

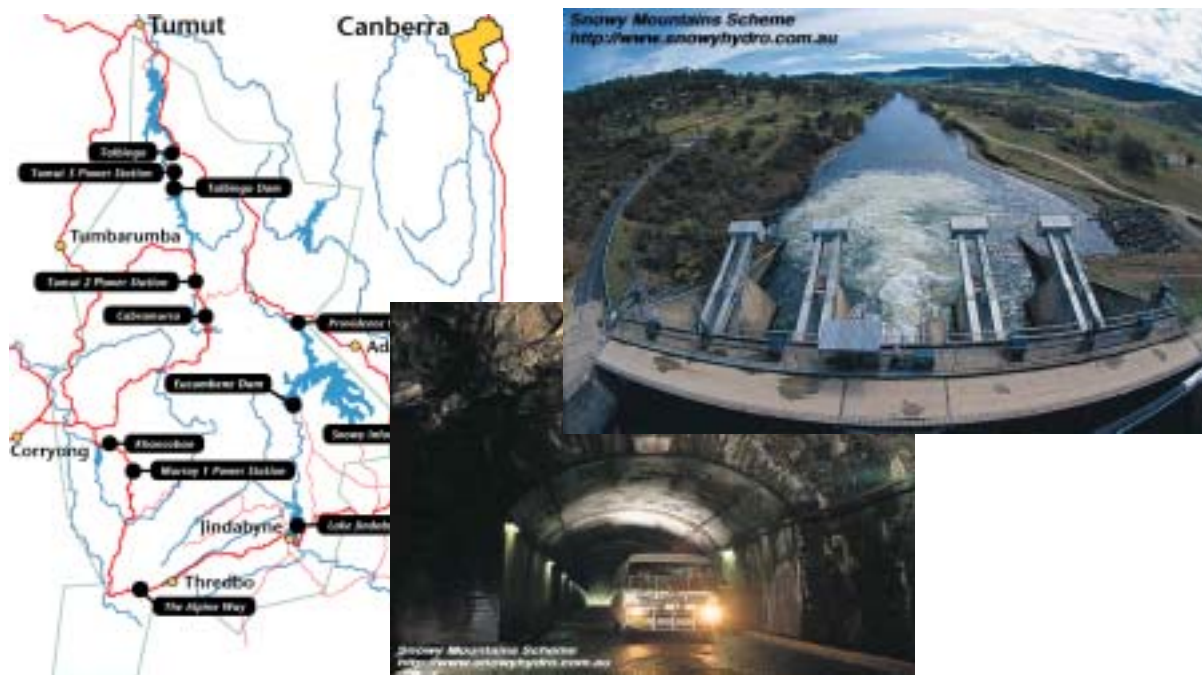
# STATISTICS MATHEMATICS INFORMATION NEWSLETTER

August 2001

*Statistics and mathematics often have a greater impact on everyday life than many people realise. This newsletter opens by illustrating where statistics has been applied to familiar events. It also illustrates through selected case studies the continuing work of Data Analysis Australia in applying these methods to problems and issues faced by a wide range of clients.*

*Dr John Henstridge  
Managing Director*

## Practical Statistics



The role and potential of statistics is often misunderstood. People often are frustrated with masses of numbers being presented to them and understandably decide that “you can prove anything with statistics”. However it is worth remembering that a major role of statistics is to reduce the mass of numbers to just the few that have real meaning. Statistics is not always about producing volumes of data – rather it is about converting that data into real information. Here we present several examples of where statistics has had a real impact on all our lives.

### *Modelling and Planning*

Practical statistics sometimes does not need any data. Australia has long been a leader in using probability models to understand the real world and to provide information at a stage before data is available. One example is in the modelling of water resources such as for the Snowy Mountains Scheme (pictures shown above). (cont overleaf).

## Practical Statistics (cont)

Spurred on by the need to plan the Snowy Mountains scheme, Pat Moran developed the area of queuing theory into a “theory of storage”. This allowed planners to understand how the random variation in rainfall can be managed through building the dams the right size.

In this area, the outcome was not volumes of numbers but rather an understanding that can be used for future policy and planning. This is perhaps statistics at its best – providing information in its most useful form.

### *Medical and Epidemiology*

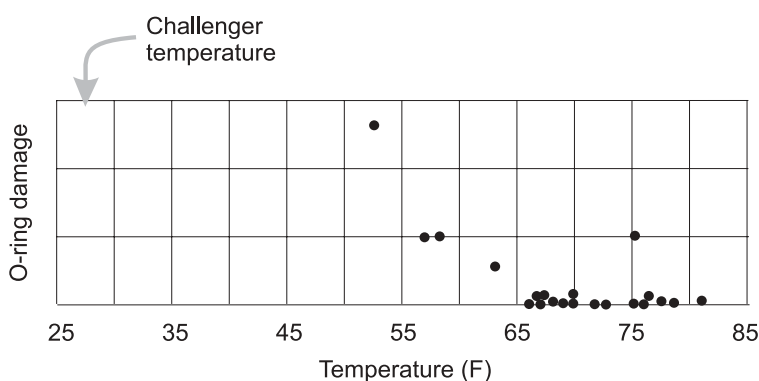
Most people are aware that Rubella or German Measles is a disease that is particularly harmful to pregnant women, since it can lead to significant medical problems for the newborn child, in particular blindness. This is a commonly accepted fact, but where did this information come from?

The answer is in a statistical study of an epidemic of child blindness carried out by one of Australia’s most prominent statisticians. Oliver Lancaster studied two Censuses and data from a range of health related sources in order to find the link between blindness and rubella.

A second example is the modelling of epidemics, where Australians such as Joe Gani made major contributions to the idea of dividing the population into three groups – those infected, those susceptible and those immune. This simple concept could account for the way that some epidemics are controlled by individuals becoming immune, as well as the need to reach a certain critical mass before the number infected explodes as a true epidemic. This model is the basis of modern models that are used, for example, to understand the HIV and BSE (mad cow) epidemics.

### *Cause and Effect*

A final example shows how statistics can be used in investigations to show cause and effect. In the aftermath of the Challenger space shuttle disaster there was an inquiry to determine the cause, which was soon traced to a failure in a seal.



Many recall the very public illustration where the Chairman of the Inquiry showed that chilling a piece of the rubber seal in iced water made it so brittle it lost its flexibility. But why did it happen on that flight and not previous ones?

A statistical analysis where data on partial failures was plotted against the temperature on the launch pad proved the cause. A scatterplot, a relatively unsophisticated statistical tool, could have changed history for the Challenger, by summarising the data from previous flights where minor damage occurred to the seals.

## Smart Statistics

People can often be overwhelmed by data due to the sheer volume of numbers, or not knowing what to do with all of the data they have. Statistics can be used to simplify the presentation of data using a range of exploratory techniques.

In reviewing client satisfaction surveys, Data Analysis Australia looks at the objectives of the survey then assesses the sampling, structure, content and application in order to ensure the results will include the required information.

This process formed part of recent reviews of complex surveys undertaken by Data Analysis Australia, and produced a valuable insight for the client.

### ***Review and Design of Victorian WorkCover Conciliation Service Annual Client Survey***

Since opening an office in Melbourne, Data Analysis Australia has forged an alliance with the Social Research Centre, a consultancy established by Darren Pennay.

The combined experience and skills of Data Analysis Australia and the Social Research Centre has seen them recently complete a project to evaluate and design the Victorian WorkCover Conciliation Service’s annual client survey.

The WorkCover Conciliation Service is an independent body that facilitates the resolution of workers’ compensation disputes in Victoria. It does this by involving all parties to the dispute in a non-adversarial environment. The Victorian WorkCover Authority is responsible for providing the administrative support necessary for the proper function of the conciliation process.

The project involved reviewing the process and effectiveness of the existing annual client survey in obtaining the range of feedback and information the Service requires.

Leading from this, the team has recommended appropriate survey methods and content to meet the Service’s client feedback requirements.

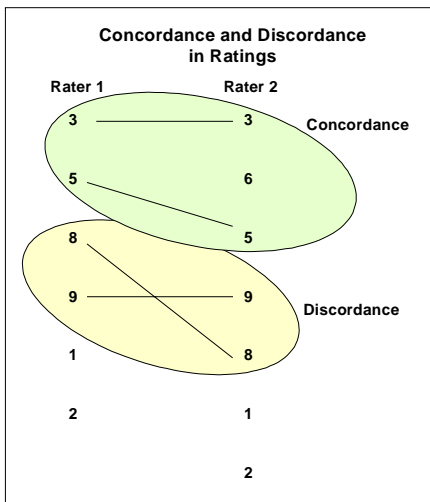
For further information, contact **Dr John Henstridge**.

# Optimisation in Selection Processes

A ranking process is regularly applied by a panel of raters when evaluating tender submissions for the provision of goods or services. In many of these situations there is a need to combine the assessments of the raters to give the best matched ranking. Sometimes this common ranking is achieved by the panel discussing their assessments and coming to a consensus. When this is not possible, a more formal method is needed.

Recently Data Analysis Australia combined ranking theory and optimisation techniques to solve a similar issue faced by the Department of Contract and Management Services, which was to select the best consultants for a project based on a list of factors ranked by past clients or project managers. Most raters had only ranked a small subset of consultants (with each subset different), resulting in a relatively sparse set of rankings.

Data Analysis Australia related this problem to the concept of ‘concordance’. A concordance is when a pair of raters order a pair of items the same way. The aim was to find the common ranking that minimises the total discordance in the individual ratings.



There are two approaches to finding a common ranking:

1. Search through the list of all possible orderings and evaluate the discordance function for each one and choose the best one.
2. Use an intelligent search algorithm that finds the best ordering without examining all the possible solutions.

The approach taken by Data Analysis Australia began with the application of a heuristic algorithm (which provided a good approximate solution) followed by a “Branch and Bound” search through all orderings after deleting all other items which have no opportunity of being in the first few places of the optimal ordering.

The approach gave CAMS the ability to make a decision on the most appropriate consultant, based on sound mathematical techniques.

For further information, please contact [Yen Nie Chong](#).

# Expert Opinion on Statistical Methods

One of the areas in which Data Analysis Australia is able to assist clients is by providing expert advice on statistical methods. Two recent case studies shown below illustrate how Data Analysis Australia can assist organisations in their informed decision-making.

## Case Study 1

A mining client required an expert opinion to confirm that they were implementing the most appropriate and accurate analysis. A more sophisticated analysis involving techniques including regression trees was performed by Data Analysis Australia.

These more complex methods confirmed that the client’s initial results were reasonable and, due to the inherent variability of the data, only modest gains could be achieved by using a more complex system. An unexpected outcome was that Data Analysis Australia identified an area where a slight bias had been introduced by data cleaning and was able to quantify the likely effect of this bias.

Although in this instance the introduced bias did not affect results used in decision-making processes, its existence highlights the need to understand data and the likely effects of removing or cleaning data.

## Case Study 2

Another client in the resources sector had conducted hardness tests on nuts and studs used in the construction of their plant, to identify whether the studs were likely to fail.

Data Analysis Australia conducted a statistical analysis of the hardness data to find the probability of obtaining a hardness value below a given “safe” value. The probability distribution of the stud strength was estimated and extrapolated to determine the probability of failure. Since there are tens of thousands of studs in a plant, a probability of one in 100,000 would be a concern.

Data Analysis Australia provided not only an assessment of the risk, but also an analysis of the sufficiency of the data used.



For further information, please contact [Donna Hill](#) or [Meredith Regan](#).

## Youngstats 2001

The WA Young Statisticians Workshop is an initiative of the Young Statisticians Group of the Statistical Society of Australia. The aim of the workshop is to foster the development of statisticians young in their career and to promote the profession. The 3<sup>rd</sup> Workshop was held recently at the Royal Perth Yacht Club (an enviable place to spend a Friday), attracting 38 undergraduates and recent graduates with an interest in statistics.

Continuing its commitment of supporting such ventures, Data Analysis Australia co-sponsored the Workshop with the WA Branch of the Statistical Society of Australia and Roche Products, and provided general support to the organising committee.

The speakers came from a wide variety of backgrounds, demonstrating the broad possibilities in the application of mathematical and statistical skills. The keynote speaker was Vivienne Snowden, managing director of Snowden Mining Industry Consultants in West Perth.

Dr John Henstridge, Managing Director of Data Analysis Australia was invited to speak at the workshop on the topic of professional statisticians. His speech invoked a lively discussion on the role of statisticians in taking control and raising the status and awareness of 'statistician' as a profession.

The day proved to be interesting and constructive for all involved. Many thanks to sponsors and the organising committee (Jodie Thompson, Data Analysis Australia and Marleen Voortman, Government Employees Superannuation Board) for their hard work.

## Staff News

Data Analysis Australia has taken on new staff, with the addition of **Meredith Regan**, a Consultant Statistician and Mechanical Engineer.

Meredith completed a Bachelor of Science and Bachelor of Engineering with Honours from the University of Western Australia before joining Data Analysis Australia. Meredith has already completed a number of complex statistical projects which have included projects in the resources and government sectors.

## Classic Quotes

"In ancient times they had no statistics so they had to fall back on lies."

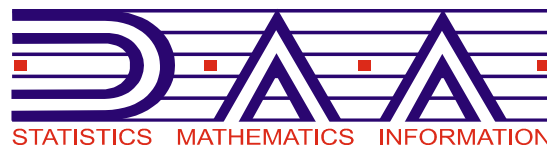
*Stephen Leacock (1869-1944), Canadian writer and economist*

"The statistics on sanity are that one out of every four Americans is suffering from some form of mental illness. Think of your three best friends. If they are okay, then it's you."

—*Rita Mae Brown*

"Experts estimate that global temperatures could rise as much as 5.8 degrees Celsius (42.4 degrees Fahrenheit) this century."

*Times of India website  
February 2001.*



## Contact Details

### *Perth Office*

**97 Broadway  
(PO Box 3258, Broadway, Nedlands, 6009)  
Nedlands WA 6009  
Australia**

**Telephone: (08) 9386 3304  
Fax: (08) 9386 3202**

### *Melbourne Office*

**262 Victoria Street  
(GPO Box 1859Q, Melbourne, 3001)  
North Melbourne VIC 3051  
Australia**

**Telephone: (03) 9326 3890  
Fax: (03) 9326 3881**

Newsletters are archived online at <http://www.daa.com.au/newsletters/>  
Data Analysis Australia can be contacted via email at [daa@daa.com.au](mailto:daa@daa.com.au)