ASOR
Recent Advances
in Operations Research

Welcome

Welcome to ASOR Recent Advances 2015.

This is our first event for the year, and continues a tradition of Recent Advances conferences stretching back many years. It is the first RA to be video-conferenced to so many cities. We are also pleased to welcome three presentations from our New Zealand (ORSNZ) colleagues.

Other upcoming ASOR events include the Worst Case Analysis Workshop in May 2015, the ASOR/MODSIM/DORS conference in December 2015, and the 2015 edition of monthly seminar series via video-conference hosted from Melbourne and Brisbane.

Presentation Format

Speakers should bring their presentation on a USB device, and have the presentation available in PDF or Powerpoint format.

Video Conference Numbers

The primary VC connections, info given below, are intended for use at the six host sites:

>   Day 1 09/02/15
>   title: ASOR Conference
>   mcu ip: 202.158.196.141
>   numeric id: 61262112642
>   Day 2 10/02/15
>   title: ASOR Conference Day 2
>   mcu ip: 202.158.196.141
>   numeric id: 61262112643

In case of problems, please contact local IT help, the ASOR hosts, or Steve Chapman at NICTA Canberra on 0478 407 838.

Our sincere thanks to NICTA, and especially Steve Chapman, for assistance in setting up the video conferencing, and for providing the VC bridge. Thanks also to our host sites for use of their facilities.

Conference Sites, Rooms and Contacts

MELBOURNE

RMIT City Campus, Swanston St, Melbourne
Building 8, Level 8, Room 13

Melih Ozlen, melih.ozlen@rmit.edu.au;
Simon Dunstall, simon.dunstall@csiro.au, 0417 330 231;
Paul Lochert, plochert@bigpond.com.au

BRISBANE

QUT Gardens Point Campus, Brisbane
Room 713, Block V
(Level Seven of the library building)

Andy Wong, aw3379@gmail.com;
Paul Corry, Paul.Corry@aurecongroup.com

ADELAIDE

UniSA Mawson Lakes campus,
Room GP2-39 (GP Building, Level 2, Room 39).

Amie Albrecht,
Amie.Albrecht@unisa.edu.au, 0407 399 071

CANBERRA

NICTA,
7 London Circuit, Canberra

Monday: Seminar Room L3.035

Tuesday: Ground Floor Seminar Room

Alan Lee, Alan.Lee@nicta.com.au

NEWCASTLE

U. Newcastle Callaghan Campus

Fabian Rigterink, fabian.rigterink@gmail.com

SYDNEY

University of Technology Sydney

Yakov Zinder, yakov.zinder@uts.edu.au

Presentations and Papers

Twenty-one abstract-only presentations, three keynote presentations, and three full papers have been accepted for this edition of the Recent Advances conference.

Except for keynotes, the presentations at Recent Advances have 25 minutes duration. We recommend that speakers use 20 minutes for slides, and leave 5 minutes for questions.

The full papers are in the final review stages and will be published in the next issue of the ASOR Bulletin, which is a ranked and indexed journal.

ASOR General Meeting

The ASOR AGM will be hosted from RMIT and will be teleconferenced nationally. The meeting commences promptly at 6pm AEDST (5pm Qld, 5.30pm SA, 3pm WA) on Monday 9 February.

The RMIT location is Building 13, Level 3, Room 9.

The audio teleconference line is hosted by CSIRO and can be connected-to using any standard landline or mobile. Please mute your phone when you are not speaking, so to keep background noise under control.

Dial-in numbers:

ACT: 02 6276 2888; VIC: 03 9545 8088;
NSW: 02 9490 8088; WA: 08 6436 8688;
SA: 08 8305 0688; TAS: 03 6232 5088;
QLD: 07 3214 2088; International: +61 2 6276 2888

Meeting ID: 0186

Abstracts

TIMES IN AEDST (Vic/NSW/ACT)

Melbourne, Monday 9:40

KEYNOTE PRESENTATION

Understanding strengths and weaknesses of optimization algorithms with new visualization tools and methodologies

Kate Smith-Miles, Monash University

Objective assessment of optimization algorithm performance is notoriously difficult, with conclusions often inadvertently biased towards the chosen test instances. Rather than reporting average performance of algorithms across a set of chosen instances, we discuss a new methodology to enable the strengths and weaknesses of different optimization algorithms to be compared across a broader instance space. Results will be presented on TSP, timetabling and graph coloring to demonstrate: (i) how pockets of the instance space can be found where algorithm performance varies significantly from the average performance of an algorithm; (ii) how the properties of the instances can be used to predict algorithm performance on previously unseen instances with high accuracy; (iii) how the relative strengths and weaknesses of each algorithm can be visualized and measured objectively; and (iv) how new test instances can be generated to fill the instance space and provide desired insights into algorithmic power.

Melbourne, Monday 10:20

Case Studies from Opturion

Mark Wallace, Opturion & Monash University

Melbourne, Monday 10:45

REFEREED PAPER

Optimal Selection of Whey Processing Facilities and Technology

<u>Rodolfo García-Flores,</u> CSIRO Digital Productivity

Ricardo Martins & Osmar Vieira de Souza, CEPEAD, Universidade Federal de Minas Gerais, Brazil

Pablo Juliano, CSIRO Food and Nutrition

This paper introduces a production-distribution model for whey utilisation that extends a globally inclusive facility location problem under the tenet that equipment selection during the initial stages of facility planning is critical. The model selects the optimal combination of processing equipment, facility locations and transportation routes subject to budget and operational constraints. The results inform the stakeholders on the infrastructure investments that better release the potential of their supply chain and avoid environmental damage. We analyse a cluster of small cheese makers in Brazil, and demonstrate that important

savings can be achieved by investing early on in adequate processing facilities.

The end of a hidden OR affair

Moshe Sniedovich, U. Melbourne

In this presentation I officially announce the end of the campaign that I launched at the end of 2006 whose aim was to contained the spread of info-gap decision theory (IGDT) in Australia. I explain the background and motivation for launching this unorthodox campaign as well as the reasons for its termination at the end of the year (2014) and its (hidden) OR content.

As far as the OR content is concerned, this affair is about decision making in the fact of severe non-probabilistic uncertainty with the aid of local robust optimization models. But far more interesting is its non-OR content, which is the role and place of rhetorics in our exposition, interpretation and understanding of mathematical models.

One of the main lessons learned from this affair is that, as far as the end-user is concerned, the rhetorics we use to describe formal OR methods and techniques can be as important as the technical content of these methods and techniques. Perhaps even more...

"Save a minute – save a day" in stroke thrombolysis: validating a complex decision-support model for investigation and improvement in health services

Mahsa Keshtkaran (1,2), Leonid Churilov (2,1), John Hearne (1), Babak Abbasi (1), Atte Meretoja (2)

(1) School of Mathematical and Geospatial Sciences, RMIT University; (2) Florey Institute of Neuroscience and Mental Health, University of Melbourne, Australia

Health services domain presents a rich and diverse context for decision modelling activities including those aimed at decision automation, routine decision-support, investigation and improvement and providing insights, as per the well-known Pidd's modelling taxonomy. For a decision-support model, the process of model validation provides enough evidence that within its domain of applicability the model possesses a satisfactory range of accuracy consistent with the intended application of the model. Models for investigation and improvement provide a particularly challenging task as far as validation is concerned due to their complex nature that often relies on a wide variety of data sources and empirical estimates for important parameters originating from the clinical literature that are used as model inputs, as well as on multiple conceptual and computational modelling techniques.

In this study, following an extensive literature review into the use of validation techniques for health care models in operations research literature, both published calls for systematic approaches for validation of complex operations research decision-support models, and a clear lack of relevant applications of validation techniques in many published health care models are identified. Subsequently, the model for evaluation of long-term benefits of faster access to thrombolysis therapy in acute ischaemic stroke is used as a case to demonstrate how multiple aspects of data validity, conceptual model validity, computerized verification, and operational model validity can be systematically addressed when developing a complex decision-support model for investigation and improvement in health services research.

Modelling with Coxian Phase Type distributions to better understand delays in stroke and cardiac emergency patient care processes

Hayden Johns (1,2),

Leonid Churilov (2,1)

Babak Abbasi (1)

(1) School of Mathematical and Geospatial Sciences, RMIT University; (2) Florey Institute of Neuroscience and Mental Health, University of Melbourne, Australia

Stroke and heart attack are debilitating and time-critical conditions. It is therefore important that emergency department processes are understood and streamlined to minimise delays in treating patients with such conditions.

Using data from a large metropolitan Melbourne health service, we present a comparative analysis of Emergency Department Length of Stay for stroke and heart attack patients using Coxian Phase Type Distributions. In particular, Coxian Phase Type distributions are fitted to model both total Length of Stay and time intervals between various well-understood emergency treatment milestones such as arrival, triage, doctor visitation, diagnosis and discharge across these two patient groups. We discuss the challenges of this method of analysis, and potential ways to overcome them. We also use simulation to provide empirical validation of a patient clustering method based on Coxian Phase Type distributions that is used to identify patient groups used in the comparative analysis.

By fitting Coxian Phase type distributions to emergency department length of stay data, we uncover a system described by 4 phases where it is possible to reach the absorption phase, and a number of "holding" phases that contribute to understanding systematic delays. Further analysis of times between treatment milestones suggest that stroke patients may experience systematic delays that cardiac patients do not experience.

REFEREED PAPER

A special case of the generalized pooling problem arising in the mining industry

Natashia Boland (1), Thomas Kalinowski (1), Fabian Rigterink (1) & Martin Savelsbergh (2)

(1) School of Mathematical & Physical Sciences, University of Newcastle, Australia; (2) H. Milton Stewart School of Industrial & Systems Engineering, Georgia Institute of Technology, USA

Iron ore and coal are substantial contributors to Australia's export economy. Both are blended products that are made-to-order according to customers' desired product qualities. Mining companies have a great interest in meeting these target qualities since deviations generally result in contractually agreed penal-ties. This paper studies a variation of the generalized pooling problem (GPP) arising in this context. The GPP is a minimum cost network flow problem with additional bilinear constraints to capture the blending of raw materials. In the variation we study, costs are not associated with network flows but with deviations from target qualities. We propose a bilinear program (BLP) that we solve locally using nonlinear programming solvers to obtain upper bounds. We linearly relax the BLP using McCormick relaxations and solve the resulting linear program (LP) to obtain lower bounds. A computational study on 26 instances, representing a real-life industry setting and having quarterly, half-yearly, annual and tri-annual planning horizons, shows that even for large-scale BLPs, these bounds can be calculated efficiently.

Newcastle, Monday 14:10

Dynamic blend optimization

Amir Salehipour, U. Newcastle

Dynamic blend optimization is about making blending decisions in a time dependent environment where supply of raw materials (coal components here) and demand for end products (blended coals) arrive at known points in time. Furthermore, the quality (grade) of raw materials changes over time as materials are extracted from the mines. We propose a mixed-integer linear programming formulation (MILP) for this dynamic blend optimization problem. The objective is to minimize the deviation from target end product qualities and late vessel arrival. An important goal of our study is to accurately model the changing quality of inventories using linear approximations. The study is motivated by a real-life industry setting.

Melbourne, Monday 14:40

KEYNOTE PRESENTATION

Delivering Software Tools to Support Analytics and Operations Research Users

Andrew Mason, U. Auckland

Melbourne, Monday 15:50

Towards Absolute Cargo Schedule Reliability in Container Liner Shipping: Distributionally Robust Optimization

Abraham Zhang, Department of Management Systems, University of Waikato Management School, New Zealand

Zhichao Zheng, Lee Kong Chian School of Business, Singapore Management University, Singapore

Chung Piaw Teo, Department of Decision Sciences, National University of Singapore Business School, Singapore.

Jasmine Siu Lee Lam, Division of Infrastructure Systems and Maritime Studies, School of Civil and Environmental Engineering, Nanyang Technological University, Singapore.

Container liner shipping is crucial to global supply chain performance as it is the primary mode of moving manufactured products across continents. Partly due to inherent uncertainties at sea and ports, the liner shipping industry has long had a notorious reputation of schedule unreliability. To the best of our knowledge, this research represents the first attempt that optimizes schedule reliability in liner shipping. We first define and formulate the vessel schedule reliability problem under a constant vessel speed. We then transform the two-stage stochastic optimization problem into a deterministic copositive programming problem by exploiting the connection between distributionally robust optimization and conic programming. The distributionally robust optimization approach does not assume the distributions of stochastic time parameters and only requires their first and second moment values which can be derived from historical data. We then extend the model to allow variable speeds. Using real data from Maersk Line, we demonstrate that our schedule performs in par with and sometimes outperforms a Daily Maersk service schedule, which has achieved more than 98% vessel schedule reliability in practice. More interestingly, we show how it is possible to achieve near 100% cargo schedule reliability without increasing the operating costs.

This research makes a theoretical contribution to define the unique research problem of schedule reliability in liner shipping. It solves a decade-long industrial problem and decodes the operational strategies of an innovative liner shipping service.

Melbourne, Monday 16:15

Improving aid mission planning and evaluation through analytics

Mark Allan, Anthony Downward, Jack McIvor & Andrea Raith (U. Auckland, New Zealand)

International aid is a multi-billion dollar a year industry. However, there have been many instances where the allocated funds have been badly spent, not only through corruption and incompetence, but also due to not fully understanding the culture and needs of the people receiving aid. For example, there are many instances where infrastructure is built and is later abandoned because systems were not put in place to ensure the infrastructure was maintained.

Often the aim of aid missions is to alleviate poverty; however, poverty comprises many attributes (such as education, health and economic prosperity). For this reason, we attempt to optimise the impact of aid missions

in a multi-objective setting. Specifically, we are optimising the impact of the projects undertaken in the mission, subject to various resource and personnel constraints.

Using an integer-programming methodology we have developed a decision support tool that presents the decision maker with a set of efficient solutions that be compared and further evaluated through online visualisations of the solutions.

Melbourne, Monday 16:40

REFEREED PAPER

Compatibilistic Analysis of Electricity Consumption Behaviours: Application in Operations Research

Omid Motlagh & George Grozev, CSIRO Land and Water

Electricity is an expensive commodity which is hard to store and that has to be available on demand. In operations research, demand forecast of different customers segments is used to decide for the optimal supply by the electricity utility. There are both deterministic and stochastic analysis methods on demand forecast in the literature. We introduce a moderate or compatibilistic approach to the problem using a feature-based analysis of demand profiles where profile features are associated with time series components such as trend and seasonality as well as deterministic factors such as household locality and demographics. The dataset consists of 400 households flagged as the control group in the recent Smart Grid Smart City project in New South Wales, Australia. The results include the market segmentation for July 2013 showing 10 distinct classes of customers with each class made up of high, medium, and low consumers yet with identical consumption behaviours. Indications about the future work and possible applications in policy planning and operations research are inclusive.

Melbourne, Monday 17:05

Engineering OR at City West Water

Ian Monks, City West Water

In 2013, City West Water reported on a number of projects that it had completed in its first two years and on others that it had in planning. Two years later we report progress on these projects, other projects that have been tackled, the maturing of our graduates and the challenges of doing OR in a commercial business

Brisbane, Tuesday 9:40

Recent Advances in Bulk Terminal Simulation

Paul Corry and Colin Eustace, Aurecon, Brisbane

Australia is one of the world's leading exporters of bulk materials such as iron ore and coal. Given the quantities of these materials being exported is within reach of 1 Giga-tonne per annum, the logistics infrastructure required is considerable on both the East and West coasts of Australia. Bulk terminals within Australia's major ports are a critical component of any bulk materials logistics chain and have been the subject of many simulation studies conducted by more than a handful of simulation providers operating in Australia. There are several approaches to modelling these systems, each with varying levels of detail and approximation. Terminal capacity is strongly dependent on reclaim rate from stockpiles and it is common to take reclaim rate as flat a nominal value, or if available an average value based on historical data. This can lead to errors in capacity estimates because reclaim rate is a dynamic variable, and average reclaim rate can change depending on terminal operating procedures and supply chain behaviour. In collaboration with mechanical and control systems engineers at Aurecon, we have developed a dynamic reclaim rate model and embedded this into our discrete event simulation library for bulk terminal simulation. This was a challenging exercise because it also requires modelling dynamic geometry of stockpiles in 3 dimensions, which is the key driver of reclaim rate dynamics. Modelling stockpile geometry comes with additional benefits in accurately capturing constraints on reclaiming due to slumping of material, and accurately capturing positional constraints and travel times required for reclaiming and stacking equipment. There is also potential for modelling of more complex aspects of terminal operation such as blending quality and operating procedures for managing spontaneous combustion risk in coal stockpiles

Brisbane, Tuesday 10:05

Analytical techniques for railway capacity determination and expansion

Robert Burdett, QUT

A comprehensive set of analytical models have been proposed for railway capacity determination and for capacity expansion planning. Return paths and cycling trains, track duplications and track sub divisions were considered. Non-linearities present in the formulations have been linearized and hence standard MIP solvers can be used. The developed MIP models have been applied successfully to a case study to demonstrate their worth.

Sydney, Tuesday 10:35

KEYNOTE

Scheduling Algorithms: Domain, Strength, Dominance

Yakov Zinder

Sydney, Tuesday 11:40

Class formation and multiple courses sequencing

Oliver G. Czibula (1,2)

Hanyu Gu & Feng-Jang Hwang (1),

Mikhail Y. Kovalyov (3)

Yakov Zinder (1)

(1) University of Technology Sydney; (2) Ausgrid; (3) United Institute of Informatics Problems, National Academy of Sciences of Belarus.

In this presentation, we discuss the problem of forming and sequencing classes of students for multiple courses subject to a single, bottleneck classroom with an ordered bi-criteria objective. In this ordered bi-criteria problem, an optimal solution is one that minimises the secondary objective over the set of solutions that minimise the primary objective. We modelled the studied problem as a single-machine batch scheduling problem with incompatible job families and parallel job processing in batches, where the batch size is family-dependent. We prove that the objective to minimise the total number of tardy jobs is NP-hard in the strong sense. We consider the case where each job has primary and secondary non-decreasing cost functions of job completion time. For the objective of the maximum cost over the schedule over each of the jobs, we consider both the single and bi-criteria cases. We present an $O(mn + n^2 \log n)$ algorithm for both cases, where m is the number of job families and n is the number of jobs. We present and computationally test an integer programming model as well as simulated annealing and genetic algorithm matheuristics to solve the bi-criteria problem.

Scheduling With Precedence Constraints in the Form of an Interval Order

Samuel Walker & Yakov Zinder, UTS

This presentation extends a well-known result in the area of scheduling theory. Specifically, the considered problem is to schedule tasks on identical parallel machines with the goal of minimising the maximum lateness. Pre-emptions are allowed and the tasks are subject to precedence constraints in the form of an arbitrary interval order. Previously, it was known to be possible to construct an optimal schedule, i.e. a schedule that minimises the makespan, using a linear program. However, the number of variables in the resultant linear program is exponential in the number of machines on which the tasks are to be scheduled. In this presentation, new results regarding the nature of interval orders are derived, and these results are used to construct a much smaller linear program, allowing the problem to be solved in an amount of time which is polynomial in the number of tasks to be scheduled

A Matheuristic Procedure for Capacity Planning in Supply Chains of Mineral Resources

Joey Fung (UTS), Gaurav Singh (CSIRO) & Yakov Zinder (UTS)

The talk presents an optimisation procedure aimed at finding a cost effective capacity expansion for a given scenario of future demand in supply chains of mineral resources. Determining a cost effective capacity expansion is an important managerial problem due to the high cost and long lead-time for building additional infrastructure. The optimisation procedure is a matheuristic - the result of the hybridisation of mathematical programming with metaheuristics. The presented matheuristic is comprised of

two optimisation engines, a mixed integer linear program (MILP) and a simulated annealing based scheduler. The optimisation procedure is iterative in nature and has the following distinctive features:

• the MILP and the scheduler use different levels of data aggregation and tackle different mathematical problems;

• the solution obtained by each optimisation engine guides the optimisation in the other; and

• the interaction of the optimisation engines is designed as a solution process of a bi-criteria optimisation problem.

The talk also presents the results of computational experiments which used data obtained from an Australian coal supply chain.

Worst-case analysis of the Brucker-Garey-Johnson algorithm

Julia Memar & Yakov Zinder, UTS

This presentation is concerned with the maximum lateness scheduling problem with parallel identical machines. It is assumed that the tasks are partially ordered, have arbitrary processing times, and the preemptions of tasks' processing are not allowed. Despite of its role in the theory and practice, much less is known about this version of the maximum lateness problem than about the two other cases: the case where all tasks have unit execution times and the case where tasks have arbitrary processing times but can be processed with preemptions.

This presentation addresses this gap in the literature by providing a tight worst-case performance guarantee for a polynomial-time approximation algorithm that can be viewed as a modification of the Brucker-Garey-Johnson algorithm (1977), which was originally developed as an exact algorithm for the unit execution time tasks and precedence constraints in the form of an in-tree.

The presented worst-case performance guarantee is tight for arbitrary large instances of the considered maximum lateness problem. If all tasks have unit execution times, the bound coincides with the tight worst-case performance guarantee in Singh & Zinder (2000)

Estimating the capability for future insertions in logistics schedules

Alan Lee (NICTA) & Phil Kilby (NICTA & ANU)

Finding efficient routes for delivery vehicles is a classical Operations Research problem and has inspired almost countless papers and endless research hours. However, this approach often assumes a static set of customers, fixed over the entire planning period. In contrast, delivery firms can have high customer turn-over rates, leading to a search for low--cost schedules which can accommodate the insertion of new customers (and remain efficient given

the removal of others). To maintain good customer relations, accommodating these changes must not alter the delivery windows for existing customers. The difficulties imposed by dynamic customer sets has received very little consideration in the literature (even though it can be extended to many VRP variants). We present an analytical geometric process to measure the robustness of a schedule to these changes. The procedure allows us to assign a robustness ``score'' without simulation or statistical analysis. We use small cases to illustrate the characteristics desirable schedules have. We also present computational experiments showing the potential profitability benefits from using robust schedules.

Canberra, Tuesday 14:30

Cardinality Constrained Multi-Cycle Problem (CCmCP) on Directed Graphs with or without Chains

Vicky Mak, Deakin University

Canberra, Tuesday 14:55

Disruption management in a supply chain system

Sanjoy Kumar Paul & Ruhul Sarker (School of Engineering and Information Technology, UNSW, Canberra)

In this presentation, two quantitative models are proposed for managing disruption in production-inventory and supply chain system. First, a production disruption management model is introduced in a single-stage batch production-inventory system, where the system can face either a sudden or multiple production disruptions, for a certain period of time. Second, a supply disruption management model is introduced in a three-tier supply chain with multiple suppliers and retailers, where the system may face sudden disruption in its raw material supply. To do these, we formulated a mathematical model for ideal conditions and then reformulated it to revise the plan after the occurrence of a disruption, for a future period, to recover from the disruption. We developed a solution approach to solve the model for a single disruption. We also extended the solution approaches for managing multiple disruptions, one after another as a series, on a real-time basis. We also compared the results with another standard solution approach for a good number of randomly generated test problems. We also presented numerical examples and random experimentations to explain the usefulness of the proposed approach.

Adelaide, Tuesday 15:25

The Armoured Breaching and Bridging Study 2014

Richard Dexter, Kerryn Owen, Julia Piotto, Marcus Tregenza (Joint and Operations Analysis Division, DSTO)

The Armoured Breaching and Bridging Study (ABBS) was executed in 2014 to determine the best mix of Breaching and Bridging capabilities for the Australian Army's Combat Brigade to satisfy most combat breaching situations. The study examined the impact of the environment, enemy threat and specific obstacles types on the effectiveness of various breaching capabilities.

Given the significant constraints of time, lack of access to empirical data and the size and scope of the problem space a refined method was adopted to address the issue. A Comparative Risk Analysis of Capability, a modification of the Australian Standard (ISO AS/NZS 31000) and the Military Risk Management process, was designed and conducted to provide the Army with a better understanding of which sets of breaching and bridging capabilities could be deployed to attack specific obstacle arrays with the lowest levels of risk.

The analysis method is designed to allow groups of expert participants to conduct assessments of the risks to specific systems within tightly defined contexts. The method provides participants with sufficient capability and context data to allow assessments to be made quickly and the design of the activity provides confidence in the data outputs.

Subsequent analysis of the data gathered during ABBS revealed specific clusters of bridging and breaching capabilities and provides insights into why specific sets of capabilities yielded certain risk levels.

The ABBS presentation will describe the problem, experiment design, conduct of the activity and subsequent data analysis.

Adelaide, Tuesday 16:15

Energy-efficient train timetables

Amie Albrecht

Melbourne, Tuesday 16:40

Electricity demand projections in Australia's National Electricity Market

Vianney Petit, CSIRO

This paper presents an analysis of historical electricity demand trends in Australia, followed by the modelling of the demand on 30-minute periods. The aim is to identify parameters influencing demand that can be used in the modelling, and to obtain a model as close as possible to real data. Specifically, demand is analysed for different periods ranging from one day to several years in each State of the National Electricity Market (Queensland, Victoria, New South Wales, South Australia, and Tasmania). It emphasizes the influence of climate data on demand, as well as human activities and consumer population. From this analysis a few models of the electricity demand in Queensland are developed, based on climate data, the type of day (weekdays and weekend days) and intraday periods. These models are built by adding parameters step by step on 30-minute historical data sets, including the type of day, temperature, dew point temperature. At each stage a new parameter is added as a correction on the previous model. Two ranges of models are produced for two levels of accuracy, the second one using time in day as an additional parameter. These models are then applied to

forecast demand in another year, which was achieved with reasonable accuracy despite no growth factor was applied.

Recursive cube of rings as a Cayley graph for interconnection networks

Hamid Mokhtar & Sanming Zhou, Department of Mathematics and Statistics, University of Melbourne

There has been significant research to design efficient communication networks with applications in parallel computing. In this paper, we study *recursive cube of rings*, recently introduced in the literature, for which our knowledge is very limited despite their advantages over well-known networks. We prove they are Cayley graphs under some necessary and sufficient condition and also give their diameter, forwarding indices, edge-bisection width and a shortest path algorithm. Furthermore, we show that the well-known cube-connected cycle and cube of rings are special cases of recursive cube of rings.

RECENT ADVANCES 2015 – FULL SCHEDULE

MONDAY 9 FEBRUARY (all times VIC/NSW/ACT daylight savings)

START	DURATION	VENUE	TYPE	SPEAKER	TITLE
9:30	10	MELB	Opening	Simon Dunstall	
9:40	40	MELB	Keynote	Kate Smith-Miles	Understanding strengths and weaknesses of optimization algorithms with new visualization tools and methodologies
10:20	25	MELB	Abstract-Only	Mark Wallace	
10:45	25	MELB	Refereed Paper	Rodolfo Garcia-Flores	Optimal Selection of Whey Processing Facilities and Technology
11:10	30		MORNING TEA		
11:40	25	MELB	Abstract-Only	Moshe Sniedovich	The end of a hidden OR affair
12:05	25	MELB	Abstract-Only	Mahsa Keshtkaran	"Save a minute – save a day" in stroke thrombolysis: validating a complex decision-support model for investigation and improvement in health services
12:30	25	MELB	Abstract-Only	Hayden Johns	Modelling with Coxian Phase Type distributions to better understand delays in stroke and cardiac emergency patient care processes
12:55	50		LUNCH		
13:45	25	NEWC	Refereed Paper	Fabian Rigterink	A special case of the generalized pooling problem arising in the mining industry
14:10	25	NEWC	Abstract-Only	Amir Salehipour	Dynamic Blend Optimisation
14:35	5		VENUE CHANGE		
14:40	40	MELB	Keynote	Andrew Mason	Delivering Software Tools to Support Analytics and Operations Research Users
15:20	30		AFTERNOON TEA		
15:50	25	MELB	Abstract-Only (ORSNZ)	Abraham Zhang	Towards Absolute Cargo Schedule Reliability in Container Liner Shipping: Distributionally Robust Optimization
16:15	25	MELB	Abstract-Only (ORSNZ)	Anthony Downward	Improving aid mission planning and evaluation through analytics
16:40	25	MELB	Refereed Paper (in review)	Omid Motlagh	Compatibilistic Analysis of Electricity Consumption Behaviours: Application in Operations Research
17:05	25	MELB	Abstract-Only	Ian Monks	Engineering OR at City West Water
17:30	30	MELB	Break		
18:00	30	MELB	ASOR NATIONAL ANNUAL GENERAL MEETING		
18:30			Close		

TUESDAY 10 FEBRUARY (all times VIC/NSW/ACT daylight savings)

START	DURATION	VENUE	TYPE	WHO	TITLE / ACTION
9:30	10	QLD	Opening	Andy Wong	
9:40	25	QLD	Abstract-Only	Paul Corry	Recent Advances in Bulk Terminal Simulation
10:05	25	QLD	Abstract-Only	Robert Burdett	Analytical techniques for railway capacity determination and expansion
10:30	5		VENUE CHANGE		
10:35	40	SYD	Keynote	Yakov Zinder	Scheduling Algorithms: Domain, Strength, Dominance
11:15	25		MORNING TEA		
11:40	25	SYD	Abstract-Only	Oliver Czibula	Class formation and multiple courses sequencing
12:05	25	SYD	Abstract-Only	Samuel Walker	Scheduling With Precedence Constraints in the Form of an Interval Order
12:30	25	SYD	Abstract-Only	Joey Fung	A Matheuristic Procedure for Capacity Planning in Supply Chains of Mineral Resources
12:55	25	SYD	Abstract-Only	Julia Memar	Worst-case analysis of the Brucker-Garey-Johnson algorithm
13:20	45		LUNCH		
14:05	25	CBR	Abstract-Only	Lee & Kilby	Estimating the capability for future insertions in logistics schedules
14:30	25	CBR	Abstract-Only	Vicky Mak	Cardinality Constrained Multi-Cycle Problem (CCmCP) on Directed Graphs with or without Chains
14:55	25	CBR	Abstract-Only	Ruhul Sarkar	
15:20	5		VENUE CHANGE		
15:25	25	ADE	Abstract-Only	Julia Piotto	The Armoured Breaching and Bridging Study 2014
15:50	25		AFTERNOON TEA		
16:15	25	ADE	Abstract-Only	Amie Albrecht	Energy-efficient train timetables
16:40	25	MELB	Abstract-Only	Vianney Petit	Electricity demand projections in Australia's National Electricity Market
17:05	25	MELB	Abstract-Only	Hamid Mokhtar	Recursive cube of rings as a Cayley graph for interconnection networks
17:30	5		Wrap-up		
17:35			Close		