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Enhancing the Process for Teaching Statistics Using Web Based Techniques

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ABSTRACT

Although there is a first year statistics unit at Macquarie having an annual enrolment of around 2500 students, it does not mean that statistics is a wildly popular subject. Indeed, the reality is that virtually every student enrolled only does so because it is compulsory for them to do it as a prerequisite for another subject. There has always been a challenge for the department to convince a significant number to continue their studies in this area. A giant step in the right direction was the recent introduction of a new first year unit involving the statistics of gambling, sport and medicine. Its immediate success was evident when over 400 students enrolled in the first year of offering alone and now the annual numbers are consistently around 300. With the creativity of Macromedia’s Director Lingo and making full use of the capabilities of the World Wide Web, the unit has now become a university showcase and has led to increased numbers in statistics units at higher levels. This paper discusses the progress of this unit from its initial conception to the completed product.

KEYWORDS

Statistics, world wide web, teaching, gambling, sport, medicine.

INTRODUCTION

Macquarie University in Sydney offers a unit with the largest enrolment of any single subject at an Australian university. This unit in introductory statistics caters for around some 2500 students each year and serves the statistical needs of all first year subject areas across the campus.

One might be forgiven for thinking that the reason for such an achievement is that the material involved in statistics is so fascinating that students simply can’t resist it. On the contrary, with very few exceptions, those enrolled are there simply because it is a compulsory prerequisite to a great many popular fields of study such as business, economics, accounting, computing, behavioural sciences to name a few.

The fact is that almost no student comes to Macquarie to major in the area of statistics, and yet they have the largest statistics department in Australia. What happens to the students after first year? For the department to survive as a viable entity, it is essential to convince at least a portion of the
captive audience from first year that the subject of statistics could be interesting, challenging and relevant. Of course, this is no easy task.

In recent years the face of statistics has changed at Macquarie. The department has repeatedly chosen to remain within the business school, despite desperate efforts on the part of some to transplant it into a school with mathematics. In hindsight, this appears to have been a wise decision with the number of tertiary mathematics students on the decline around the country.

To this end, since around 1996 the statistics department has systematically removed a number of compulsory mathematics prerequisites from its units, preferring to teach whatever mathematics is needed within the unit itself. It’s fair to say that the introduction of a formal mathematics prerequisite on a statistics unit usually leads to a dramatic fall in numbers. The downgrading of assumed mathematical knowledge has been extremely beneficial in attracting more students to the department, but the rigour of the material has been maintained.

It is always important to diversify and modernise the offerings in statistics and the department has also been very successful in this regard. Whether we like it or not, the word ‘statistics’ simply does not sound very exciting to the majority of students and so the term has been replaced where possible with another that might be more ‘catchy’, although the unit content is largely the same. Examples of these changes include replacing ‘Applied Probability’ with the name ‘Risk and Chance’ and ‘Statistical Inference’ with ‘Modern Statistical Concepts’. The numbers in the units immediately increased markedly.

Perhaps the most significant departure from the way in which the department offered its units was a radical change of direction in an attempt to lure some of the huge number of students enrolled in the business areas. To do this it was necessary to convince prospective customers that there were careers to be made in statistics and that employers were ready to embrace these skills. Although ‘traditional’ statistics had served reasonably well, the numbers of students had certainly levelled off and in some cases were falling.

The situation was turned around several years ago by the introduction of a Bachelor of Commerce degree with a major in statistics that concentrated in the field of operations research. This meant the introduction by the department of new units in statistics that covered the subjects, in addition to operations research itself, of logistics, market research, quality management and, most recently, e-commerce. The interest from students was immediate with the numbers enrolling at third year level operations research averaging over 150 per unit while some of the more ‘traditional’ statistics units could only manage around 30 students.

While some statistics staff have lamented the ‘downgrading’ of these tried and trusted subjects, there is no doubt that the survival of the department is now largely dependant on the continued success of these operations research units that are firmly geared to the requirements of business and industry. This is a very important aspect as far as students are concerned since one of the most common questions asked is ‘who will employ me if I get one of these degrees?’ There is now a much wider range of options in this respect.

Having an attractive program in statistics at the higher levels is important enough, but it is even more essential that the students have their appetite whetted from an early stage. The beginning introductory statistics unit covers the usual topics of descriptive techniques, hypothesis testing and linear regression. After having used Minitab as the computer package of choice, the department has now switched to the statistics module of Microsoft Excel for Windows. The rationale here is that this is a program to which most students will have access after graduation.
Although the often obligatory first year unit had massive enrolments each year, over 90% were still choosing not to proceed further with the study of statistics – either because they weren’t interested or they could not fit it into their program. In addition, there were simply many hundreds of students across the university who did not do any statistics units at all because they had no compulsion or inclination to do so.

To remedy the situation, in 1998 an informal survey of students was conducted to determine just what aspects of ‘the real world’ contained statistics that might be of interest to them. The overwhelming favourite topic was gambling, followed closely by sport. The third topic medicine was selected after consultation with staff. No other application of statistics seemed to spark much interest at all.

**TEACHING STATISTICS USING GAMBLING**

Catering to the market, in 1999 a new unit called Gambling, Sport and Medicine was introduced at first year level with no pre-requisites, but with a STAT prefix so that there could be no mistake that it was indeed a statistics unit. The response was overwhelming to say the least with nearly 400 students enrolling from across twenty-six different study areas across the campus. In 2002 the numbers have levelled off to a consistent 300 each year with the result that our numbers in second year units have noticeably increased as well.

To teach a unit involving gambling takes a great deal of planning, especially since involves sensitive issues with associated social problems and, moreover, a number of the students had not yet reached the legal gambling age of 18 years. As well as teaching from a statistical point of view, it was also necessary to talk about the negative side of gambling and the devastating impact it can have on those who do not gamble wisely and the effect on their families and friends.

The unit was also able to provide innovations in a number of key areas. When news of its introduction reached the media there was an immediate positive response, including television, radio and press coverage that an educational unit on gambling was being taught at an Australian university. It was also clear that this is not simply a unit that teaches you how to win at gambling – on the contrary, its aim is to present statistical principles in a way that captures the imagination but at the same time is challenging and informative.

It was correctly felt that one of the best ways of achieving this goal is to employ visual aids or ‘props’, and there is no shortage of these when it comes to the topics under discussion. The department was fortunate enough to receive a donation from Penrith Panthers Club in the west of Sydney of two working poker machines. These machines have been a highlight of the teaching of probability and expected returns and added a new dimension of excitement to the learning process.

Other gambling devices that were purchased inexpensively included a two-up kip, coins, dice and packs of cards. A roulette wheel was more difficult issue since they cost around $20,000 for a new one and $3500 for one that is reconditioned. Since both were beyond the budget, an imitation plastic one costing around $100 did the job nicely, although smaller in size than would have been liked in a large lecture theatre.

As far as sport went, teaching staff supplied their own equipment including cricket bats and balls, tennis racquets, basketballs and ice hockey sticks to illustrate these games. Medicine, also being the shortest section, usually did not require any such aids.
WEB BASED TEACHING

To further enhance the educational process, a successful application was made by myself for a Macquarie University Flagship Grant to present the unit as one that effectively utilised the capabilities of the World Wide Web. This was a two year project that initially involved considerable time developing the specifications for a web site unlike any that had been devised before at Macquarie. Doing so presented a real challenge to the programmers whose task it was to put it into practice. References in the design goals in a learning environment and variations in the delivery of instruction include Duffy and Cunningham (1996), Lefoe (1998) and Wilson (1996).

The opening screen of the STAT175 website (with URL [http://online.mq.edu.au/pub/STAT175](http://online.mq.edu.au/pub/STAT175)) is shown in Figure 1. When the user clicks on any of the three icons GAMBLING, SPORT or MEDICINE they are then led through a series of public pages that describe various aspects of the unit including detailed information on each topic along with the unit outline and due dates of assessment.

![Figure 1](image1.png)

Figure 1 The opening screen of the public section of the website for Gambling, Sport and Medicine

To access more in-depth material relevant to the unit, users click on the LOGIN icon and must supply a password. Each student is given their own unique password for the duration of the unit. This enables the teaching staff to communicate directly with each individual and they can also contact each other privately. The actual lecture notes are not be placed on the web since it is felt that this would be a discouragement to attending lectures. The specifications of the web site include the following requirements that have their individual icon on the screen.

- a discussion board (among themselves)
- a direct email to the lecturing staff
- access to unit information
- frequently asked questions
- practice exercises and solutions
practice mid-term examinations and solutions
practice final examinations and solutions
files that may be downloaded
assignments

After logging on to the private section of the site, the screen presented is that shown in Figure 2. Undoubtedly the most exciting feature of these icons is the introduction of an animated simulation component in which students can play games such as Two-up, Keno, Roulette, Craps, Keno Heads or Tails? and even poker machines. The simulations, written using the powerful authoring environment of Macromedia’s Director Lingo, were the most expensive and complex part of the site but undoubtedly well worth the effort since, apart from being colourful and challenging, they can be used to test strategies and the verify the theoretical statistical results. The simulations screen is shown in Figure 3.

Figure 2 The opening screen of the private section of the website for Gambling, Sport and Medicine

![Figure 2](image2.jpg)

Figure 3 The gambling simulations for the website of Gambling, Sport and Medicine

![Figure 3](image3.jpg)
For the gambling section, the lecturer in charge wrote a textbook called *The Statistics of Gambling: understanding tactics and risk* (Croucher, 2001) and students purchase this book since it contains many of the relevant notes on gambling. Other reference books on this topic include Epstein (1977) and Malmuth (1994).

It was also quite timely that Sydney hosted the Olympic Games in the year 2000 since this provided a golden opportunity to demonstrate statistical techniques using sporting data. In particular, one lively topic of discussion was the times and distances that athletes and swimmers would have to achieve in order to win a gold medal. With an abundance of historical data, students were able to use their statistical skills to come up with various intervals within which they feel the winning performance would lie. Then they could compare their answers with what actually happened.

Apart from the Olympics, there are a number of popular sports including football, cricket and basketball that are all covered in some aspect. Some of these are along the lines of developing or testing of strategies for play, while for others it is considering the effect of rule changes. One of the beauties of teaching statistical principles using sport is that there is never any shortage of information to analyse and it is always topical. In all, after six weeks of learning about the statistics of gambling, the next four weeks is spent on the statistics of sport. References here included books by Ladany & Machol (1977) and Bennett (1998).

The medical statistics component of the unit is the shortest with usually only two or three weeks spent discussing the statistics aspects of medicine. Although well liked by the students, it does not enjoy the popularity of the gambling or sport sections. The topics considered include clinical trials, medical research that involves statistical principles and the statistical controversies surrounding DNA evidence in law. For those students who are keen to undertake further studies in this area, at third year level the department offers a complete unit in epidemiology and a number of graduates with this interest have gone on to find employment in the medical area.

**REMARKS**

Undoubtedly this unit, which prominently features gambling, has been an outstanding success and has in a short space of time attracted many hundreds of students along with hundreds of thousands
of dollars in funds to the department. The media has been very supportive, as has the gaming industry itself in assisting a venture that provides an essential public education program in this controversial area.

The pressure is always on academics to be able to present their material in a way that is relevant, challenging and stimulating. Although this may be easier to do in some areas of study than others, the results are well rewarded, as evidenced by the Macquarie experience in this unit. The hunt is now on to repeat this success by offering other types of units that will also attract the attention of students who otherwise would not have ever envisaged studying statistics.

**References**


