



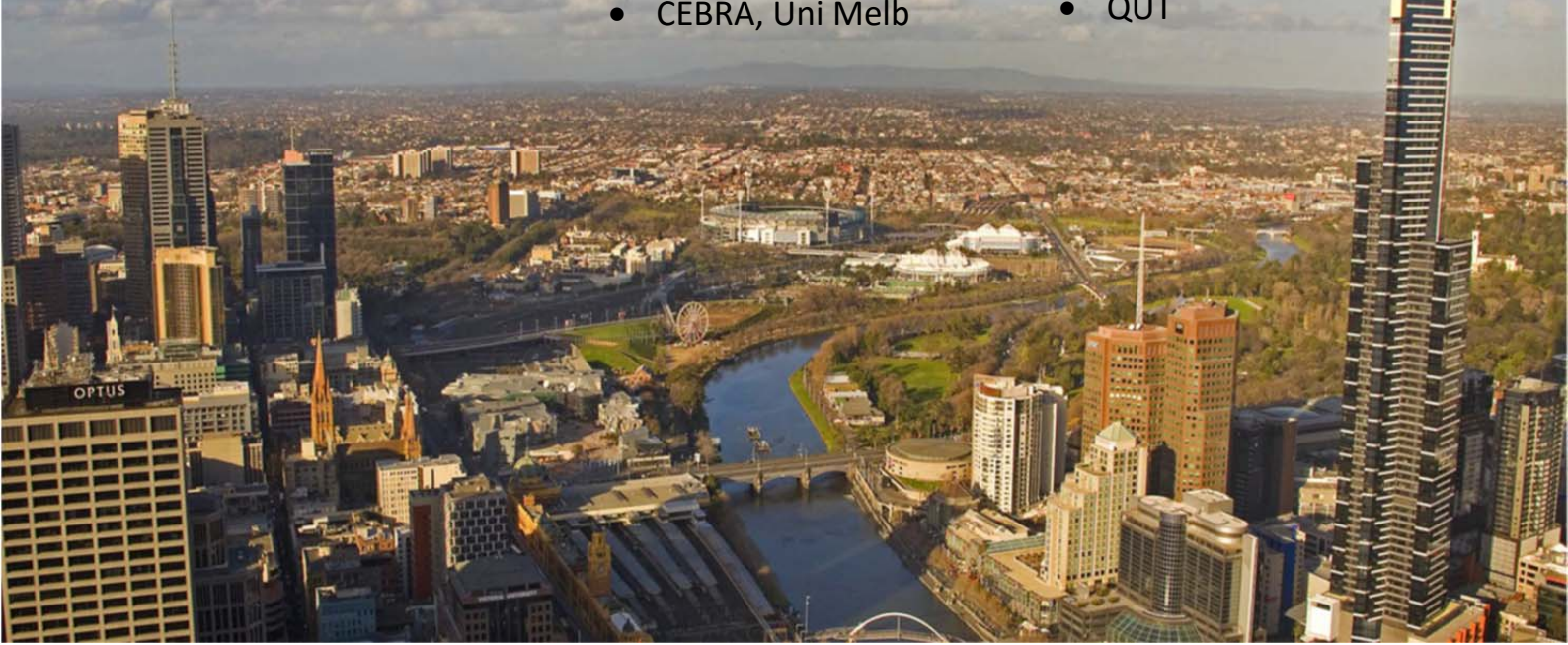
Australasian Bayesian Network Modelling Society

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**Updates from:**

- Norman Fenton, QMUL
- Bayesian Intelligence
- CEBRA, Uni Melb
- Bruce Marcot, US Forest Service
- QUT



**ABNMS 2015 Conference  
23 – 26 November 2015  
Melbourne, Australia**



## President's Report

ABNMS began in Melbourne in 2009 as Bayesian network modellers found a common need for communicating and getting feedback, as well as an organization that could help train students and researchers new to the techniques. Mark Burgman of the Centre of Excellence for Biosecurity Analysis (CEBRA) at the University of Melbourne hosted that first conference (it was ACERA then, however, Australian Centre of Excellence in Risk Analysis). So, it's fitting that CEBRA is the leading sponsor of ABNMS this year, when it returns to Melbourne. To be sure, the venue has shifted down the road to Monash Caulfield (which seems just discernible to the left of the Eureka Tower on the right side of the cover image).

Since 2009 ABNMS, and Bayesian network technology, has been prospering, with ever new applications and opportunities developing. The 7th annual tutorial and conference will surely reflect that, so you are most welcome to join us at the Society conference in Melbourne!

Last year's conference was highly memorable, thanks to the excellent organization provided by Steve Pawson of SCION Research, Rotorua, New Zealand (thanks, Steve!), justifying the "Asian" in our Society's title "Australasian Bayesian Network Modelling Society". From the Australian point of view, there was a worry that not enough attendees would cross the ditch, but the lure of some holiday time on a snakeless island proved too strong, and attendance was very good. The Society used the occasion to continue our overseas connections, bringing Dr Bruce Marcot of the US Forest Service in to talk about his projects and use of Bayesian networks in forest management. We're fortunate enough to have him return this year, with a new keynote address. He's

written the Society a letter about his recent research using Bayesian networks in environmental science, as well as research projects he'd like to collaborate on.

As before, we shall run a two-day tutorial program ahead of the conference, introducing Bayesian networks, tools, modelling techniques, GIS integration, expert elicitation and data mining. You can see last year's tutorial program here. We shall probably run a similar program this year, but if you have suggestions or would like to present something new, please let us know.

This year we continue our student travel scholarships, as well as one scholarship for a tutorial attendee from last year, worth up to \$500. If you are eligible, you are encouraged to apply.

This year, as we have a program spanning Monday through Thursday the week of 23rd of November, we are organizing also a couple of social events for Friday for anyone staying on in Melbourne. These are outings to two of Melbourne's better attractions: the Melbourne Museum and the National Gallery of Victoria.

I want to thank everyone who's helped make the Society a success over the years, especially those who have served on the Board, given conference presentations and led tutorials in our workshops. Especially I thank Steve Pawson for his efforts to put on a great show last year and Steven Mascaro, who's been the stalwart behind our web presence. It's been a great 6 years!

If you're using, or thinking about using, this great technology, please do submit an abstract for this year's conference. Work ready for publication is very welcome, but

so too are less developed projects. As a less formal conference, you can get early feedback on your ideas, designs and plans, and you may find a new collaborator while you're at it!

I look forward to seeing you in Melbourne.

Regards,  
Kevin Korb.

## ABNMS 2015 Conference

<http://www.abnms.org/conferences/abnms2015/>

The 2015 ABNMS conference will be held at Monash University's Caulfield campus in Melbourne's southeast from the 23-26<sup>th</sup> November. The modelling workshops 23-24<sup>th</sup> November (Caulfield Building K Level 1 Room 10) will be followed by the ABNMS Conference on the 25-26<sup>th</sup> November (Caulfield Building H Level 1 Room 25). Accommodation is available in the Caulfield area or in the city centre, a quick train ride away (Caulfield station is next to the Monash campus); see our travel and accommodation [web page](#).

### Pre-conference BN Tutorials

*23 and 24 November 2015*

A two-day introduction to Bayesian Networks (BNs) and related technology. Includes an overview of BNs and software platforms, expert elicitation for parameterizing BNs, GIS integration, sensitivity analysis and an introduction to more complex BNs, e.g., object orientated, plus more.....

- Tutors from ABNMS and Bayesian Intelligence Pty Ltd.
- Cost: \$100 (member) or \$200 (non-member)

- Limited to 25 participants.

### ABNMS Conference

*25 and 26 November 2015*

### Keynote Speakers

- **Dr Bruce Marcot**, US Forest Service
- **Dr Dan Ababei**, Lighttwist Software
- **Dr Jonathan Keith**, MAXIMA, Monash University

**Abstracts** are invited from any area of application or science using Bayesian networks for analysis, modelling, decision making or problem solving. Submissions describing methods and research on Bayesian net technology itself (e.g., tools, interfaces, data mining, Bayesian updating) are likewise encouraged.

- Abstract Submissions Due: 4 Sept 2015
- Registration Deadline: 11 Sept 2015
- Cost: Students: \$100; Members: \$200; Non-members: \$250

See our [Call for Abstracts](#) page for more details.



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Date: 8 August 2015

Dr. Kevin Korb, President  
Australasian Bayesian Network Modelling Society  
School of Information Technology  
Monash University  
Clayton, Victoria 3800  
Australia

Dear Kevin,

I wanted to take this opportunity to express my gratitude to you and ABNMS for providing a forum and society to help advance excellence in modelling. I was very pleased to attend the ABNMS annual conference last November 2014 in Rotorua, where the Board voted me in as the first honorary member. I very much look forward to attending this year's conference in Melbourne where I have been asked to provide a keynote address and where I will enjoy further collaborations with attendees.

I also wanted to take an opportunity to share a summary of my ongoing projects here that use Bayesian network modeling. The BN modeling approach, as you well know, is a remarkably flexible framework, and I am currently using it in the following projects:

- Evaluating the relative influence of environmental and anthropogenic stressors on the global populations of polar bears, to help advise U.S. Fish and Wildlife Service for their conservation and recovery program for the species.
- Mapping marine habitat suitability and knowledge uncertainty of northeastern Pacific benthic macrofauna, to help advise U.S. Bureau of Ocean Energy Management for their projects to site tidal and wave energy platforms.
- Estimating tidal marsh bird distributions on the northeastern seaboard U.S., and habitat associations of tidal marsh obligate species of small mammals in north San Francisco Bay, California, to help U.S. agencies and regional planners identify and prioritize areas for conservation, given sea level rise under climate change.
- Identifying what I call "vocal clades" of birds, particularly to analyze variations in the primary song of the Great Horned Owl (*Bubo virginianus*) throughout its distributional range.
- Development and implementation of a major decision advisory system for identifying potentially invasive and injurious freshwater fish, to help U.S. Fish and Wildlife Service rapidly screen essentially several thousand potentially invasive species for potential listing under a U.S. national law preventing their importation and spread. This is a major advance and game-changer.
- Assessing the impacts of human recreation on brown bears (*Ursus arctos*) in Alaska, to help advise managers on appropriate control measures.

Other colleagues of mine here in North America are using BN modeling, mostly in relatively simple ways, to depict elements of wildlife species' habitats and predict impacts on species and ecosystems from alternative management scenarios.



In fact, risk analysis, scenario planning, and **Bayesian decision networks** are areas of broad and growing interest here. There may be some common lines of research to pursue on merging areas of decision science (structured decision making) with BN modeling, in particular incorporating the decision theoretic methods of cognitive mapping, objective hierarchy analysis, analytic hierarchy and analytic network processes, comparative risk analysis, heuristic optimization methods, and multi-attribute utility theory.

Much of my current and previous project work using BN modeling also has led me to identify some additional "hot topics" that I would like to pursue next, perhaps some in collaboration with ABNMS:

- **Completing the CPT.** Particularly when inducing CPT values from machine-learning algorithms (e.g., expectation maximization), there typically remain many "holes" in the CPT table that, by default, get filled with uniform probability distributions that are uninformative. I have developed a few work-arounds for this, and have explored others' tools and methods (e.g., Bayesian Intelligence's CPTelicitor, and Cain's [2001] methods), but we really need a generalized theory and approach to solve this common problem.
- **Partitioning the components of variation and uncertainty** in Bayesian network models of ecological systems. Current BN modeling tools do not explicitly provide for separating the various categories and sources of error and variation (e.g., parameter value uncertainty, model structure uncertainty, measurement error).
- Related to the above item is the need to **explicitly depict confidence in CPT values.** Cain (2001) called it "uncertainty about uncertainty," and few researchers have attempted to make this explicit in BN models (e.g., Wilhere 2012).
- Provide a set of **guidelines on common quandaries and mistakes in BN modeling and their practical solutions.** I know that Ann Nicholson has written a bit on this, but in my own work and many journal manuscript reviews, I have also encountered a number of other common dilemmas and errors that people make in BN modeling. I have some answers but would like to collaborate on this topic.

I hope to have opportunities to discuss these and other areas of mutual modeling interest with yourself and conference attendees this November. Perhaps we can also continue to pursue ways to further strengthen ABNMS' collaborations across the hemispheres and more formally engage a North American component.

Again, my thanks for the great forum that ABNMS provides.

Sincerely,

/s/ *Bruce*

Bruce G. Marcot, Ph.D.  
Research Wildlife Biologist  
Ecological Process and Function Research Program  
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## News and Updates

### **BN Research at ACEMS, QUT**

The ARC Centre of Excellence for Mathematical & Statistical Frontiers (ACEMS) comprises a diverse range of partners, working closely together to deliver world-leading research in mathematical and statistical theory and methods to address challenging scientific problems in the real world. The mathematicians and statisticians at the QUT node of ACEMS are actively engaged in several Bayesian network projects in diverse areas such as health, industry and the environment. Current projects include:

- The development and application of quantitative statistical tools to the management and conservation of marine ecosystems such as the Great Barrier Reef (ACEMS-AIMS research project). This includes developing dynamic BNs to model marine ecosystems for analysing and predicting spatial and temporal responses to cumulative impacts to support decision makers in managing coastal development works such as dredging.
- ARC linkage project "Improving the productivity and efficiency of Australian airports", a collaborative project with numerous government and industry partners, seeks to develop real-time video analytics capabilities and BN based dashboards to assist managers in adapting to a rapidly changing operational environment.
- A multidisciplinary approach to combining social and technical aspects of interventions to achieve reductions in network peak demand of electricity by households. Associated with this

project, two case studies were conducted (1) qualitative data from various energy use scenarios of householders on Magnetic Island, Queensland, were compared to model outputs and (2) the anticipated impact on network peak demand of using various levels of education and engagement activities with a range of modelled interventions.

Some of the previous BN model projects conducted at QUT are: Cheetah translocation and conservation challenges, Risk of ground collision of unmanned aerial vehicles, Dairy Sustainability Scorecard, Gladstone Harbour Report Card, Object-oriented approach to BN modelling, Validation of expert elicited BNs, Blue-green algal (*Lyngbya majuscula*) bloom initiation, Pest risk management, Way finding and Inbound passenger facilitation at airports, and Methicillin-resistant *Staphylococcus aureus* (MRSA) infections in hospitals.

### **New Projects at the Centre of Excellence for Biosecurity Risk Analysis (CEBRA)**

#### Theme: Data Mining

#### **1501C: Improving Ballast Water Risk Tables**

Previous ACERA and CEBRA work identified several shortcomings in the modelling approach used to develop Ballast Water Risk Tables. This project will research opportunities to improve ballast water risk assessments, including through improved reporting and analysis of factors such as sea-surface temperature data;

ship movements; and species presence and range data from port monitoring surveys.

#### **1501E: Compliance and Risk Based Sampling for Horticulture Exports**

This project will support CEBRA to make recommendations to improve the Horticultural Export Program. CEBRA will analyse the inspection data using several approaches including combining likelihoods and empirical Bayes, and make recommendations regarding suitable mechanisms for inspection of small or multi-product consignments, and for the intervention management of low-risk pathways, using e.g. one of the CSP family of inspection algorithms.

#### **1501F: Import Clearance Performance Measurement**

CEBRA will support the Border Compliance Division develop a suite of performance indicators and the necessary infrastructure to collect the needed data. The project involves a review of current performance indicators, documentation and existing intervention practices for each regulated pathway. CEBRA will then deliver a report recommending performance indicators for each pathway, including quantitative descriptions of leakage surveys (if applicable), data and data collection requirements.

### **Theme: Spatial Analysis**

#### **1502C: Estimation of National-level Farm Demographic Data for Preparedness of Highly Infectious Livestock Disease Epidemics**

Project 1402C developed a suite of statistical models that estimate the number of animals on farms in New Zealand from remotely sensed data at a scale that is relevant to support emergency response planning. These

models have identified areas where data are sparse and where uncertainties are relatively high. The economic impacts of these inaccuracies have not been modelled, and there is no way for assessing priorities for reducing these uncertainties. Project 1502C will fill this knowledge gap.

#### **1502D: Criteria in Prioritising Plant Pests Along the Biosecurity Continuum**

This project is designed to address the prioritisation of plant pests for surveillance in Australia. This project will review and assess methods for prioritisation in invasive species and environmental management that have been recommended or used elsewhere; identify the approach best suited to the Australian plant-pest prioritisation context; and develop a plan for identifying the most effective way of rolling out the assessment process in Australia.

#### **1502E: Risk Maps for Optimising Biosecurity Surveillance**

We will develop a spatially explicit Bayesian Network base approach to allocate surveillance effort based on risk. Empirical data are available to support an assessment of risk for some factors. We will use expert elicitation to quantify risks where no formal data is available. The model will be implemented in a geospatial environment.

### **Theme: Intelligence**

#### **1503A: Intelligence Gathering and Analysis**

International Biosecurity Intelligence System (IBIS) is a web search tool that provides real-time intelligence on emerging pests, diseases and pathogens. The next stage of research and development will focus on improved architecture for the IBIS site. The

architecture will be redesigned so that the existing deficiencies are accounted for, providing the environment necessary to implement the next set of developments and improvements in the user experience.

### **1503B: Intelligence Tools for Regulated Goods Traded Via E-Commerce**

Internet commerce facilitates long distance dispersal of alien species (risk goods), but the effects of this trade are neither well understood nor documented. The magnitude of the threat is not known and tools for managing the risk are undeveloped. This project will be a desktop exercise involving reviews of available literature and data and discussions with staff in other jurisdictions. Existing software will be evaluated against a set of functionality requirements, concentrating our efforts on assessing the software used by regulatory agencies in various jurisdictions.

### **Theme: Benefit Cost**

### **1504C – SP: Testing Incentive-Based Inspection Protocols**

The focus of this phase of the project is running field pilots of proposed compliance based inspection protocols in order to give a more complete understanding of participants' responses. The field pilots will involve introducing changed protocols on two plant-product pathways and observing the responses of importers, suppliers and customs brokers. The compliance-based inspection protocols that will be rolled out arise from the theoretical work in CEBRA Project 1304C, together with any refinements suggested in CEBRA 1404C.

1504D: Using Decision Support Tools in Emergency Animal Disease Planning and Response

As an important component of disease planning and preparedness for the department, the project will report on key information that could be used in an FMD outbreak to infer the potential scale of an outbreak and information to support disease management decision-making taking into account variable objectives of control and influence of variables such as effectiveness of measures and resource issues.

### **Theme: Pathways**

### **1505A: Ornamental Fish Import Surveillance Systems**

The Department has proposed changes to the way it manages the disease risks associated with imported ornamental fish. The proposed changes include the introduction of on-arrival health surveillance that will allow the department to monitor the performance of overseas authorities and exporters in meeting the health requirements for ornamental fish exported to Australia. This ongoing project (ACERA 1206G, CEBRA 1305A, and CEBRA 1405A) focuses on developing and trialling a sampling framework for the proposed surveillance program.

### **Norman Fenton Reports on a recent study at Queen Mary University of London: Bayesian network approach to Drug Economics Decision Making**

Consider the following data:

A relatively cheap drug (drug A) has been used for many years to treat patients with disease X. The drug is considered quite successful since data reveals that 85% of patients using it have



a 'good outcome' which means they survive for at least 2 years. The drug is also quite cheap, costing on average \$100 for a prolonged course. The overall "financial benefit" of the drug (which assumes a 'good outcome' is worth \$5000 and is defined as this figure minus the cost) has a mean of \$4985.

There is an alternative drug (drug B) that a number of specialists in disease X strongly recommend. However, the data reveals that only 65% of patients using drug B survive for at least 2 years (Fig. 1(b)). Moreover, the average cost of a prolonged course is \$500. The overall "financial benefit" of the drug has a mean of just \$2777."

On seeing the data the Health Authority recommends a ban against the use of drug B. Is this a rational decision? The answer turns out to be no. The short paper here: <https://www.eecs.qmul.ac.uk/~norman/papers/Drug%20Economics.pdf> explains this using a simple Bayesian network model that you can run (by downloading the free copy of the [AgenaRisk software](#)).

## Bayesian Intelligence Pty Ltd

BI has had a busy and productive year. We completed a bushfire project for Victoria's DELWP (environment, land, water, etc.) working with Deloitte. We also finished a prototype project on forest biosecurity surveillance for New Zealand's MPI and are wrapping up another biosecurity project for northern Australia. We have additional projects on cognitive modelling, bushfire, environmental modelling, and Bayesian network visualization.

## Training

BI will be running its two-day **Introduction to Bayesian Networks** workshop in Sydney on the 8<sup>th</sup> and 9<sup>th</sup> of October, 2015. This is an excellent opportunity to learn the foundations of Bayesian networks, common extensions and network with others in using the techniques.

BI will also be running a one-day training session immediately following the ABNMS Conference (27/11/15) on **BN API programming** for Netica and GeNie. Topics will be selected from:

- Building Bayesian and decision networks
- Probabilistic inference and decision making
- Generating CPTs from data and equations
- Evaluate networks with predictive accuracy and sensitivity analysis

If you would like to attend, please register at the following site:

<http://bayesian-intelligence.com/training/>

You can also visit the above site for more information about our workshops or you can contact Owen Woodberry on [owen.woodberry@bayesian-intelligence.com](mailto:owen.woodberry@bayesian-intelligence.com) or on [+61 406 924 446](tel:+61406924446).

## The Twelfth Annual Bayesian Modeling Applications Workshop

BMAW 2015 was held in conjunction with Uncertainty in AI in Amsterdam on 16 July. It provided a forum for exchange about real-world problems among applications practitioners, tool developers, and researchers. The aim of the workshop is to foster discussion on the challenges of building applications whilst considering

stakeholders, user interaction, tools, knowledge elicitation, learning, validation, system integration, and deployment.

The theme of the Workshop has adapted from year to year, as real-world problems change and technologies evolve to meet them. The frenzy to apply conventional machine learning methods for commercial applications has the danger of overwhelming Bayesian methods where

they might be best applied. Bayesian methods face a similar challenge to the one they faced a decade ago by this community: To demonstrate their timeliness in the current environment of intelligent systems and a long tail of related decision and prediction tasks.

The organizers this year were John Mark Agosta and Rommel Novaes Carvalho.