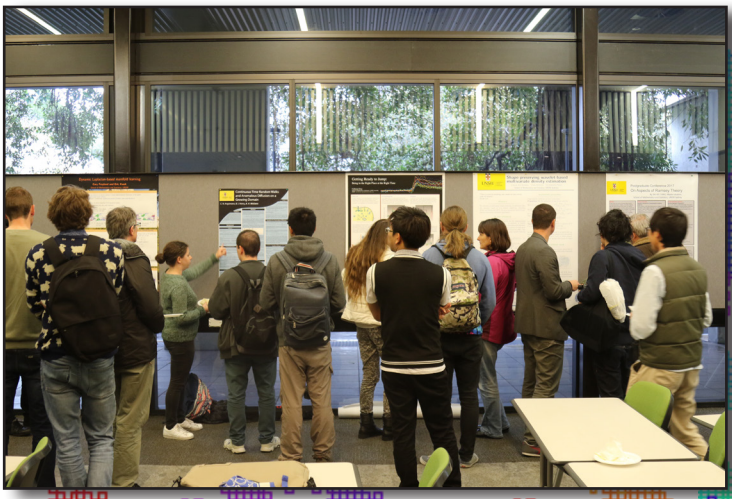
UNSW SYDNEY | Australia's Global University

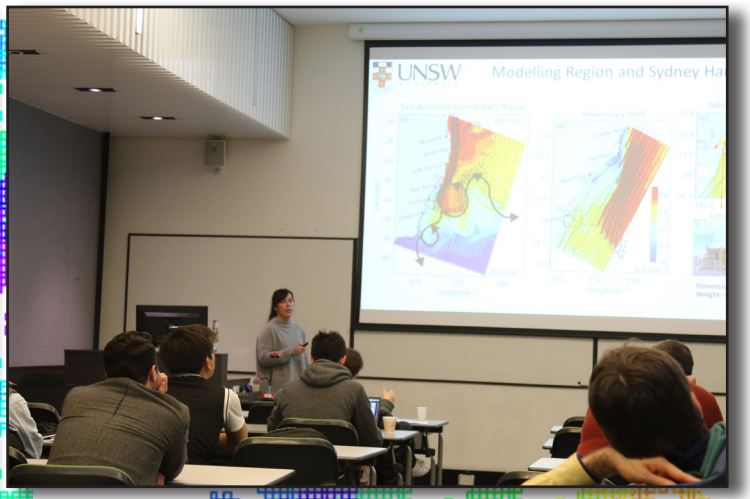
School of Mathematics and Statistics

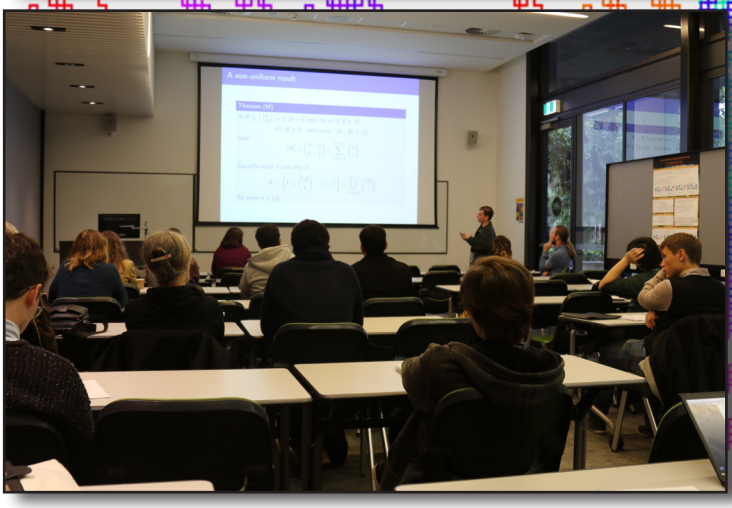
Postgraduate Conference 2018

Abstracts

Colombo Theatres







Postgraduate conference 2018,
School of Mathematics and Statistics, UNSW, Friday 8th June, 2018

Colombo Theatre C

08:50-09:00	Welcome and Opening	Chair: David Warton
09:00-10:00	**Wai Hong Tan** Predicting the Popularity of Tweets Using Internal and External Knowledge: An Empirical Bayes Model **Harry Crimmins** Stability and approximation of statistical properties of Anosov maps	

	Seminar room LG01 Session A1 — Chair: Dominic Vella	Seminar room LG02 Session B1 — Chair: Fadi Antown
10:00-10:20	**Sebastian Blefari** Relative Circle Inversion	**Carlos Rocha** A High – resolution Biogeochemical Model of the East Australian current system
10:20-10:40	**Jeremy William Nugent** Semi-degenerate superintegrable systems	**Sin Keong Tong** Inversion distribution of multisets and distribution of integer sequences
10:40-11:00	**Shaymaa Shawkat Al Shakarchi** AC(σ) spaces and a problem in graph theory	**Adam Mammoliti** Balanced diagonals in frequency squares

11:00-11:20	Morning tea	
11:30-12:00	**Simon Macourt** Incidence results and bounds on exponential sums	Chair: Anna McGann

	Session A2 (in LG01) — Chair: Jinghao Huang	Session B2 (in LG02) — Chair: Jeremy Nugent
12:00-12:20	**Raveen de Silva** Maximum Generalised Roundness of Random Graphs	**Max Kulinich** Statistical Methods for Climate Model Ensembles
12:20-12:40	**Haya Aldosari** Estimating the expected number of substructures in random hypergraphs	**Yi Lung Chen** Regenerative Simulation for the Bayesian Lasso
12:40-13:00	**Peter Ayre** Contiguity in Hypergraph Colouring Models	**Kam Hung Yau** Improvements on Linear multiplicative characters sums

13:00-14:00	Lunch and poster session	

Eduardo Vitarelli de Queiroz, Ocean observations show cyclonic fronts intensify internal tides off eastern Australia
Amdrzej Jarynowski, Understanding Adherence to Standard Precautions in hospitals using Structural Equation Modelling
Dan Mackinlay, Fun with spectra and optimisation

14:00-14:30	**Ed McDonald** The conformal trace theorem for Julia sets of quadratic polynomials	Chair: Peter Donovan

	Session A3 (in LG01) — Chair: Kam Hung Yau	Session B3 (in LG02) — Chair: Dan Mackinlay
14:30-14:50	**Thomas Scheckter** What is Quantum Stochastic Calculus?	**Manzoor Khan** Regression to the mean effects in bivariate binomial distribution
14:50-15:10	**Dominic Vella** Dixmier traces in the noncommutative plane	**Thomas Whitaker** Logistic Regression Models for Histogram-valued Symbolic Data
15:10-15:30	**Jinghao Huang** The derivation problem introduced by Barry Johnson	**Elliot Dovers** Fast Approximations for fitting log-Gaussian Cox Process regression models to point patterns

15:30-15:50	Afternoon tea	
15:50-16:20	**Fadi Antown** Optimal linear response for Markov chains	Chair: Thomas Scheckter
16:20-16:50	**Tom Stindl** Renewal Hawkes Process with applications to finance	
16:50-17:00	Awards and Closing	
17:00-19:00	After party (the White House)	

Welcome!

Welcome to the fifth annual School Postgraduate Conference!

As last year we have organised talks in a mixture of plenary and parallel sessions – the plenary talks in Colombo C, the parallel sessions in LG01/02. Plenary talks are reserved for students who recently published their research in a top international journal, and for students preparing to present their research overseas. As last year, there will be a poster session over lunch. Shortly after 1pm, poster presenters will give a 60-second lightning talk on their research in Colombo C, then they will answer questions at their posters over the remainder of the lunch break. As last year we will have prizes for especially outstanding talks and posters, which will be announced at the close of proceedings. If you have any thoughts on your favourite talks, feel free to put in a good word or maybe even a bribe to Anna Cai or Chris Angstmann (regarding Applied students), Alina Ostafe or Denis Potapov (Pure students), Feng Chen or David Warton (Stats students). Poster judges are Galina Levitina and Wei Wu, thanks for their efforts.

Something a bit different this year – after the first session, normally the session chairs are all current postgrad students. However this time around, one of the plenaries will be chaired by a former student who graduated 50 years ago, to celebrate his anniversary!

We hope you enjoy the conference,

The organising committee.

Organising committee, left-to-right: David Warton, Thomas Scheckter, Manzoor Khan, Robert Nguyen

Our postgraduate research students and their recent achievements

The conference is a chance to celebrate the achievements of our postgraduate students, who have a significant role in progressing research and other facets of life in the school. Please make the most of this opportunity to meet our postgrad students and find out more about them and their research, whether you are a staff member, another postgrad, a student considering a postgraduate research degree, or passing through on your way to outdoor table tennis.

We now boast 48 enrolled postgraduate research students, plus six more with their theses in review. They are a diverse group of people, coming from 13 countries across four continents. I am continually impressed by our postgraduate cohort who quickly come across as intelligent and highly motivated students with a lot to contribute, and I expect you will be similarly impressed.

Publishing research while still enrolled in a PhD is the goal of every student but it is difficult to do, given the time it takes to write a paper (many are writing their first) and the potentially long waiting times for review outcomes. Top journals in particular typically have low acceptance rates so are particularly challenging, but despite this, enrolled students manage a swag of publications each year, with several accepted into top journals each year. A big congratulations to the following students:

Angstmann, C., Henry, B., Jacobs, B. & **McGann, A.** (2017a). A time-fractional generalised advection equation from a stochastic process. *Chaos, Solitons & Fractals*, **102**, 175–183.

Angstmann, C., Henry, B. & **McGann, A.** (2017b). Generalized fractional diffusion equations for subdiffusion in arbitrarily growing domains. *Physical Review E*, **96**, 042153.

Angstmann, C. N., **Erickson, A. M.**, Henry, B. I., **McGann, A. V.**, Murray, J. M. & Nichols, J. A. (2017c). Fractional order compartment models. *SIAM Journal on Applied Mathematics*, **77**, 430–446.

Angstmann, C. N., Henry, B. I., Jacobs, B. & **McGann, A. V.** (2017d). Integrablization of time fractional PDEs. *Computers & Mathematics with Applications*, **73**, 1053–1062.

Antown, F., Dragičević, D. & Froyland, G. (in press). Optimal linear responses for Markov chains and stochastically perturbed dynamical systems. *Journal of Statistical Physics*.

Cavenagh, N. & **Mammoliti, A.** (in press). Balanced diagonals in frequency squares. *Discrete Mathematics*.

Chen, F. & **Stindl, T.** (in press). Direct Likelihood Evaluation for the Renewal Hawkes Process. *Journal of Computational and Graphical Statistics*.

Chen, F. & **Tan, W. H.** (in press). Marked Self-Exciting Point Process Modelling of Information Diffusion on Twitter. *Annals of Applied Statistics*.

Connes, A., **McDonald, E.**, Sukochev, F. & Zanin, D. (2017). Conformal trace theorem for Julia sets of quadratic polynomials. *Ergodic Theory and Dynamical Systems*, pp. 1–26.

Khan, M. & Olivier, J. (in press). Quantifying The Regression to The Mean Effect in Poisson Processes. *Statistics in Medicine*.

Levitina, G., Sukochev, F., **Vella, D.** & Zanin, D. (2018). Schatten Class Estimates for the Riesz Map of Massless Dirac Operators. *Integral Equations and Operator Theory*, **90**, 19.

Lord, S., **McDonald, E.**, Sukochev, F. & Zanin, D. (2017). Quantum differentiability of essentially bounded functions on Euclidean space. *Journal of Functional Analysis*, **273**, 2353–2387.

Macourt, S. (2018a). Incidence Results and Bounds Of Trilinear and Quadrilinear Exponential Sums. *SIAM Journal on Discrete Mathematics*, **32**, 815–825.

Macourt, S. (2018b). Visible points on exponential curves. *Bulletin of the Australian Mathematical Society*, pp. 1–7.

McGann, A., Henry, B. & Angstmann, C. (in press). Anomalous Diffusion on a Growing Domain. *Bulletin of the American Physical Society*.

Stindl, T. & Chen, F. (2018). Likelihood based inference for the multivariate renewal Hawkes process. *Computational Statistics & Data Analysis*, **123**, 131–145.

Thanks

The conference organising committee is: Manzoor Khan, Robert Nguyen, Thomas Scheckter and myself, of whom the students did pretty much everything! Including this book. So a special thanks to them.

Thanks to Susannah Waters who helped with advertising and poster set-up, and thanks to Kaye Sedgers who helped organise catering, and to Kaye, Susannah and Gemayne Magbanua for help on the day.

Thanks to our all-postdoc poster judging panel: Galina Levitina and Wei Wu.

The Postgraduate Annual Review panel members this time around are Chris Angstmann, Anna Cai, Feng Chen, Alina Ostafe, Denis Potapov, and myself. They will spend the day judging talks and the next couple meeting students to discuss their plans over the coming year. A big thanks for the time and energy they put into this important role.

Prof David Warton
Director of Postgraduate Studies (Research)
School of Mathematics and Statistics, UNSW

Estimating the expected number of substructures in random hypergraphs

Haya Aldosari *(12:20-12:40 pm, Colombo LG01)*

A hypergraph is a pair (V, E) where V is a vertex set, and E is a set of subsets of V, which is called the edge set. An uniform hypergraph is a hypergraph where all edges contain precisely the same number of vertices. Let X be a given uniform hypergraph on the vertex set V. In this talk I will present our formula for the probability that a random uniform hypergraph with given degree sequence contains no edges of X. I will also talk about some applications of this result to estimate the expected number of substructures in random hypergraphs.

Supervisor: Dr. Catherine Greenhill

About the speaker: I did Master degree in mathematics in King Saud University in Saudi Arabia. I have been enrolled in PhD for about two years.

$AC(\sigma)$ spaces and a problem in graph theory

Shaymaa Shawkat Al-shakarchi *(10:40-11:00 am, Colombo LG01)*

A theorem of Gelfand and Kolmogorov in 1939 asserts that, the compact spaces X and Y are homeomorphic if and only if the algebras of continuous functions C(X) and C(Y) are isomorphic as algebras. In 2005, the algebras of absolutely continuous functions $AC(\sigma)$ was defined by Doust and Ashton on a compact subset σ of the complex plane, and they studied whether there was a similar link for these algebras between the properties of the domain σ and the Banach algebra properties of the function space. In one direction Doust and Leinert (2015) showed that if $AC(\sigma_1)$ is algebra isomorphic to $AC(\sigma_2)$ then $sigma_1$ and σ_2 must be homeomorphic, so the interest now is in examining the converse implication. In general the answer is no. We have examples of infinite families of homeomorphic spaces $\{\sigma_n\}$ for which the corresponding $AC(\sigma_n)$ spaces are mutually nonisomorphic. On the other hand, if one only considers sets σ lying in restricted families, then one can obtain positive results. Doust and Leinert showed that if the sets $sigma_1$ and σ_2 are polygonal compact subsets of the plane then $AC(\sigma_1)$ is algebra isomorphic to $AC(\sigma_2)$. It is conjectured that this result also holds if σ_1 and σ_2 are finite unions of closed line segments. Examination of this case leads to an interesting question in geometric graph theory which I will discuss.

Supervisor: Ian Doust

About the speaker: I studied my master degree in the college of science in the Baghdad university .

Optimal linear response for Markov chains

Fadi Antown *(03:50-04:20 pm, Colombo Theatre C)*

The linear response of a dynamical system refers to changes to properties of the system when small external perturbations are applied. Much of the theoretical focus on linear response has been on establishing that for various classes of systems, there is a principle of linear response. Our focus in this work is in a much less studied direction, namely, determining those perturbations that lead to 'maximal' response. The practical implication of optimizing response is that it allows the identification of the perturbations that provoke a maximal system response. In the finite-state Markov chains setting, we consider selecting the perturbations that (i) maximise the linear response of the equilibrium distribution of the system, (ii) maximise the expectation of the linear response with respect to an observable, and (iii) maximise the linear response of the rate of convergence of the system to the equilibrium distribution. Furthermore, application of the theory to various dynamics will be given.

Supervisor: Gary Froyland

About the speaker: I did my undergraduate degree at UNSW. After completing honours I enrolled in the PhD program.

Contiguity in Hypergraph Colouring Models

Peter Ayre *(12:40-01:00 pm, Colombo LG01)*

A hypergraph colouring is an assignment of colours to the vertices of the graph so that no hyper-edge is monochromatic. In studying the problem, the most obvious approach is to first randomly generate a hypergraph, and then choose a colouring uniformly at random. However, actually generating a proper colouring of a hypergraph can be particularly difficult. Rather, there is an alternate model in which we first generate a map from the set of vertices to the colourings and then add in the edges. The two probability models are different (in particular, in the second a hypergraph arises with probability proportional to the number of colourings), however calculations are significantly easier to perform in the latter. The talk discusses a recent result that proves these two probability models are contiguious, meaning if any event happens with high probability in one than it does so in the other.

Supervisor: Catherine Greenhill

About the speaker: B.Science (Advanced Mathematics) @ UNSW (Pure). Currently 3rd year PhD UNSW

Relativistic Circle Inversion

Sebastian Blefari *(10:00-10:20 am, Colombo LG01)*

The talk will be centred on framing classical circle inversive geometry in a rational algebraic setting. Starting with Euclidean (blue) geometry and then moving onto a Relativistic (green) geometry, where circles look like hyperbola, we will explore some of the similarities and differences between the two. In particular we will look into the toroidal nature of the relativistic inversive plane, and how extra points at infinity give a novel approach to the inversion of points, lines and circles in this setting.

Supervisor: Norman Wildberger

About the speaker: Undergraduate at Unsw, Honours with Norman Wildberger on Quadrangle centroids in Universal Hyperbolic geometry (a projective geometry). One year into PhD with Norman, looking now into circle geometry in the affine and projective spaces.

Regenerative Simulation for the Bayesian Lasso

Yi Lung Chen *(12:20-12:40 pm, Colombo LG02)*

The Gibbs sampler of Park and Casella is one of the most popular MCMC methods for sampling from the posterior density of the Bayesian Lasso regression. As with many Markov chain samplers, their Gibbs sampler lacks a theoretically sound and rigorous method of output analysis — a method for estimating the variance of a given ergodic average and estimating how closely the chain is sampling from the stationary distribution, that is, the burn-in. In this talk, we shall demonstrate how one can identify the so-called regeneration times from the output of the Park and Casella sampler. The regenerative structure provides both a strongly consistent variance estimator, and an estimator of (an upper bound on) the total variation distance from the target posterior density. The result is a simple and theoretically sound way to assess the stationarity of the Park and Casella sampler.

Supervisor: Zdravko Botev

About the speaker: My Bachelor degree was Commerce/Advanced science (mathematics) at UNSW. I enjoyed the mathematics component of my degree a lot and I deliberately picked courses that showed me how mathematics could be applied in other disciplines for the commerce component of my degree. I was fortunate enough to work as a summer vacation scholar in CSIRO, and that was

Stability of statistical properties for some dynamical systems

Harry Crimmins *(09:30-10:00 am, Colombo Theatre C)*

For sufficiently chaotic dynamical systems the existence of statistical laws, such as a Central Limit Theorem or Large Deviation Principle, can be obtained by examining the spectral properties of an analytically 'twisted' transfer operator. It is natural to ask if these statistical properties are robust to perturbations in the dynamics, which may arise e.g. via the idealisation of a physical system, or the numerical approximation of an abstract one. We extend the methods for proving the stability of the spectrum for 'untwisted' transfer operators to the twisted case, and consequently prove the stability of various statistical properties with respect to general perturbations. As an application, we use the theory developed to compute the variance and rate function associated with the dynamics of a piecewise expanding map in one-dimension.

About the speaker: Harry completed his undergraduate degree at UNSW in 2016, with a honours thesis on the statistical properties of dynamical systems. In 2017 he began a PhD in the same area.

Maximum Generalised Roundness of Random Graphs

Raveen De Silva *(12:00-12:20 pm, Colombo LG01)*

Given a metric space, we can define its maximum generalised roundness, a non-negative real number which determines properties including embeddings into L^p spaces. We investigate the distribution of the maximum generalised roundness of large random graphs, endowed with the path length metric, presenting experimental data and discussing the limiting behaviour.

Supervisor: A/Prof Ian Doust

About the speaker: I completed my undergraduate study in Mathematics and Computer Science with honours in pure mathematics at UNSW in 2015. My honours thesis was in operator algebras, supervised by A/Prof Ian Doust. I am now a third year PhD student.

Fast Approximations for fitting log-Gaussian Cox process regression models to point patterns

Elliot Dovers *(03:10-03:30 pm, Colombo LG02)*

The log-Gaussian Cox process (LGCP) can enable researchers to account for latent variables within regression models of point patterns. However, such a formulation invokes an intractable objective function and current methods of analysis are slow or infeasible on large datasets. This talk will describe progress developing fast approximation methods for fitting LGCP regression models, using variational approximation and dimension-reducing approaches (fixed rank kriging and predictive processes), together with TMB software. In this context, variational approximation of an intractable marginal likelihood permits a closed form solution that differs only by the Kullback-Leibler divergence between some favourably-selected density and the true posterior. A challenge however is dealing with large spatial covariance matrices, tools considered here to address this are fixed rank kriging and predictive processes, which approximates the LGCP's latent field via spatial basis functions. We will discuss practical issues around the choice of basis functions sufficient to balance accuracy and computation cost, as well as a comparison of approximations (both of the latent field and marginal likelihood) in fitting such regression models to point patterns. We use the Template Model Builder (TMB) package in R to compute the likelihood function quickly using C++ code, and to use automatic differentiation for fast model fitting using generic optimisation software. This methodology is applied to both simulated and real data. Early comparisons suggest this approach allows fitting of LGCP rapidly with relatively little loss in accuracy.

Supervisor: David Warton

About the speaker: I completed my undergraduate studies at the University of Queensland before taking up a year contract with CSIRO as an entry-level researcher in environmental statistics. I then took some time out, living overseas for a few years before returning to Australia where I took a job as a data analyst in advertising. Since the start of 2017 I have been enrolled in a PhD at UNSW.

The derivation problem introduced by Barry Johnson

Jinghao Hung *(03:10-03:30 pm, Colombo LG01)*

The derivation problem introduced by Barry Johnson is one of the classical problems in operator algebra theory. The Johnson-Parrott-Popa theorem states that every derivation from a von Neumann subalgebra of $B(H)$ into $K(H)$ of all compact operators on H is inner. In 1985, Kaftal and Weiss showed that every derivation $\delta : A \to L_p(M, \tau) \cap M$, $1 \leq p < \infty$, is inner if A is an abelian (or properly infinite) von Neumann subalgebra of a semifinite von Neumann algebra M, where τ is a faithful semifinite normal trace on M and $L_p(M, \tau)$, $1 \leq p < \infty$, is the non-commutative L_p-space relative to τ. However, the question whether every derivation from an arbitrary von Neumann subalgebra into $L_p(M, \tau) \cap M$, $1 \leq p < \infty$, is inner was left unresolved in that paper. In this talk, I will give an overview of the previous results and outline my work (with Ber, Levitina, Sukochev) which characterizes the ideals of M such that every derivation from a von Neumann subalgebra of M into these ideals is inner. In particular, our result unifies and extends the results by Johnson, Parrott and Popa, and, by Kaftal and Weiss.

Supervisor: Fedor Sukochev

About the speaker: This is the third year of my PhD. Prior to my PhD, I studied Maths at Sun Yat-sen University (Guangzhou, China).

Understanding Adherence to Standard Precautions in Hospitals using Structural Equation Modeling

Andrezj Jarynowski *(01:00-02:00 pm, Poster presentation)*

The aim of this study was to analyze the perception and compliance with Standard Precautions among Polish healthcare workers in accordance with their organizational status and experience using a questionnaire of Australian origin. Causal modelling and confirmatory analysis were applied using a Polish adaptation of this tool. The local organizational culture examined, with the help of algorithmized research tools, provides the foundation for effective management reform in the context of infectious disease risk minimization in hospital.

Supervisor: Andrzej Grabowski

About the speaker: Andrzej Jarynowski is a mathematician from Poland (graduated from Hugo Stainhaus Center for Statistical Modelling, Wroclaw University of Technology) , who is currently a visiting academic at UNSW. He is a statistical consultant at Polish National Sanitary Inspection and PhD candidate at Smoluchowski Institute Jagiellonian Univ. in Cracow. Andrzejs work involves studying disease propagation on agent based networks.

Regression to The Mean Effects in Bivariate Binomial Distribution

Manzoor Khan *(02:30-02:50 pm, Colombo LG02)*

Regression to the mean (RTM) is said to have occurred when subjects having relatively high or low measurements are remeasured and found closer to the population mean. RTM can potentially influence the conclusion in a pre-post study design. Situations exist where the response variables are the number of successes in a fixed number of trials and follow the bivariate binomial distribution (BBD). Expressions for quantifying RTM effects are derived when the underlying distribution is the BBD. A comparative study for quantifying RTM under a normal approximation to the BBD is carried out using the percentage relative difference. Expressions for maximum likelihood estimates for RTM along with its asymptotic distribution are derived. A simulation study is conducted to empirically assess the statistical properties of the RTM estimator and its asymptotic distribution. A data example is discussed for a manufacturing process for the number of nonconforming cardboard cans.

Supervisor: Dr. Jake Olivier

About the speaker: I'm in second year of my PhD. I completed my M-Phil study from Quiad-e-Azam University Islamabad, Pakistan.

Statistical Methods for Climate Model Ensembles

Max Kulinich *(12:00-12:20 pm, Colombo LG02)*

Climate models are complex computer programs that simulate the physical and chemical processes in the atmosphere and oceans. The results of such simulations are used for various purposes such as research, policy-making, etc. Since different climate models are better at capturing different aspects of the complex climate processes, it has become standard practice to produce ensembles of climate projections using multiple climate models. How best to combine these climate models to produce a single probabilistic projection has become an important research question and is the main goal of my PhD project. This goal will be achieved by expanding the application area of classical mathematical research methods such as Bayesian inference and by addressing currently open challenging questions such as models dependencies. The future developed methodology of accounting for models dependencies and optimization of ensemble techniques can be further applied in other fields such as Machine Learning, Financial Analysis, Bioinformatics etc.

Supervisor: Yanan Fan, Spiridon Penev, Jason Evans

About the speaker: I did my undergraduate study at Belarusian State University with specialization in Computational Mathematics. My Masters Degree in Complex Adaptive Systems is from University of Gothenburg. For the past 10 years I worked as a Data Scientist and other similar roles at AB Volvo in Gothenburg.

Fun with spectra and optimisation

Dan MacKinlay *(01:00-02:00 pm, Poster presentation)*

Efficient on-line classification and analysis of audio time series data with neural networks presents numerous challenges. Existing methods for neural classification in the *convolutional* style, which have been highly successful in image classification, are not easily applicable to the extremely long correlations in audio data. Despite this, the large filter sizes used in these networks are long enough both to introduce large delays in the classifier during real-time operations, and large enough that specialised hardware such as GPUs to run fast. Noting that, empirically, the filters learned by a convolutional classifier have a very simple form, we propose a solution which overcomes these difficulties. Our novel architecture replaces large non-recurrent convolutional filters with parsimonious recurrent filters which nonetheless attain a similar capacity in practice, using far fewer parameters. Such architectures are rarely used on this class of problem due to the slow and unstable nature of the traditional stochastic gradient descent training. We address this difficulty through a combination of careful parameterisation of the recurrent operators to ensure stability, and control of the update rate by recurrent-adapted regularisation. Our revised architecture attains lower computational prediction cost, smaller storage requirements and similar accuracy at the cost of greater overall training time as compared to the baseline existing methods.

Supervisor: Zdravko Botev

About the speaker: Dan's origins are lost in the murky depths of prehistory, but modern archeological methods promise great advances of knowledge in this exciting research area in the near future.

Incidence results and bounds on exponential sums

Simon Macourt *(11:30-12:00 am, Colombo Theatre C)*

We provide a background on exponential sums and the relationship between them and incidence results. We will then provide a new bound on the number of collinear triples for two arbitrary subsets of a finite field. This leads to new stronger bounds on trilinear and quadrilinear exponential sums, which also gives some new results on bounds of trinomial and quadrinomial exponential sums.

Supervisor: Igor Shparlinski

About the speaker: I studied a Bachelor of Actuarial Studies and Mathematics and a Master of Research at Macquarie University. I am now in my 2nd year of my PhD in number theory.

Balanced diagonals in frequency squares.

Adam Mammoliti *(10:40-11:00 am, Colombo LG02)*

A frequency square L of type $F(n, \lambda)$ is an $n \times n$ array filled with elements of $\{1, \ldots, m\}$ such that each row and column contains each symbol λ times. A balanced diagonal in a frequency square L of type $F(n, \lambda)$ is a set S of n entries, with exactly one entry in each row and in each column, such that each of the m symbols occur exactly λ times as values of the entries of S. In this talk I will give a brief background of frequency squares and their relation to the more familiar Latin squares. I also will present results showing that a balanced diagonal exists in any frequency square with $m = 2, 3$ with one exception for $m = 2$ up to equivalence. This is joint work with Nick Cavenagh.

Supervisor: Thomas Britz

About the speaker: I did my undergraduate at UNSW and did Honours in Combinatorics. I am currently in my 3rd Year of my Phd in Combinatorics.

The conformal trace theorem for Julia sets of quadratic polynomials

Ed McDonald *(02:00-02:30 pm, Colombo Theatre C)*

Using singular traces it is possible to give a formula for the Hausdorff measure of Julia sets for polynomials with a unique attracting fixed point. I will briefly outline the formula, its proof, and prospects for further extension.

Supervisor: Fedor Sukochev

About the speaker: Dmitriy Zanin Undergraduate study at UNSW, enrolled for 2.5 years.

Semi-degenerate superintegrable systems

Jeremy Nugent *(10:20-10:40 am, Colombo LG01)*

Semi-degenerate superintegrable systems are a new type of superintegrable system closely related to those studied in detail by Kalnins, Kress, Miller et al. Some new developments have been made in the past few years on these systems which I will review.

Supervisor: A/Prof. Jonathan Kress

About the speaker: Did undergraduate study at UNSW, graduating in 2014 with a Bachelor of Science (Advanced Mathematics). Have been studying part-time since 2015 and involved in a number of different projects at UNSW since then in conjunction with the PVC(E).

A High-resolution Biogeochemical Model of the East Australian Current System

Carlos Rocha *(10:00-10:20 am, Colombo LG02)*

Phytoplankton is the first link in the marine food chain and plays an integral role in marine biogeochemical cycling. Understanding phytoplankton dynamics is critical across a range of topics spanning from fisheries management to climate change mitigation. It is particularly interesting in the East Australian Current System, as the regions eddy field strongly conditions nutrient availability and therefore phytoplankton biomass. Numerical models provide unparalleled insight into these biogeochemical dynamics, yet modelling efforts off East Australia have either targeted case studies (small spatial and temporal scales) or encompassed the whole EAC system but focused on climate change effects at the mesoscale (with a spatial resolution of 1/10). We couple a model of the pelagic nitrogen cycle to a 10-year high-resolution (2.5 - 5 km horizontal) three-dimensional ocean model to address this gap and resolve both regional and finer scale biogeochemical processes occurring in the East Australian Current System. We use several statistical metrics to compare the simulated surface chlorophyll to an ocean colour dataset for the 2003-2011 period and show that the model can solve the observed phytoplankton surface patterns with a domain-wide rmse of approximately 0.3 mg chla m-3 and a correlation coefficient of 0.76. We use this coupled configuration as a framework to examine phytoplankton dynamics and biogeochemical cycling in the EAC system, with special focus on the environment created by different mesoscale eddies

Supervisor: Moninya Roughan

About the speaker: I completed Marine Sciences (Hons.) and Meteorology and Physical Oceanography (MSc.) at University of Aveiro (Portugal), where I also worked as a research fellow for five years. Ive started my PhD at UNSW in 2015, on the topic of biogeochemical modelling of the East Australian Current system.

What is Quantum Stochastic Calculus?

Thomas Scheckter *(02:30-02:50 pm, Colombo LG01)*

In this talk we introduce the theory of quantum stochastic calculus, from the perspective of non-commutative integration. We will outline the view of probability theory through the lens of von Neumann algebras, how stochastic calculus manifests itself in this setting, and then discuss current research in the field.

Supervisor: Fedor Sukochev; Dmitriy Zanin

About the speaker: I completed my BSc at Victoria University of Wellington, and am currently in my third year of PhD studies. My main research interests lie in applications of non-commutative integration, and its relation to the geometry of Banach spaces.

Renewal Hawkes Process with applications to Finance

Tom Stindl *(04:20-04:50 pm, Colombo Theatre C)*

The classical Hawkes self-exciting process has recently been modied to allow the immigration process to be dened in terms of a renewal process rather than a homogeneous Poisson process. The authors claim that computation of the likelihood for the renewal Hawkes (RHawkes) process requires exponential time and therefore is practically infeasible. As the likelihood has a fundamental role in statistical inference, a method for likelihood evaluation is highly desirable. In this talk, I will briefly discuss our direct likelihood evaluation approach to parameter estimation which pose some additional computational challenges but only requires quadratic computational time. As a by-product of our likelihood evaluation algorithm we have a computationally efficient method for goodness-of-t assessment and a simple, yet eefficient procedure for future event prediction. The examples discussed will show that the use of the RHawkes process and its multivariate and marked extensions are readily implementable, and do not require substantial computational time and lead to parameter estimates and standard errors which produce satisfactory finite sample performances.

Supervisor: Feng Chen

About the speaker: UNSW through and through, with my undergraduate degree majoring in Actuarial studies and Statistics. Currently, a third year PhD Student in Statistics with Dr Feng Chen looking at point processes and some data analysis.

Predicting the Popularity of Tweets Using Internal and External Knowledge: An Empirical Bayes Model

Wai Hong Tan *(09-09:30 am, Colombo Theatre C)*

We consider the problem of predicting the number of retweets originating from an ancestral tweet. The retweet time sequence is modelled by an inhomogeneous Poisson process, with the intensity function depending on the age of tweet and the calendar time. The parameters of the intensity function are estimated by using both internal knowledge on the times of historical retweets by a certain censoring time, and external knowledge on complete retweet sequences in the training data set, combined using an empirical Bayes type approach. The model with parameters set to their maximum likelihood estimates is then used to predict the future occurrences of retweets. Compared to existing approaches on tweet popularity prediction, the proposed methodology is efficient and demonstrates superior prediction accuracy.

Supervisor: Feng Chen

About the speaker: I completed my Master of Applied Statistics in the University of Malaya (UM), Malaysia and have currently been enrolled in PhD for over 2.5 years.

Inversion Distribution of Multisets and Distribution of Integer Sequences

Sin Keong Tong *(10:40-11:00 amColombo LG02)*

For a sequence s, the *sort process* places pairs of elements out of order into correct order. The *inversion count* $I(s)$ counts the number of pairs of elements in s that are out of order. The count is dependent on the permutation of the elements of some set. Let S be the multiset

$$\{\overbrace{e_1, \ldots, e_1}^{n_1}, \overbrace{e_2, \ldots, e_2}^{n_2}, \ldots, \overbrace{e_k, \ldots, e_k}^{n_k}\}$$

with n_1 copies of e_1, n_2 copies of e_2, and so on, where $n_i \in \mathbb{Z}^+$, $e_i < e_j$ for $i < j$. For the symmetry group S_n where the elements are distinct, the generating function, closed form and the asymptotic functions are known. This talk provides a method of calculating the distribution of inversion counts for various families of permutations S where the elements may be repeated. In addition, the talk will present analyses of density, compactness, partitioning and inversion count tests for natural and robotic sequences.

Supervisor: Dr Thomas Britz

About the speaker: B.SC. (hons) '71 - Sydney Uni Enrolled since Semester 2 - 2017.

Dixmier traces in the noncommutative plane

Dominic Vella *(02:50-03:10 pm, Colombo LG01)*

The Dixmier trace is one of the most familiar singular traces from Connes' noncommutative geometry, but computations remain troublesome. In this talk, we show that, through recent work, one might obtain expressions for the Dixmier trace as a limit of classical traces.

Supervisor: Fedor Sukochev

About the speaker: Dominic Vella has studied at UNSW since 2012, completing his B.Sc. (Adv. Math.) with first class honours in 2016. He is currently studying noncommutative integration theory for his Ph.D. under the supervision of Prof Fedor Sukochev and Dr Dmitriy Zanin.

Ocean observations show cyclonic fronts intensify internal tides off eastern Australia

Eduardo Vitarelli de Queiroz *(01:00-02:00 pm, Poster presentation)*

Internal waves can generate ocean mixing, surface convergences and near-bottom currents, so their predictability is of interest. They can modulate temperature and nutrient concentrations, which can affect biological productivity. The interaction between internal waves and mesoscale ocean features is still relatively unknown. Using data of temperature, salinity and velocities from an array of deep ocean moorings, this study characterises the strength and variability of the internal wave at the tidal frequency, in both time and space, off eastern Australia (27S). Energy in the diurnal frequency band is, generally, greater than in the semidiurnal band. Internal tide variability is compared to local tidal forcing, stratification, current velocities and eddy kinetic energy to determine the influence and interaction with mesoscale ocean circulation. The results reveal that the strength of the locally generated internal tide above the continental slope is modulated by the passing of mesoscale cyclonic front that alters the local stratification and velocity field. The results provide insight into the origin of the internal tides propagating onto the shelf and the mechanisms of variability. Studying the characteristics of internal tides and their interaction with ocean features helps us understand their variability and improve predictability which is non-trivial and in contrast to the deterministic barotropic tides that generate them.

Supervisor: Moninya Roughan

About the speaker: I am an oceanographer and I did my under-graduation at the University of Vale do Itajai, Brazil. I work with physics oceanography, more specifically with waves, tides and coastal process. Im in my second year of my PhD and Im working with internal tides at the continental slope.

Logistic Regression Models for Histogram-valued Symbolic Data

Tom Whitaker *(02:50-03:10 pm, Colombo LG02)*

Logistic regression models provide an effective classification method to predict the probability of categorical response data. However, they are severely underdeveloped when the explanatory variables take non-standard forms such as intervals, histograms and lists. Logistic regression on interval-valued data is generally performed by applying the general framework only to some interval features (endpoints, ranges, etc.) and do not provide predictions at the data level. Furthermore, as far as we can tell, there are no existing methods for logistic regression analysis with histogram-valued predictors. In this paper we extend to the classification setting the symbolic likelihood function described in Beranger et. al (2018), whereby symbolic-valued data can be analysed in the same parametric framework as the underlying classical data. By deriving a likelihood function that allows the analysis of a combination of classical and symbolic-valued data, we reduce the effect of the curse of dimensionality on the symbolic likelihood function. Furthermore, with some distributional assumptions about the relationship between predictor variables, we derive a histogram logistic regression model that only requires univariate integrations, despite D ¿ 2 predictor variables. This leads to huge computational gains over the classical equivalent for a moderate number of observations. The performance of our procedure in terms of inferential and computational efficiency is examined in a simulation study. While there are small amounts of bias for some parameters with the univariate symbolic method, the overall prediction accuracy is comparable with that of the classical case for a certain level of data aggregation. Finally, the effectiveness of these methods are illustrated through the logistic regression analysis of two real examples.

Supervisor: Scott Sisson

About the speaker: I completed my undergraduate degree in Advanced Mathematics majoring in Advanced Statistics at UNSW. Following on from that, I undertook an honours year in Symbolic Data Analysis with Scott Sisson. Currently I am a 3nd year PhD candidate with Scott Sisson, investigating problems related to dimensionality and symbolic data analysis.

Improvements on linear multiplicative character sums

Kam Hung Yau *(12:40-01:00 pm, Colombo LG02)*

Bounds for character sums has vast applications in analytic number theory. We give an account for various bounds for said sums and provide a stretch on an improvement for the classical Burgess bound. This is joint work with Kerr and Shparlinski.

Supervisor: Prof. Igor Shparlinski

About the speaker: Half way through PhD