THE AUSTRALIAN SOCIETY FOR OPERATIONS RESEARCH INCORPORATED

Recent Advances in Operations Research,

Wednesday 25 November 2009

At RMIT Access Grid Room 8.9.66

PROGRAMME

8.45 – 9.15	Registration
9.15 – 11.00	Gaurav Singh, Andreas Ernst, and David Sier *Rail Schedule Optimisation In The Hunter Valley Coal Chain* Riley Clement *Decision Support Tool, Optimisation, Lagrange Relaxation* A Ceglowski, R Sultana *Why do I have to wait so long at the emergency department?*
11.00 – 11.15	Morning Tea
11.15 – 12.45	Heng-Soon Gan, Charles Hu and Tony Wirth *Heuristics for Project Scheduling with Stochastic Crashing Durations* Tristan Barnett *Applying Risk Theory to Game theory* Geoff Robinson *Solving stochastic scheduling problems by dealing with uncertainty one component at a time*
12.45 – 1.45	Lunch
1.45 – 3.15	Robin Hill *A dynamic programming approach to the solution of infinite-dimensional linear programming problems with Toeplitz structure* James Foster *Alternative Energy Planning using Mixed Integer Prgramming* Alan Brown *A Tale about Tails*
3.15 – 3.30	Afternoon tea
3.30 – 5.00	Moshe Sniedevich *A Critique of Info-Gap Decision Theory: From Voodoo Decision-Making to Voodoo Economics* Andrew Eberhard *On a Primal Proximal Point Heuristic and the Feasibility Pump in Discrete Optimization* Dudley Foster *Student Projects: Reflections on 35 years Experience*

Title: **Rail Schedule Optimisation In The Hunter Valley Coal Chain**

Authors: Gaurav Singh, Andreas Ernst, and David Sier

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Abstract:
The Hunter Valley Coal Chain (HVCC) is the largest coal export operation in the world with total export of more than 90 million tonnes of coal in 2009. HVCC contains over 30 mines and the coal is exported by HVCC Logistics Team (HVCCLT) using over 20 coal load points spread across the region. Recently the CSIRO has developed a decision support tool to assist schedulers of HVCCLT in developing optimal schedules for rail operations. The tool reduces time taken to develop these schedules, and its fast execution time also allows schedulers to test the outcomes of various planning strategies before finalising the schedule. In this talk, we present the underlying mathematical model implemented in this decision support tool along with results from computational experiments. A demonstration of this decision support tool will also be presented.

Keyword(s):
Scheduling, Decision Support Tool, Optimisation, Lagrange Relaxation

TITLE: **Supply Chain management for Hunter Valley Coal Industry**

SPEAKER: Riley Clement
PhD student, University of Newcastle

ABSTRACT: Australia is the world's largest exporter of coal and is also home to Port Waratah Coal Services (PWCS), who export more coal by volume than any other export coal terminal in the world. PWCS service the Hunter Valley Coal Chain, which consists of 35 mines spread over 350km in the Hunter Valley.
Managing the supply chain requires the planning and coordination of train and ship movements, subject to a number of operational constraints. This task is critical as increasing coal export is limited by the capacity of the supply chain. Two mixed integer
programming (MIP) models are developed for producing a detailed rail and port schedule --- a time indexed formulation, and a positional date and assignment formulation. The performance of these models is compared using historical data provided by PWCS, and Gurobi, a commercially available solver for MIP optimisation problems.

Title: Why do I have to wait so long at the emergency department?

Process modelling and Complexity in Hospital Emergency Departments

A. Ceglowski (Monash University, Australia)

R.Sultana (Epworth Hospital, Australia)

Despite years of research, applied projects and lots of hard thinking y bright people, the problems of sporadic long waits for attention persist at most hospital emergency departments (EDs) around the world. Long waits are symptomatic of deeper ills such as ED overcrowding, exit blockage (when the associated hospital is unable or slow to admit ED patients) and ambulance bypass

(when ambulances have to be diverted to alternative EDs because the target Ed is unable to deal with new cases). Long waits might also affect the health and recovery time of the patient.
We have learnt a fair bit about the dynamics of EDs over the years. For instance, long waits are often triggered when patients are slow to leave the ED, often because there is not a bed available in the hospital to admit them to. Many EDs have implemented "short stay" units where patients can be "admitted" in order to overcome the problem of matching patients to ward beds. It's readily apparent that this is akin to increasing ED resources, so the measure works to some extent, until demand once again overwhelms available resources.
While the matter of hospital bed occupancy is very relevant to the ED state, it is "outside" the EDs control. Long waits for service are very obviously a resource issue (under the assumption that the clinical work is performed efficiently), so the question becomes one of balancing limited resources against the risk of triggering a queue for service. Measures to counter the problem of long wait times have concentrated on altering the queuing characteristics of the ED from a single preferential queue where patients are constantly rearranged according to triage class (most urgent patients "jump the queue" to be treated first) to multiple servers where non urgent patients also receive prioritised treatment ("fast track" initiatives), to other variations of multiple server systems based on their treatment (multitrack systems). As OR people we know that the most efficient use of resources is the single queue/multiple server option, so these options are just playing around the edges.
Better forecasting of future demand is one of the ways of reducing uncertainty where scarce resources have to meet fluctuating demand. Many researchers have followed this route. This paper will demonstrate how attempts to forecast patient arrival rates are bound to failure because the ED environment is inherently chaotic. It describes the complexity of ED queue composition and how this impacts upon patient wait times.

Title: Heuristics for Project Scheduling with Stochastic Crashing Durations

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ABSTRACT

Deterministic models for project scheduling ignore the potential detrimental effect of violating project deadline when random influences exist. Here we consider the problem of project scheduling under stochastic crashing durations with a finite project deadline. Under no resource constraint, the normal duration of jobs are deterministic but when crashed is randomly distributed. We aim to minimise the sum of job-crashing cost and the "loss" due to violation of the project deadline. Several heuristics are proposed for this problem, and some preliminary results are presented.

Title: Applying Risk Theory to Game Theory

Tristan Barnett
Victoria University

Abstract :
The *Minimax Theorem* is the most recognized theorem for determining strategies in a two-person zero-sum game. Other common strategies exist such as the *maximax principle* and *minimize the maximum regret principle*. All these strategies follow the Von Neumann and Morgenstern linearity axiom which states that numbers in the game matrix must be cardinal utilities and can be transformed by any positive linear function f(x)=ax+b, a>0 without changing the information they

convey. This talk describes risk-adverse strategies where the linearity axiom may not hold. Examples are given from zero-sum games, Prisoner's Dilemma from non-zero sum games and the *Nash arbitration scheme*.

TITLE: Solving stochastic scheduling problems by dealing with uncertainty one component at a time

SPEAKER Geoff Robinson

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Abstract:
We are interested in obtaining good solutions to large scheduling problems such as stockyards for bulk materials that involve many sources of uncertainty and are too large to be solved exactly. One way to make progress is to approximate the losses associated with schedules by considering the effects of one component of uncertainty at a time. This is computationally cheaper than simulation. In our first example, we find an approximate solution to the scheduling of one job on one machine in the presence of three sources of uncertainty.
The final example involves scheduling 50 jobs on 10 machines, including features such as: jobs which must be run on particular machines, precedences between jobs, uncertain release dates, and uncertain process times. Solutions based on deterministic evaluation, simulation and one component at a time are compared and discussed.

Title: A dynamic programming approach to the solution of infinite-dimensional linear programming problems with Toeplitz structure.

Speaker: Robin Hill
RMIT

Abstract: I will show how to construct the optimal solution to an infinite-dimensional linear programming problem with constraints described by a linear time-invariant dynamic system. The non-linear dynamics driving the optimal solution are identified explicitly. I work backwards in time from a known point on the optimal trajectory, using standard dynamic programming ideas strengthened by the use of duality. The optimal solution can be pictured geometrically as evolving on the boundary of a convex, compact, centrally-symmetric body in Euclidean space.

Title: Alternative energy planning using mixed-integer programming.

Speaker: James Foster
PhD student University of Newcastle

Abstract:
The expanding interest in renewable and alternative energy sources has suggested the need to find useful tools for planning new infrastructure. In the area of distributed generation, the traditional model of one power plant with many consumers has given way to a bilateral power flow model of interchanging demand and source nodes over the electricity distribution network. Our research has focused on using mixed-integer programming for the allocation of small-scale generators across a power system network with distributed generation in order to optimize energy efficiency.

We compare solutions of a model involving a mixed-integer nonlinear program (MINLP) with nonconvex quadratic constraints to models with approximate linearised convex constraints - on both the speed of solution and quality of network designs obtained - for a set of networks well-known in the power engineering literature ranging from 6 to 57 nodes. The programs are implemented in the AMPL system with the MINLP solver Bonmin.

Title: A Tale about Tails

Speaker: Alan Brown

Abstract

An investigation into a flawed model in sport exposed a fallacy caused by the use of an asymptotic formula in a situation where it produced unreliable results. At the same time an investigation into unsatisfactory investment results arising from the impact of the GFC was undertaken.

By mixing the two lines of study, it was found that “Balanced Superannuation is not balanced”. The wider implication, that other financial model results based Quadratic Programming may be unreliable, will be discussed.

Title: A Critique of Info-Gap Decision Theory: From Voodoo Decision-Making to Voodoo Economics

Moshe Sniedovich
Department of Mathematics and Statistics
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Abstract:

The title of this presentation is borrowed from a book that I am writing on my effort over the last six years to contain the spread of Info-Gap decision theory in Australia. However, the main question that I address in this presentation is not discussed in this book. Rather, it is one of the main questions addressed in my other book on this topic, which is tentatively entitled "The Rise and Rise of Voodoo Decision-Making". The basic question is this: given the very harsh and detailed criticism of this theory that is freely available and easily accessible to the public and which shows that this theory is a classic example of a voodoo decision theory, how is it that this fundamentally flawed theory is still promoted from the pages of respectable refereed journals? I address this fascinating question from an Operational Research perspective.

Title: On a Primal Proximal Point Heuristic and the Feasibility Pump in Discrete Optimization

Speaker: A. C. Eberhard (co author N. L. Boland)

Abstract: We provide some mathematical analysis that models the feasibility pump heuristic as a discrete version of a primal-proximal point algorithm involving a polyhedral norm. This provides model algorithm closely related to the feasibility pump. We peruse this paradigm to develop a number of other model algorithms closely related to the feasibility pump strategy. This is work in progress and awaits numerical experimentation.

Title: Student Projects: Reflections on 35 years Experience

Author: Dudley Foster.

Apart from 6 years as an academic, the author has spent most of the past 35 years as an OR practitioner, both within a corporate OR departments and as an external consultant. However, over the past 10 years, he has also developed a role as a specialist in the supervision student projects undertaken for organisations **external** to the university concerned. As might be expected, he has found that the issues pertaining to the management of client relations for such projects are very similar to those he encountered within a corporate OR department. The talk concentrates on experiences gained on the Masters in Logistics Management at RMIT (delivered in Hong Kong as well as Australia, the MBA at Victoria University (in both Kuala Lumpur and Melbourne) and, most recently, for the MSc in Operational Research at the University of Edinburgh. One of the keys to success with external projects, as with all projects is thorough problem definition and the author is a strong advocate for requiring students to produce a *Scoping Document*, which is not just something to be marked, but a commitment to provide constructive actionable written feedback from both the client and the supervisor.