

Expanding Statistical Education: A New Zealand Retrospect

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1. Introduction

Expanding any kind of education has challenging difficulties, and expanding statistical education a very generous share. Some frustrating attitudes (slightly exaggerated!) have been:

(general) "I didn't know you could teach statistics - I thought they just were!", "Statistics can prove anything.", "Dreary arithmetic."

(pure mathematicians) "... a bit of the icing on the top of the mathematics cake, best added (if at all!) at the end."

(applied mathematicians) "a minor topic worth about as much time as statics, but with an unjustifiably more pretentious name."

(research workers - notably medical) "My paper has been faulted for lack of statistical analysis. Could you please append some and forward it to the editor.", "This conclusion is obvious - could you please demonstrate it statistically."

Then there has been the nature of the subject itself. The concepts and thought processes are rather subtle, not easy to grasp in the first place and rapidly lost if not well reinforced; once mastered they become obvious, so that the teacher tends to underestimate the students' difficulties. The terminology doesn't help - normal distributions that aren't, error and bias that aren't, goodness-of-fit tests that are tests of badness of fit, insignificant significance, and so on. And the main achievement seems rather negative: stopping people drawing conclusions (which is what they most like to do!).

2. Personal retrospect : industries, universities, agriculture

In the later years of the war, when almost all university teachers in Britain were on war work, I was one of a dozen or so raw mathematics graduates directed into a small section SR17 of the Ministry of Supply. After learning the relevant statistics from books and the handful of more experienced people already there we were sent round ordinance factories to install quality control charts and sampling inspection schemes, and so on. In convincing others that we had a good product to sell we convinced ourselves, and after the war the section exploded like a London bomb into missionary statistical occupations all over the country. I was a piece of shrapnel that landed in Sheffield to help A W Swan to start a statistical section in the United Steel Companies research division. We taught helpers in the factories (and also a visitor who was to try similar methods in India), taught management as much as we could, and gave expository talks to the RSS local group. Swan used to maintain that one could get a long way with little more than an understanding use of the standard error of the mean, and I agree with this. However, non-independence of successive observations can play havoc with the usual formula and its regression counterpart, and this can be far more serious than non-normality, though it gets little if any space in textbooks. It was meeting this in the steel industry that found me a field for research later on.

In 1947, when it was clear that the section was going to survive, I took an opportunity to move to the Mathematics Department at the University of Sheffield, my brief being to initiate appropriate statistics courses, give statistical help to other departments, and do research. It was essentially a one-man job, except that the statistical help (in increasing demand!) was used to justify the appointment of a mathematics graduate as a research assistant, to help with the computing and practical classes. Initially I gave a course in mathematical statistics in the final year of the mathematics honours course, a course in economic statistics for economics honours students, a course in statistical methods for staff and research students (which had some high-level takers), and an extra-mural course attended by all and sundry, including teachers and industrial workers. Later, when the last two of these had met the current need, I was able to reach engineering students by taking on their second year mathematics service course, into which I was allowed to put some statistics. To get the teaching of statistics going I have often had to teach it along with other topics: numerical analysis for the mathematicians, official statistics for the economics students, differential equations for engineering students. This expanded my own education but could make the load rather heavy and when I sought relief it was apt to come in unexpected ways involving some loss of ground. The engineering mathematics was taken over by an applied mathematician with concerns of his own, with a resulting contraction in statistical education. So the moral is that if you want to expand statistical education, follow the example of the politicians and try to stay in power.

In 1956 a small department of statistics was created, staffed by myself as senior-lecturer-in-charge, two research assistants, a computing assistant and a part-time technician, with some teaching help from the departments of Economics and Pharmacology. This meant that statistics was recognised as a subject in its own right, not just a topic in mathematics, and could be taken as a complete stage 1 subject by science students. It was put to me that it should be seen by students as substantial a commitment as the others, and that this could be achieved by matching lecture and

laboratory hours with those of physics and chemistry. For a long time I had been promoting direct involvement with the generation of experimental data as an important component in expanding the quality of statistical education, and was able to exploit the matching of laboratory hours as an opportunity to do the involvement job properly. A typical year's laboratory programme was made to include half a dozen or so substantial projects involving interesting apparatus (mostly home-made and very simple but sometimes borrowed from other departments) which illustrated concepts and purposes, went hand in hand with lectures, and were designed to provide statistical experiences in fields of application and motivate the subject. The course went well; the practical work was something of a novelty at the time and is described in Jowett and Davies (1960). Creation of the department received a lot of support from the Faculty of Medicine, who were major users of its consulting services, and the department got a toe into the medical curriculum via three lectures in the Pharmacology course.

By the end of 1959 things were going well; a consulting statistician from another department had moved over to us as a lecturer, and one of the research assistants was ready for promotion. Professorial status for the subject seemed a long way away, however, and I was persuaded by the need for experience of advanced teaching, among other things, to move to the Department of Statistics at the University of Melbourne, where there was a three-year honours course in mathematical statistics and a lot of emphasis on consulting work for local hospitals and industry, as well as plans for new courses in operation research, much of which involves statistics. I was given facilities to introduce practical work of the Sheffield type into the courses I taught, which covered most of them since I stood in for Professor M H Belz during his absence on leave.

In 1964 I moved back into a mathematics department, this time to the new chair of statistics at the University of Otago. It was a bit like starting all over again except that I had more experience and influence, and that there was already a well-established one-year course in statistical mathematics, currently taught by an experienced statistician on the staff of the Department of Preventive Medicine who was an honorary lecturer in statistics. Once again it was a matter of making what progress I could just with a continuation of his help and that of a research assistant who had just graduated in mathematics and wanted to go on in statistics.

The first year went well, with legislation set in place for statistics options in mathematics that would provide an honours degree substantially equivalent to that in Melbourne, a service course Mathematical and Statistical Methods, and a foray into school mathematics to introduce some statistics (to be described later). The following year went less well, since the mathematics side of the department almost collapsed and I found myself holding the fort. In trying to cope, I found that in New Zealand it was not only statisticians that were in short supply but other sorts of mathematicians too. Graduating students usually took their scholarships overseas and often found posts there, and advertisements even for chairs brought few if any replies. Eventually the position in mathematics was righted, and a senior biometrician from the NZ Department of Agriculture came as a lecturer for a few years, being persuaded to return only when the group he had left was threatened with collapse. Staffing in statistics was difficult throughout my time, but even so we managed to educate several mathematical statisticians who are now lecturers or in senior posts of other kinds, and the service course which in my time grew from a dozen or so to 450 students has continued its phenomenal growth, with a substantial follow-on course established by Brian Manly

who now occupies the statistics chair.

After a preliminary trial of statistics in the medical curriculum by three lectures contributed to the physiology course, it was expanded into a one-term course on its own. A postgraduate diploma in statistics was constructed by combining the second and third advanced-year papers in mathematical statistics with other appropriate papers, such as computer science and accounting. To make small staff resources go a long way it was often necessary to make one course serve two or more purposes, and this sometimes required very careful structuring of material, sometimes to make it acceptable to quite different types of student (as when the Geography Department arranged to send their students to the course for medicals), sometimes to make it possible to attend courses simultaneously that were normally attended sequentially.

One expansion technique that worked very well was collaboration with other departments in developing statistical methods courses. A big problem with service courses in statistics is that there is sometimes little reinforcement in the user departments of the material given, or if there is it is done in a different way and causes confusion. Partly to help and partly to learn, experienced members of staff from Commerce and Geography came as tutors in practical classes involving their students, and after my departure took over the statistics teaching of their own students.

In 1972 I moved to the public service Department of Agriculture as a biometrician (on the staff of my former lecturer) stationed at Invermay, a research station just over the hill from Dunedin. While nominally the job was to operate as a local consultant and to help scientists to get their results computed, it still had a strong content of expanding statistical education. An important aim was to get scientists interested and competent in the statistical analysis of their own data and improve technicians' understanding of the statistical purpose underlying the structure of the trials which were their everyday work. (Another was to stop them swamping us with requests for analyses that they didn't really want.) Much of the education was person-to-person, but sometimes by seminars or one-week courses. Occasionally these were at other centres (e.g. one for dairy scientists in the North Island, another for a group of top executives in Wellington).

It was during this period that personal computers arrived on the scene, with their tremendous potential for getting statistical ideas across, particularly those connected with sampling distributions and inference. We acquired an Apple computer which had a secondary use with big borrowed monitors as a lecturing aid, allowing on-the-spot statistical demonstrations and analyses in front of the class. Sadly it was thirty-five years too late for most of what I would have liked to have done with it, but at least I did have the experience.

3. Statistics in schools : teaching the teachers

During my time in university work opportunities arose to contribute to the expansion of statistical education in all three locations by becoming involved with public examining. Unfortunately this very influential activity tends to attract opprobrium rather than respect in academic circles, being regarded as a way of making a bit of extra cash that academics (who ought to be devoting their spare energies to research) are allowed to use.

