



2017 ORSNZ Annual Conference  
(with the NZSA / IASC-ARC conference)

## Conference Welcome

The organising committee for ORSNZ 2017, and University of Auckland are delighted to welcome delegates to the 51st Annual Conference of the Operational Research Society of New Zealand. We are especially pleased to have ORSNZ 2017 running in parallel to NZSA/IASC-ARS this year. We wish delegates a successful and interesting conference and hope you also get a chance to enjoy beautiful Auckland city, New Zealand.

## Conference Organising Committee

**A/Prof Cameron Walker**

*Department of Engineering Science, University of Auckland*

**Dr Tony Downward**

*Department of Engineering Science, University of Auckland*

**A/Prof Golbon Zakeri**

*Department of Engineering Science, University of Auckland*

**Dr Michael O’Sullivan**

*Department of Engineering Science, University of Auckland*

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## Sponsors



**ENGINEERING**



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<b>Presenters' Abstracts .....</b>	<b>13</b>

# Programme

Time	Monday 11 December							
0845	Housekeeping, 098 Lecture Theatre (260-098)							
0850	Opening Ceremony							
0910	<b>R in Times of Growing User Base and Data Sizes</b> <b>Simon Urbanek, AT&amp;T Labs, USA</b> 098 Lecture Theatre (260-098)							
<b>1000</b>	<b>Morning Tea (30 minutes)</b>							
	<b>098 Lecture Theatre (260-098)</b>	<b>OGGB4 (260-073)</b>	<b>OGGB5 (260-051)</b>	<b>Case Room 2 (260-057)</b>	<b>Case Room 3 (260-055)</b>	<b>Case Room 4 (260-009)</b>	<b>ORSNZ Case Room 1 (260-005)</b>	
1030	Robust Principal Expectile Component Analysis <b>Liang-Ching Lin</b>	Effect Of Area Level Deprivation On Body Mass Index: Analysis Of Nz Health Surveys <b>Andrew Adiguna Halim</b>	Calendar-Based Graphics For Visualising People'S Daily Schedules <b>Earo Wang</b>	Nonparametric Test For Volatility In Clustered Multiple Time Series <b>Paolo Víctor Redondo</b>	IGESS: A Statistical Approach To Integrating Individual Level Genotype Data And Summary Statistics In Genome Wide Association Studies <b>Xiang Wan</b>	Author Name Identification For Evaluating Research Performance Of Institutes <b>Tomokazu Fujino</b>	YPP (Student) Sessions  <a href="#">1030: A study on bid and budget optimization for sponsored search - Harish Krishna</a>	
1050	A Computational Tool For Detecting Copy Number Variations From Whole Genome And Targeted Exome Sequencing <b>Yu-Chung Wei</b>	Clustering Using Nonparametric Mixtures And Mode Identification <b>Shengwei Hu</b>	Bayesian Curve Fitting For Discontinuous Function Using Overcomplete Representation With Multiple Kernels <b>Youngseon Lee</b>	Estimation Of A Semiparametric Spatiotemporal Models With Mixed Frequency <b>Erniel Barrios</b>	Lsmm: A Statistical Approach To Integrating Functional Annotations With Genome-Wide Association Studies <b>Jingsi Ming</b>	A Study Of The Influence Of Articles In The Large-Scale Citation Network <b>Frederick Kin Hing Phoa</b>	<a href="#">1045: Ultra-capacitor electric buses: Efficient placement of charging infrastructure within existing bus networks - Russell Stewart</a>	
1110	Estimating links of a network from time to event data <b>Tso-Jung Yen</b>	Estimation Of A High-Dimensional Covariance Matrix <b>Xiangjie Xue</b>	Innovative Bayesian Estimation In The Von-Mises Distribution <b>Yuta Kamiya</b>	Evidence Of Climate Change From Nonparametric Change-Point Analysis <b>Angela Nalica</b>	Joint Analysis Of Individual Level Genotype Data And Summary Statistics By Leveraging Pleiotropy <b>Can Yang</b>	An Advanced Approach For Time Series Forecasting Using Deep Learning <b>Balaram Panda</b>	<a href="#">1115: Improvements in Water Resource Planning - Oleg Barbin [11:00] Short-Term Modelling of Electricity Prices in New Zealand - Alan Ansell</a>	
1130		Genetic Map Estimation Using Hidden Markov Models In The Presence Of Partially Observed Information <b>Timothy Bilton</b>	A Simple Method For Grouping Patients Based On Historical Doses <b>Shengli Tzeng</b>	Semiparametric Mixed Analysis Of Covariance Model <b>Joseph Ryan Lansangan</b>	Adaptive False Discovery Rate Regression With Application In Integrative Analysis Of Large-Scale Genomic Data <b>Can Yang</b>	Structure Of Members In The Organization To Induce Innovation: Quantitatively Analyze The Capability Of The Organization <b>Yuji Mizukami</b>	<a href="#">1130: Piecewise linear supply offers in the NZ Electricity Market - Weiming Zhi</a>	
1150		Vector Generalized Linear Time Series Models <b>Victor Miranda</b>	Local Canonical Correlation Analysis For Multimodal Labeled Data <b>Seigo Mizutani</b>	A Practitioners Guide To Deep Learning For Predictive Analytics On Structured Data <b>Balaram Panda</b>		Clustering Of Research Subject Based On Stochastic Block Model <b>Keisuke Honda</b>	<a href="#">1145: SDDP.jl: a Julia package for Stochastic Dual Dynamic Programming - Oscar Dowson</a>	
<b>1210</b>	<b>Group photo, followed by Lunch (1 hour 10 minutes)</b>							
1320	<b>Zen And The aRt Of Workflow Maintenance</b> <b>Jenny Bryan, University of British Columbia</b> 098 Lecture Theatre (260-098)							

	<b>098 Lecture Theatre (260-098)</b>	<b>OGGB4 (260-073)</b>	<b>OGGB5 (260-051)</b>	<b>Case Room 2 (260-057)</b>	<b>Case Room 3 (260-055)</b>	<b>Case Room 4 (260-009)</b>	<b>ORSNZ Case Room 1 (260-005)</b>
1410	Canonical Covariance Analysis For Mixed Numerical And Categorical Three-Way Three-Mode Data <b>Jun Tsuchida</b>	Variable Selection Algorithms <b>Fangyao Li</b>	Estimating Causal Structures For Continuous And Discrete Variables <b>Mako Yamayoshi</b>	Incorporating Genetic Networks Into Case-Control Association Studies With High-Dimensional Dna Methylation Data <b>Hokeun Sun</b>	Adaptive Model Checking For Functional Single-Index Models <b>Zhenghui Feng</b>	Mobile Learning In Teaching Bioinformatics For Medical Doctors <b>Taerim Lee and Jung Jin Lee</b>	YPP (Student) Sessions  <a href="#">1410: Modelling Traffic Assignment Objectives with Emission Cost Functions - James Tidwell</a> <a href="#">1440: Balancing Physician Workloads Under Uncertain Admissions - Tom Adams [14:25]</a> <a href="#">Solving a Generalised Staff Rostering Problem - Isaac Cleland</a> <a href="#">1455: Mathematical model to determine optimal investment for battery and solar power for shifting the load from peak to off-peak, from the point of view of line companies - J.M Omar Khaiam</a> <a href="#">1510: Ambulance simulation and optimisation - Samuel Ridler</a>
1430	On Optimal Group Testing Designs: Prevalence Estimation, Cost Considerations, And Dilution Effects <b>Shih-Hao Huang</b>	The Use Of Bayesian Networks In Grape Yield Prediction <b>Rory Ellis</b>	Pattern Prediction For Time Series Data With Change Points <b>Satoshi Goto</b>	Test For Genomic Imprinting Effects On The X Chromosome <b>Wing Kam Fung</b>	Fluctuation Reduction Of Value-At-Risk Estimation And Its Applications <b>Shih-Feng Huang</b>	E-learning courses on introductory statistics using interactive educational tools <b>Kazunori Yamaguchi</b>	
1450	Estimation Of Animal Density From Acoustic Detections <b>Ben Stevenson</b>	Mixed Models For Complex Survey Data <b>Xudong Huang</b>	Regression With Random Effects For Analysing Correlated Survival Data: Application To Disease Recurrences <b>Richard Tawiah</b>	Genetic Predictors Underlying Long-Term Cognitive Recovery Following Mild Traumatic Brain Injury <b>Priya Parmar</b>	Bayesian Structure Selection For Vector Autoregression Model <b>Ray-Bing Chen</b>	Three-Dimensional Data Visualization Education With Virtual Reality <b>Dae-Heung Jang</b>	
1510	Talk Data To Me <b>Lisa Hall</b>	Smooth Nonparametric Regression Under Shape Restrictions <b>Hongbin Guo</b>	Elastic-Band Transform: A New Approach To Multiscale Visualization <b>Guebin Choi</b>	Meta-Analytic Principal Component Analysis In Integrative Omics Application <b>Sunghwan Kim</b>	Flight To Relative Safety: Learning From A No-Arbitrage Network Of Yield Curves Model Of The Euro Area <b>Linlin Niu</b>		
<b>1530</b>	<b>Afternoon tea (30 minutes)</b>						
	<b>098 Lecture Theatre (260-098)</b>	<b>OGGB4 (260-073)</b>	<b>OGGB5 (260-051)</b>	<b>Case Room 2 (260-057)</b>	<b>Case Room 3 (260-055)</b>	<b>Case Room 4 (260-009)</b>	<b>ORSNZ Case Room 1 (260-005)</b>
1600	Bayesian Analyses Of Non-Homogeneous Gaussian Hidden Markov Models <b>Shin Sato</b>	Robustness Of Temperature Reconstruction For Past 500 Years <b>Yu Yang</b>	Nonparametric Causal Inference By The Kernel Method <b>Yuchi Matsuoka</b>	A Unified Regularized Group Pls Algorithm Scalable To Big Data <b>Pierre Lafaye de Micheaux</b>	Evaluation Of Spatial Cluster Detection Method Based On All Geographical Linkage Patterns <b>Fumio Ishioka</b>	Scoring Rules For Prediction And Classification Challenges <b>Matt Parry</b>	YPP (Student) Sessions  <a href="#">16:00: Co-optimization of Energy and reserve for a major consumer of electricity over a finite time horizon. - Mahbubeh Habibian</a> <a href="#">16:15: Upper and lower bounds for saddle functions - Regan Baucke</a> <a href="#">16:30: Integer Programming Optimization of Geothermal Production - Rishi Adiga</a> <a href="#">16:45: Computing the frustration index in signed graphs using binary programming - Samin Aref</a>
1620	Meta-Analysis With Symbolic Data Analysis And Its Application For Clinical Data <b>Ryo Takagi</b>	Real-Time Transit Network Modelling For Improved Arrival Time Predictions <b>Tom Elliott</b>	Visualization And Statistical Modeling Of Financial Big Data <b>Masayuki Jimichi</b>	Sparse Group-Subgroup Partial Least Squares With Application To Genomic Data <b>Matthew Sutton</b>	Genetic Approach And Statistical Approach For Association Study On Dna Data <b>Makoto Tomita</b>	Modeling Of Document Abstraction Using Association Rule Based Characterization <b>Ken Nittono</b>	
1640	Bayesian Static Parameter Inference For Partially Observed Stochastic Systems <b>Yaxian Xu</b>	Bayesian Survival Analysis Of Batsmen In Test Cricket <b>Oliver Stevenson</b>	Covariate Discretisation On Big Data <b>Hon Hwang</b>	Big-Sir A Sliced Inverse Regression Approach For Massive Data <b>Benoit Lique</b>	Symbolic Data Analytical Approach To Unauthorized-Access Logs <b>Hiroyuki Minami</b>	My Knee Still Hurts; The Statistical Pathway To The Development Of A Clinical Decision Aid <b>Robert Borotkanics</b>	
1800	<b>NZSA Young Statisticians Networking Evening</b> Bluestone Room, 9-11 Durham Ln, Auckland 1800 - 2000						

Tuesday 12 December							
0900	Housekeeping, 098 Lecture Theatre (260-098)						
0910	<b>Could Do Better &amp;hellip; A Report Card for Statistical Computing</b> <b>Ross Ihaka, University of Auckland</b> 098 Lecture Theatre (260-098)						
1000 Morning Tea (30 minutes)							
	098 Lecture Theatre (260-098)	OGGB4 (260-073)	OGGB5 (260-051)	Case Room 2 (260-057)	Case Room 3 (260-055)	Case Room 4 (260-009)	ORSNZ Case Room 1 (260-005)
1030	R&D Policy Regimes In France: New Evidence From A Spatio-Temporal Analysis <b>Benjamin Montmartin</b>	Analysing Scientific Collaborations Of New Zealand Institutions Using Scopus Bibliometric Data <b>Samin Aref</b>	Family Structure And Academic Achievements Of High School Students In Tonga <b>Losana Vao Latu Latu</b>	Analysis Of Multivariate Binary Longitudinal Data: Metabolic Syndrome During Menopausal Transition <b>Geoff Jones</b>	Clustering Of Curves On A Spatial Domain Using A Bayesian Partitioning Model <b>Chae Young Lim</b>	The Uncomfortable Entrepreneurs: Bad Working Conditions And Entrepreneurial Commitment <b>Catherine Laffineur</b>	<a href="#">Modelling Warranty Costs with a Generalised Alternating Renewal Process</a> <a href="#">Sarah Marshall</a>
1050	Spatial Surveillance With Scan Statistics By Controlling The False Discovery Rate <b>Xun Xiao</b>	Statistical Models For The Source Attribution Of Zoonotic Diseases: A Study Of Campylobacteriosis <b>Sih-Jing Liao</b>	Towards An Informal Test For Goodness-Of-Fit <b>Anna Fergusson</b>	Identifying Clusters Of Patients With Diabetes Using A Markov Birth-Death Process <b>Mugdha Manda</b>	Bayesian Temporal Density Estimation Using Autoregressive Species Sampling Models <b>Seongil Jo</b>	How Does The Textile Set Describe Geometric Structures Of Data? <b>Ushio Tanaka</b>	<a href="#">Improving estimation using order statistics</a> <b>Andy Philpott</b>
1110	Intensity Estimation Of Spatial Point Processes Based On Area-Aggregated Data <b>Hsin-Cheng Huang</b>	Bayesian Inference For Population Attributable Measures <b>Sarah Pirikahu</b>	An Information Criterion For Prediction With Auxiliary Variables Under Covariate Shift <b>Takahiro Ido</b>	Analysis Of A Brief Telephone Intervention For Problem Gambling And Examining The Impact On Co-Existing Depression? <b>Nick Garrett</b>	Prior-Based Bayesian Information Criterion <b>Woncheol Jang</b>	Correlated Defaults With A Distance To Default <b>Chu-Lan Kao</b>	Scholarly contributions of theory of constraints to operations management <b>Maram Mirzaei</b>
1130	Geographically Weighted Principal Component Analysis For Spatio-Temporal Statistical Dataset <b>Narumasa Tsutsumida</b>	Dimensionality Reduction Of Multivariate Data For Bayesian Analysis <b>Anjali Gupta</b>	An Ewma Chart For Monitoring Covariance Matrix Based On Dissimilarity Index <b>Longcheen Huwang</b>	Adjusting For Linkage Bias In The Analysis Of Record-Linked Data <b>Patrick Graham</b>	Bayesian Semiparametric Hierarchical Models For Longitudinal Data Analysis With Application To Dose-Response Studies <b>Taeryon Choi</b>	Optimizing Junior Rugby Weight Limits <b>Ankit Patel</b>	<a href="#">Using the Theory of Constraints to resolve long-standing resource and service issues in a large public hospital</a> <b>Vicky Mabin</b>
1150	Spatial Scan Statistics For Matched Case-Control Data <b>Inkyung Jung</b>	Whitebait In All Its Varieties: One Fish, Two Fish, Three, Four, Five Fish. <b>Bridget Armstrong</b>	Latent Variable Models And Multivariate Binomial Data <b>John Holmes</b>	Asking About Sex In General Health Surveys: Comparing The Methods And Findings Of The 2010 Health Survey For England With Those Of The Third National Survey Of Sexual Attitudes And Lifestyles <b>Philip Prah</b>	Bayesian Continuous Space-Time Model Of Burglaries <b>Paul Brown</b>	Tolerance Limits For The Reliability Of Semiconductor Devices Using Longitudinal Data <b>Thomas Nowak</b>	<a href="#">Convex Hull Representations for Multi-Level Renewable Power System Optimisation</a> <b>Grant Read</b>
1210 Lunch (1 hour 10 minutes)							
1320	<b>Session in Memory of Alastair John Scott</b> <b>Speakers: Professor John Neuhaus (UCSF), Professor Chris Wild, Professor Alan Lee, Professor Thomas Lumley</b> 098 Lecture Theatre (260-098)						
1530 Afternoon tea (30 minutes)							

	<b>098 Lecture Theatre (260-098)</b>	<b>OGGB4 (260-073)</b>	<b>OGGB5 (260-051)</b>	<b>Case Room 2 (260-057)</b>	<b>Case Room 3 (260-055)</b>	<b>Case Room 4 (260-009)</b>	<b>ORSNZ Case Room 1 (260-005)</b>
1600	Model-Checking For Regressions: A Local Smoothing-Based Global Smoothing Test <b>Lingzhu Li</b>	Breeding Value Estimation In Partially-Genotyped Populations <b>Alastair Lamont</b>	Bivas: A Scalable Bayesian Method For Bi-Level Variable Selection <b>Mingxuan Cai</b>	Ranking Potential Shoplifters In Real Time <b>Barry McDonald</b>	Two Stage Approach To Data-Driven Subgroup Identification In Clinical Trials <b>Toshio Shimokawa</b>		<a href="#">Simulating Risk Measures with Estimated Relative Errors</a> <b>Steven Kou</b>
1620	Inverse Regression For Multivariate Functional Data <b>Ci-Ren Jiang</b>	Including Covariate Estimation Error When Predicting Species Distributions: A Simulation Exercise Using Template Model Builder <b>Andrea Havron</b>	Adjusted Adaptive Index Model For Binary Response <b>Ke Wan</b>	Factors Influencing On Growth Of Garments Industry In Bangladesh <b>Md. Shahidul Islam</b>	Comparison Of Exact And Approximate Testing Procedures In Clinical Trials With Multiple Binary Endpoints <b>Takuma Ishihara</b>		<a href="#">Management Insights from Covariance Based and Partial Least Squares Structural Equation Modelling</a> <b>Robert Cavana</b>
1640	Multiple Function-On-Function Linear Regression With Application To Weather Forecast Calibration <b>Lu-Hung Chen</b>	Modelling The Distribution Of Lifetime Using Compound Time-Homogenous Poisson Process <b>Kien Tran</b>	Detecting Change-Points In The Stress-Strength Reliability $P(X \leq t; Y)$ <b>Hang Xu</b>	New Zealand Crime And Victims Survey: Filling The Knowledge Gap <b>Tianying Chu</b>	Missing Data In Randomised Control Trials: Stepped Multiple Imputation <b>Rose Sisk</b>		<a href="#">Field Officer Planning for Census 2018: Algorithms and Implementation</a> <b>Andrew Mason</b>
1700		<b>NZSA Annual General Meeting</b> 1700 - 1815	<b>IASC General Assembly</b> 1700-1815				
1830	<b>IASC-ARS/NZSA Conference Dinner</b> Owen G Glenn Building Foyer Level 1, 20 Grafton Road 1830-2230						<b>ORSNZ Dinner</b> presented by Suez Number 5 Restaurant 5 City Rd, Grafton

Time	Wednesday 13 December						
0900	Housekeeping						
0910	<b>Professor Michael Ferris, University of Wisconsin - Madison, USA</b> <b>ORSNZ Keynote</b> 098 Lecture Theatre (260-098)						
<b>1000</b>	<b>Morning Tea (30 minutes)</b>						
	<b>098 Lecture Theatre (260-098)</b>	<b>OGGB4 (260-073)</b>	<b>OGGB5 (260-051)</b>	<b>Case Room 2 (260-057)</b>	<b>Case Room 3 (260-055)</b>	<b>Case Room 4 (260-009)</b>	<b>ORSNZ Case Room 1 (260-005)</b>
1030	Promoting Your R Package <b>Hadley Wickham</b>	A Smoothing Filter Modelling Approach For Time Series <b>Marco Reale</b>	Online Learning For Bayesian Nonparametrics: Weakly Conjugate Approximation <b>Yongdai Kim</b>	Improving The Production Cycle At Stats Nz With Rstudio <b>Gareth Minshall</b>	A Max-Type Multivariate Two-Sample Baumgartner Statistic <b>Hidetoshi Murakami</b>	Random Search Global Optimization Using Random Forests <b>Blair Robertson</b>	<a href="#">AROS - Asset Risk Optimisation Suite</a> <b>Josh Dawes</b>
1050	Gridsvg: Then And Now <b>Paul Murrell</b>	Probabilistic Outlier Detection And Visualization Of Smart Meter Data <b>Rob Hyndman</b>	The Joint Models For Nonlinear Longitudinal And Time-To-Event Data Using Penalized Splines: A Bayesian Approach <b>Thi Thu Huong Pham</b>	R – A Powerful Analysis Tool To Improve Official Statistics In Romania <b>Nicoleta Caragea</b>	Simultaneous Test For Mean Vectors And Covariance Matrices In High-Dimensional Settings <b>Takahiro Nishiyama</b>	Dimension Reduction For Classification Of High-Dimensional Data By Stepwise Svm <b>Elizabeth Chou</b>	International Applications of Operations Research and Analytics in the Water Industry <b>Evan Atkinson</b> (Suez)
1110	Bringing Multimix From Fortran To R <b>Murray Jorgensen</b>	Specification Of Garch Model Under Asymmetric Error Innovations <b>Oyebimpe Adeniji</b>	Performance Of Bayesian Credible Interval For Binomial Proportion Using Logit Transformation <b>Toru Ogura</b>	Statistical Disclosure Control With R: Traditional Methods And Synthetic Data <b>Matthias Templ</b>	High Dimensional Asymptotics For The Naive Canonical Correlation Coefficient <b>Mitsuru Tamatani</b>	Deep Learning High-Dimensional Covariance Matrices <b>Philip Yu</b>	<a href="#">Investments in Electricity Generation for Auckland's Growth</a> <b>Tony Downward</b>
1130	R In Industry – Application On Pipe Renewal Planning <b>Glenn Thomas</b>	Empirical Comparison Of Some Algorithms For Automatic Univariate Arma Modeling Using Rcmdrplugin.Spss <b>Dedi Rosadi</b>	Bayesian Optimum Warranty Length Under Type-Ii Unified Hybrid Censoring Scheme <b>Tanmay Sen</b>	Imputation Of The 2016 Economic Census For Business Activity In Japan <b>Kazumi Wada</b>		Applying Active Learning Procedure To Drug Consumption Data <b>Yuan-Chin Chang</b>	<a href="#">Severity risk of forecasting errors for solar energy infeed in South-West Germany</a> <b>Callum Ferguson</b>
1150	R For Everything <b>Jared Lander</b>	R Package For New Two-Stage Methods In Forecasting Time Series With Multiple Seasonality <b>Shubhabrata Das</b>		Analysis Of Official Microdata Using Secure Statistical Computation System <b>Kiyomi Shirakawa</b>		Presenting Flexi, A Statistical Program For Fitting Variance Models <b>Martin Upsdell</b>	<a href="#">Water Infrastructure Planning under Long Term Uncertainty</a> <b>Josh Dawes</b>
<b>1210</b>	<b>Lunch (1 hour 10 minutes)</b>						
1320	<b>Space And Circular Time Log Gaussian Cox Processes With Application To Crime Event Data</b> <b>Alan Gelfand, Duke University</b> 098 Lecture Theatre (260-098)						
	<b>098 Lecture Theatre (260-098)</b>	<b>Case Room 1 (260-005)</b>	<b>OGGB5 (260-051)</b>	<b>Case Room 2 (260-057)</b>	<b>Case Room 3 (260-055)</b>	<b>Case Room 4 (260-009)</b>	<b>ORSNZ OGGB4 (260-073)</b>
1410	Cluster-Wise Regression Models Combined By A Quasi-Linear Function <b>Kenichi Hayashi</b>	Hierarchical Structural Component Analysis Of Gene-Environment Interactions <b>Taesung Park</b>	Wavelet-based power transformation of non-Gaussian long memory time series <b>Kyungduk Ko</b>	Cross Covariance Estimation For Integration Of Multi-Omics Data <b>Hyungwon Choi</b>	Relationships Between Linguistic Characteristics And The Use Of Māori Loanwords In New Zealand English. <b>Steven Miller</b>	Transfer Regression And Predictive Distributions <b>Jinfang Wang</b>	<b>Analytics Forum</b>
1430	An Overview Of The Correspondence Analysis Family <b>Eric Beh</b>	Testing For Genetic Associations In Arbitrarily Structured Populations <b>Minsun Song</b>	Threshold Determination for the Meteorological Data Quality Control in Korea <b>Yung-Seop Lee</b>	Regularized Noise-Reduction Methodology For High-Dimensional Data <b>Kazuyoshi Yata</b>	Computation Of Influence Functions For Robust Statistics <b>Maheswaran Rohan</b>	Adaptive Model Averaging In High-Dimensional Linear Regression <b>Tzu-Chang Forrest Cheng</b>	



1450	Model-Based Clustering For Multivariate Categorical Data With Dimension Reduction <b>Michio Yamamoto</b>	Phylogenetic Tree-Based Microbiome Association Test <b>Sungho Won</b>	Fitting Additive Hazards Model Using Calibrated Weights for Case-Cohort Data <b>Sangwook Kang</b>	Selecting The Number Of Principal Components <b>Yunjin Choi</b>	Rolling Survival Extrapolation Algorithm For Estimating Life Years Lost Among Subjects Exposed To Long-Term Air Pollution <b>Jing-Shiang Hwang</b>	Enhancing The Flexibility Of Regression Modeling By Liquid Association <b>Ker-Chau Li</b>	
1510	Clusterwise Low-Rank Correlation Analysis Based On Majorization <b>Kensuke Tanioka</b>		Bayesian analysis for fitting zero-inflated count data with data augmentation <b>Beomseuk Hwang</b>	Towards A Sparse, Scalable, And Stably Positive Definite (Inverse) Covariance Estimator <b>Joong-Ho Won</b>	Tick-by-tick effect on the inference of ultra-high frequency data <b>Zhi Liu</b>	High Mortality Predictions With Lines Or Curves Fitted To Over-Dispersed Exposure-Mortality Data <b>John Maindonald</b>	
<b>1530</b>	<b>Afternoon tea (30 minutes)</b>						
	<b>098 Lecture Theatre (260-098)</b>	<b>Case Room 4 (260-009)</b>	<b>OGGB5 (260-051)</b>	<b>Case Room 2 (260-057)</b>	<b>Case Room 3 (260-055)</b>	<b>Case Room 1 (260-005)</b>	<b>ORSNZ OGGB4 (260-073)</b>
1600	Lattice Polytope Samplers <b>Martin Hazelton</b>	Statistical Modelling And Analysis Of Cosmic Microwave Background Data <b>Andriy Olenko</b>	Measure Of Departure From Marginal Average Point-Symmetry For Two-Way Contingency Tables With Ordered Categories <b>Kiyotaka Iki</b>	Sparse Estimates From Dense Precision Matrix Posteriors <b>Beatrix Jones</b>	Dimension Reduction Strategies For Modeling Bi-Clustered High Dimensional Data <b>Michael Van Supranes</b>	Investigating methods to produce price indexes from big data <b>Mathew Stansfield</b>	<b>Analytics Forum</b>
1620	Computing Entropies With Nested Sampling <b>Brendon Brewer</b>	Spline-Based Drift Models For High Temperature Operating Life Tests <b>Thomas Nowak</b>	A New Approach To Distribution Free Tests In Contingency Tables <b>Thuong Nguyen</b>	A Bayesian Inference For Time Series Via Copula-Based Markov Chain Models <b>Li-Hsien Sun</b>	Modified Gene Shaving Algorithm - A Dimension Reduction And Clustering Method <b>Donna Mae Santos</b>	The Potential of Web Scraping <b>Sam Olivecrona</b>	
1640		A Simple Method To Construct Confidence Bands In Functional Linear Regression <b>Kengo Kato</b>	Separation Of Symmetry For Square Contingency Tables With Ordinal Categories <b>Kouji Tahata</b>	Scalable Kernel-based Variable Selection with Sparsistency <b>Junhui Wang</b>	Testing For Presence Of Clustering Effect In Multilevel Model With High-Dimensional Predictors <b>Frances Claire San Juan</b>	Towards a big data CPI for New Zealand <b>Alan Bentley</b>	

Time Thursday 14 December							
0900	Housekeeping						
0910	<b>ALTREP: Alternate Representations of Basic R Objects</b> <b>Luke Tierney, University of Iowa, USA</b> 098 Lecture Theatre (260-098)						
<b>1000 Morning Tea (30 minutes)</b>							
	<b>098 Lecture Theatre (260-098)</b>	<b>OGGB4 (260-073)</b>	<b>OGGB5 (260-051)</b>	<b>Case Room 2 (260-057)</b>	<b>Case Room 3 (260-055)</b>	<b>Case Room 4 (260-009)</b>	<b>ORSNZ Case Room 1 (260-005)</b>
1030	Penalized Vector Generalized Additive Models <b>Thomas Yee</b>	A Package For Multiple Precision Floating-Point Computation On R <b>Junji Nakano</b>	Dissimilarities Between Groups Of Data <b>Nobuo Shimizu</b>	Comparison Of Tests Of Mean Difference In Longitudinal Data Based On Block Resampling Methods <b>Hirohito Sakurai</b>	Ssrsm: A Summary-Statistics-Based Random Effect Model To Estimating Heritability, Co-Heritability And Effect Sizes In Gwas Data Analysis <b>Jin Liu</b>		<a href="#">Forecasting Future Medical Speciality Workforce Supply</a> <b>Emmanuel Jo</b>
1050	Consistency Of Linear Mixed-Effects Model Selection With Inconsistent Covariance Parameter Estimators <b>Chihhao Chang</b>	An Incomplete-Data Fisher Scoring With An Acceleration Method <b>Keiji Takai</b>	Interactive Visualization Of Aggregated Symbolic Data <b>Yoshikazu Yamamoto</b>	Analysis Of Spatial Data With A Gaussian Mixture Markov Random Field Model <b>Wataru Sakamoto</b>	Forward Selection In Regression Models Based On Robust Estimation <b>Shan Luo</b>		<a href="#">A multi-stage stochastic optimization model of a New Zealand dairy farm</a> <b>Oscar Dowson</b>
1110	Selecting Generalised Linear Models Under Inequality Constraints <b>Daniel Gerhard</b>	Improvement Of Computation For Nonlinear Multivariate Methods <b>Yuichi Mori</b>			Feature Selection In High-Dimensional Models With Complex Block Structures <b>Zehua Chen</b>		<a href="#">Excel Based Tool for Interactive Optimization Models</a> <b>Anthony Downward</b>
1130	Statistical Generalized Derivative Applied To The Profile Likelihood Estimation In A Mixture Of Semiparametric Models <b>Yuichi Hirose</b>						
1200	<b>Closing Ceremony</b> 098 Lecture Theatre (260-098)						
<b>1220 Lunch (1 hour 10 minutes)</b>							

# General Information

## Catering and dietary requirements

Lunches, morning and afternoon teas will be served in the Owen G Glenn Building (OGGB) Level 0 foyer on each day of the event. Care has been taken to ensure all advised, special dietary requirements are catered to. If you specified your dietary requirements when registering, please make yourself known to the catering staff.

## Name tags

Please wear your name tag during the conference. Your name tag is your ticket for any social events you have signed up for or purchased tickets for.

## Presentations

As a courtesy to our presenters, please ensure you arrive at each session location prior to the start of presentations and have your cellphone off.

## Presenting authors

Your presentation length has been previously notified. Please make sure you keep to your allotted time.

If you are scheduled to give a presentation, please ensure your PowerPoint/PDF is uploaded at the Registration Desk well before your presentation time.

## Recording Presentations

No electronic recording of presentations is permitted in any form without the express written permission of the conference organisers and speakers.

## Urgent messages and lost property

Urgent messages for attendees and lost property can be directed to the registration desk.

Messages and lost property will be held there for collection until the conclusion of the conference.

## Wi-Fi access

Wireless internet access is available for all conference attendees' use.

Select the UoA-Guest-WiFi network and log in with the following:

*From Sunday - Wednesday*

Username - iasc@2017.com

Password - yLOx63YQ

*On Thursday only*

Username - iasc@2017.com1

Password - m6Yekxlu

## IASC-ARS/NZSA and ORSNZ Welcome Function

Sunday 10th December, 5pm

Level 0 Foyer, Owen G Glenn Building, University of Auckland

## ORSNZ Dinner

Brought to you by SUEZ

Tuesday 12th December, 6.30pm  
Number 5 Restaurant, 5 City Road, Grafton

The ORSNZ dinner is available to those who have previously registered their attendance at this event.

# Conference Location



## Owen G Glenn Building:

12 Grafton Road,  
Auckland

## Number 5 Restaurant:

5 City Road,  
Grafton, Auckland

# Keynote

## Integrated Modeling for Optimization of Energy Systems

**Prof. Michael Ferris, University of Wisconsin-Madison.**

Stephen C. Kleene Professor in Computer Science, and (by courtesy) Mathematics and Industrial and Systems Engineering

Director of Data Sciences Hub, Wisconsin Institute for Discovery

**Abstract:** We present an integrated model framework for the economic impact assessment of policy reforms where electricity markets play a central role. A prime example of such policy reforms is the promotion of electricity production from renewable energy which is at the core of transition strategies towards a low-carbon economy. The massive advancement of carbon-free renewable energy technologies has major implications on the generation, distribution and use patterns of electricity. An adequate simulation of electricity system responses to regulatory changes essentially calls for the accounting of real power flows. Real power flows depend on complex interactions between the spatial injection and withdrawal of power and the inability to store electricity within a network at any point in time. As electricity based on renewable energy sources is becoming the dominant energy carrier of the overall economy, the interactions of the electricity system with the rest of the economy play a critical role for the assessment of larger electricity system changes. Apart from issues of energy security, key questions of economic adjustment relate to the competitiveness impacts for energy-intensive industries and the incidence of electricity market reforms across generators, system operators, and consumers. Answers to these questions require an economy-wide framework which captures complex substitution, output, and income effects across various markets of the economy.

We consider models built up from a collection of optimizations within an interacting physical, economic or virtual system. We show how optimization and equilibrium concepts can be deployed and resulting models solved within an extended mathematical programming framework. We propose a hybrid bottom-up top-down framework which combines the technological explicitness of real power flow electricity networks with the economic comprehensiveness of computable general equilibrium models.

**Bio:** Michael C. Ferris is Professor of Computer Sciences and leads the Optimization Group within the Wisconsin Institutes for Discovery at the University of Wisconsin, Madison, USA. He received his PhD from the University of Cambridge, England in 1989.

Prof. Ferris' research is concerned with algorithmic and interface development for large scale problems in mathematical programming, including links to the GAMS and AMPL modeling languages, and general purpose software such as PATH, NLPED and EMP. He has worked on many applications of both optimization and complementarity, including cancer treatment planning, energy modeling, economic policy, traffic and environmental engineering, video-on-demand data delivery, structural and mechanical engineering.

Prof. Ferris is a SIAM fellow, an INFORMS fellow, received the Beale-Orchard-Hays prize from the Mathematical Programming Society and is a past recipient of a NSF Presidential Young Investigator Award, and a Guggenheim Fellowship. He serves on the editorial boards of Mathematical Programming, Transactions of Mathematical Software, and Optimization Methods and Software.

# Presenters' Abstracts

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## Forecasting future medical specialty workforces supply with age distribution using health workforce annual practicing certificate data

**Emmanuel Jo, Kimberly Mathis and Justin Goh.**

**Abstract:** Objectives: To introduce a newly developed workforce forecasting model (the model) using historic annual practicing certificate (APC) data to forecast future supply of medical specialty workforce with age distribution for each specialty.

**Methods:** We tracked individual medical specialist APC data for the last 6 to 10 years to gather age or age-group, specialty specific exit rates, full time equivalent (FTE) per head count (HC) ratios, and entry/re-entry age distributions. These parameters were used with an in-house developed dynamic modelling algorithm to forecast future medical specialty workforce supply in New Zealand. The input parameters and the model has been gradually improved and validated through numerous discussions with medical colleges, and associations.

**Results:** The model calculated the age distribution of each specialty workforces over the next 10 years, and projected that many specialty workforces may have a lower ratio of specialists to corresponding population groups in 2026 compared to 2016

**Conclusions:** The model has opened a new way of using APC data for evidence-informed planning and policy development, and the outputs of the model have been used within the New Zealand health sector. The model is easily scalable and can be adapted for other workforces and used in regional workforce planning

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## Computing the frustration index in signed graphs using binary programming

**Samin Aref, Andrew J. Mason and Mark C. Wilson.**

**Abstract:** Computing the frustration index of a signed graph is a key to solving problems in many fields. In social networks the frustration index determines the distance of a network from a state of structural balance. Although the definition of the frustration index goes back to 1960, an efficient algorithmic computation method has not yet been proposed. The main reason seems to be the complexity of computing the frustration index which is closely related to well-known NP-hard problems such as

MAXCUT. New quadratic and linear binary programming models are developed to compute the frustration index exactly. We introduce several speed-up techniques involving prioritised branching and valid inequalities inferred from graph structural properties.

The speed-up techniques make our models capable of processing graphs with thousands of nodes and edges in seconds on inexpensive hardware. We also discuss some applications of the proposed models in social networks, physics, chemistry, finance, international relations, and biology. The structural balance of such signed networks has different meanings and interpretations depending on the context. The findings unify the applications of a graph-theoretical measure in understanding complex structures in several fields of research.

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## Simulating Risk Measures with Estimated Relative Errors

**Steven Kou and Wei Jiang**

**Abstract:** Risk measures, such as value-at-risk and expected shortfall, are widely used in stochastic models. With the necessary sample size being computed using asymptotic expansions of relative errors for a wide class of dependent samples, we propose a general framework to simulate these risk measures via a sorting algorithm. The asymptotic expansions appear to be new even for independent and identical samples. An extensive numerical study is conducted to compare the proposed algorithm against existing algorithms, showing that the new algorithm is easy to implement, fast and accurate, even at the 0.001 quantile level. Applications to the estimation of intra-horizon risk and to a comparison of the relative errors of value-at-risk and expected shortfall are also given.

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## AROS - Asset Risk Optimisation Suite

**Joshua Dawes, Michael O'Sullivan and Cameron Walker.**

**Abstract:** AROS is both an organisational asset management and investment planning tool. AROS allows the user to score assets, and risks against those assets, against a consistent scoring framework, and uses an integer programming optimisation model to select the most appropriate interventions from the list of user-specified options.

This paper presents the tool, how it is implemented, and an exploration of the issues encountered when deploying the tool in practice at DONG energy, a thermal generation supplier in Denmark. A particular focus is the challenge of marshalling and effectively using data in an organisation that is implementing data-driven decision making for the first time, and the implications of this for practitioners.

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## Water Infrastructure Planning under Long Term Uncertainty

Joshua Dawes, Michael O'Sullivan, and Cameron Walker.

**Abstract:** This paper presents a Stochastic Optimisation model, solved using integer programming, that produces investment plans for water infrastructure investment under long term uncertainty.

The planning scenarios involved are generated based on several sources of uncertainty - natural weather and rainfall variation, longer term climate change, and projected water demand trends are considered. Customer preferences are also included and costed - the reduced likelihood of a water shortage is traded off against an increased water bill, by modelling water use restrictions.

Interventions are assessed based on their initial and operational costs, as well as monetised and constrained key metrics, for example environmental impacts and health and safety risks.

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## Modelling Warranty Costs with a Generalised Alternating Renewal Process

Sarah Marshall, Richard Arnold, Stefanka Chukova and Yu Hayakawa.

**Abstract:** Meeting the financial obligations associated with warranty claims can have a significant impact on a warrantor. It is important, therefore, to accurately estimate the cost of warranty claims over both the warranty period and the life-cycle of a product. In this research we provide a model for the warranty claims process and use it to evaluate the warranty costs under a variety of scenarios.

We model the cost of a warranty claim as a function of the repair time. We assume that the product operates until failure and then must undergo repair, which returns the product to an "as new" condition. We assume that as a product ages, the operational time (time until before failure) will decrease, and that the repair time will increase. To account for product ageing, we use a decreasing geometric process to model the consecutive operational times and an increasing geometric process to model the consecutive repair times. Together, these two geometric processes form a Generalised Geometric Alternating Renewal (GGAR) process. We present results relating to the GGAR process over a finite horizon and use them to evaluate the warranty costs over the warranty period and over the life-cycle of the product under the non-renewing free repair warranty (NRFRW) and renewing free repair warranties (RFRW). Simulation is used to estimate the expected costs over the warranty period and life-cycle. The model is applied to warranty claims data from an automotive manufacturer.

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## A study on bid and budget optimization for sponsored search

Harish Krishnan and Andrew Mason.

**Abstract:** Sponsored search auctions are ubiquitous these days and search engine marketing companies such as Google make billions of dollars in revenue. Advertisers spend a significant portion of their marketing budget on sponsored search and this is only expected to increase in the future. Mitre 10 New Zealand Ltd is one such advertiser. This paper discusses the experiments conducted on Mitre 10's sponsored search auction data and the subsequent findings. These experiments were conducted as a part of my Masters' thesis to optimize Mitre 10's sponsored search spend.

Initial results indicate the optimization problem to be stochastic in nature. This conjecture is strengthened by the findings of a scraping experiment conducted in two different search markets. Subsequent experiments conducted on various bid and budget amounts across different search markets present interesting findings on the nature of the relationship among the three key variables in a sponsored search process - bid amount (b), budget amount (B) and impressions (I)

The paper presents the findings of the experiments conducted thus far.

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## Ultra-capacitor electric buses: Efficient placement of charging infrastructure within existing bus networks

Russell Stewart, Andrea Raith and Bob Grün.

**Abstract:** The purpose of this research project was to review the current status of electric bus technology and build a mixed-integer optimisation model that aimed to minimise the cost of electric bus charging infrastructure.

The technology analysed was very short range, ultra-capacitor electric buses that can flash charge at en route charging stations. To minimise total charger cost, the model efficiently distributes charging stations at existing bus stops, such that simulated bus energy requirements are met.

The project focused specifically on Auckland's city bound bus routes that run along Mt. Eden and Dominion roads. The exact number and placement of chargers along these routes is a function of user defined bus and charger parameters, and an upper bound on allowable delay to service caused by charging. The project also demonstrated the importance of accurate energy consumption modelling for this technology.

While the results obtained are specific to one electric bus technology and existing bus public transport network, this project puts in place a model framework that could be adapted to other transport networks or bus technologies.

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## Improvements in Water Resource Planning

Oleg Barbin, Michael O'Sullivan and Cameron Walker.

**Abstract:** In the face of ever-changing water supply and demand, UK water utility companies are obligated to provide long-term plans every five years that outline additional developments and restrictions needed to ensure a safe supply of water. To assist with this, ICS Consulting (UK) is developing an optimisation framework for producing investment plans that accommodate uncertainty in supply and demand. As well as options for investing in infrastructure, water utilities can utilise temporary restrictions on water demand that carry a non-linear economic cost. In an integer programming context, this presents significant challenges, as the cost function now needs to be discretised and controlled through binary variables. We aimed to find novel ways to deal with the computational burden presented by the way restrictions are handled in the optimisation framework. Both existing methods and completely new options were closely investigated. At the completion of this project, we have contributed several new solution techniques and improvements. These additions were combined with all existing approaches and through a testing framework, we were able to extract valuable information about: 1) probable causes of slow solution times; and 2) the best approach to apply for further development.

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## Short-Term Modelling of Electricity Prices in New Zealand

Alan Ansell, Golbon Zakeri and Andreas Kempa-Liehr.

**Abstract:** Wholesale electricity prices in New Zealand are calculated for each half-hour trading period by solving a complex dispatch problem. These prices are highly volatile and difficult to forecast. This is problematic for consumers who purchase electricity at wholesale rates, as they often cannot react quickly enough to price spikes to avoid incurring significant losses. We used a data science approach to develop a methodology for accurately forecasting electricity prices over the short term.

Electricity consumers have access to WITS, a source of real-time data which includes information about market supply in future trading periods, aggregated over the North and South Island. We begin by forming a model for total electricity demand in the two islands. We develop a model which combines the demand predictions produced by this model with the data available through WITS to approximate the behaviour of the full market dispatch problem. We then show how to use our approximate dispatch model to predict prices. Finally we evaluate our price prediction pipeline and find that it achieves a mean absolute error of 15% of the mean price value.

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## Piecewise linear supply offers in the NZ Electricity Market

Weiming Zhi, Kazem Abbaszadeh, Golbon Zakeri and Geoffrey Pritchard.

**Abstract:** The New Zealand Electricity Market currently accepts offers from suppliers in the format of a step function. This study aims to investigate the effects of redesigning the market to require offers to be in the form of continuous piecewise-linear functions, rather than discontinuous step functions. This change prevents degenerate solutions with non-unique dual prices in the market clearing problem, and decreases the volatility of electricity prices. \\

We convert publicly available historical offers into piecewise-linear format. Modifications were made to vSPD, a replica of the market clearing engine used by the market operators. We simulate market clearing using supply offers in both the step function and piecewise-linear function format. We empirically show that using piecewise-linear offers leads to reduced price volatility, and results in more consistent movement of price, under changing demand.

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## Severity risk of forecasting errors for solar energy infeed in South-West Germany

Callum Ferguson, Andreas W. Kempa-Liehr and Golbon Zakeri.

**Abstract:** In April 2000, Germany introduced the Renewable Energy Sources Act.

The purpose of this act is to minimise climate change and damage to the environment by encouraging renewable energy generation through the compensation and prioritisation of renewable energy sources in the national grid.

This act was effective. Photovoltaics produced 38.1 TWh in 2016 and covers up to 35% of the momentary electricity demand on sunny weekdays.

Because the solar energy infeed depends significantly on the respective weather conditions, accurate forecasts are important for network stability, because unforeseen changes of weather conditions are expensive to balance.

This work presents a machine learning approach for estimating the severity risk of forecasting errors for solar infeed in South-West Germany based on published time series data for predicted and measured solar infeed.

We are discussing an automated time series feature extraction approach based on the FRESH algorithm (FeatuRe Extraction based on Scalable Hypothesis tests) and evaluate day-ahead estimations of extreme forecasting errors.

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## A multi-stage stochastic optimization model of a New Zealand dairy farm

Oscar Dowson, Andy Philpott, Andrew Mason and Anthony Downward.

**Abstract:** Pastoral dairy farmers continually make sequential decisions in the face of long term environmental uncertainty and price volatility. Decisions made early in the season such as the number of cows to stock per hectare can have significant effects later in the season if the farmer is forced to import additional feed to meet the cows' energy demands during a drought. In this paper, we present POWDER: the Milk Production Optimizer incorporating Weather Dynamics and Economic Risk. POWDER is a novel multistage stochastic program that divides the dairy farming season into weeks and links these weeks by a system of linear dynamics. By applying POWDER to a case farm in New Zealand, we demonstrate POWDER's promise as a strategic level planning tool that can help participants in the New Zealand dairy industry understand, and plan for, farming in a stochastic world.

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## Modelling Traffic Assignment Objectives with Emission Cost Functions

James Tidswell and Andrea Raith.

**Abstract:** Vehicle emissions make up a significant proportion of greenhouse gases, which has provoked interest in capturing emissions in traffic models. This research provides methods of modelling vehicle emissions for specific emission types in the context of traffic assignment to provide traffic flow patterns with minimal vehicle emissions. Speed limits are incorporated to enable the identification of the minimum total vehicle emissions for a traffic network with given fixed demand. Using a method of emission costing, such as CO<sub>2</sub>-equivalent or health risk values, similar approaches can be applied to an objective function with a weighted combination of emissions, given a general link cost function that captures a range of emissions. These methods are applied to an example network to indicate the differences in emissions for different flow patterns. Bounds on the lowest emissions possible, for given traffic demand, for each emission type are stated. Increased emissions attributed to cold-starting a vehicle are examined, with the purpose of identifying methods of modelling cold-start-optimal traffic flow patterns.

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## Balancing Physician Workloads Under Uncertain Admissions

Thomas Adams, Michael O'Sullivan and Cameron Walker.

**Abstract:** The number of patients that physicians care for depends on how many new admissions arrive during the shifts that they work. Therefore the workloads of the physicians depend on their roster and the distribution of patients among physicians can be improved by changing the roster. This presentation discusses a method for creating a roster that balances the workloads of the physicians given a number of scenarios of patient admissions, and evaluates the value of such an approach.

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## Investments in Electricity Generation for Auckland's Growth

Anthony Downward and Alex Hammon.

**Abstract:** In this work, we consider the economic viability of solar PV and battery storage as a way of meeting the energy and capacity requirements of Auckland, given uncertainties around population growth over the next 30 years.

We develop a multi-stage stochastic programming model for electricity investment planning, and derive optimal investment policies contingent on the population growth that is observed.

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## Excel Based Tool for Interactive Optimization Models

Anthony Downward.

**Abstract:** In this talk we will demonstrate a new tool for creating interactive optimization problems in Excel using Javascript.

We will show examples of scheduling and routing applications utilizing the SolverStudio modelling framework for Excel.

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## SDDP.jl: a Julia package for Stochastic Dual Dynamic Programming

Oscar Dowson and Lea Kapelevich.

**Abstract:** In this paper we present SDDP.jl, an open-source library for solving multi-stage stochastic optimization problems using the Stochastic Dual Dynamic Programming algorithm. SDDP.jl is built upon JuMP, an algebraic modelling language in Julia. This enables a high-level interface for the user, while simultaneously providing performance that is similar to implementations in low-level languages. We benchmark the performance of SDDP.jl against a C++ implementation of SDDP for the New Zealand Hydro-Thermal Scheduling Problem. On the benchmark problem, SDDP.jl is approximately 30% slower than the C++ implementation. However, this performance penalty is small when viewed in context of the generic nature of the SDDP.jl library compared to the single purpose C++ implementation.

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## Convex Hull Representations for Multi-Level Renewable Power System Optimisation

Grant Read and Ramu Naidoo.

**Abstract:** We were asked to optimise least-cost generation expansion plans for a Pacific island, over a wide range of long term scenarios. While one can sometimes exploit the special structure of the problem, a small power system is not necessarily simpler to model, because the detailed interaction between particular generating units and technologies becomes quite critical. This study focussed on a particular hydro development, which both complemented and competed with potential geothermal, solar and battery developments, and with the Diesel generators currently supplying all ancillary services.

Rather than make potentially unrealistic assumptions about the way these technologies might interact in the novel system configurations emerging from the analysis, we developed a framework within which different optimisation/simulation approaches could be employed at three nested levels: Thermal operation, reservoir management, and capacity investment. We briefly discuss some issues that emerged with respect to renewable power system development, and report on experience with a “convex hull” approach to representing sub-system performance that seems applicable in a wide variety of contexts.

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## Solving a Generalised Staff Rostering Problem

Isaac Cleland, Andrew Mason and Michael O’Sullivan.

**Abstract:** The Staff Rostering Problem involves optimizing the assignment of staff to shifts, whilst fulfilling rules associated with these assignments. There are significant time-saving benefits to solving Staff Rostering Problems automatically and so there have been many attempts over the years to solve these problems with optimisation and heuristics. However, these problems are very difficult to solve automatically; they are NP-Hard, regularly have a very large number of variables, have a non-linear or multi-objective cost function, and are tightly constrained.

We have developed a suite of Matheuristics with a hybrid of column generation and neighbourhood search to solve a large variety of Staff Rostering Problems both accurately and efficiently. This presentation will outline our investigations into the effectiveness of different methods of neighbourhood search within column generation and a comparison of various algorithms using those neighbourhood search methods to solve Staff Rostering Problems.

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## Mathematical model to determine optimal investment for battery and solar power for shifting the load from peak to off-peak, from the point of view of line companies

J M Omar Khaïam and Tony Downward.

**Abstract:** Over the past decade, interest in distributed generation has been increasing from both lines companies and consumers, enabling both reduced electricity costs and improved reliability. Moreover, the price of both solar panels and energy storage systems (EES) have dropped substantially in recent times, they will soon be serving important roles in distribution networks. Although solar panels, installed on residential rooftops, can only be used for load reduction during the day, nevertheless through a combination of solar panels and EES, it is possible to shift load from peak to off-peak periods. If consumers use EES only, those who have fixed price contracts with the distribution companies will have no load reduction or shifting; however there can be incentives to use it for load-shifting, if the consumer has a time-of-use pricing scheme. If a substantial numbers of consumers have both EES and solar panel, the distribution companies need to be careful to incentivise a reduction in the peak, not simply creating a new peak period.

The main aim of this paper is to derive a mathematical formulation for shifting the load from peak to off-peak by using solar panel and EES considering different distribution pricing schemes.

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## Ambulance simulation and optimisation

Samuel Ridler, Andrew Mason and Andrea Raith.

**Abstract:** Emergency medical services aim to provide timely medical care, and transport of patients. The provision of this service entails many decisions to be made, such as where to place ambulance stations, how many ambulances will be required at each station, ambulance dispatching behaviour, etc. An ambulance simulation package has been developed in the programming language Julia, allowing for performance evaluation of different decisions or policies for these problems. The simulation can also be used in a simulation-based optimisation framework, to find high quality solutions. Details of the simulation will be presented, along with some results of simulation-based optimisation.

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## Multi-stage Demand-side Management for Major Consumers of Energy in New Zealand Electricity Market

Mahbubeh Habibian, Anthony Downward and Golbon Zakeri.

**Abstract:** In this paper we take an approximate dynamic programming approach to solve a multistage stochastic optimization of demand response for a major consumer. We introduce a mixed integer program that co-optimizes consumption and interruptible load reserve for a major consumer over a finite time horizon. We decompose our model by approximately pricing the constraint that links the stages together. We introduce consumption-utility curves that provide optimal actions to our model, and present heuristics to improve the policies. At the second part we solve our model with uncertainty using a similar approach. We conduct an experiment for a major consumer in New Zealand Electricity Market and report on numerical results.

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## Field Officer Planning for Census 2018: Algorithms and Implementation

Andrew Mason, Geoff Leyland and John Crequer.

**Abstract:** For the 2018 census, Statistics NZ will encourage New Zealanders to submit census forms online. However, before the census, every street in the country has to be visited by a field officer to identify potential dwellings and to deliver paper forms to selected areas. After the census, non-responding households will need to be visited to encourage them to respond.

To plan the census, the country is divided into about 60,000 meshblocks. For each phase of the census, a field officer needs to be assigned to every meshblock of interest. New assignments need to be made

each day that reflect meshblocks that have been completed while taking into account the remaining work, any partially completed meshblocks, travel distances between meshblocks, distances from a field officer's home, and any changes in staffing since the last work assignment was planned. The first "address canvassing" phase of this operation has now been completed successfully using new software developed to run this process. We report on the algorithms developed for this and our experiences in delivering new solutions to hundreds of staff each day for 6 weeks. We also detail the algorithms we have now developed for use in 2018.

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## Upper and lower bounds for saddle functions.

Regan Baucke, Golbon Zakeri and Anthony Downward.

**Abstract:** In this talk, we will present an intuitive construction of upper and lower bound functions for a given saddle function. We will present these bounding functions in the context of an algorithm which computes a saddle point of the given saddle function. Finally, we demonstrate how these upper and lower bounding functions play a part in a more complex algorithm used to solve a class of minimax stochastic dynamic programmes.

Examples of such problems are risk averse multistage stochastic programmes, stochastic programming problems where uncertainty appears in both the right-hand-side and the objective function, and stochastic sub-game perfect equilibria.

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## Integer Programming Optimization of Geothermal Production

Rishi Adiga, John O'Sullivan and Andy Philpott.

**Abstract:** Geothermal power generation is not keeping pace with other renewable energy technologies. This is due to a number of factors, including the industry's high capital cost, of which wells account for a significant portion. Hence, it is imperative to maximize value from wells drilled by selecting them optimally. An important technology used when making well placement decisions is computer simulation of production. This is usually done manually, with experts creating reservoir models, simulating wells at candidate locations and comparing the predicted production scenarios. Manual selection in this manner is slow and labor intensive.

Various heuristics have been investigated to try and automate this process, mainly based on gradient descent and stochastic search methods. However, no strict form optimization that guarantees the best solution has been attempted for the complex problem of selecting multiple production wells to maximize value. This paper uses Mixed Integer Programming (MIP) to address this problem. An economic model was created to calculate Net Present Values (NPVs) for a set of candidate wells and

the interactions between them using AUTOUGH2 simulation results of an example geothermal system. Binary decision variables were used in the optimization to select the combination of wells that would maximize total NPV.

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## Improving estimation using order statistics

**Andy Philpott, Eddie Anderson and Karen Willcox.**

**Abstract:** Motivated by models for optimization under uncertainty, we discuss the use of ordered samples to improve the variance of estimators. As shown by Lloyd in 1952 (and observed long ago by Fisher in 1922), the average of the lowest and highest values in a sample of a rectangular distribution has a lower variance than the sample average. We revisit Lloyd's analysis and apply it to some simple examples in point estimation and regression.

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## Using the Theory of Constraints to resolve long-standing resource and service issues in a large public hospital

**Vicky Mabin, Vanessa Caldwell, Sally Babington, Julie Yee and Robyn Moore.**

**Abstract:** Public health care providers typically struggle with the need to meet demand for services, within a limited budget. This paper describes an analysis of a large public hospital, using the Theory of Constraints' (TOC) comprehensive set of mapping tools to logically represent a problematic situation and investigate options for resolution. Based on the symptoms present, root causes and conflicts were identified, along with potential solutions. Further TOC tools were used to check for possible side effects of the solution, and identify obstacles that might impede successful implementation. Based on the TOC analysis, a trial project was implemented with significant benefits for two departments. Outcomes included dramatically reduced patient wait times and staff overtime, increased patient satisfaction, increased efficiencies, smoothed workload, and improved staff morale and retention, while maintaining patient safety and integrity of treatment, and staying within defined cost parameters.

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## Management Insights from Covariance Based and Partial Least Squares Structural Equation Modelling

**Robert Y. Cavana and Lisa R. Woods.**

**Abstract:** This paper outlines the use of more advanced statistical methods in helping to provide additional management insights beyond a standard mixed methods research study. A previous paper analysed a survey based on a large sample of undergraduate students on management courses in a New Zealand university, exploring students' perceptions of feedback given to them on their formative assessments. A factor analysis and correlation analysis were undertaken with the collected data. In this paper, we discuss a more advanced statistical analysis of this data involving both Covariance Based and Partial Least Squares Structural Equation Modelling (SEM). The results and insights from both these statistical analyses will be discussed. The BAM conference presentation will also discuss when it is useful to go beyond a basic statistical analysis, exploring the benefits of a more rigorous SEM multivariate statistical analysis. The advantages and disadvantages of this additional work will be reflected on.

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## A study on bid and budget optimization for Google Adwords

**Harish Krishnan and Andrew Mason.**

**Abstract:** Sponsored search auctions are ubiquitous these days and search engine marketing companies such as Google make billions of dollars in revenue. Advertisers spend a significant portion of their marketing budget on sponsored search and this is only expected to increase in the future. Mitre 10 New Zealand Ltd is one such advertiser. This paper discusses the experiments conducted on Mitre 10's sponsored search auction data and the subsequent findings.

Initial results indicate the optimization problem to be stochastic in nature. This conjecture is strengthened by the findings of a scraping experiment conducted in two different search markets. Subsequent experiments conducted on the various bid and budget amounts across different search markets present interesting findings on the nature of the relationship among the three key variables in a sponsored search process – bid amount ( $b$ ), the budget amount ( $B$ ) and impressions ( $I$ ). The paper then outlines the future course of actions.

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