Australia New Zealand
Applied Probability
Workshop 2015

7 – 10 April, 2015

Barossa Valley, Australia
Welcome to the 4th Australia New Zealand Applied Probability Workshop

Applied Probability is undoubtedly a strong field of mathematics in Australia and New Zealand and this workshop plays a valuable role in bringing together researchers in the discipline. In particular, we have a balanced programme between senior and junior members of our community, which will assist in maintaining our reputation for world-leading research into the future.

We acknowledge the support from the Australian Mathematical Sciences Institute (AMSI), the Australia and New Zealand Industrial and Applied Mathematics society (ANZIAM), the ARC Centre of Excellence for Mathematical and Statistical Frontiers (ACEMS), the School of Mathematical Sciences of the University of Adelaide, and Prof. Peter Taylor through his ARC Laureate Fellowship.

In addition to your scientific enjoyment, we hope you make the most of the location. The scenic Barossa Valley is one of the world’s best wine regions and is home to many culinary delights. Enjoy!

Local Organisers
Nigel Bean, Andrew Black, Michael Lydeamore, Giang Nguyen, Nic Rebuli, Joshua Ross, Vikram Sunkara, Mingmei Teo.

Organising Committee
Nigel Bean, Andrew Black, Jeff Hunter, Fima Klebaner, Yoni Nazarathy, Giang Nguyen, Phil Pollett, Leonardo Rojas-Nandayapa, Joshua Ross, Peter Taylor, I lze Ziedins.
SCHEDULE

Tuesday, April 7

9:00  Bus pickup from Adelaide University
9:30  Bus pickup from Adelaide Airport
11:25–11:30 Opening: Giang Nguyen
11:30–12:20 Session Chair: Giang Nguyen
   11:30  Phil Pollett
          Metapopulations with dynamic extinction probabilities
   11:55  Andrew Barbour
          Individual and patch behaviour in structured metapopulation models
12:20–13:20 Lunch
13:20–14:10 Session Chair: Leonardo Rojas-Nandayapa
   13:20  Ellen Muir (S)
          Approximating the gains from trade in large markets
   13:45  Thilaksha Tharanganie (S)
          Density forecasting using a functional data approach
14:10–14:55 Ton Dieker
          A change-of-measure love story – Part 1
          Session Chair: Peter Taylor
14:55–15:15 Afternoon tea
15:15–16:00 Ton Dieker
          A change-of-measure love story – Part 2
          Session Chair: Peter Taylor
16:00–16:50 Session Chair: Malgorzata O'Reilly
   16:00  Nicolas Rebuli (S)
          Hybrid Markov chain models for disease dynamics
   16:25  Andrew Smith
          When is the initial size important?
17:00–18:00 Applied Probability discussion session
18:00– Welcome BBQ

Note: (S) = Student Talk.

All talks will be held in Function Room 1 of the Vine Inn.
Wednesday, April 8

9:00–9:50  
Session Chair: Bo Friis Nielsen  
9:00  Guy Latouche  
Local time: The treachery of words  
9:25  Mogens Bladt  
Phasetype distributions and heavy tails

9:50–10:35  
Mariana Olvera-Cravioto  
Queues in the Cloud: Generalizing the single server queue to massively parallel networks – Part 1

Session Chair: Phil Pollett

10:35–10:55  
Morning tea

10:55–11:40  
Mariana Olvera-Cravioto  
Queues in the Cloud: Generalizing the single server queue to massively parallel networks – Part 2

Session Chair: Phil Pollett

11:40–12:30  
Session Chair: Mogens Bladt  
11:40  Kate Saunders (S)  
Investigation of an automated approach to threshold selection for Generalised Pareto  
12:05  Peter Braunsteins (S)  
Coupling and capacity value in an $M/M/1/C$ queue

12:30–13:30  
Lunch

13:30–15:10  
Session Chair: Robert Cope  
13:30  Matt Roughan  
Maximum-entropy spatially-embedded random graphs  
13:55  Azam Asanjarani (S)  
Markovian Transition Counting Process as an alternative to Markov Modulated Poisson Process  
14:20  Leonardo Rojas-Nandayapa  
Approximation of Heavy-tailed distributions via infinite dimensional phase-type distributions  
14:45  Nicholas Read (S)  
The probability of Bushfire ignition

15:10–  
Excursion and free time
Thursday, April 9

9:40–10:55  Session Chair: Andrew Black
9:40  Daryl Daley
    Can we model dengue fever epidemics in Singapore?
10:05  Peter Ballard (S)
    What is the probability of an epidemic dying out in the first trough after the initial outbreak?
10:30  Shrupa Shah (S)
    Understanding the contribution of space in the spread of infectious diseases using an individual level modelling approach

10:55–11:15  Morning tea

11:15–12:30  Session Chair: Guy Latouche
11:15  Azucena Campillo Navarro
    On the use of functional calculus for phasetype distributions
11:40  Masakiyo Miyazawa
    Revisit large queues in a heterogeneous multi-server queue using a piecewise deterministic Markov process and a harmonic function
12:05  Moshe Haviv
    The conditional distribution of the remaining service or vacation time in the $M_n/G/1$ queue with vacations

12:30–13:30  Lunch

13:30–14:45  Session Chair: Sophie Hautphenne
13:30  Zbigniew Palmowski
    On optimal dividend problem for an insurance risk models with surplus-dependent premiums
13:55  Brendan Patch (S)
    A Monte Carlo Approach to Stability Verification
14:20  Jerzy Filar
    Detecting Non-Hamiltonicity in Cubic Graphs

14:45–15:05  Afternoon tea

15:05–16:20  Session Chair: Joshua Ross
15:05  Bikramjit Das
    Hidden large deviations for regularly varying Lévy processes
15:30  Robert Elliott
    Binomial Tree Malliavin Calculus and Convex Risk Measures
15:55  Dale Roberts
    The Kuramoto Model with Lévy Noise

18:40  Bus leaves for conference dinner
19:00  Conference Dinner

Note: (S) = Student Talk.
Friday, April 10

9:40–10:30  Session Chair: Moshe Haviv

9:40  Bo Friis Nielsen
Queueing models with matrix-exponential distributions and rational arrival processes

10:05  Jie Yen Fan
Limit theorems of the age structure of a population with a high carrying capacity

10:30–10:50  Morning tea

10:50–12:05  Session Chair: Yoni Nazarathy

10:50  Vikram Sunkara

11:15  Sophie Hautphenne
How old is that bird? The age distribution under some phase sampling schemes

11:40  David A. Stanford
On Waiting Times for Nonlinear Accumulating Priority Queues

12:05–13:05  Lunch

13:05–13:55  Session Chair: Nigel Bean

13:05  Laleh Tafakori
A class of Cauchy type heavy tail distributions and its statistical inferences

13:30  Zdravko Botev
Monte Carlo Separation of Variables

13:55–14:00  Closing: Nigel Bean

15:00  Bus to Adelaide departs
**Keynote Talks**

**Ton Dieker**, Georgia Institute of Technology

*A change-of-measure love story*

The change-of-measure technique plays a key role in applied probability. I have been involved in several research efforts where this technique led to new theorems and/or simulation algorithms, and this talk describes some of them.

Based in part on papers with Thomas Mikosch, Jon Warren, and Benny Yakir.

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**Mariana Olvera-Cravioto**, Columbia University

*Queues in the Cloud: Generalizing the single server queue to massively parallel networks*

Motivated by today's cloud computing capabilities in large server farms, we present a queueing model where jobs are split into a number of pieces which are then randomly routed to specific servers in the network to be processed in parallel, with the constraint that all fragments of a job must initiate their service at the same time. The main feature of the model is the need for synchronization, which creates blocking and idleness in the network, to be compensated by the fast service time resulting from the parallel processing. The analysis of this model under a many servers limit leads to a natural generalization of Lindley’s equation for the single-server queue, that can be solved within the framework of weighted branching processes. Using the Implicit Renewal Theorem on Trees (Jelenkovic, Olvera-Cravioto (2012)), we describe the exact asymptotics for the limiting waiting time of jobs, which fully extends the celebrated Cramér-Lundberg approximation for the supremum of a random walk to the branching case.
Tuesday, 7th

**Phil Pollett**, University of Queensland

*Metapopulations with dynamic extinction probabilities*

We study a model for a population network that accounts for the evolution over time of landscape characteristics which affect the persistence of local populations. Specifically, we allow the probability of local extinction to evolve according to a Markov chain. This covers the widely studied case where habitat patches are classified as being either suitable or unsuitable for occupancy. Threshold conditions for persistence of the population are obtained using an approximating deterministic model that is realized in the limit as the number of patches becomes large.

Joint work with Jessica Chan and Ross McVinish.

**Andrew Barbour**, Universität Zürich

*Individual and patch behaviour in structured metapopulation models*

Density dependent Markov population processes with countably many types can often be well approximated over finite time intervals by the solution of the differential equations that describe their average drift, provided that the total population size is large. They also exhibit diffusive stochastic fluctuations on a smaller scale about this deterministic path. Here, it is shown that individuals in such processes experience an almost deterministic environment. Small groups of individuals behave almost independently of one another, evolving as Markov jump processes, whose transition rates are prescribed functions of time. In the context of metapopulation models, we show that ‘individuals’ can represent either patches or the individuals that migrate among the patches; in host–parasite systems, they can represent both hosts and parasites. As an example, we are able to prove a conjecture of Metz and Gyllenberg, relating to the evolution of metapopulations.

Joint work with Malwina Luczak.

**Ellen Muir**, University of Melbourne

*Approximating the gains from trade in large markets*

We consider the efficient outcome of a canonical economic trade model for a market with $N$ buyers and $M$ sellers. We wish to approximate the quantity of units traded and the gains from trade when there are a large number of market participants. By taking appropriate transformations, the problem is reduced to studying two independent empirical quantile processes (one associated with demand and one associated with supply). These empirical quantile processes may be approximated by appropriately weighted Brownian bridges for large $N$ and $M$. The quantity traded in the market is then approximated by exploiting a functional version of the delta method. Finally, the gains from trade can be approximated using known results relating to integrals of Brownian bridges.

**Thilaksha Tharanganie**, Monash University

*Density forecasting using a functional data approach*

We consider the problem of forecasting a time series of density functions, with an estimated density function at each time period. A data set comprising many observations is recorded at each time period, and the associated probability density function is to be estimated for each time period. A logspine approach is applied to each data set separately where each estimated density has common knots but different coefficients. These estimated densities form a “functional time series”. We forecast future densities by decomposing the functional time series into orthonormal functional principal components and their uncorrelated principal component scores. Different sets of future densities are forecasted using univariate time series models applied to the scores obtained from various decomposition algorithms: functional principal component analysis, and eight projection pursuit algorithms for robust principal component analysis. We apply our methods to two simulated data sets (unimodal and bimodal) and four real data sets. The four real data sets comprise UK and Australian income and age data over many years with thousands of observations per year. We evaluate the calibration of our density forecasts using a form of probability integral transforms. Proper scoring rules are then used to evaluate the relative sharpness of the density forecasts. We conclude that two of the projection pursuit algorithms produce relatively good forecast densities.

Joint work with Rob J. Hyndman.

**Nicolas Rebuli**, University of Adelaide

*Hybrid Markov chain models for disease dynamics*

Continuous-time Markov chains (CTMCs) continue to increase in popularity for modelling disease dynamics. But how useful are they? In this talk I consider the well known susceptible–infectious–recovered (SIR) CTMC epidemic model. The SIR CTMC owes its popularity to finding an appropriate balance between computational feasibility and sufficient realism when modelling small populations, like households or workplaces. However, this balance is lost when one attempts to model larger populations, like towns or cities, due to the size of the state-space. In this talk I present two novel methods for overcoming this apparent state-space problem. These so called SIR hybrid models approximate the SIR CTMC on a subset of its state-space using either a deterministic or diffusion approximation. I use the SIR hybrid models to predict various properties of an epidemic. I compare the predictions of the hybrid models to those of the SIR CTMC to assess their accuracy and efficiency.
Andrew Smith, University of Adelaide

Metapopulation Models: When is the initial size important?

A metapopulation describes the abundance of individuals on spatially distinct habitat patches and particular models can account for births and deaths on each patch, and migration between patches. When the population ceiling becomes large in our model, the stochastic dynamics can be approximated by a system of differential equations. Typically, two behaviours are observed regardless of initial values: either the populations become extinct, or they persist. However, in some cases, an ‘Allee’ effect occurs, whereby for initial values above some threshold the population persists, but for initial values below the threshold it becomes extinct.

The goal of this study was to investigate the conditions under which the Allee effect occurs. We show the boundaries in parameter space between different system behaviours (extinction, Allee effects, and persistence), and the techniques we used to determine these boundaries. We also consider, via simulation, the behaviour of stochastic metapopulations when parameter choices approach these thresholds.
Wednesday, 8th

Guy Latouche, Université Libre de Bruxelles

Local time: The treachery of words

Physicists have at one time decided that quarks have flavors, two of which being strangeness and charm. In a kind of ‘in your face’ reaction, some philosophers arbitrarily assign new meanings to standard mathematical terms. As the Bard wrote,

What’s in a name? That which we call a rose
By any other name would smell as sweet.
(Romeo and Juliet — II, ii, 1–2)

Clearly, what matters is that one should be coherent within the context of one’s work, and if local time does not have the dimension of time but of speed$^{-1}$, so be it. Still, the usage of that term is ambiguous, and this is bothersome.

I shall explain why this is important to me. Starting with the stationary distribution of two-boundaries fluid queues, for which every component has a very clear physical interpretation, I shall move to Markov-modulated Brownian motion, for which some elucidation is still required.

Based on joint work with Giang T. Nguyen.

Mogens Bladt, National University of Mexico

Phase–type distributions and heavy tails

In this talk we propose a class of infinite-dimensional phase-type distributions, PH$_{\infty}$ with finitely many parameters as models for heavy tailed distributions. Though the class of finite-dimensional phase-type distributions is dense in the class of distributions on the positive reals, and may hence approximate any such distribution, a finite dimensional approximation will always be light–tailed. This may be a problem when the functionals of interest are tail dependent such as e.g. a ruin probability. The distributions in PH$_{\infty}$ may be genuinely heavy tailed, and the class is dense in the class of distribution on the positive reals.

A characteristic feature of the class PH$_{\infty}$ is that the formulas from finite–dimensional phase–type theory remain valid even in the infinite dimensional setting. The numerical evaluation of the infinite–dimensional formulas however differ from the finite–dimensional theory, and we shall provide algorithms for the numerical calculation of certain functionals of interest, such as e.g. the renewal density and a ruin probability. Finally we present an example from risk theory where we compare ruin probabilities for a classical risk process with Pareto distributed claim sizes to the ones obtained by approximating the Pareto distribution by an infinite–dimensional hyper–exponential distribution.

Based on joint work with Paul Tune.

Kate Saunders, University of Melbourne

Investigation of an automated approach to threshold selection for Generalised Pareto

Courtesy of agricultural stakeholders, mean rainfall processes in Australia are fairly well understood; conversely the drivers and processes behind extreme rainfall still pose a significant question for researchers. Given the short temporal length of rainfall records in Australia, to determine the probability of an extreme rainfall event we can use extreme value theory and fit a Generalised Pareto distribution. However, fitting requires the selection of an appropriate threshold. Traditional methods for threshold selection are subjective. This poses a problem as we seek to examine extreme rainfall at multiple time scales, gauge locations and under different seasonal conditions. An automated approach to threshold selection is therefore desired. We investigate the application of a method for automated threshold selection using an Information Matrix test for model misspecification. The performance of the automated approach is found to produce good results for daily rainfall extremes at range of sites with different climate conditions.

Peter Braunsteins, The University of Melbourne

Coupling and capacity value in an $M/M/1/C$ queue

Consider an $M/M/1/C$ queue run by a manager who has the option of buying and selling units of capacity at specific moments in time. We calculate the prices at which the manager should buy and sell a unit of capacity and observe some counter-intuitive properties of these prices. Coupling is then used to give a better understanding of these results.

Matt Roughan, University of Adelaide

Maximum-entropy spatially-embedded random graphs

Random graph models are used in a variety of applications, ranging from social network studies to biological networks. One useful family of random graphs are Spatially Embedded Random Networks (SERNs), where edges between vertices depend on the underlying geometry of some space. There are many possibilities, however, for embedding space and the relationship between this space and the link probabilities. How should we choose one, with limited data? Maximum entropy models allow us to state some series of assumptions or constraints on a model and build a model satisfying these, without accidentally including additional assumptions. We can thereby show the link between assumptions and modelling consequences. For instance, in the case of random graphs certain assumptions, such as a distance-based cost, naturally lead to certain classes of SERNs that resemble, but are subtly different from the commonly used Waxman random graph.

Joint work with Paul Tune.
Azam Asanjarani, University of Queensland

Markovian Transition Counting Process as an alternative to Markov Modulated Poisson Process

Finding a versatile model to describe the observed data is a principal target in stochastic modelling. Here we revisit a popular Markovian arrival process known as the Markov Modulated Poisson Process (MMPP) that can be applied in modelling a variety of phenomena such as queueing processes and traffic intensity in telecommunication networks.

As an alternative model for the MMPP we introduce a model which we call the Markovian Transition Counting Process (MTCP). The latter is simply a point process counting the number of transitions of a finite continuous-time Markov chain. We show that the MTCP exhibits many of the qualitative, quantitative, analytical and modelling properties of the MMPP.

Joint work with Sophie Hautphenne and Yoni Nazarathy.

Leonardo Rojas-Nandayapa, University of Queensland

Approximation of Heavy-tailed distributions via infinite dimensional phase-type distributions

Phase-type distributions are distributions of first passage times to an absorbing state of Markov jump processes with one absorbing state and a finite number of transient states. Phase-type distributions are often used as inputs in a wide variety of stochastic models because they are mathematically tractable and form a dense class in the non negative distributions. However, phase-type distributions are inherently light-tailed and cannot capture the characteristic features of heavy-tailed phenomena—a notorious example is the probability of ruin in classical risk models.

In this talk we present a novel and systematic methodology for approximating heavy-tailed distributions via infinite mixtures of phase-type distributions. Such an extended class inherits the mathematical tractability and dense property of phase-type distributions but in contrast these can be heavy-tailed. Our approach is simple but provides an excellent adjustment in the tails. We complement our results with estimation procedures, applications in risk and bounds for the error of approximation.

This is based on joint works with Mogens Bladt and Oscar Peralta.

Nicholas Read, University of Melbourne

The probability of Bushfire Ignition

Bushfire is a significant and increasing threat to Australia. It is an old problem and the scientific literature on forecasting bushfire is large although perhaps not as diverse as it could be. This talk will outline the practical problem, discuss the currently popular models before proposing some point process models for lightning fire ignition.
Mixing population and a spatially-explicit mixing population. Present a comparison of disease dynamics in a homogeneously relaxed in a small space-time closed population model? I will to the disease dynamics if the homogeneous mixing assumption to be mixing with other individuals uniformly. What will happen behaviour and physiology, and in a large population, very unlikely other. Realistically individuals are different from one another in consists of homogeneous individuals who mix uniformly with one an- other. The classic epidemic models usually assume the population consists of homogeneous individuals who mix uniformly with one another. Realistically individuals are different from one another in behaviour and physiology, and in a large population, very unlikely to be mixing with other individuals uniformly. What will happen to the disease dynamics if the homogeneous mixing assumption is relaxed in a small space-time closed population model? I will present a comparison of disease dynamics in a homogeneously mixing population and a spatially-explicit mixing population.

Peter Ballard. University of Adelaide

What is the probability of an epidemic dying out in the first trough after the initial outbreak?

An epidemic may experience a “boom then bust” on its initial outbreak. The number of infected individuals reaches a high first peak, and then falls to a low first trough as individuals recover and become immune. During this first trough the infection may fade out completely (“epidemic fade-out”), or rise again to an endemic level due to the gradual influx of new susceptible individuals.

I consider the probability of epidemic fade-out in the Markovian “SIR with demography” model. An exact calculation is computationally intensive, while previously published approximations are not always accurate. I propose an efficient computation method, using an approximation of the exact model. This gives only a small error, and is fast enough to be practical even for large population sizes.

Understanding the contribution of space in the spread of infectious diseases using an individual level modelling approach

The classic epidemic models usually assume the population consists of homogeneous individuals who mix uniformly with one another. Realistically individuals are different from one another in behaviour and physiology, and in a large population, very unlikely to be mixing with other individuals uniformly. What will happen to the disease dynamics if the homogeneous mixing assumption is relaxed in a small space-time closed population model? I will present a comparison of disease dynamics in a homogeneously mixing population and a spatially-explicit mixing population.

Azucena Campillo Navarro. Technical University of Denmark

On the use of functional calculus for phase-type distributions

This talk introduces functional calculus techniques as a new method in the tool box of phase-type distributions. In this class of distributions one is often confronted with the problem of finding representations or computing functionals of the corresponding random variables. We will present two primary examples of such problems: a closed form formula for the Mellin transform and a proba- bilistic derivation of representations for moment distributions. In both cases the functional calculus techniques provides an intuitive though rigorous method for evaluating functionals of matrices and this method turns out to be particularly well suited for the area of phase-type distributions. Based on our results, we have seen that functional calculus techniques may substantially simplify many expressions in terms of functions of matrices and has the potential to obtain further results in the theory of phase-type distributions and as well as for the more general class of matrix-exponential distributions.

Masakiyo Miyazawa. Tokyo University of Science

Revisit large queues in a heterogeneous multi-server queue using a piecewise deterministic Markov process and a harmonic function

We are interested in large queues in a $GI/G/k$ queue with heterogeneous servers. For this, we consider tail asymptotics and a heavy traffic approximation for the stationary distribution of its queue length process under the stability condition, where service time distributions are assumed to have light tails. They are basically known. For example, the tail asymptotics are obtained in Neute & Takahashi (1981) and Sadowsky & Szpankowski (1995) under some extra conditions, and a diffusion approximation is obtained for the queue length process in Chen & Ye (2011). We aim to give a unified and intuitively appearing approach for them using a piecewise deterministic Markov process and its extended generator. A key step of this approach is to derive a harmonic function for the extended generator in terms of the logarithmic moment generating functions, so called rate functions, of the point processes for arrivals and services. This idea is an extension of a similar one for the $GI/G/1$ queue in Miyazawa (2015).

Moshe Haviv. The Hebrew University of Jerusalem

The conditional distribution of the remaining service or vacation time in the $Mn/G/1$ queue with vacations

The somewhat overlooked queueing model of $Mn/G/1$ is as the well-know $M/G/1$ but with one key distinction: The Poisson arrival process is with queue-length dependent rates. This model was dealt with by Yoav Kerner. In particular, a recursion for the distribution functions of the residual (remaining) service time given the number of the customers in the system was derived. In this
paper we add the feature that the server takes (repeated) vaca-
tions whenever he becomes idle. The arrival rate vary both with
the queue length and with the status of the server. We derive
the corresponding recursions for this model. As a by-product we
get the conditional upon queue length probabilities, for the arrival
to be the first to arrive during the current service period. We
note that the importance of having such results is in assessing the
waiting time given how many are ahead upon arrival.

Zbigniew Palmowski. University of Wroclaw

On optimal dividend problem for an insurance risk models with
surplus-dependent premiums

In this talk we present an optimal dividend distribution problem for
an insurance company which risk process with surplus-dependent
premium (in the absence of dividend payments). Such a risk
process is a particular case of so-called piecewise deterministic
Markov process. The control mechanism chooses size of dividend
payments. The objective is to maximize the sum of the expected
cumulative discounted dividend payments received until the mo-
moment of ruin and a penalty payment at the moment of ruin which
is an increasing function of the size of the shortfall at ruin. A
complete solution is presented to the corresponding stochastic
control problem. We identify the associated HJB equation and
find a necessary and sufficient conditions for optimality of a sin-
gle dividend-band strategy, in terms of a particular Gerber-Shiu
function. A number of concrete examples are analyzed.

Brendan Patch. University of Queensland and University of
Amsterdam

A Monte Carlo Approach to Stability Verification

We will discuss methods of detecting if a queueing network is
unstable for a set of loads. The focus will be a study of over-
loaded networks via a simulated annealing implementation where
the cooling parameter varies with the network congestion level.

Joint work with Neil Walton, Yoni Nazarathy and Michel Mandjes.

Bikramjit Das. Singapore University of Technology and De-

Hidden large deviations for regularly varying Lévy processes

We discuss (hidden) large deviations in regularly varying Lévy pro-
cesses. It is well-known that large deviations of such processes are
related to one large jump. We exhibit that by stripping away appropri-
ate spaces, we can see subsequent jumps of the process
under proper scaling. The results concentrate on the α-stable
Lévy process. We study convergences under the notion of M-
convergence which has been used to study regular variation on a
variety of cones.

This is joint work with Parthanil Roy.

Robert Elliott. University of Adelaide

Binomial Tree Malliavin Calculus and Convex Risk Measures

The classical, canonical framework used to discuss simple financial
pricing is the binomial model. This talk presents in a novel way
several advanced concepts in this situation. These include mar-
tingale representation, Malliavin derivatives, backward stochastic
difference equations and dynamic risk measures.

Joint work with Sam Cohen in Oxford and Ken Siu at Macquarie.

Dale Roberts. Australian National University

The Kuramoto Model with Lévy Noise

The Kuramoto model is a dynamical system of coupled oscillators
on a network that has been used as a stylised representation of
synchronisation in physical, biological, chemical and social systems.
In this talk we shall discuss the Kuramoto model perturbed by a
Lévy process and, in particular, the case of the tempered stable
process which is a variation of the stable process that admits fi-
nite moments of all orders. This extends a large body of literature
on the stochastically perturbed Kuramoto model in an attempt to
understand how heavier and lighter tailed noise can impact the
synchronisation properties of the Kuramoto model on different
classes of random networks (e.g., small world, Erdős-Rényi, scale-
free).

Joint work with Dr Alex Kalloniatis at DSTO.
Discontinuous Galerkin method for computing densities arising in stochastic fluid-fluid models

Writing down analytical solutions for generators which evolve over a continuous state space is non-trivial. In the probabilistic framework, a solution must satisfy constraints such as point masses, smoothness (differentiability) and conservation of probability. Even though one can show existence, writing an analytical expression is not possible. Hence, we revert to using finite dimensional approximations. We propose to use the Discontinuous Galerkin method (DG); this method guarantees solutions which don’t violate the conservation of probability, can handle point masses and furthermore capture the underlying dynamics in the original operator. In this talk we will introduce the DG method and demonstrate their utility by approximating generators which describe two fluid queues, with interdependent fluid rates. Lastly to validate the approximation, we construct some performance measures which can be computed analytically. Using these performance measures as a reference solution, we will present the order of convergence of the DG method.

Joint work with Na Li, Peter Taylor and Ilze Ziedins.

Friday, 10th

Bo Friis Nielsen, Technical University of Denmark

Queueing models with matrix-exponential distributions and rational arrival processes

Traditional proofs of the matrix geometric solutions for queues of the GI/M/1 type use probabilistic arguments related to the sample paths of Markov chains. Such an approach is not directly applicable when the components with which we model consist of matrix-exponential distributions and rational arrival processes. In this talk we will focus on an approach based on results for Markov chains on general state spaces when considering state changes in the embedded Markov chain of the queue.

Joint work with Nigel Bean.

Jie Yen Fan, Monash University

Limit theorems of the age structure of a population with a high carrying capacity

We consider a general branching process which is supercritical below and subcritical above a carrying capacity, and whose reproduction parameters may depend on the age structure of the population. The law of large number and the central limit theorem of the age structure, as the carrying capacity increases, are established.

Joint work with Kais Hamza, Peter Jagers and Fima Klebaner.

Vikram Sunkara, University of Adelaide

Discontinuous Galerkin method for computing densities arising in stochastic fluid-fluid models

In 1967, Kleinrock and Finkelstein considered a class of nonlinear accumulating priority queues in which priority accrues as a power of the incurred waiting time, and on the basis of an equivalence to the linear case they, obtained the mean waiting times in their model, which they renamed the accumulating priority queue (APQ), obtaining the waiting time distribution for each class of customers in terms of its Laplace-Stieljes transform (LST). Recently, Stanford, Taylor and Ziedins (2014) reconsidered Kleinrock’s model, which they renamed the accumulating priority queue (APQ), obtaining the waiting time distribution for each class of customers in terms of its Laplace-Stieljes transform (LST).

We consider a model for a bird population in which the lifetime of each bird follows a phase-type distribution with transient phases 1, 2, ..., m and absorbing phase 0. The phases do not necessarily have any particular physical interpretation. The model allows us to compute several interesting features such as the expected number of birds in each phase at time t, or the asymptotic frequency of each phase.

In an attempt to translate these features, so that they can be viewed in terms of age-classes instead of phases, we need to be able to answer questions of the type “what is the conditional age distribution of a bird given its phase?” This problem may be tackled in several ways, depending on how we define the observation scheme. In this talk I will present and compare some of them.

David A. Stanford, University of Western Ontario

On Waiting Times for Nonlinear Accumulating Priority Queues

We consider a model for a bird population in which the lifetime of each bird follows a phase-type distribution with transient phases 1, 2, ..., m and absorbing phase 0. The phases do not necessarily have any particular physical interpretation. The model allows us to compute several interesting features such as the expected number of birds in each phase at time t, or the asymptotic frequency of each phase.

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Sophie Hautphenne, University of Melbourne

How old is that bird? The age distribution under some phase sampling schemes

We consider a model for a bird population in which the lifetime of each bird follows a phase-type distribution with transient phases 1, 2, ..., m and absorbing phase 0. The phases do not necessarily have any particular physical interpretation. The model allows us to compute several interesting features such as the expected number of birds in each phase at time t, or the asymptotic frequency of each phase.

In an attempt to translate these features, so that they can be viewed in terms of age-classes instead of phases, we need to be able to answer questions of the type “what is the conditional age distribution of a bird given its phase?” This problem may be tackled in several ways, depending on how we define the observation scheme. In this talk I will present and compare some of them.

Vikram Sunkara, University of Adelaide

Discontinuous Galerkin method for computing densities arising in stochastic fluid-fluid models

Writing down analytical solutions for generators which evolve over a continuous state space is non-trivial. In the probabilistic framework, a solution must satisfy constraints such as point masses, smoothness (differentiability) and conservation of probability. Even though one can show existence, writing an analytical expression is not possible. Hence, we revert to using finite dimensional approximations. We propose to use the Discontinuous Galerkin method (DG); this method guarantees solutions which don’t violate the conservation of probability, can handle point masses and furthermore capture the underlying dynamics in the original operator. In this talk we will introduce the DG method and demonstrate their utility by approximating generators which describe two fluid queues, with interdependent fluid rates. Lastly to validate the approximation, we construct some performance measures which can be computed analytically. Using these performance measures as a reference solution, we will present the order of convergence of the DG method.

Joint work with Na Li, Peter Taylor and Ilze Ziedins.

Friday, 10th

Bo Friis Nielsen, Technical University of Denmark

Queueing models with matrix-exponential distributions and rational arrival processes

Traditional proofs of the matrix geometric solutions for queues of the GI/M/1 type use probabilistic arguments related to the sample paths of Markov chains. Such an approach is not directly applicable when the components with which we model consist of matrix-exponential distributions and rational arrival processes. In this talk we will focus on an approach based on results for Markov chains on general state spaces when considering state changes in the embedded Markov chain of the queue.

Joint work with Nigel Bean.

Jie Yen Fan, Monash University

Limit theorems of the age structure of a population with a high carrying capacity

We consider a general branching process which is supercritical below and subcritical above a carrying capacity, and whose reproduction parameters may depend on the age structure of the population. The law of large number and the central limit theorem of the age structure, as the carrying capacity increases, are established.

Joint work with Kais Hamza, Peter Jagers and Fima Klebaner.

Vikram Sunkara, University of Adelaide

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Joint work with Na Li, Peter Taylor and Ilze Ziedins.
Laleh Tafakori, University of Melbourne

A class of Cauchy type heavy tail distributions and its statistical inferences

We introduce an interesting class of continuous distributions on positive real line, called Cauchy type mixture. Then we discuss its properties, provide new integral formulas including an extension for the Kotz and Ostrovskii (1996) mixture representation. Furthermore, we consider its connections with the generalized Linnik distributions and the class of discrete distributions induced by stable laws. Finally, we present its potential application in modelling erratic phenomena.

Joint work with Ahmad Reza Soltani (Kuwait University).

Zdravko Botev, University of New South Wales

Monte Carlo Separation of Variables

We consider the efficient Monte Carlo estimation of multivariate Gaussian integrals, multivariate student integrals, and the volume of bounded irregular polytopes. We show that all three estimation problems have a common structure, which can be exploited by the so-called Monte Carlo separation of variables method. We show that this method yields strongly efficient estimators in the Gaussian and student case. Numerical examples suggest that this is the current best approach to the evaluation of such integrals.
Practical information

Bus Pickup

The pickup point for the bus from Adelaide Uni will be in front of the Benham building (see map below). The meeting point at the airport will be at the bottom of the stairs on the ground floor, near to the luggage area. The driver will have a sign.

Wineries/Cellar Doors

There are 3 winery cellar doors within walking distance: Elderton Wines Penfolds, and First Drop Wines-Home of the Brave (see map below). First Drop Wines-Home of the Brave is next door to Penfolds, this is a new cellar door.

Walking Tracks

A visit to the Barossa Bushgarden is recommended - this community project is successfully growing plants that are indigenous to the area, while the Bush Chapel at Coulthard Reserve is a place for quiet reflection or celebration. Town founder William Coulthard’s original bluestone home ‘Coulthard House’, opposite the police station, is worth a look as around this property and the generosity of its owner the town grew and prospered. The peaceful North Para River meanders through town and Nuriootpa Linear Park provides a delightfully scenic riverside walk from Coulthard Reserve to Tolley Reserve on the Barossa Valley Way. All the above are easy walking distance from the Vine Inn. The North Para River is directly behind the hotel. The attached town map shows all these areas.
Vine Inn Plans

VINE INN BAROSSA
SITE PLAN

VINE COURT MOTEL

MURRAY STREET

CARPARK

Motel Rooms

EVACUATION
ASSEMBLY
POINT

MAIN BUILDING
MURRAY STREET
DRIVE
THRU
BOTTLESHOP

CARS

BARS
FOYER
GAMING
ROOM

KITCHEN

UPSTAIRS
LAUNDRY

VINEGARDEN
BISTRO
& FUNCTION
AREA

POOL

1 2 3 4 5 6
UPSTAIRS

7 8 9 10 11 12
DOWNSTAIRS

13 14 15 16 17 18
Motel Rooms

To Contact Reception: Reception Hours Dial '9'
Outside of Hours Dial '0' for an outside line, then 1800 088 167

Breakfast: 7 Days 7:00am - 10:00am (Vine Garden Bistro Only)

MEALS - 7 Days of the Week
Vine Garden Bistro & Sports Bar
Lunch: 12:00pm - 2:30pm
Dinner: 6:00pm - 8:30pm

Other facilities at the Vine Inn
Perce’s Gaming Lounge
Sip’n’Save Bottle shop with TAB and Keno

Welcome to the Vine Court Barossa