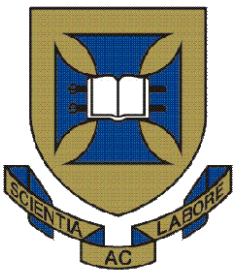
Australia New Zealand Applied Probability Workshop

8 – 11 July, 2013

Brisbane, Australia



THE UNIVERSITY
OF QUEENSLAND
AUSTRALIA

Welcome to the Australia New Zealand Applied Probability Workshop held at The University of Queensland (UQ), July 8 –11 2013. This workshop brings together researchers in the field of applied probability from the region and elsewhere. The scope includes stochastic financial models, queueing theory, actuarial science, stochastic biological models, Monte-Carlo methods, inference for stochastic models, general applied and pure probability as well other related fields and applications.

We acknowledge kind support from the Australian Mathematical Sciences Institute (AMSI) as well as from the School of Mathematics and Physics and the Department of Mathematics at UQ. The workshop is also co-sponsored by the Institute of Mathematical Statistics (IMS).

From the organizers: Let us enjoy and discover!

Nigel Bean, Jeff Hunter, Dirk Kroese, Yoni Nazarathy, Phil Pollett, Leonardo Rojas-Nandayapa, Joshua Ross, Peter Taylor, Ilze Ziedins.

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SCHEDULE

Monday, July 8

9:00–9:30 Registration

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The Tricentenary of the Weak Law of Large Numbers
Session Chair: Joshua Ross

10:30–11:00 Break (in dining hall verandah)

11:00–11:50 Session Chair: Yoni Nazarathy
11:00 Owen Jones
The Hausdorff spectra of a class of multifractal processes
11:25 Aihua Xia
Point processes characterized by their one dimensional distributions

11:50–13:00 Lunch

13:00–13:50 Session Chair: Leonardo Rojas-Nandayapa
13:00 Giang Nguyen
Brownian motions in a strip
13:25 Werner Scheinhardt
Reliable sequential testing for statistical model checking

13:50–14:10 Break

14:10–15:25 Session Chair: Sophie Hautphenne
14:10 Moshe Haviv
Regulating an M/G/1 queue when customers know their demand
14:35 Liron Ravner@
Arrival times to a queue with order penalties
15:00 Georgy Sofronov
An optimal sequential procedure for a multiple selling problem

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15:50–16:40 Session Chair: Thomas Taimre
15:50 Zdravko Botev
Rare-event probability estimation and Convex Programming
16:15 Shane Henderson
A Bayesian Approach to Stochastic Root Finding

Note: '@'=Student Talk.

Tuesday, July 9

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Stability and rare events in stochastic models – Part 1
Session Chair: Giang Nguyen

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10:15 Kais Hamza
On the mixing advantage
10:40 Malgorzata O'Reilly
Multi-stage stochastic fluid models for congestion control

11:05–11:15 Break

11:15–12:05 Session Chair: Georgy Sofronov
11:15 Ross McVinish
The behaviour of large metapopulations
11:40 Andrew Black
Parametrising Markovian epidemic models using household level data

12:05–13:15 Lunch

13:15–14:05 Session Chair: Thomas Taimre
13:15 Ali Eshragh
Fisher Information for a Partially-Observable Simple Birth Process
13:40 Mark Fackrell
Modelling Patient flow in an Emergency Department

14:05–14:25 Break (in dining hall verandah)

14:25–15:40 Session Chair: Sean Robinson
14:25 Han Liang Gan@
Approximation of the conditional number of exceedances
14:50 David Price@
Modelling and optimisation of group dose-response challenge experiments
15:15 Shaun McKinlay@
A characterisation of transient random walks on stochastic matrices with Dirichlet distributed limits

This day ends earlier than the rest to allow a free afternoon.

Wednesday, July 10

9:00–9:50 Sergey Foss
Stability and rare events in stochastic models – Part 2
Session Chair: Giang Nguyen

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10:15 Mingmei Teo@
Interval Markov chains and interval mean hitting times
10:40 Tuan Van Dinh@
Modelling a supercomputer with an $M_t/G/\infty$ model: a case study of the Swinburne Supercomputer

11:05–11:15 Break

11:15–12:30 Session Chair: Zdravko Botev
11:15 Aminath Shausan@
Spread of an SIS Epidemic in a Network
11:40 Andrew Smith@
A Metapopulation Model with Environmental Influence
12:05 Jeffrey Hunter
The Role of Generalized Matrix Inverses in Markov Chains

12:30–13:30 Lunch

13:30–14:20 Session Chair: Ali Eshragh
13:30 Ruth Williams
Correlation of Intracellular Components due to Limited Processing Resources
13:55 Ioane Muni Toke
Some properties of the one-side limit order book as a queueing system

14:20–14:35 Break

14:35–15:25 Malwina Luczak
A fixed-point approximation for a routing model – Part 1
Session Chair: Ross McVinish

15:25–15:50 Break (in dining hall verandah)

15:50–16:40 Session Chair: Andrew Black
15:50 Sean Robinson
Alignment of Time Course Microarray Data with Hidden Markov Models
16:15 Daryl Daley
Asymptotic output variance of service systems stabilized by loss

17:45 Walk to CityCat Ferry Terminal
18:30 Workshop Dinner (CARAVANSERAI Turkish Restaurant)

Note: '@'=Student Talk.

Thursday, July 11

9:00–9:50 Malwina Luczak
A fixed-point approximation for a routing model – Part 2
Session Chair: Ross McVinish

9:50–10:05 Break

10:05–10:55 Session Chair: Werner Scheihardt

10:05 Kostya Borovkov
On the asymptotic behaviour of a dynamical version of the von Neyman contagious point process

10:30 Lachlan Andrew
Optimality, fairness and robustness in speed scaling designs

10:55–11:10 Break (in dining hall verandah)

11:10–12:25 Session Chair: Daryl Daley

11:10 Ilze Ziedins
Self-optimising state-dependent routing in parallel queues

11:35 Sophie Hautphenne
Multitype branching processes in a random environment: Would they survive forever?

12:00 Andrew Barbour
Approximating the epidemic curve

12:25–12:35 Closing: Nigel Bean

12:35 Lunch

ABSTRACTS

KEYNOTE TALKS

Sergey Foss, Heriot-Watt University and Russian Academy of Sciences

Stability and rare events in stochastic models

Abstract In the first part of these tutorial lectures I will provide an overview of modern stability methods in the analysis of stochastic models. This overview will include the classical Lyapunov-type techniques, coupling methods (including Harris ergodicity and renovation theory), fluid approximations (including random fluid limits), weak stationarity method, saturation rule, and the random contraction principle. In addition, I will speak about more recent techniques that include convergence of functionals of stochastic recursions, multi-component Markov chains, and monotone Markov-modulated models.

In the last quarter of my lectures, I will introduce a classification of typical trajectories (sample paths) that lead to a large value of the supremum of a random walk with i.i.d. increments. This classification principally comprises five cases, three light-tailed and two heavy-tailed ones. In particular, the Cramer-Lundberg (light-tails) and the Veraverbeke (heavy-tails) theorems are the most known here.

Malwina Luczak, Queen Mary, University of London

A fixed-point approximation for a routing model

Abstract The following dynamic route-allocation model was studied fairly extensively in the 1990s. There are a number of nodes, and calls arrive between each pair as a Poisson process. Where possible, a call is allocated to the direct link between the two nodes. However, the link between each pair of nodes has a fixed capacity: when the direct link is at capacity, some number of two-link paths is inspected, and one of them is used for the incoming call if possible. The duration of each call is an exponential random variable with fixed mean. It is natural to expect that, in equilibrium, around each node, the number of links of each load will be an approximation to the fixed point of a certain differential equation, provided there is just one fixed point. We show that this is indeed true provided the arrival rate is sufficiently small or sufficiently large.

We survey what is known about this model, and discuss the techniques involved in the proof, which we expect to find further applications.

This is partly joint work with Graham Brightwell.

Eugene Seneta (presented by Peter Taylor), The University of Sydney

The Tricentenary of the Weak Law of Large Numbers

Abstract
Jacob Bernoulli's Theorem, the first limit theorem of probability theory, was the initial instance of what came to be known as the Weak Law of Large Numbers (WLLN). The theorem was published in 1713 within the book *Ars Conjectandi* after the death of its author Jacob Bernoulli (1654-1705). Consequently, 2013 will see several celebrations of the Tricentenary within this *International Year of Statistics*.

Jacob Bernoulli's theorem has multiple aspects: 1. As a limit theorem (sample size $n \to \infty$) describing the approach of relative frequency to probabilty p; 2. Determining sufficiently large sample size n for specified precision and specified p; 3. Determining sufficiently large sample size n for specified precision when p is unknown (the inversion problem). The study evolved historically along both frequentist (DeMoivre) and Bayesian (Laplace) lines.

The Bienaymé-Chebyshev Inequality was a transition point from the French to the Russian direction. The Russian direction focussed on exact bounds on precision for fixed sample size n in a frequentist setting. The French direction had focussed on approximation.

A Bicentenary celebration of the WLLN was organized in 1913 in St. Petersburg by A. A. Markov (1856-1922), after whom Markov chains are named. Additionally, in 1913 Markov published the 3rd, substantially expanded, version of his celebrated monograph *Ischislenie Veroiatnostei [Calculus of Probabilities]*, which contains what is now known as *Markov's Inequality*, and contains an advanced version of the WLLN now known as *Markov's Theorem*. Markov's results were publicized and extended in the Soviet Union by S.N. Bernstein (1880-1968), and in the west by J.V. Uspensky (1883-1947) who had been in instrumental in the Bicentenary celebrations.

This talk will to tend to focus on the Russian development. A more comprehensive account by the author will appear in a Tricentenary issue of the journal *Bernoulli*, under the title *A Tricentenary History of the Law of Large Numbers.*

CONTRIBUTED TALKS

Lachlan Andrew, Swinburne University of Technology

Optimality, fairness and robustness in speed scaling designs

Abstract System design must strike a balance between energy and performance by carefully selecting the speed at which the system will run. In this work, we examine fundamental tradeoffs incurred when designing a speed scaler to minimize a weighted sum of expected response time and energy use per job. Notably, this work derives a stochastically optimal system, and provides "worst case" bounds for the resulting system (in which variables are chosen adversarially rather than stochastically). We prove that a popular dynamic speed scaling algorithm is 2-competitive for this objective and that no 'natural' speed scaler can improve on this. Further, we prove that energy-proportional speed scaling works well across two common scheduling policies: Shortest Remaining Processing Time (SRPT) and Processor Sharing (PS). Third, we show that under SRPT and PS, gated-static speed scaling is nearly optimal when the mean workload is known, but that dynamic speed scaling provides robustness against uncertain workloads. Finally, we prove that speed scaling magnifies unfairness, notably SRPT's bias against large jobs and the bias against short jobs in non-preemptive policies. However, PS remains fair under speed scaling. Together, these results show that the speed scalers studied here can achieve any two, but only two, of optimality, fairness, and robustness.

Andrew Barbour, Universitaet Zuerich

Approximating the epidemic curve

Abstract Many models of epidemic spread, such as stochastic versions of the Kermack & McKendrick model, the Reed–Frost model, and the Volz configuration model, have a common qualitative structure. The numbers of infected individuals during the initial stages of an epidemic can be well approximated by a branching process, after which the proportion of individuals that are susceptible follows a more or less deterministic course. In this talk, we show that both of these features are consequences of assuming a locally branching structure in the models, and that the deterministic course can itself be determined from the distribution of the limiting random variable associated with the backward, susceptibility branching process.

Joint work with Gesine Reinert (Oxford University).

Andrew Black, University of Adelaide

Parametrising Markovian epidemic models using household level data

Abstract
It has become common that during the outbreak of a new disease data is collected at the household level to try and understand the dynamics of the disease. Typically cohorts of households are monitored and onset times for various symptoms are recorded. This leads to statistics such as the serial interval, which is the time from the onset of symptoms in a primary case and the date of symptom onset in one of its secondary cases. I will discuss some work Joshua Ross and myself have done on using this type of household level data for parameter inference using Markovian models. The overall goal here is to use data collected at the household level during the early stages of an outbreak to parametrise population level models and hence inform public health policy.

Kostya Borovkov, University of Melbourne

On the asymptotic behaviour of a dynamical version of the von Neyman contagious point process

Abstract
We consider a finite point process in R^d evolving in discrete time as follows. Starting with an arbitrary initial configuration of finitely many points with nonnegative weights, at each step a point is chosen at random from the process according to the distribution with probabilities proportional to the points' weights. Then a random number of new points is added to the process, each displaced from the location of the chosen point by a random vector and assigned a random weight. Under broad conditions on the random sequences of the numbers of newly added points, their weights and displacement vectors, we obtain the asymptotic behaviour of the point last added to the process and also that of the scaled mean measure of the point process as the number of steps goes to infinity.

Zdravko Botev, University of New South Wales

Rare-event probability estimation and Convex Programming

Abstract In this talk we present a new approach to rare-event probability estimation, in which the quantity of interest is the solution to a convex optimization problem. We show that this indirect method of estimating a rare-event probability yields excellent numerical results compared to traditional importance sampling. A theoretical investigation suggests that the resulting estimators can sometimes be strongly efficient.

Daryl Daley, University of Melbourne

Asymptotic output variance of service systems stabilized by loss

Abstract The output of a stable Poisson queue is Poisson at the rate as the input process. When the input rate exceeds the service rate stability can be achieved via a loss mechanism — a buffer, or balking, or reneging — an the output is again (approximately) Poisson. Nazarathy and Weiss (QUESTA, 2008) showed that for a single-server system with a large buffer, the variance rate of the output process is consistent with a Poisson process rate except when the input and service rates are equal. This phenomenon persists in many-server systems, and in many-server systems with reneging provided there is also a buffer.

We shall attempt an explanation via Ornstein–Uhlenbeck and Brownian diffusions, and speculate on the wider implications for the output of networks.

Joint work with Yoni Nazarathy (UQ) and Johan van Leeuwaarden (TU Eindhoven).

Tuan Van Dinh, Swinburne University of Technology

Modelling a supercomputer with an $M_t/G/\infty$ model: a case study of the Swinburne Supercomputer

Abstract
A cluster-based supercomputing system consists of many computing servers that serve sequences of jobs submitted by users. There are several factors that motivate us considering M t /G/∞ for such a system, with a few simplifications. Studies on Swinburne Supercomputer workload shows that job seems to arrive in batch as in a sequence of jobs which demand similar amount of resources and this supercomputer has also been mostly under-utilised. The model is then used as a foundation for a control framework that aims to improve energy efficiency of the supercomputer.

Joint work with Lachlan Andrew and Yoni Nazarathy.

Ali Eshragh, University of Adelaide

Fisher Information for a Partially-Observable Simple Birth Process

Abstract In this talk, we study the Fisher Information for a partially-observable simple birth process involving n observations at times $t_1, t_2, \cdots, t_n$. We suppose that at each observation time t_i, each individual in the population can be observed independently with known fixed probability p. For the case $n = 1$, we derive an explicit form of the Fisher Information. However, finding the Fisher Information for higher values of n appears intractable. Nonetheless, for $n = 2$, we find a very good approximation function for the Fisher Information by exploiting the probabilistic properties of the underlying stochastic process. Both numerical and theoretical results strongly support the latter approximation and confirm its high level of accuracy.

Joint work with Nigel Bean and Joshua Ross.

Mark Fackrell, University of Melbourne

Modelling Patient flow in an Emergency Department

Abstract In this talk I will present some initial results in the analysis of patient flow in the emergency department of a major metropolitan hospital.

Han Liang Gan, University of Melbourne

Approximation of the conditional number of exceedances

Abstract
Given a stationary sequence, we seek to study the distribution of the number of exceedances above a high threshold, given the number is between two positive integers. To prove any theoretical limiting results, often many strong assumptions are required. In contrast to this approach, we aim to approximate the conditional number of exceedances with well understood random variables and calculate the distance between the two using a variety of metrics by applying Stein's method. Stein identities for both conditional Poisson and conditional negative binomial distributions are devised and appropriate Stein factors are derived.

Kais Hamza, Monash University

On the mixing advantage

Abstract Corresponding to n independent non-negative random variables $X_1, \ldots, X_n$ are values $M_1, \ldots, M_n$, where each M_i is the expected value of the maximum of n copies of X_i. We obtain sharp upper bounds for the expected value of the maximum of $X_1, \ldots, X_n$ in terms of $M_1, \ldots, M_n$. These inequalities are sharp.

Sophie Hautphenne, University of Melbourne

Multitype branching processes in a random environment: Would they survive forever?

Abstract
We consider multitype Markovian branching processes living in a random environment. It is well known that the extinction criterion of such a process is related to the conditional growth rate of the population, given the history of the environment, and that it is usually hard to evaluate. In a special case where the random environment corresponds to a catastrophe process and the survival of an individual depends on its type, we determine upper and lower bounds using a duality approach. The upper bound appears to be often much tighter than the lower bound. We then adapt our approach to other types of random environments

Moshe Haviv, The Hebrew University of Jerusalem

Regulating an M/G/1 queue when customers know their demand

Abstract
Selfish customers do not necessarily join a queue at a socially optimal rate. Hence, queueing systems may call for regulation. For customers in an M/G/1 unobservable (not necessarily FCFS) M/G/1 queue and homogeneous with respect to waiting costs and service rewards, we show how queueing systems can be regulated by imposing entry, holding, or service fees in the case where customers know their service requirements. We start with a unified approach, assuming minimal assumptions on the waiting functions, and state the socially optimal fees. We show that customers are always worse off under a flat entry free in comparison with holding and service fees. As for holding vs. service fees, the answer depends on the queueing regime and/or the service length. For example, under FCFS, service fees are preferred by all. Details are given on some common service regimes. For the sake of completeness we also review the case where customers know only their distribution, but not its requirement.

Shane Henderson, Cornell University

A Bayesian Approach to Stochastic Root Finding

Abstract The problem of stochastic root finding is to locate the root of a monotone decreasing function on the interval [0, 1], where the function value at any queried point can only be observed with additive noise. An alternative to stochastic approximation is the probabilistic bisection algorithm, which was introduced in 1963 by Horstein. In this method, one updates a prior belief on the location of the root according to the sign of noisy function evaluations. Till now, a convergence theory has only been available for a discretized version of the algorithm. I will describe our convergence results for the continuous version of the algorithm, and discuss an extension using power-one tests that can yield a practical root-finding algorithm.

Joint work with Rolf Waeber and Peter Frazier.

Jeffrey Hunter, Auckland University of Technology

The Role of Generalized Matrix Inverses in Markov Chains

Abstract
Generalized matrix inverses play significant roles in solving for various key properties of finite, irreducible, Markov chains, in particular, the stationary distribution and the moments of the first passage time distributions. This arises from the observation that generalized matrices are used to solve systems of singular linear equations. In the context of Markov chains, we consider generalized matrix inverses of the singular Markovian kernel, I - P, where P is the transition matrix of the Markov chain.

We survey the application of generalized matrix inverses to such problems. We also establish that, under the aforementioned conditions, all generalized inverses of the Markovian kernel can be uniquely specified in terms of the stationary probabilities and the mean first passage times of the underlying Markov chain. Special sub-families include Meyer's group inverse of I - P, Kemeny and Snell's fundamental matrix of the Markov chain, and the Moore-Penrose g-inverse.

Owen Jones, University of Melbourne

The Hausdorff spectra of a class of multifractal processes

Abstract The Multifractal Embedded Branching Process (MEBP) process and Canonical Embedded Branching Process (CEBP) process were introduced by Decrouez and Jones (2012). The CEBP is a process in which the crossings of dyadic intervals constitute a branching process. An MEBP process is defined as a multifractal time-change of a CEBP process, where the time-change is such that both it and the CEBP can be simulated simultaneously in an on-line fashion. In this talk I describe the scaling properties of the CEBP, the time-change, and the MEBP. Under various moment conditions, we show that CEBP processes have a constant modulus of continuity, obtain the Hausdorff spectrum of the time-change, and thus obtain the Hausdorff spectrum of an MEBP process.

Joint work with Geoffrey Decrouez and Ben Hambly.

Shaun McKinlay, University of Melbourne

A characterisation of transient random walks on stochastic matrices with Dirichlet distributed limits

Abstract
We characterise the class of distributions of random stochastic matrices X with the property that the products $X(n)X(n-1)X(1)$ of i.i.d. copies $X(k)$ of X converge a.s. as $n \to \infty$ and the limit is Dirichlet distributed. This extends a result by Chamayou and Letac (1994) and is illustrated by several examples that are of interest in applications.

Ross McVinish, University of Queensland

The behaviour of large metapopulations

Abstract A metapopulation is a collection of local populations occupying spatially distinct habitat patches that are connected by migration. Stochastic patch occupancy models (SPOMs) are a class of Markov chains that model the presence/absence of the focal species in the collection of habitat patches. We analyse the behaviour of a particular SPOM as the number of habitat patches tends to infinity and establish conditions under which the metapopulation may persist for a long time.

Ioane Muni Toke, École Centrale Paris

Some properties of the one-side limit order book as a queueing system

Abstract I propose a short talk in two parts. In the first part, we study the analytical properties of a one-side order book model in which the flows of limit and market orders are Poisson processes and the distribution of lifetimes of cancelled orders is exponential. Although simplistic, the model provides an analytical tractability that should not be overlooked. Using basic results for birth-and-death processes and letting the tick size go to zero, we build an analytical formula for the shape of a continuous order book model which is both founded by market mechanisms and very close to empirically tested formulas. We relate this shape to the probability of execution of a limit order and the stationary price/spread distribution. In a second part, in an effort towards analytical tractability of a more flexible order book model, we derive analytical formulas for the Laplace-Stieltjes transform of the completion times of low-priority customers in a two-class priority queue with general service times and exponential impatience (two-class M/G/1+M). Computation is done expanding the classic derivation of completion times in priority queues without impatience. In the special case of exponential service times, results are applicable to the limit order book of the first part.

Giang Nguyen, University of Adelaide

Brownian motions in a strip

Abstract
In this talk, we focus on a Markov-modulated Brownian motion process reflected at two boundaries 0 and $b < \infty$, where the drift and the variance are driven by an underlying finite Markov chain. We present a formula for its stationary distribution, which contains a linear combination of two matrix-exponential terms. While the Laplace transform of the stationary distribution of such a process has been recently obtained, this is the first direct analysis of the stationary distribution itself.

Malgorzata O'Reilly, University of Tasmania

Multi-stage stochastic fluid models for congestion control

Abstract
We present multi-stage stochastic fluid models (SFMs), driven by applications in telecommunications and manufacturing in which control of the behaviour of the system during congestion may be required. In a two-stage SFM, the process starts from Stage 1 in level 0, and moves to Stage 2 when reaching threshold b_2 from below. Stage 1 starts again when reaching threshold $b_1 < b_2$ from above. While in a particular stage, the process evolves according to a traditional SFM with a unique set of phases, generator and fluid rates. We use matrix-analytic methods and derive efficient methodology for the transient and stationary analysis of this class of models.

David Price, University of Adelaide

Modelling and optimisation of group dose-response challenge experiments

Abstract
An important component of scientific research is the 'experiment'. Effective design of these experiments is important and, accordingly, has received significant attention under the heading 'optimal experimental design'. However, until recently, little work has been done on optimal experimental design for experiments where the underlying process can be modelled by a Markov chain. In this talk, I will discuss some of the work that has been done in the field of optimal experimental design for Markov Chains, and some of the work that I have done in applying this theory to dose-response challenge experiments for the bacteria Campylobacter jejuni in chickens.

Liron Ravner, The Hebrew University of Jerusalem

Arrival times to a queue with order penalties

Abstract
Customers are often faced with a choice of when to arrive to a congested queue with some desired service at the end. Suppose the server operates for a certain time interval , and customers are served according to their arrival order. We study a model where the customers incur not only congestion (waiting) costs but also penalties for their index of arrival. Arriving before other customers is desirable when the value of service decreases with every admitted customer. Examples of such scenarios are arriving at a concert or a bus with unmarked seats and going to lunch in a cafeteria. We provide game theoretic analysis of such queueing systems, specifically we characterize the arrival process which constitutes a symmetric Nash equilibrium.

Joint work with Moshe Haviv.

Sean Robinson, University of Adelaide

Alignment of Time Course Microarray Data with Hidden Markov Models

Abstract
Time course microarray experiments allow for insight into biological processes by quantifying changes in gene expression over a time period of interest. The work presented in this talk was motivated by time course microarray data from an experiment conducted on grapevines over the development cycle of the grape berries at a number of different vineyards in South Australia. Although the underlying biological process is the same at each vineyard, there are differences in the timing of the development cycle at different vineyards due to local conditions.

We aim to obtain a common representation of the gene expression over the development cycle of the grape berries for each gene by first aligning the data from the different vineyards. Hidden Markov models (HMMs) have been used to model time series data in a number of domains and have also been used to model time course microarray data. I will present an extension of HMMs as well as a novel alignment methodology based on this extension to apply to the motivating grapevine data.

Werner Scheinhardt, University of Twente

Reliable sequential testing for statistical model checking

Abstract We introduce a framework for comparing statistical model checking (SMC) techniques, and propose a new, more reliable, technique. Statistical model checking is a simulation-based method, typically used to check whether the probability p of some event in a stochastic model, is larger or smaller than some threshold p_0. It has recently been implemented in several tools, to be able to also handle models which are too complex for (the more traditional) numerical analysis. However, these SMC techniques turn out to have shortcomings, most notably that the validity of their outcomes depends on parameters that must be chosen a priori. Our new technique does not have this problem. We prove its correctness, and numerically compare its performance to existing techniques.

Aminath Shausan, University of Queensland

Spread of an SIS Epidemic in a Network

Abstract
An important factor in modelling the spread of infectious diseases in human populations is the social and spatial structure of the populations. Humans usually live in groups such as towns and cities and there is constant mobility of individuals between these groups. This type of population structure can be modelled as a network where the groups are represented by nodes and the paths of migrating individuals are represented by links. I will model the spread of a disease with Susceptible–Infective–Susceptible (SIS) dynamics in such a network using a continuous time Markov chain. Approximation methods will be used to analyse the model in the case of large populations, addressing questions concerning the behaviour of the population at equilibrium.

Andrew Smith, University of Queensland

A Metapopulation Model with Environmental Influence

Abstract Many population models are constructed with the premise that their parameters, for example birth and death rates, do not depend on time. However, the presence of breeding seasons, cold snaps, catastrophes and various other influences entail the need to allow for such dependence. I will present a time heterogenous model whose parameters vary stochastically in time. A law of large numbers will be presented, which allows us to identify an appropriate approximating dynamical system. This system is then analysed to give qualitative results that relate back to the original stochastic model. I will present conditions for population extinction.

Georgy Sofronov, Macquarie University

An optimal sequential procedure for a multiple selling problem

Abstract A sequential problem of selling several identical assets over the finite time horizon with a fixed number of offers per time period and no recall of past offers is considered. We observe a sequence of independent identically distributed random variables and have to decide when we must stop, given that there is no recall allowed, that is, a random variable once rejected cannot be chosen later on. Our decision to stop depends on the observations already made, but does not depend on the future which is not yet known. We derive in an explicit view a decision rule for identifying the number of stoppings and a corresponding optimal procedure for this selling problem.

Mingmei Teo, University of Adelaide

Interval Markov chains and interval mean hitting times

Abstract
It is not often that we know the true value of our model parameters. So what can we do about it? We may choose to use sensitivity analysis to help explore the space around our chosen parameter estimates. Alternatively, we may seek to develop methods that incorporate intervals into our models to account for the uncertainty in parameter values. I will discuss how one might do this and also how to bound function values given interval inputs in a Markovian framework. Then, I will proceed to illustrate this method in a Markovian model of population dynamics to calculate bounds on the time to population extinction.

Ruth Williams, University of California, San Diego

Correlation of Intracellular Components due to Limited Processing Resources

Abstract
A major challenge for systems biology is to deduce the molecular interactions that underlie correlations observed between concentrations of different intracellular components. Of particular interest is obtaining an understanding of such effects when biological pathways share common elements that are limited in capacity. Here we use stochastic models to explore the effect of limited processing resources on correlations when these resources are positioned downstream or upstream of the molecular species of interest. Specifically, we consider two situations where correlations in protein levels are the object of interest: (i) degradation of different proteins by a common protease, and (ii) translation of different mRNA transcripts by a limited pool of ribosomes. In developing and analyzing stochastic models for these systems, we use insights from the mathematical theory of multiclass queues. In both models we observe a correlation resonance: correlations tend to have a peak slightly beyond the point where the systems transition from underloading to overloading of the processing resources, although the sign of the correlation is different in the two cases. As time permits, related experimental work will be described.

This presentation is based on joint work with current or former members of the UCSD Biodynamics lab and in particular with William H. Mather, Natalie A. Cookson, Tal Danino, Octavio Mondragon-Palomino, Jeff Hasty and Lev S. Tsimring.

Aihua Xia, University of Melbourne

Point processes characterized by their one dimensional distributions

Abstract In this talk, I'll look at the relationship between uncorrelation and independence, and deduce the conditions that make these two concepts equivalent. These conditions are then 'projected' to obtain the common structure of point processes, including the well-known Poisson process, whose distributions are specified by their one dimensional distributions.

Ilze Ziedins, The University of Auckland

Self-optimising state-dependent routing in parallel queues

Abstract It is well-known that adding extra capacity to queues in networks where individuals choose their own route can sometimes severely degrade performance, rather than improving it. We will discuss two examples of queueing networks containing batch service queues where this is the case under probabilistic routing, but where under state-dependent routing the worst case performance is no longer seen in numerical examples. This raises the more general question of whether giving arrivals more information about the state of the network can lead to better performance, and the performance of state-dependent routing with other types of queue, such as processor sharing.

This is joint work with Heti Afimeimounga, Lisa Chen, Mark Holmes, Bill Solomon, and, latterly, Niffe Hermansson and Elena Yudovina.

PRACTICAL INFORMATION

Contact

In case of urgent matters:

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School of Mathematics and Physics at UQ: +61 (0) 7 3365 3277
Women's College: +61 (0) 7 3377 4500
King's College: +61 (0) 7 3871 9600
University Security: Routine Security enquiries: +61 (0) 336 51234

Venue

The workshop is held at Women's College at the St. Lucia Campus of The University of Queensland.

Address: College Rd. St. Lucia QLD 4067.

Talks are in the College Playhouse.

Transportation

To and from the airport: A cab costs roughly $50 to the CBD or $70 to UQ St. Lucia Campus. You may ask the driver to "use the airport link tunnel". An alternative is to use AirTrain which connects to the CBD from which you can take a bus.

In and out of UQ: There is a CityCat ferry terminal at UQ as well as two major bus stop areas: UQ Chancellors Place and UQ Lakes (see maps below).

All public transport including trains, ferries and buses essentially require a "GoCard". This may be purchased at the NewsAgent at UQ and/or vending machines. Visit http://translink.com.au/ for all public transport schedules except for AirTrain which is on: http://www.airtrain.com.au/.

CityCat to and from the south bank/city: A nice possibility for a "self-excursion", perhaps on the late afternoon of Tuesday, July 9, is to take the CityCat to South Bank (5 stops from UQ) and have a stroll on South Bank and/or cross the pedestrian bridge to the Botanical Gardens. Alternative dining options with a nice view to the Story Bridge and Kangaroo Point cliffs, can be found by getting off the CityCat, 2 stops after South Bank, in Riverside.

To and from the workshop dinner: The workshop dinner is at CARAVANSERAI restaurant at 1-3 Dornoch Tce, West End. We will jointly leave from the lobby of Women's College on Wednesday at 17:45 and take a CityCat boat to the dinner.

See also the maps section below.

Meal Options

At Women's College: Breakfast is complementarity for guests of the Women's College and it is served during 7:00 – 9:00. People not staying at Women's College may purchase breakfast for $12. The college also offers dinner (not included in the accommodation price) for $15. Dinner is served during 17:30 – 19:00.

At UQ: There are several coffee shops and eateries on campus. Specific details are here: http://www.uq.edu.au/about/places-to-eat. Keep in mind, that things in Brisbane and especially on Campus close rather early.

Hawken Village: Located a kilometer away from Women's College and near King's College, Hawken Village has several eating options, a super market and a bottle shop.

Lunch will be served for the workshop participants. Lunch times are in the workshop schedule.

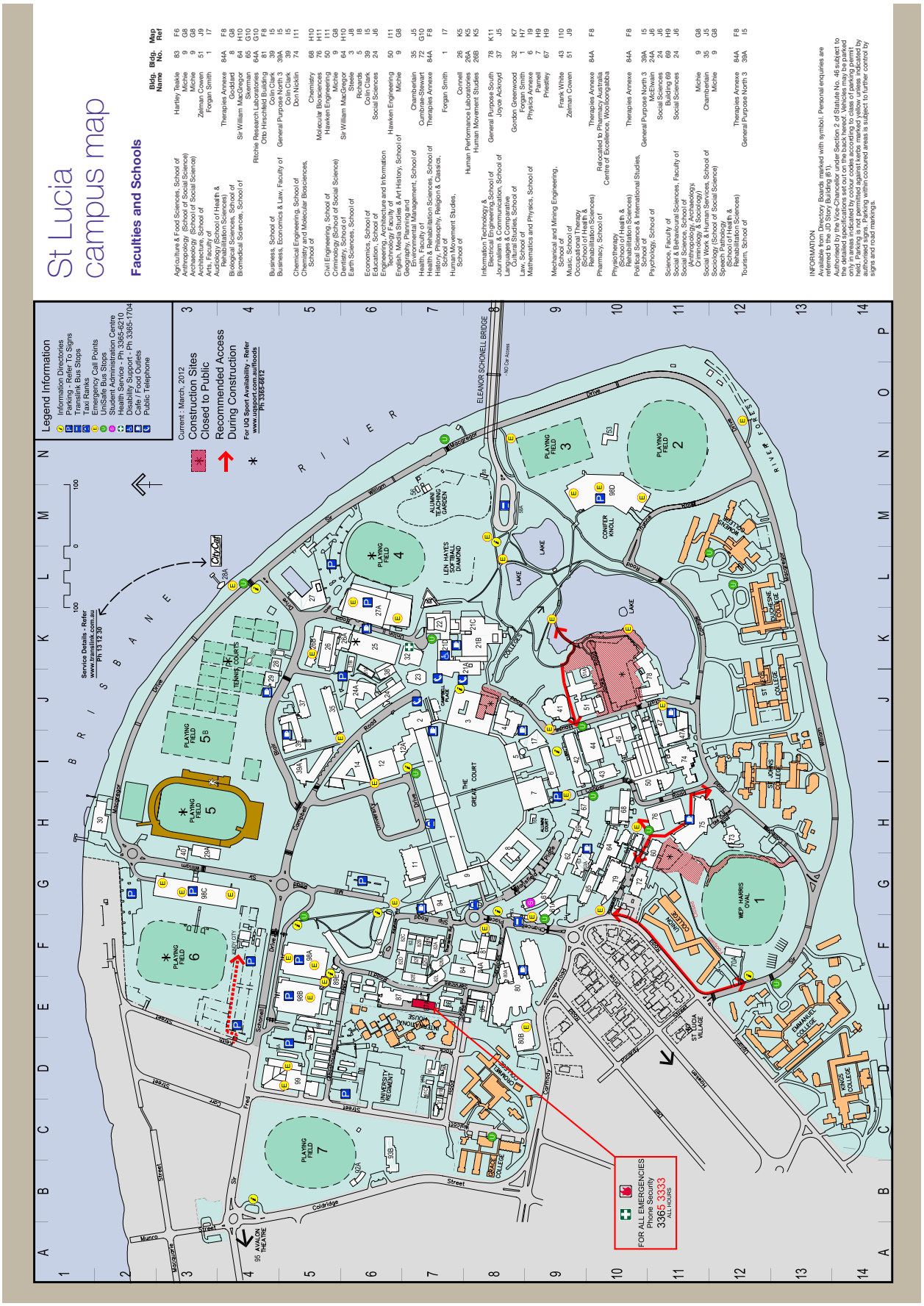
Internet Access

Eduroam wireless access is available at the common areas at Women's College. Note that the wireless reception at the rooms of Women's College is not guaranteed to be strong enough.

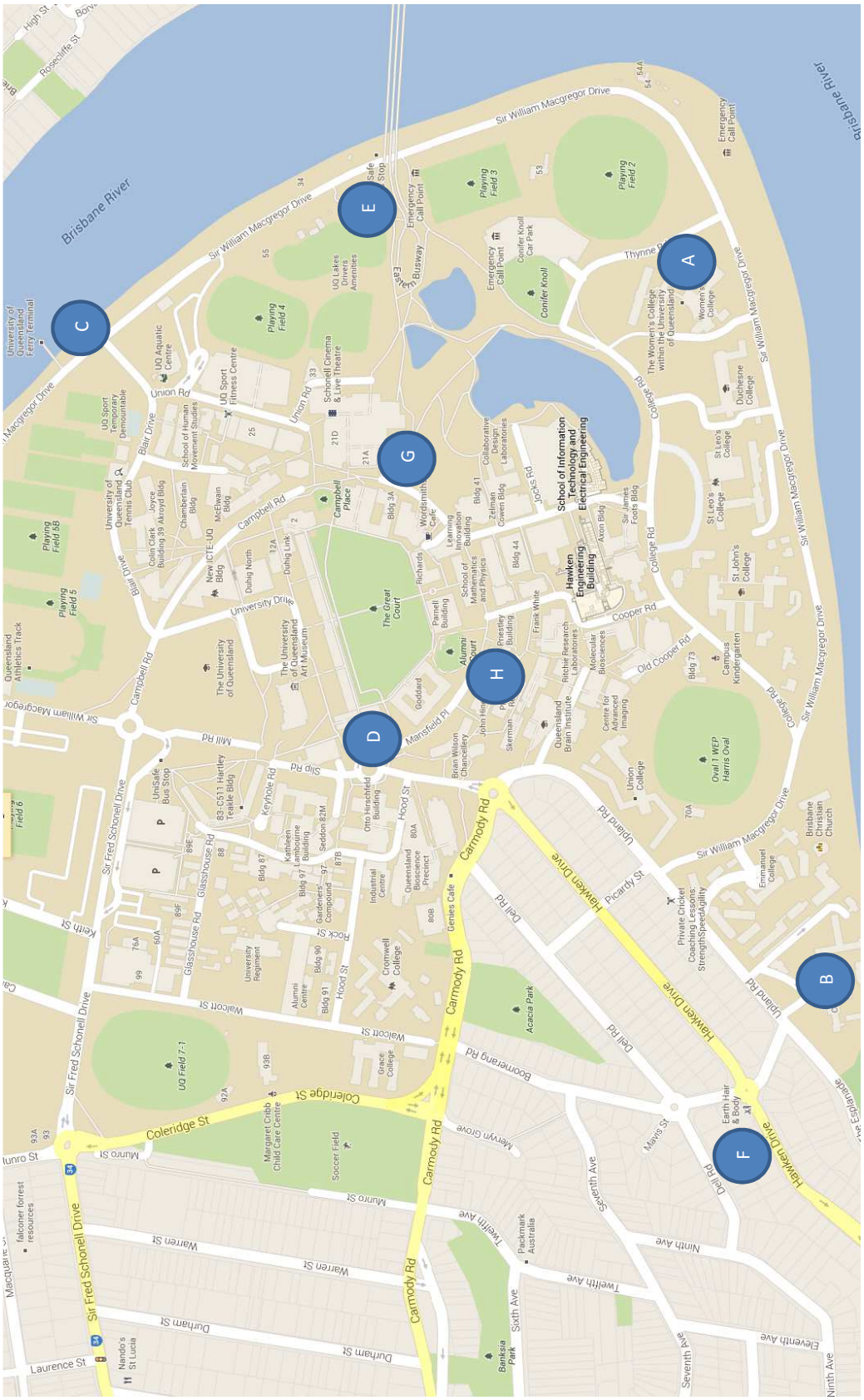
It is highly recommended that you verify with your home institution that Eduroam is set-up on your laptop and/or other devices. An alternative to Eduroam is to purchase a UQ Connect wireless access account at the reception of Women's College. $10 gives 350Mb. This can also be purchased at the newsagent at UQ.

Maps

Women's College is in M–12 in the map below:

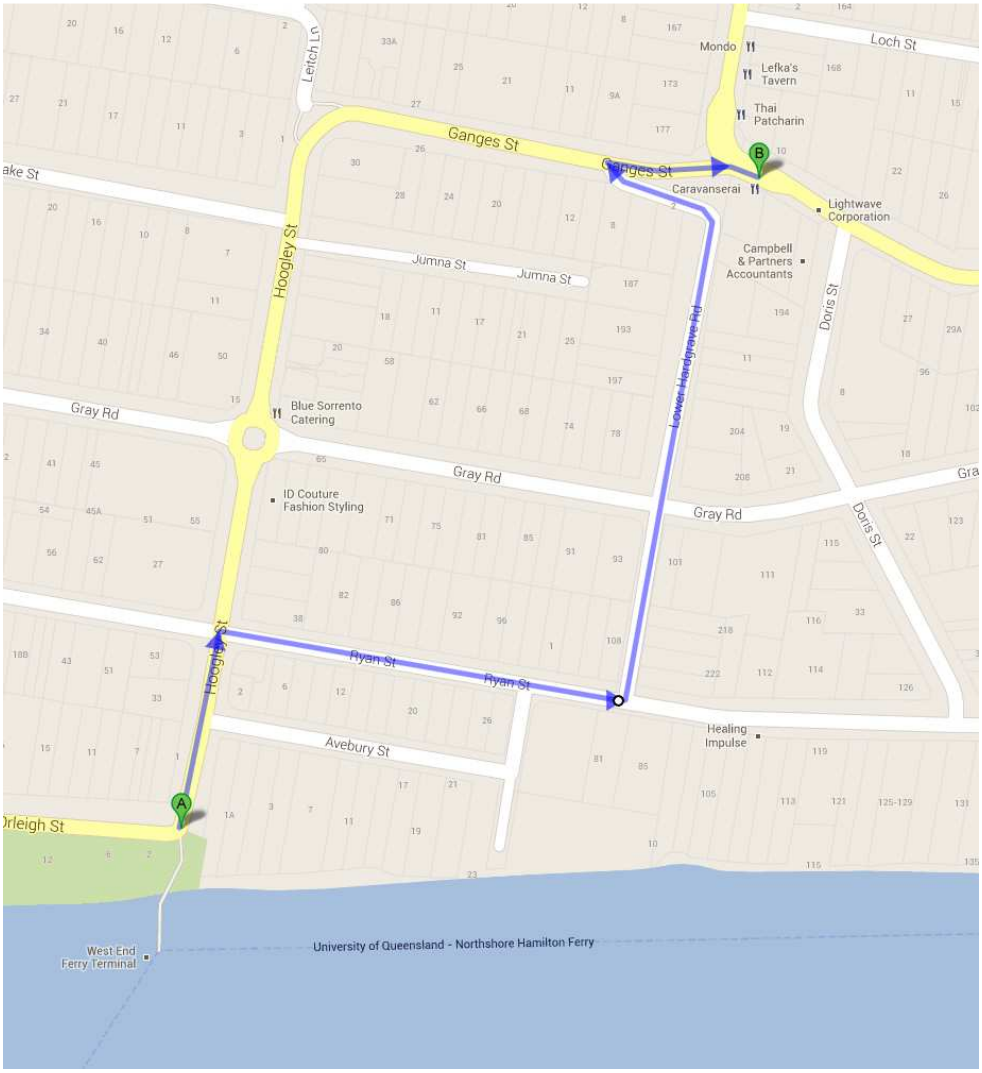


Here is another map highlighting some key spots around the campus:



Legend: (A) Women's College. (B) King's College. (C) UQ CityCat Ferry Terminal. (D) UQ Chancellor's place bus stops and taxi rank. (E) UQ Lakes bus stops. (F) Hawken Village. (G) News agent, ATM and other services. (H) Department of Mathematics.

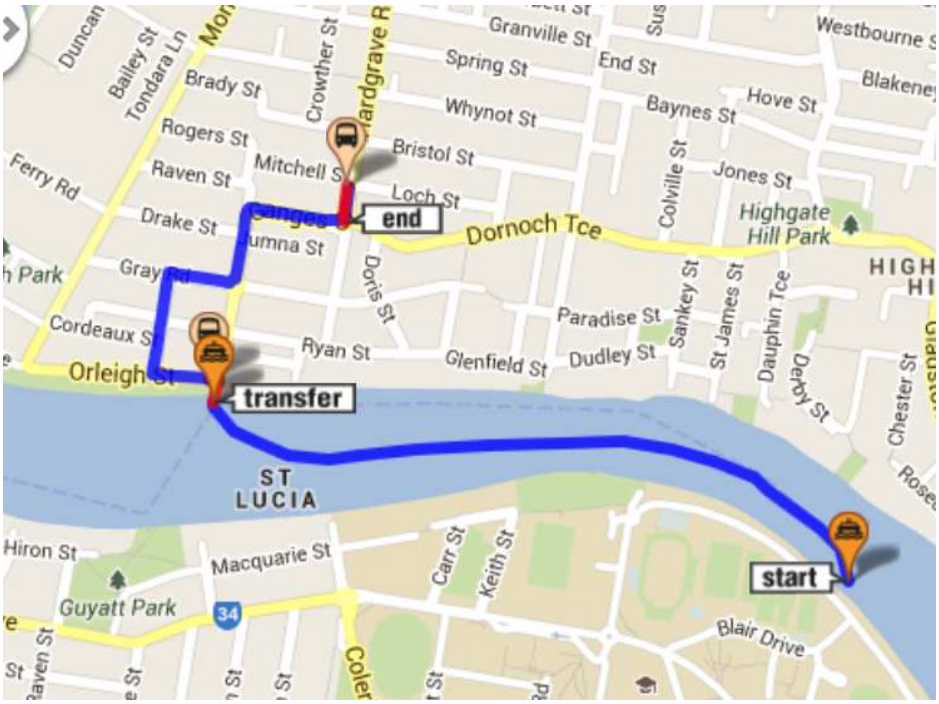
700m walk from West End Ferry Terminal to CARAVANSERAI Restaurant (Workshop Dinner):



Destination: CARAVANSERAI Restaurant1-3 Dornoch Tce, West End.

Map of CityCat Route from UQ CityCat Ferry Terminal to West End Ferry Terminal, followed by Bus Route (Bus 199) as alternative for walking to the Workshop Dinner. Get off at the third stop (stop number 12) and walk 50 meters back (red line in map) to CARAVANSERAI Restaurant.

Note that the fare paid for the CityCat (either by a ticket or GoCard) includes a transfer to the bus. Keep the CityCat ticket if applicable.



Destination: CARAVANSERAI Restaurant1-3 Dornoch Tce, West End.