Statistics: a job for professionals

SSAI

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What's this booklet about?

We live in a world awash with numbers. They underpin far-reaching decisions being made by governments about our health, our safety and security, our social and economic progress, our environment, our jobs and our daily lives.

Unfortunately, many of the people who collect, analyse and interpret these numbers are not trained or qualified to do so. Resulting decisions can be fatally flawed, and may adversely affect millions of people.

You probably wouldn't trust your life to an untrained doctor, or your teeth to an untrained dentist. You probably wouldn't trust your money to an unqualified accountant.

Yet every day we rely on policies affecting our health, prosperity and security that are founded on unprofessional use of statistics.

Statistics is a complex and delicate field requiring both high level training and experience. An aptitude for figures, or the ability to turn on a computer, just isn't enough. **Statistics is a job for professionals!**

The purpose of this booklet is to make this point through some serious and not-so-serious success and disaster stories ... in the hope that the next time you have to make significant decisions based on data, you'll seek appropriate assistance.

Consulting a **professionally accredited** statistician will help you make cost-effective use of your data and provide you with the assurance that your decisions will be soundly based. The Statistical Society of Australia operates the only professional accreditation program in Australia. Visit our website at **www.statsoc.org.au** to find a contact list of Accredited Statisticians.

And enjoy the booklet!

Statistical Successes and Disasters

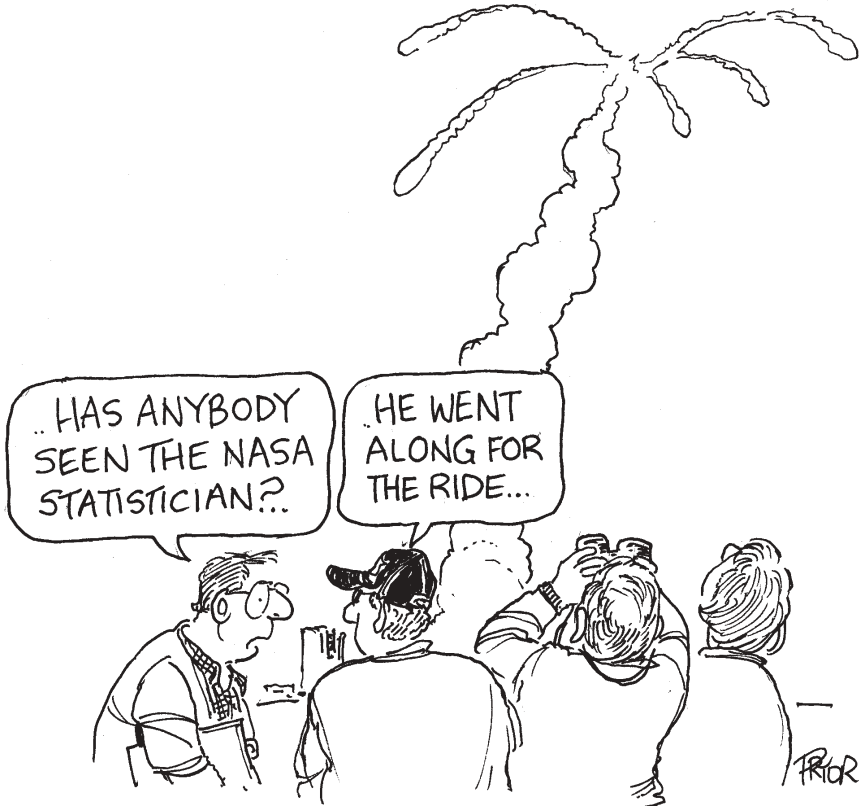
Challenger – a statistical disaster

When Space Shuttle Challenger exploded before the horrified eyes of the world on January 28, 1986, it was as much a statistical as an engineering disaster.

Prior to launch, the risk of catastrophic failure in the shuttle was estimated by NASA management at 1:100,000. Engineers put it at between one in 100 and one in 300.

When statisticians analysed the same figures afterwards they calculated the actual risk of disaster was 12–14 per cent or about one chance in eight. And this calculation could have been performed before the shuttle was launched!

The professional statistical work should have been done in the first place.



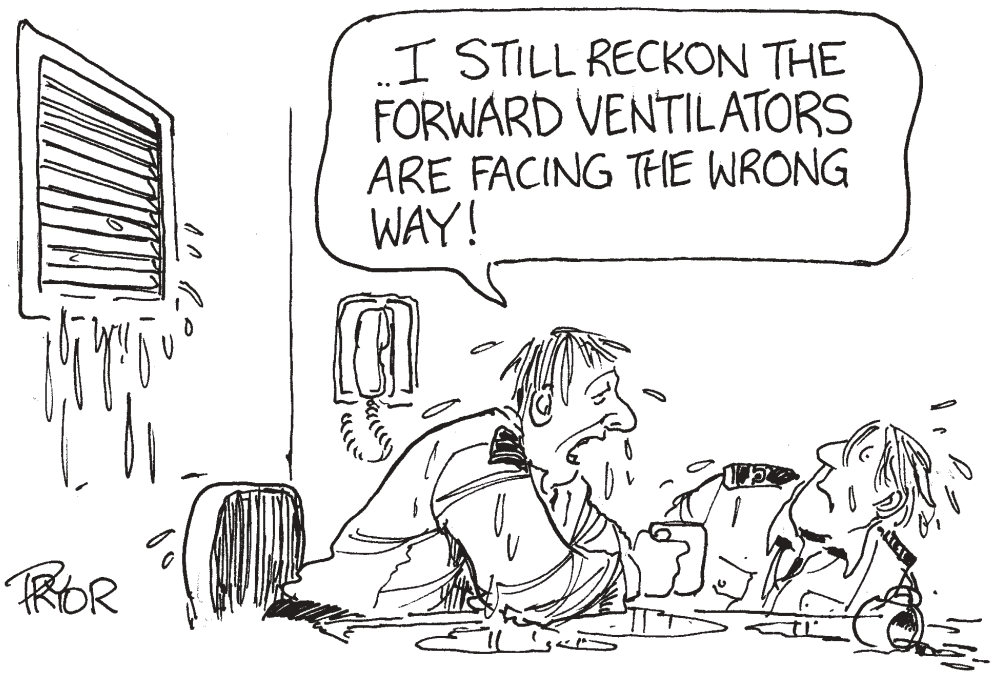
Sinking mystery

In 1980 the 90,000 tonne bulk ore tanker MV Derbyshire sank with all hands in a typhoon, south of Japan – the largest British ship ever lost at sea.

Analysis of the wreck 4 kms beneath the Pacific revealed it had sunk when the forward cargo hatch failed – and the crew was blamed.

But statisticians were able to show the loss was really due to gradual leakage through forward ventilation pipes forcing the bows lower in the water, until pounding waves finally burst the hatch.

The crew were exonerated posthumously, thanks to statistics solving a problem that had puzzled investigators for 20 years.



Statistical miscarriage

British mother Sally Clarke was convicted of murdering her two baby sons, because the court believed it was highly improbable she could lose two babies to cot death.

Medical experts, unqualified in statistics, had testified that the chance of her losing two babies to SIDS was 1 in 73,000,000 and the jury believed them.

The Royal Statistical Society later rejected their estimate, stating it was without statistical basis, likely to contain a very large error and was 'probably false'.

While doctors are qualified to give medical evidence, to avoid such errors statistical evidence ought to be presented by those who were statistically qualified, the Royal Society said.

Birth defect discovery

It's a little known fact, but the discovery that rubella causes congenital deafness and blindness was made by an Australian statistician.

A statistician was passing the former NSW Institute for the Deaf, Dumb and Blind when he had the inspiration of looking in its publicly available records. This confirmed his hunch that peaks of deafness and blindness among infants in the population all coincided with epidemics of rubella.

Because Australia was isolated, it experienced only periodic outbreaks of rubella (which also affected pregnant women), whereas Europe and America had the disease constantly, making the cause of congenital defects impossible to pick up. The Australian discovery has played a key role in global public health vaccination campaigns to eliminate the disease.

Million dollar blue

An Australian government department was being supplied with raw materials by several contractors, who were paid according to quality. The contractors sampled the material when it left their plant – and the government sampled it on delivery.

A dispute arose when the contractors claimed their product was top quality, but government samples showed it to be much lower. It went to court – and the government lost. Subsequent statistical analysis showed the government department had under-estimated the variability of its sampling process.

It was a case where failure to adopt a sound statistical approach in the first place cost the government – and taxpayers – several million dollars.

Deadly lottery

Fifty thousand Americans died in the Vietnam War, many of them conscripts. Later, statisticians concluded that the 1970 birth date lottery by which conscripts were drafted was flawed and unfair.

The lottery planned to select birth dates in random order. Birth date capsules were placed in a bowl a month at a time, starting with January and finishing with December. Because the capsules weren't mixed thoroughly enough, men born later in the year had a higher chance of selection (capsules nearer the top). Undoubtedly some of these men were among the war's casualties, while others, who were not called up, escaped.

A case of how misplaced statistics can have life and death consequences.

How can Government Departments benefit from accredited statisticians?

- Assurance of genuine professional qualifications and experience in collecting, analysing and interpreting quantitative data
- Appropriate criterion when awarding contracts requiring significant statistical work
- Enhanced credibility of policy decisions
- Protection against unprofessional work, inside and outside the department

Skin cancer solved

The fact that Australian children are taught to "slip, slop and slap" to prevent skin cancer in later life is largely thanks to a statistician.

A research statistician was the genius who made the connection between deaths from melanoma (or black mole cancer as it used to be known) and the intensity of sunlight in different parts of the continent.

His findings were published in the British Medical Journal in 1956 and attracted world attention. Up to a thousand Australians still die each year as a result of cancers from over-exposure to ultra-violet radiation – but the fact that the toll is now starting to come down is largely due to this statistician's perceptive use of statistics.

Death by statistics

A medical study of deaths in an old-age home in the Netherlands reached the bizarre conclusion that the state of health of the patients had only a short-term effect on the rate at which they were dying.

The finding was the result of a statistical muddle, in which the researchers (who were not statisticians) had continued to use the original number of patients in the survey, and forgot to subtract the ones who had actually died. As a result, the mortality rates for sick patients looked far lower than they actually were.

Fortunately, experienced statisticians were able to sort it out, before the conclusions were taken into the medical literature and used for planning aged healthcare.

Phantom vans

In a huge US auto fraud, a dealer managed to skim $A800 million off one of the world's leading car makers.

Makers lend their dealers money to cover the cost of keeping vehicles for sale on their lots. In this case the dealer borrowed $12 billion over six years, using some of it for his own purposes and the rest to pay back previous loans.

What should have alerted the car maker was the statistics: in one month the dealer borrowed $850 million, supposedly to buy 17,000 customised vans – equal to the entire US production for that month. Of course, the vans did not exist.

Another case where not keeping a professional hand on the numbers can prove expensive.

Claims, damned claims…

In the hotly-competitive pharmaceutical industry, companies often challenge the marketing claims of their competitors.

In one case a company claimed its drug reduced risk by 70 per cent based on a human trial – and was challenged before the Industry Conduct Committee by its competitor. The committee rejected the claim because it found the results were inconsistent with two other previous, but shorter, studies.

However a statistician convinced the appeals committee that the pivotal study results were consistent: the main trial had run for much longer and so the drug had emerged as more effective than in the short trials. The appeal was upheld.

Catching drug cheats at the Sydney Olympics

An Australian statistician helped protect the good name of the Sydney Olympics and sport in general by devising a test to detect athletes abusing the drug erythropoietin.

The drug is hard to detect because it occurs naturally in the human body. However when the synthetic drug is used it causes red blood cell numbers to climb sharply – then drop again sharply when usage stops or declines.

A statistician devised a testing regime that gave a one-in-four or one-in-three chance of catching drug cheats. Sports officials believe this was enough to deter would-be abusers and keep the Olympics as clean as possible.

Particular consequences of unprofessional work

- **waste and inefficiency** because too much data or the wrong data was collected
- **lack of trust in data** as a result of faulty interpretation
- **bad policy decisions** as a result of incorrect analysis
- **inability to understand messages** because of poor presentation

Medical fraud

An Australian doctor who had made over 17,000 Medicare bulk billing claims in one year came to the notice of the Federal Government, under the Health Insurance Act, for inappropriate practice.

In the course of the inquiry, the investigative procedure used was rejected partly because there was “no attempt to deal with statistical samples". The case went to the Federal Court and full bench of the Federal Court on appeal – and still failed.

The amended Act now authorises a sampling methodology that may be used to quantify the level of inappropriate practice. The amended Act also allows for other sampling procedures to be used, provided that they have been approved by an Accredited Statistician.

A clear case where a professional statistical approach has closed a major loophole in the system.

Census discrimination

During World War II, American census officials violated confidentiality laws by allowing census information to be used in the round-up of Japanese-Americans for internment.

In the two weeks following Pearl Harbor the US Census Bureau released detailed information on Japanese, German and Italian citizens of the US and provided authorities with fine detail (such as locations) for the round-up.

Censuses depend for their value on the voluntary co-operation of the population. If people suspect that they are going to be classified by race, religion and locality and the information released to others, they won’t co-operate. The census will become useless for planning national and local policies.

A case where the unprofessional and illegal use of statistics led to ethnic and racial discrimination.

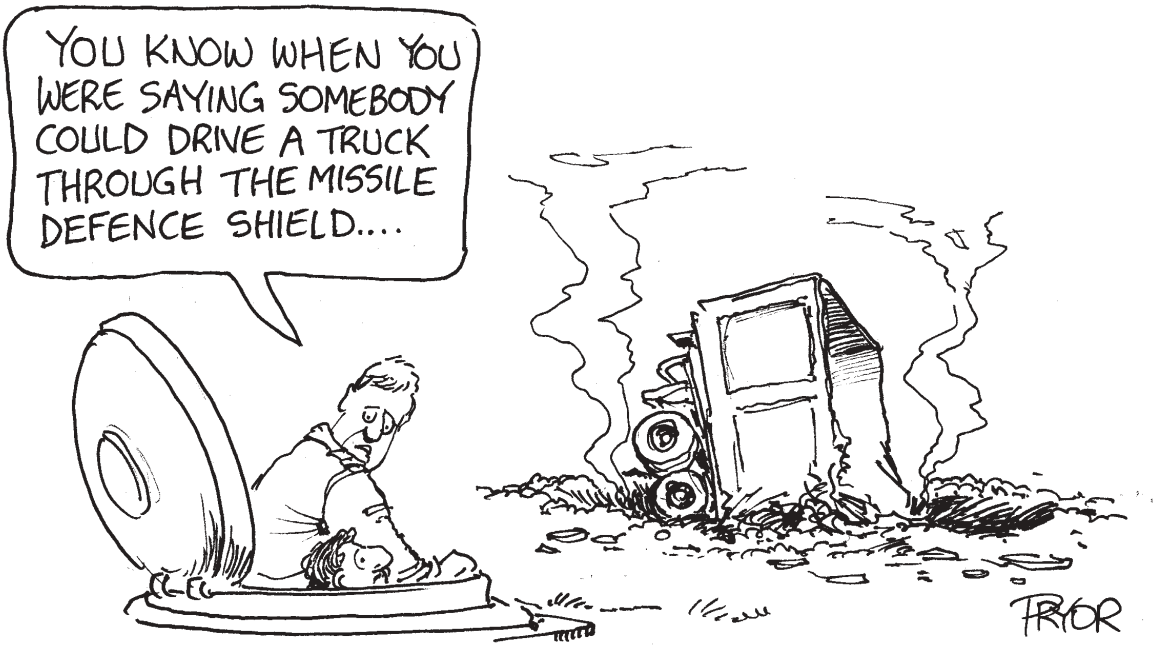
Holes in the missile shield

Simple statistics were sufficient to blow holes in the US Government's plans for a national missile defence shield.

Nobel physics laureate Burton Richter pointed out that if there is an 80 per cent chance of an interceptor killing an incoming warhead, then if five warheads are launched, the probability of hitting all five is only 33 per cent, meaning that some are bound to get through.

To reduce the chance of a warhead striking the US to 10 per cent, the interceptors have to be at least 98 per cent reliable, he pointed out. Warheads can be deployed with decoys that reduce the intercept rate, so the chance of getting all the active warheads without one getting through becomes highly problematic.

A case where a sensible look at the statistics might save a lot of political argument and expense.



Patching the missing holes

During WWII a research group charged with protecting bombers from anti-aircraft fire decided to put extra armour plating on the places found on returning aircraft to have the most bullet and flak-holes.

Their statistician protested. "No," he said, "Let's put the extra shielding on the places where there are no bullet holes."

His logic was that, if the bombers had got back safely, then the places where they had been hit were clearly not vital.

It's a case of how designers and planners can reach the wrong conclusion without a sound statistical approach.

Smoothing the Internet

Contrary to popular belief, the Internet actually gets smoother and faster the more traffic there is on it, a statistics team has discovered.

Their discovery may lead to a more efficient system, better network designs and improved performance at a lower cost.

The Lucent team analysed billions of packets individually, the way network equipment sees them. They found traffic on a high-capacity link becomes more random, regular, smooth, and manageable when the numbers of users and computer-to-computer connections go up.

Traffic at the core of the Internet is more like traffic on an ideal highway – a steady, high-speed stream that can be full to capacity with few serious delays.

Teenage tipplers

Teenagers may not be the hardened boozers that a major US university once claimed.

Columbia University made international headlines when it cited research indicating that 25 per cent of all alcohol was consumed by teenagers.

The research was based on data from a national household survey of drug abuse, which was deliberately weighted so that almost half of respondents were in their teens. The university forgot to re-weight the statistics, and so came up with an estimate for teenage alcohol consumption which was more than double the US government's own estimate.

What is Professional Accreditation?

- **'certification' of competence** – like the requirement for doctors, dentists, engineers, accountants, *etc.* to be appropriately registered
- **administered by the SSAI**
- **backed by a Code of Conduct**

Risks of unprofessional work

- Government departments live in a world awash with numbers that underpin far-reaching decisions about people's health, safety and security, social and economic progress, environment, jobs and daily lives.
- Unfortunately, many of the people who collect, analyse and interpret these numbers are not trained or qualified to do so. Resulting decisions can be fatally flawed, and may adversely affect millions of people.
- You probably wouldn't trust your life to an untrained doctor, or an untrained engineer. You probably wouldn't trust your money to an unqualified accountant. Why trust the numerical foundations of your policy decisions to unqualified statisticians?

What's a professionally accredited statistician?

Accreditation as a professional statistician is not easy to obtain. As a potential employer or customer, you wouldn't want it any other way!

Firstly, candidates for professional accreditation have to demonstrate that they have completed a program of university studies covering a wide range of essential statistical topics. Typically, this is achieved by having at least a Bachelor's degree, majoring in statistics, but usually a more advanced degree.

Next, they have to provide evidence of several years of experience practising as statisticians, working in real consulting situations.

Next, samples of their work are submitted to a panel of leading statisticians, who assess all aspects of what has been done – correct formulation of the problem, appropriate design of any experiments in terms of efficiency and cost-effectiveness, approach taken to data acquisition, use of suitable methodology to extract the best information from the data, and how the results were presented so as to make the conclusions evident to the customer, with all limitations highlighted.

And finally, reports are sought from leading statistical referees about the professionalism of the candidates.

Once professional accreditation is approved, a candidate must agree to observe the Society's professional *Code of Conduct,* before the award is made.

But that's not the end of it! Professionally accredited statisticians are expected to keep themselves up to date with current best statistical practice. Accreditation is only awarded for five years, after which a re-accreditation process has to be undergone.

Please visit our website at **www.statsoc.org.au** to find out more about professional accreditation and to find a contact list of Accredited Statisticians.