in my 3rd year of PhD and enjoy playing Oztag and Touch footy in my free time.

Do vesicles queue? A queuing model of GLUT4 translocation

Applied Mathematics

Brock Sherlock (brock.sherlock@unsw.edu.au)

Mammalian cells regulate their glucose levels by redistributing glucose transporter proteins within the cell. The main insulin activated transporter is Glucose Transporter 4 (GLUT4) - a membrane embedded protein found in fat and muscle cells. GLUT4 is constantly recycled throughout the cell and in the absence of insulin in primarily sequestered within the cell. In response to insulin stimulation GLUT4 is released from intracellular storage and translocated to the cell surface, i.e., higher levels of insulin correspond to a higher expression of GLUT4 at the cell surface. Currently, our understanding of the mechanisms of GLUT4 sequestration and release is incomplete.

Here, a stochastic model, a closed queuing network, is used to identify possible mechanisms by which GLUT4 is released to the cell surface in response to insulin. The parsimonious mathematical model developed consists of plausible biological mechanisms. In this talk, the assumptions of the model and the biology that informed the modelling choices will be explored. Fitting to experimental data, it was found that constraining insulin action to only the SNARE proteins (the cell machinery that fuses GLUT4 to the cell surface) is sufficient to explain experimental observations.

Keyword(s): Mathematical Model, GLUT4 Translocation, Queuing Network

Supervisor(s): Adelle Coster, Michael Watson, Maria Vlasiou (University of Twente), Marko Boon (Eindhoven University of Technology)

About the speaker: Brock is a third year PhD student in mathematical biology. He is also other things: guitarist, cat dad, and consumer of caffeine to name a few. During his youth Brock was an aspiring rugby player. However, due to injury, and coming to his senses that he can't continue punishing his body, he has retired. Since retirement Brock has taken to coaching instead.

Wei's Duality Theorem: from fields to rings

Hopein Christofen Tang (hopein.tang@unsw.edu.au)

In 1991, Victor Wei proved a remarkably elegant and useful property of linear error-correcting codes over finite fields. This theorem, now known as Wei's Duality Theorem, has been since generalised to other mathematical objects outside coding theory, in particular combinatorial structures. However, it has been a challenge to generalise this theorem from finite fields to more general finite rings. In this talk, I will present Wei's Duality Theorem using simple examples that require no prior knowledge of coding theory. I will then describe my recent results in this area, namely the extensions of Wei's Duality Theorem with respect to a class of finite rings with a prime power number of elements. These results are as far as we know the first generalisation of this theorem to finite non-field rings.

Keyword(s): coding theory, combinatorics, finite rings

Supervisor(s): Thomas Britz

About the speaker: I am currently in the second year of my PhD. I received my bachelor's and master's degrees from Institut Teknologi Bandung, Indonesia. I don't have any hobbies now, unless you count sleeping as one.

Well-Posedness for a Magnetohydrodynamical Model with Intrinsic Magnetisation

Applied Mathematics

Noah Vinod (n.vinod@unsw.edu.au)

The magnetohydrodynamic model was a Nobel-prize winning discovery in Physics that modelled the motion of electrically conducting fluids with many applications to solar physics, geophysics, plasmas and more. More recently, a 'ferromagnetic' magnetohydrodynamic model was constructed by Lingam (Lingam, 'Dissipative effects in magnetohydrodynamical models with intrinsic magnetization', Communications in Nonlinear Science and Numerical Simulation Vol 28, pp 223-231, 2015) which models the motion of electrically conducting fluids with intrinsic magnetic properties (i.e., intrinsic magnetisation) and has potential applications for better understanding classical ferrofluids and maybe even astrophysical and fusion plasmas. It is a generalisation of the magnetohydrodynamic equations and now couples the Landau-Lifshitz-Gilbert equation with the usual combination of the Navier-Stokes equation and Maxwell's equations. We study the local existence, uniqueness and regularity of solutions to this system of equations.

Keyword(s): partial differential equations; navier-stokes equation; magnetohydrodynamics; landau-lifshitz equation; well-posedness

Supervisor(s): Thanh Tran

About the speaker: Hi! I'm Noah and I'm a western Sydney local who also did his undergrad here at UNSW. Outside of enjoying mathematics, I love hanging out with the boys and spending quality time with friends. But I equally love my alone time going for a walk, reading non-fiction, writing down my thoughts and reflections and learning ancient Greek and Hebrew to grow in my understanding of the Bible because Jesus and the life that is only found in him is the most precious thing I have.

A tensor product for representations of the Cuntz algebra

Dilshan Wijesena (d.wijesena@student.unsw.edu.au)

In a series of articles, we studied the so-called Pythagorean (unitary infinite-dimensional) representations of the Thompson groups. These representations extend to obtain all representations of the Cuntz algebra. The study of these representations have turned out to be surprisingly fruitful, yielding powerful classification results. In this talk we introduce a novel tensor product for a large class of Pythagorean representations of the Thompson groups. This provides the first known tensor product for (a large class) representations of the Cuntz algebra. We obtain a tensor category and many interesting fusion rules.

Better yet, this talk doesn't require any knowledge of the Thompson groups, Cuntz algebra or working in infinite-dimensional spaces! Only pre-requisite is finite-dimensional linear algebra.

Keyword(s): Thompson groups, Cuntz algebra, Jones' representations, tensor categories

Supervisor(s): Arnaud Brothier

About the speaker: I am currently enjoying the third year of my PhD. When I am not working on maths, I am an avid sports fan. I particularly enjoy cricket and running. I also like to ready fantasy books. I am currently reading a series by Robin Hobb.

Approximate Bayesian Computation for Factor Copula Models

Hanwen Xuan (z5113694@ad.unsw.edu.au)

Analyzing and modelling high-dimensional data has attracted great interests in statistics, particularly in applications relevant to time-series analysis and econometrics. In recent years, people have attempted to combine the ideas from the literature on factor analysis and copulas theory together to build up the so-called factor copula models. The use of factor copula models has been growing as its ability to explain the dependence structure of high dimensional variables in terms of a few latent factors. This feature saves a large amount of computational burden and provides a decent alternative for analyzing high-dimensional datasets. Our focus is on the factor copula model proposed by Oh and Patton (2017), where people could incorporate the class of dynamic factor models proposed in the literature of time series analysis with arbitrary marginal distributions. We extend their proposed factor copula models into a Bayesian framework by using Approximate Bayesian Computation (ABC) methods to replace the simulation-based estimation procedures. It enables us to not only overcome the issues of lacking closed-form solution in the factor copulas but also capture the model parameter uncertainties and enhance the predictions. The performance of our Bayesian estimation method will be examined on both a simulation study and a real time- series dataset.

Keyword(s): Bayesian Statistics, Time Series Analysis, High-Dimensionality, Factor Copula, Approximate Bayesian Computation

Supervisor(s): A/Prof. Feng Chen, Dr. Clara Grazian (USYD), Dr. Luca Maestrini (ANU)

About the speaker: I did Bachelor of Advanced Mathematics (Honours) and Commerce in UNSW. I was originally from China, but I have been in Australia for more than 10 years. This is going to be my final year of my PhD study. I like to play chess and other board game when I have time :)

Hello Session

This session showcases our newly admitted students in the School of Mathematics and Statistics, UNSW from T3 2023 to T2 2024 with short presentations on their research projects.

Applied Mathematics

Reg Dowse, Tilting of Mesoscale ocean eddies in the Tasman Sea. Supervisor(s): Shane Keating and Moninya Roughan.

Boris Huang, The compounded Sibuya random walk and the fractional Laplacian. Supervisor(s): Christopher Angstmann.

Yat Long Lee, The dynamic Laplacian and the harmonic mean metric. Supervisor(s): Gary Froyland, Upanshu Sharma.

Lincan Li, Advancing molecular classification with graph neural networks and machine learning. Supervisor(s): Adelle Coster, Wenjie Zhang.

Kevin Felipe Kühl Oliveira, Machine learning and operator-theoretic methods for nonlinear dynamical systems. Supervisor(s): Gary Froyland, Upanshu Sharma

Nick Peters, Operator based techniques for the analysis of dynamical systems. Supervisor(s): Gary Froyland.

Qi (Wenky) Wang, Algebraic Techniques for Polynomial Optimization. Supervisor(s): Mareike Dressler, Guoyin Li.

Pure Mathematics

Chip Corrigan, A large sieve inequality for moduli generated by a quadratic. Supervisor(s): Lee Zhao.

Daniel Dunmore, Module Categories over Soergel Bimodules. Supervisor(s): Anna Romanov, Arnaud Brothier.

Victor Zhang, Diagrammatic Lusztig-Vogan Category. Supervisor(s): Anna Romanov, Pinhas Grossman.

Statistics

Mehreen Afzaal, Data Summaries using Meta analyses. Supervisor(s): Jake Olivier, Boris Beranger.

Mst Bithi Akter, Universal Copula Modeling. Supervisor(s): Gery Geenens, Spiridon Penev.

Zelong Bi, Dependence Measurement between Random Variables. Supervisor(s): Gery Geenens, Pierre Lafaye de Micheaux.

Shenghan Gao, Theory and Applications of distributionally robust statistical inference. Supervisor(s): Professor Spiridon Ivanov Penev.

Amuchechukwu Ibenegbu, Bluebottle migration analysis using explainable artificial intelligence. Supervisor(s): Dr Rohitash Chandra and Associate Professor Pierre Lafaye de Micheaux.

Jason Lambe, Sequential Monte Carlo for the discretely observed Hawkes process. Supervisor(s): A/Prof Feng Chen and Dr Tom Stindl.

Shuo (Andrew) Zhang, Credit risk modelling with ensemble statistical methods. Supervisor(s): Feng Chen; Jinxia Zhu; Jeffery Tsz-kit Kwan.

Jenny Zhao, Regime switching model with periodic rate matrix. Supervisor(s): Dr. Leung Chan, Prof. Spiridon Penev, Prof. Josef Dick.

First-year Short Biographies

Applied Mathematics

Reg Dowse: I am an MRes student in Applied Mathematics, specialising in Oceanography. I have a deep love for the ocean, which I express through surfing, swimming, and working as a lifeguard at the oceanfront Bondi Icebergs Pool.

Lincan Li: I'm a first year PhD student, starting at 2024 T1. I have long interest in data science and data mining, especially heterogeneous graph data.

Kevin Felipe Kühl Oliveira: I am a Brazilian PhD student studying Dynamical Systems through the lens of Operator Theory. Prior to my PhD, I completed a bachelor's degree in computer engineering at the University of São Paulo, Brazil, an engineering degree from Télécom Paris and a master's degree in applied mathematics at the Institut Polytechnique de Paris, both in France. My research interests lie at the intersection of random dynamical systems, scientific machine learning, operator theory, and spectral theory. Outside of academia, I enjoy playing the violin and spending time in nature.

Nick Peters: I'm a PhD student from New Zealand, where I completed the Master of Mathematical Sciences degree at the University of Canterbury in 2023. I'm currently looking at data driven methods for approximating the transfer and Koopman operators of dynamical systems. Outside of maths, I also do fencing and taekwondo and I like painting.

Qi (Wenky) Wang: Hi, I'm Wenky! I grew up in China and then came to Australia almost two years ago for further studies. I am currently in my first year of my MRes focusing on polynomial optimization. I love capturing moments on my phone and I'm really into matcha!

Pure Mathematics

Daniel Dunmore: I'm a first year PhD student studying categorical representation theory.

Victor Zhang: I completed an undergraduate degree in Mathematics with honours and Computer Science at UNSW in 2023. Outside of mathematics and away from my computer, I enjoy rock climbing, playing badminton and painting.

Statistics

Mehreen Afzaal: I am originally from Pakistan and have relocated to Sydney to undertake my PhD studies. Currently, in my first year of the program. I enjoy reading during my leisure time.

Mst Bithi Akter: My name is Mst Bithi Akter and I am from Bangladesh. I have completed my graduate and postgraduate degree from the Department of Statistics at Jahangirnagar University. I have got the opportunity to start my PhD at UNSW. My research is about Universal Copula

Modeling. My supervisors are Dr. Gery Geenens and Professor Spiridon Penev. **Zelong Bi**: My name is Zelong Bi. I obtained my undergraduate degree from UNSW last year and just started my PhD around two months ago. My research is about analysing dependence structure between two random variables using different mathematical techniques.

Shenghan Gao: I got a bachelor's degree in mathematics from Xi'an Jiaotong University and a master's degree in statistics from the University of New South Wales.

Amuchechukwu Ibenegbu: I am from the south-eastern part of Nigeria, and I did my bachelors and Masters degree in Nnamdi Azikiwe University, Nigeria. Before coming to Sydney for PhD, I worked in a health Insurance company in Nigeria. Aside my research, I love dancing, Musics and sports such as football, volleyball and badminton.

Jason Lambe: I completed my honours in statistics at UNSW in 2022, and also studied economics in undergraduate. Outside of my studies, I enjoy practising karate and watering my bonsai trees.

Shuo (Andrew) Zhang: I am currently a first year PhD student. I graduate with an honours Bachelor of Science degree from the University of Sydney in 2016, I majored in applied mathematics as well as financial mathematics and statistics. I worked overseas after my graduation, specifically in the financial technology industry doing data analysis and building statistical models. Now I have returned to pursue a postgraduate research degree.

Jenny Zhao: My name is Jenny Zhao, and I am a first-year PhD student here at UNSW. I completed my undergraduate studies at Renmin University of China, majoring in Mathematics and Applied Mathematics, and pursued a master's degree in Financial Mathematics at UNSW.

I am fortunate to be guided by three esteemed professors: Prof. Leung, Prof. Spiridon, and Prof. Josef. My research primarily focuses on option pricing, specifically within the realm of stochastic volatility. Currently, I am exploring how to modify the regime switching model using a periodic generator matrix.