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Abstracts

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Info-Gap Methods for Decision Support

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Abstract

The following questions underlie this lecture:
* How can severe uncertainty in knowledge and understanding be modelled and managed?
* Why is satisficing a strategically advantageous design strategy under severe uncertainty?
* What is the relation between min-max and robust-satisficing strategies for design?

In this talk we discuss theorems asserting that, under severe uncertainty, a robust-satisficing decision has a better probability of survival than a best-model outcome-optimizing decision. These theorems are based on non-probabilistic info-gap decision theory, which provides a quantification of Knightian uncertainty. We discuss applications of info-gap decision theory to a generic design problem, and to conservation planning. We touch on monitoring to detect invasive species, and investment for bio-diversity.

References

* Yakov Ben-Haim, 2006, *Info-Gap Decision Theory: Decisions Under Severe Uncertainty,* 2nd edition, Academic Press, London.

* Yakov Ben-Haim, 2004, Uncertainty, probability and information-gaps, *Reliability Engineering and System Safety,* 85: 249-266.

* David R. Fox, Yakov Ben-Haim, Keith R. Hayes, Michael McCarthy, Brendan Wintle and Piers Dunstan, 2007, An info-gap approach to power and sample size calculations, *Environmentrics*, vol. 18, pp.189-203.

* Helen M. Regan, Yakov Ben-Haim, Bill Langford, Will G. Wilson, Per Lundberg, Sandy J. Andelman, Mark A.~Burgman, 2005, Robust decision making under severe uncertainty for conservation management, *Ecological Applications,* vol.15(4): 1471-1477.

* Yohay Carmel and Yakov Ben-Haim, 2005, Info-gap robust-satisficing model of foraging behavior: Do foragers optimize or satisfice?, *American Naturalist,* 166: 633-641.

* John K. Stranlund and Yakov Ben-Haim, Price-based vs. quantity-based environmental regulation under Knightian uncertainty: An info-gap robust satisficing perspective, to appear in *Journal of Environmental Management.*

More references, links to international workshops on info-gap theory, and other sources, can be found on my website: http://www.technion.ac.il/yakov

A user's evaluation of info gap

Mark Burgman

Info-gap decision theory provides a means for evaluating the uncertainty of a decision among a set of alternatives, centering on a specific model (or set of models or parameters). It is useful mainly because it answers a very specific question: "how wrong could this model be, before I should change my decision". This presentation outlines how the framework contributes to decision-making in conservation biology, and explores views on the limitations of the method.

A Critique of Info-Gap: Myths and Facts

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Abstract

Info-Gap is a relatively young methodology for decision making under severe uncertainty. Yet, it has already become very popular in the bio-security and conservation biology communities in Australia. On the other hand, a formal examination of Info-Gap reveals that there are huge discrepancies between what it claims to be and do and what it actually is and does. In this presentation we examine some of the myths and facts concerning the conceptual, theoretical and technical aspects of Info-Gap and their implications in the area of risk analysis. The overall conclusion is that Info-Gap is fundamentally flawed and is not suitable for decision making under severe uncertainty. The presentation is based on a number of papers on this topic that can be found at: www.ms.unimelb.edu.au/~moshe/frame_maximin.html

Robust methods for Multi-criteria Decision Analysis

Helen Regan

One of the over-riding issues with all decision making frameworks is uncertainty. A reliable decision can only be made when the problem is sufficiently well understood and the empirical data used to inform the process is of high quality. In multi-criteria decision analysis (MCDA), criteria weights are usually assigned subjectively by individual group members and any weight aggregated across the group will have an associated variance due to differing opinions across group members. Moreover, weights are dependent on group composition. If a different group convenes it is likely that the criteria weights could change. As a result, weights assigned to criteria in a group MCDA are highly uncertain. Another significant source of uncertainty is in the numerical assessment of alternatives against criteria. Usually, empirical data will be used to assess how well the alternatives satisfy each criterion in the decision tree, however, in the absence of empirical data, expert opinion will often be used. Whether the assessment is objective or subjective the assessment score will be uncertain. A thorough consideration of uncertainty is crucial to ensure that reliable decisions are being made within the adopted decision framework. We present the tentative results of the ACERA working group on “Robust multi-criteria decision analysis”. We will present a range of uncertainty analysis techniques applied to a practical MCDA case study relevant for biosecurity risk assessment.

An environmentally sustainable design atlas of Australia based on extreme value statistics of temperature and rainfall

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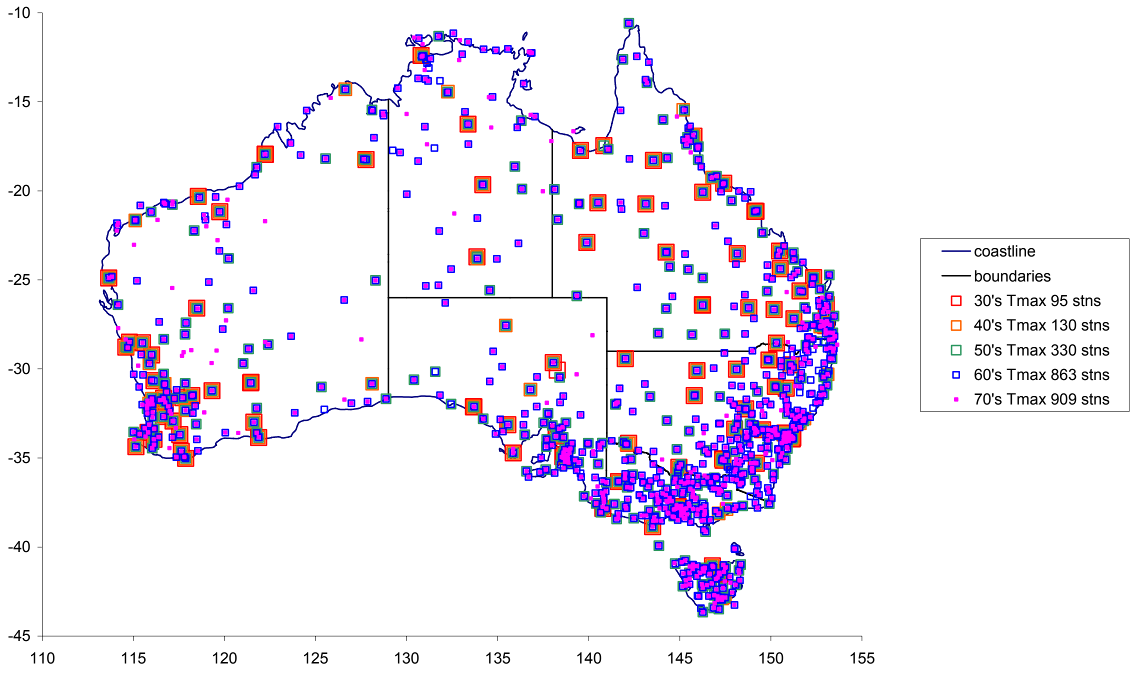
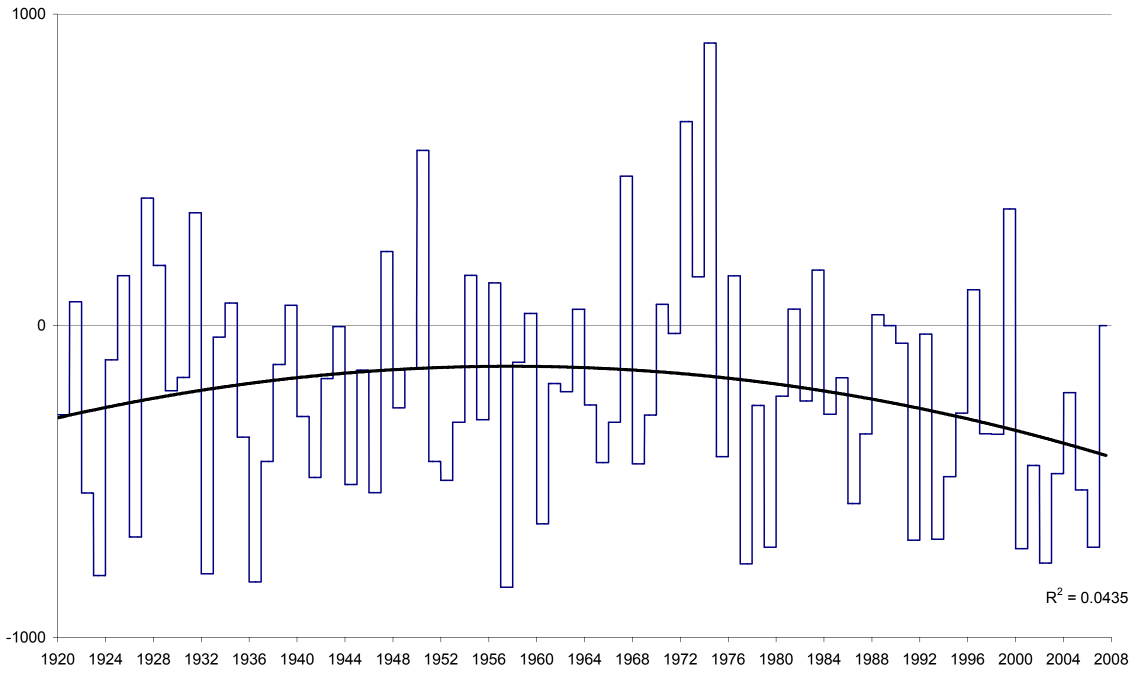
The present research is targeted to deliver site-specific design data throughout Australia to predict the requirements and performance of Heating, Ventilation, Air-conditioning, and rainwater harvesting systems in the built environment. This is challenging since climate change has accelerated since the 1970s, when published design datasets are derived from observations before that time.

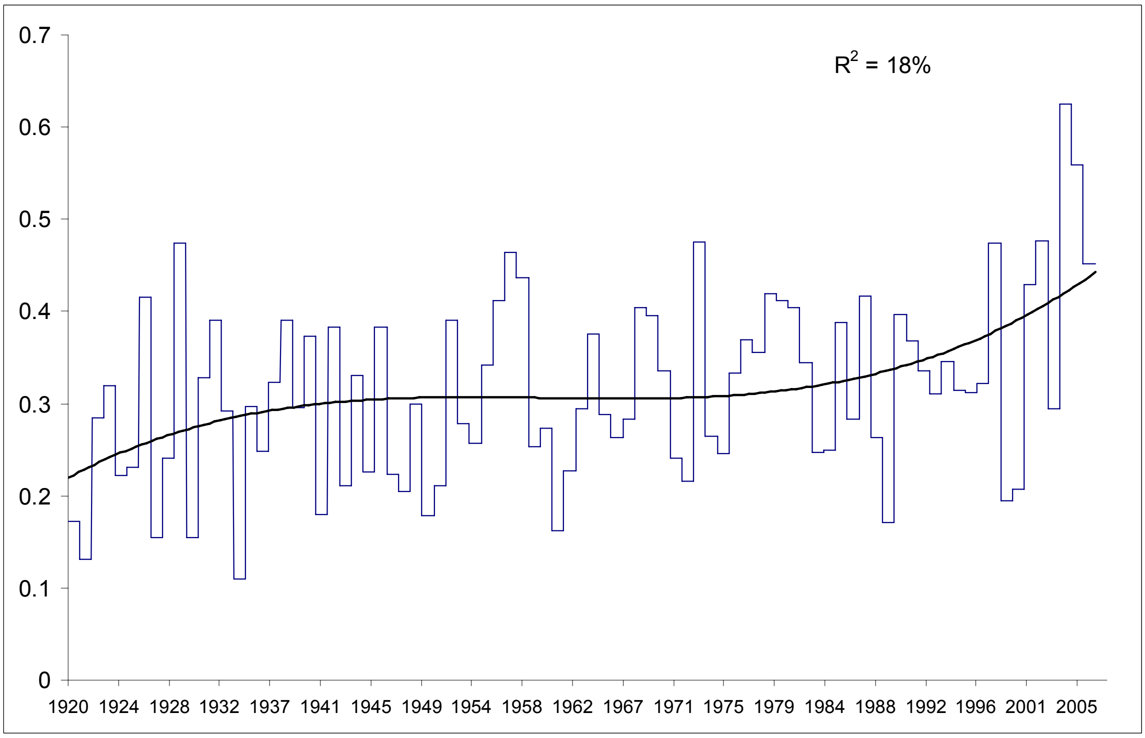
Peterson, Williams, Gilbert, and Bremhorst published a reanalysis of the tenth-hottest observation in recent years for 100 locations in Queensland in through 2005. The present research is being extended to over 1200 locations throughout Australia, with double the density of the previous publication (200 sites in Queensland) and reporting of numerous parameters, including humidity, rainfall, evaporation, and solar energy in addition to temperature. This has been made possible by application of the SILO datadrill facility maintained by the Queensland Department of Natural Resources and Water.



The above figure plots the 1200 stations and marks the time-evolution of primary temperature observations, making it clear that interpolations in regional locations are more reliable during the later half of the 20th century. Longer time series are reliable in the vicinity of capital cities and other major centres. An example of one point time series is presented below, with the annual difference between rain and FAO evaporations in Brisbane 40223, with an increasing the gap between rainfall and evaporative losses.



Another parameter that is currently being promoted in the new design atlas are heating degree days (HDD base 18) and cooling degree days (CDD base 24). Cooling degree days measure the energy demand to maintain air conditioning comfort, as it is based on the amount above the indoor base temperature (24 C) of the average outdoor temperature (Tmax + Tmin)/2 and not just the daily maximum. This reflects the problem of heat waves when relief is not found at night and building mass successively heats up day after day. Average annual cooling degrees (CD) = annual sum of CDD/365, and as illustrated in the following plot for Brisbane this is increasing in recent years.



Reference Peterson, E.L., N. Williams, D. Gilbert, K. Bremhorst (http://www.airah.org.au/eco_feb06.asp AIRAH Ecolibrium February 2006).

Estimating the risk of residue detection in export meat. A novel method of residue decay analysis using censored regression and MCMC.

Dr Simon Barry

This is a report of recent work we did for the Australian Pesticides and Veterinary Medicines Authority to explore ways to improve their method of setting 'export slaughter intervals' (ESI). The ESI is a mandatory withholding period between administration of a drug to an animal and slaughter for export, set in order to gain assurance that its residues in the meat will be below internationally-agreed levels.

The setting of an ESI is complicated. If it is set too short breaches may occur and trade may be compromised, if it is too long it can interfere with management practices and have commercial impacts on the drug manufacturer. The APVMA were interested in decision support tools which clearly communicated the risks involved in decision making to the various stakeholders involved.

The analysis of this data has a number of distinct features which are considered in the analysis. First, experiments typically involve a small number of test animals so the appropriate uncertainty needed to be calibrated. Second, many residue measurements are below the limit of detection (i.e. censored). Third, consideration of the test equipment used in the approval process and the test equipment and procedure used in the overseas market needed to be considered.

Our method makes use of censored regression techniques that allows readings that are below some limit of detection or quantitation to contribute appropriately to the residue decay curve, by using a MCMC approach which is based on recorded variability in the analytical method. It then goes on to provide an estimate of the probability of detection and rejection as a function of time.

Using a Bayesian Net to aid in the selection of candidate variables

Grant Hamilton, Ross McVinish, Kerrie Mengersen
School of Mathematical Sciences, QUT

There has been an increasing awareness of the value of Bayesian analytical techniques in a variety of fields, including risk analysis. In Bayesian analysis, the support for multiple competing models can be assessed. While various strategies exist for determining the best models from among a field of candidates, the candidate model selection stage is critical, since the accuracy of the analysis in the first instance hinges on the set of candidate models including the ‘true” model, or at least a reasonable approximation thereof. This selection process is in part subjective, bringing together various elements including expert knowledge, scientific literature, contemporary debate and personal experience. This is probably one of the most important and difficult stages in model building, and the one for which there is the least help. We demonstrate the use of a graphical model as a structured and rational means to integrate various forms of knowledge and to select candidates from among a large number of possible covariates.

Methodological Issues in Import Risk Assessment

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The decision whether or not to import a particular item of commerce is a binary decision. The outcome is either yes (with appropriate management practices in place if required) or no. Here we look at the entire decision making process from the point of view of Bayesian decision theory, and outline a theoretical and methodological approach which can form the basis of a trustworthy and dependable decision. This approach is characterised by being rational, and coherent.

A loss function is associated with any decision, $L(\theta, a)$ which represents the loss incurred when action a is taken, with θ representing the state of nature as expressed through the parameters of an appropriate model. As the state of nature is unknown at the time of decision making, there will be uncertainty associated with θ, which may be expressed through a probability density $p(\theta)$, which represents our beliefs about the state of nature at the time of the decision, and recognises that those beliefs contain some uncertainty. Thus the exact loss associated with the decision can not be calculated, as it will depend on the "true" value of θ, which will typically remain unknown. Given the probability density $p(\theta)$, however, we may find the expected loss, and use this as the basis for a decision.

To make a robust decision it is equally important to quantify the uncertainty about θ, obtain the correct form of the loss function $L(\theta, a)$, and quantify risk aversion. For example, if we were to estimate the chance that there is at least one establishment of a pest resulting from one year's importation of a commodity, then we would expect the analysis from the importer's viewpoint to reflect that overestimation of this chance by a unit involves less risk than underestimation by the same margin. In this context the best estimate might be an appropriate upper percentile of the relevant distribution rather than the median which would be applicable if neither under nor over estimating the chance of establishment were considered more risky.

The presentation will develop the methodological basis for making a decision under uncertain knowledge, and compare the proposed ideal methodology with the methodology adopted in recent Australian government pest risk assessments.

We identify several areas where the decision making methodology ought to be improved. These include the current practice of considering separate pest risk assessments for each pest instead of considering the consequences collectively; the use of an inconsistent approximation to the probability of actual loss (the median); the failure to effectively take account of uncertain knowledge in decision making; and the failure to differentiate between variation due to natural stochasticity and uncertain knowledge.

While we specifically comment on these major issues in this presentation, there are many other concerns, major and minor that have been raised with the IRA methodology, and these are documented in various industry submissions to the Australian government [1, 2].

References

[1] Apple and Pear Australia Ltd. The Australian apple and pear industry's technical response to importation of apples from New Zealand revised draft IRA report December 2005. Available from Biosecurity Australia: www.daff.gov.au/ba/ira/current-plant/banana-philippines/submissions, 2005.

[2] Australian Banana Growers' Council Inc. Submission in relation to revised draft IRA report (2007). Annexure on methodological issues. Available from Biosecurity Australia: www.daff.gov.au/ba/ira/final-plant/applesnz/submissions, 2007.

Solutions to a "Tricky" Surveillance Problem

N. Cogger, R. Morris, and D. Prattley

Trichinella is a zoonotic parasite that causes the food-borne disease trichinellosis. Historically, trichinellosis has been associated with consumption of undercooked pork products. More recently, cases of trichinellosis have been associated with the consumption of horse meat. To date the United Kingdom is one of the few countries whose meat products (either for domestic consumption or export) have not been linked to a confirmed case of trichinellosis in humans. Furthermore, routine testing of foxes, horses, and domestic pigs has provided no evidence of the parasite being present. This data supports a claim that Great Britain has negligible risk of suffering autochthonous cases of trichinellosis in the human population. However, the European Commission (Regulation 2075/2005) does not recognise regions of disease freedom and has imposed requirements on all Member States of the European Union that they conduct surveillance testing for *Trichinella*. Consequently, Great Britain must conduct routine surveillance for *Trichinella*, be it at a lower level than countries with a non-negligible risk of trichiniellosis in the human population. We believe the best way to ensure detection of *Trichinella*, if it is present in Great Britain, is to focus on surveillance of animal species and sub-populations that pose a greater risk of infection. In other words, the relevant authorities should implement a targeted surveillance strategy that focuses on testing wildlife species (in particular foxes) and domestic pigs that are raised in a manner that increased their risk of infection.

The risk status for an individual farm was calculated by taking the weighted average of the risk of *Trichinella* infection in breeding[1] and growing[2] pigs and then making adjustments for the size of the farm. It was necessary to consider the risk in breeding and growing pigs separately because the management of these groups may differ (e.g. growing pigs housed indoor and breeding pigs housed outdoors) and the cumulative incidence of *Trichinella* infection increases with age. Hence, the likelihood of *Trichinella* infection in growing and breeding pigs is likely to differ. The presentation will show the risk profile for a number of different farm types located in the area in the UK with the lowest upper 95% CI for *Trichinella* prevalence (i.e. 3.21×10^{-6}).

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[1] A pig more than 30 weeks of age

[2] A pig that has been removed from the sow and is less than or equal to 30 weeks of age

POST-FARM GATE DISEASE SURVEILLANCE OF PIGS IN EASTERN AUSTRALIA.

M. Hernández-Jover, N. Cogger, N. Schembri, J. A. Toribio and P. K. Holyoake

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There are 15 major live pig auctions in Australia, where approximately 5% of the total pigs in the country are sold. Sales occur weekly, fortnightly or monthly and the number of pigs marketed at each saleyard ranges from 500 to 7,000 pigs per month. Livestock auctions at saleyards are likely to contribute significantly to the risk of emergency animal disease introduction and dissemination (1). The risk associated with livestock auctions is due to the high degree of commingling of pigs from different farms and the housing of different species (particularly ruminants) at the same locations. Producers trading through saleyards are predominantly non-commercial small operators but commercial pig producers use the saleyards to sell cull stock and livestock that are outside their consignment contracts. Disease surveillance at saleyards and abattoirs is required for early disease detection and to ensure the health and welfare of animals.

The aim of this project was to investigate the different movement pathways of pigs in Australia to evaluate the likelihood of disease detection at saleyards and abattoirs under current legislation. The first stage of the project will focus in New South Wales (NSW) and the second phase will extend the focus to Victoria and Queensland.

Piggery operations were defined as commercial if they were a primary source of income for the owner and if the main trading system was directly to an abattoir. Non-commercial producers reared pigs as a secondary source of income or as part of a mixed farming enterprise and if selling was primarily through saleyards. Farms were classified as breeding, growing, farrow-to-finish, boar stud and backyard operations according to animals kept and sold. Animals were defined as weaner, porker, baconer, backfatter and breeding stock according to age and live weight.

Four different post-farm-gate destinations of pigs were identified: (i) abattoirs processing meat only for domestic consumption (ii) abattoirs processing meat for domestic consumption and export (iii) saleyards and (iv) other farms. According to recent studies (2) the saleyards were considered the main destination for pigs from non-commercial operations and the export abattoirs the main destination for pigs from commercial operations.

A scenario tree that describes the movement of pigs from non-commercial producers to each of the four destinations has been developed. The tree includes nodes where a disease may be identified. In this first instance this scenario tree will be used to qualitatively evaluate the probability of disease detection and notification at the saleyard and abattoir. Information on producer post-farm-gate practices will be sourced from a current research project focused on non-commercial pig producers (2). Information on surveillance activities will be determined from a review of the legislation and policies related to disease surveillance at each state and from the evaluation of disease surveillance and inspection activities currently implemented in NSW, Victoria and Queensland. Depending on the quality of the data a quantitative analysis may also be undertaken.

Results obtained will provide information on the efficiency of the current inspection services for disease detection in Eastern Australia and the possible alternative surveillance systems which could improve the likelihood of disease detection.

References

1. Schembri N, Hart K, Petersen R, Whittington R. Assessment of the management practices facilitating the establishment and spread of exotic diseases of pigs in the Sydney region. Aus Vet J. 2006; 84(10):341-348.
2. AB-CRC Project 3.016RE: Peri-urban regional surveillance for biosecurity for the pig industry in Eastern Australia.

Metrics for National Security Capability Development
(Dynamic Risk Models)

Alexei Filinkov and Ian Fuss

Centre for Quantification and Management of Risk
The University of Adelaide
and
Defence Science and Technology Organisation

We propose a general way of thinking about risk in National Security. This includes a unifying framework that is suitable for decision makers/risk managers at all levels: from Whole-of-Government level down to managers of specific security areas.

Making Management Decisions in the Face of Uncertainty: A Bayesian Approach to Stochastic Dynamic Programming

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ABSTRACT

The fields of conservation, wildlife harvest and weed control are all faced with the need to make management decisions, typically under substantial uncertainty. Adaptive management or active manipulation of a system to learn its dynamics with subsequent updating of management decisions is one solution to this problem. However, successful implementations of active adaptive management are rare, in part due to the difficulty of making decisions which, in the short term, are perceived to be suboptimal.

We explore an alternative approach that is structured in a Bayesian framework, which allows one to make optimal decisions and learn about the system dynamics simultaneously. The approach incorporates uncertainty into the decision making process by drawing state transition probabilities from the posterior distribution of a statistical description of the system dynamics, inputting the simulated value into the transition probability matrix and solving to find the optimal decision using SDP. The result is a probability distribution of management actions for each state in the system from which an optimal decision can be determined.

A key finding of our work is that a pessimistic belief about the probability of recovery is not precautionary with respect to management choices.

Meta-uncertainty: exploring the big picture of uncertainty and risk

Paul Keese

Uncertainty is an inherent part of risk: where there is no uncertainty, there is no risk. However, many internationally recognised standards in risk analysis (eg Codex Alimentarius, World Organisation for Animal Health (OIE), International Plant Protection Convention (IPPC), USA Presidential/Congressional Commission on Risk Assessment and Risk Management) provide minimal guidance on the consideration of uncertainty. In part, this is due to lack of an agreed lexicography and absence of comprehensive methodologies for recognising, analysing and evaluating uncertainty. Not surprisingly, there is no recognition of "uncertainty of uncertainty" assessments (meta-uncertainty). Nevertheless, in keeping with Nature's abhorrence of vacuums, the Precautionary Principle has become the *de facto* surrogate for meta-uncertainty, but remains a controversial mechanism for judging and responding to uncertainty. Therefore, it is suggested that meta-uncertainty analysis may provide a more useful tool for regulators to effectively apply uncertainty assessments to the consideration of risk, including:

- providing principles and methodology for probing uncertainty in risk assessments
- assessing the quality of uncertainty assessments
- providing guidance on the acceptable levels of uncertainty
- assessing the appropriateness of applying formal risk analysis to pursuits such as regulation and surveillence
- as a mechanism to resolve undecidable concepts in risk and risk analysis methodology
- revealing the incongruities that distinguish risk vs safety assessments
- providing insights to a broader perspective of risk when either the Likelihood or Consequence dimension of risk is unknown or unknowable, and
- as a mechanism to integrate utility, perception and decision-making with risk analysis.

Uncertainty analysis in salinity risk models

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Increasing salinity is a major threat to many of Australia's biological systems and a key component in managing this problem involves predicting how organisms are likely to be affected at different salinity levels. As part of the multi-year NAP/NHT funded project 'Biodiversity Thresholds to Salinity' a number of novel approaches to risk modelling were developed. Previous methods for uncertainty analysis in exposure-effects models have defined uncertainty as the lack of fit of an assumed model to scalar values. In the example presented, Probability Bounds Analysis is applied to characterising uncertainty in modelling the effect of increasing salinity on communities of native species. The results are discussed with reference to the effects of uncertainty on management decisions.

ACERA Update

Mark Burgman

ACERA began operation on March 1st, 2006. So far, it has commissioned 21 projects, and it's looking at a further 5 or 6, to commence in the later half of 2007. The projects contribute to 'research themes' agreed with DAFF: biosecurity framework development; eliciting judgements; risk analysis methods; surveillance and monitoring; and, communication and decision-making. Five are complete, on qualitative methods (loop analysis and networks), extreme event risk analysis, communicating probabilities, stakeholder mapping, and integrating risk over volume of trade. The presentation will outline some of their results. They illustrate the breadth of the work and some of the links that we hope to encourage. The talk will outline briefly the forthcoming projects, intending to spark further interest and collaboration with people not yet involved in ACERA projects.

Biosecurity, surveillance and risk - what, why, how and who

Stephen Prowse
Australian Biosecurity Cooperative Research Centre for Emerging Infectious Disease

Disease surveillance is the systematic collection, analysis and interpretation of health information and is a critical component of our biosecurity infrastructure. Surveillance is undertaken for a variety of reasons related to early warning, disease control programs, national disease status, protection of public health and agricultural production. Surveillance can be a targeted process aimed at the collection of information on a particular disease. This may be required to demonstrate disease status in support of international trade. Alternatively, surveillance can be directed towards the early detection of unknown diseases. The latter is a process of scanning the broader environment to identify anomalous events. A structured process of risk assessment is required to identify the areas in which to focus surveillance activities. The information collected is combined with underpinning information on populations, disease biology and ecology. The information can then be analysed and the analysis used to guide policy, decision making and risk management.

Simulating dispersal syndromes and surveillance protocols for invasive plants

Julian C. Fox[1,3*], Yvonne M. Buckley[2], Dane Panetta[3,4] and David Pullar[1]

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Surveillance for weed incursions is expensive and resource limited, and is often done on an 'ad hoc' basis. A novel way to improve the efficiency of surveillance efforts is to replicate the various dispersal syndromes and plant life history factors that influence the spread of invasive plants and concentrate surveillance in areas that are most susceptible to invasion. A GIS based modelling system is presented that replicates invasive plant spread across real landscapes for identifying areas susceptible to invasion. These areas can then be targeted for surveillance, improving the success of containment and eradication efforts. The system is used as the basis of a simulation study for identifying surveillance protocols for different weed life forms spreading under different dispersal syndromes (wind, water, road, long-distance dispersal) in real landscapes. Surveillance methods (random, systematic, seek and destroy, sampling in suitable habitat, and adaptive sampling) are evaluated against these invasion scenarios for the identification of surveillance protocols that can be generally applied.

Hierarchical Bayesian models to manage emergency plant pest invasions

Mark Stanaway

Field surveillance is the primary source of information used to manage a response to an emergency plant pest invasion. While we aim to perfectly specify the incursion boundary at a specific time, the potential for false absences forces a probabilistic interpretation of the status of sites. It is intuitive that, in the absence of positive records, our belief in true absence at a site is determined by both the thoroughness of the surveillance and our understanding of exposure to colonisation pressure. It is also generally true of pest populations that they remain difficult to detect for a limited time after colonisation. Hierarchical Bayesian models offer a framework to use surveillance data to condition our prior knowledge of colonisation pathways and population growth processes. The resulting posterior distributions can be used for predictive inference on the probability that a site is colonised at a particular time. Formalising our belief in the spatial distribution of a pest can then identify the critical areas of uncertainty to be addressed by research on process parameters or by targeted surveillance.

Making something from nothing: Calculating the efficacy of pre-emptive pest surveillance that yields only negative results

Dr Stephen Pratt

If we look for something but don't find it, it is either not there or we didn't look hard enough. This circumstance can arise when searching for a rare animal or plant, or at the end of an eradication campaign. It also arises from pre-emptive surveillance for an exotic pest, which is not known to occur within the country. Early detection of an incursion could lead to a successful (and cheap) eradication campaign, so there are good reasons to look for exotic pests before they are known to have arrived, but funding agencies want reassurance that a lack of positive pest detections is not a waste of effort. How do we express our confidence of absence, given a lack of detections? Or to put it another way, how do we measure the efficacy of the surveillance?
Given that the available effort is tiny compared to what would be required for a comprehensive survey, but that we are aiming for just a single detection, there are several techniques we can use to improve our surveillance efficacy. This presentation reports the approaches we are developing to estimate surveillance efficacy for exotic pests in metropolitan areas.

You-Gan Wang:

Estimating the numbers of the Foreign Fishing Vessels from Coastwatch Surveillance Data

Each year Coastwatch and Defence Air and Surface Surveillance and Response Assets report Foreign Fishing Vessels (FFV). It is problematic to accurately determine the quantity of FFV that actually do operate in the Australian Exclusive Economic Zone (AEEZ) because of:-

(a) FFV sightings comprise of various types,
(b) some FFV may have been reported on multiple occasions,
(c) whether the FFV is detected or not by a flight is a random event whose probability depends on how far the FFV is away from the flying path and the detection gear,
(d) sampling is biased because high risk regions will have more frequent flights,
(e) the dataset is large.

In this talk, I outline the estimation methodology to overcome these issues and provide estimates of the FFV numbers per month.

HOW BIOSECURE ARE SMALL-SCALE PRODUCERS WHO TRADE LIVE PIGS THROUGH SALEYARDS?

N. Schembri, M. Hernández-Jover, J. A. Toribio and P. K. Holyoake

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Biosecurity and disease surveillance are essential to conserve the health status of individual farms and national livestock industries. In recent times, a widening gap has been reported between government veterinarians and the pig industry in terms of disease reporting in at least one Australian state(1). Small-scale pig producers tend to be less informed about the risks of animal pests and diseases. This lack of knowledge could contribute to disease outbreaks and challenge the efforts of other producers (2).

The aims of this study were to improve our understanding of herd health monitoring and on-farm biosecurity practices undertaken by producers who trade pigs at saleyards. We also sought to assess the likelihood of disease reporting and the interaction with animal health facilities to identify producer reporting mechanisms.

Face-to-face interviews (n = 106) and discussion groups (5 groups, n = 40 producers) were conducted to determine the production practices of farmers who trade pigs at saleyards in eastern Australia. Study participants were recruited at saleyards or from a cohort of producers who had previously participated in a related postal survey. Interview respondents were classified by herd size, with small herds consisting of 0 to 149 sows (n = 97; 91.5%), and large herds with 150+ sows (n = 9; 8.5%). Responses were entered in a purpose-built database (Microsoft® Access 2002) and analysed using Fisher's Exact test and Ordinal Logistic Regression in GenStat Release 9.1©.

A higher percentage of producers with large herds (100%) had utilised veterinary services in the previous 12 months than producers with small herds (40.2%). However, veterinarians visited small herds more frequently (nearly 4 times per year) than large herds (2 visits per year). The veterinarian was the primary contact for most (88.1%) respondents following the observation of an unusual health event in their herd, followed by the Department of Primary Industries (66.0%). Producers sought advice mostly from their veterinarian, other producers and their friends and family. The national pig industry body (Australian Pork Ltd) was ranked "high" to "very high" as a useful source of information by only 21.1% of producers, whilst the Department of Primary Industries fared better (40.2%) in this respect. The outcomes of producer discussion groups supported the results obtained at the interviews regarding producer disease reporting and communication (education and extension).

Producers with small herds instigated few biosecurity interventions on their farms, with 94.8% having less than 4 of 7 listed precautionary practices on-farm. There was no herd-size difference ($P > 0.05$) in the proportion of producers who allowed visitors on to their property or who asked visitors about prior pig contacts. A higher percentage of producers with large herds (33.3%) quarantined incoming pigs than producers with small herds (3.1%).

These results provide an insight into the reporting behaviour and relationship of "non-commercial" pig producers with authorities in eastern Australia and will assist with future risk assessments of the likelihood of emergency animal disease introduction and spread in this sub-population of producers.

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Peri-urban biosecurity and risk perception/communication

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Biosecurity is science dominated, policy relevant and subject to uncertainty. It has multiple and conflicting objectives sought by many and diverse stakeholders. In short it has been firmly constructed as a risk requiring close management and effective communication. Biosecurity within peri-urban Australia has attracted particular attention given the geographical and economic importance of this zone to agriculture and the existence of multiple, conflicting (land) values and practices. This paper draws upon some recent empirical work conducted by the Bureau of Rural Sciences which identifies peri-urban landholders, examines pests and diseases of concern, establishes factors affecting biosecurity risk and answers the question of whether peri-urban landholders pose a biosecurity risk to Australian agriculture. It draws upon theoretical advances in psychology and sociology in relation to the risk perception and risk communication literature. It illustrates the evolution of these fields before examining biosecurity risk perception and communication in more detail through the use of three key ideas: biosecurity risk and otherness; biosecurity expertise and uncertainty; and biosecurity risk and proximity. It concludes with a brief discussion of some of the implications for the collective management and communication of biosecurity risk in peri-urban Australia.

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Abstract: Muttering, mattering and defining engagement: how process and intent align in stakeholder discussions

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Stakeholders and members of the public are regularly invited to comment on voluminous and highly technically risk assessments. They may be invited to participate in reference groups, attend public meetings or engage in consultations. In a time of heightened risk and uncertainty, we can be sure that there is political sense in widening the circle of engagement, despite pressure from within some quarters for a return to the primacy of 'expert' knowledge.

We argue that declining levels of public trust in agencies and increasing public scepticism about the role of science as the arbiter of decision-making around risk create new dilemmas for decision processes among policy makers. Significant among these is how to establish a transparent methodology that assists in making the stakeholder process less a minefield of competing claims and more a pathway of potential engagement.

We further argue that it is time to re-examine the social and scientific assumptions underlying stakeholder involvement in risk analysis, the processes we use and the outcomes we are looking for. Furthermore, we propose that an approach based on the concept of risk 'governance' (rather than risk analysis) may provide a more useful framework for addressing the very real challenges of effective stakeholder engagement in assessing and managing risk.

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