# Trends in Statistics Teaching in UK Universities

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## 1. Introduction

In many countries, including the UK, there is a perception that the position of statistics as an academic discipline is in decline. The evidence is partly anecdotal and partly factual. The facts relate to the closure of some departments of statistics and the anecdotes to the difficulty of filling vacant posts and to the loss of service teaching. In order to obtain better evidence the Teaching Statistics Trust and the Committee of Professors of Statistics (COPS), supported by other interested groups and university departments, sponsored a review of the teaching of statistics in UK universities. The first aim was to examine existing data sources to see if there was any evidence of a decline. In addition a survey of statistics groups within universities was carried out to establish the current position of statistics teaching and the future prospects. The review was completed in October 2006 and the draft report was discussed at a meeting of the Royal Statistical Society in December. The final report appears in Smith and Staetsky (2007).

## 2. Sources and trends

In the UK data on university staff and students is compiled by the Higher Education Statistical Agency (HESA). Because statistics is a universal scientific discipline it can be found in many different groups within a university and with many different identities. Administrative returns typically cannot cope with this complexity and so the returns to HESA for statistics are unreliable. After careful examination it was decided that they were inadequate for determining past trends. Fortunately the COPS had been collecting data on statistics staff and postgraduate students since the 1980s. They produced annually a Directory of Academic Statisticians (DAS) which listed, by group and by name and research interest, staff who identified with the title statistician. Figure 1 shows the raw data. The trend is dominated by the change in the number of institutions after 1992 when polytechnics were designated as universities. For trend purposes we are not comparing like with like.
The actual numbers were judged to be reliable for groups in the mathematical sciences and also for those related to medicine. For other groups, such as those in economics, psychology, management and informatics, the coverage of the DAS was inadequate for reliable quantitative analysis. Thus the report concentrated on trends in statistics teaching within the mathematical and medical sciences. The core groups for teaching are those in the mathematical sciences, and these are also the groups that submit their research for assessment under the UK's Research Assessment Exercise (RAE). Figure 2 shows the trend in statistics staff for a fixed set of core statistics groups defined by RAE 2001 for the period 1984-2004, giving a like with like comparison. Figure 3 shows the trend since 1996 broken down by RAE score.

The pattern in Figure 2 is clear. Since 1996, in a period when total student numbers in universities have increased by more than 20%, there has been a decline of over 7% in statistics staff. Figure 3 shows that this decline is related to RAE score. A high score means higher funding which in turn allows staff levels to be maintained. Good staffing leads to high recruitment of students, leading to even higher funding. The market mechanism is working and the Matthew principle applies.

**Figure 1. Raw Counts on the DAS, 1984-2004**

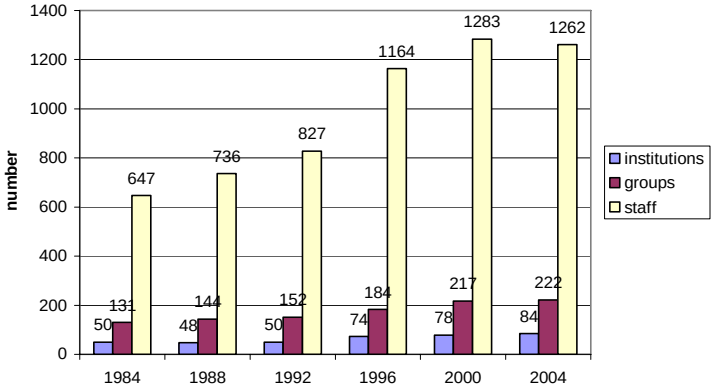



**Figure 2. Numbers of staff in core groups defined by RAE 2001, 1984-2004**

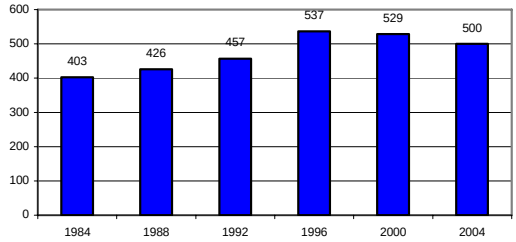
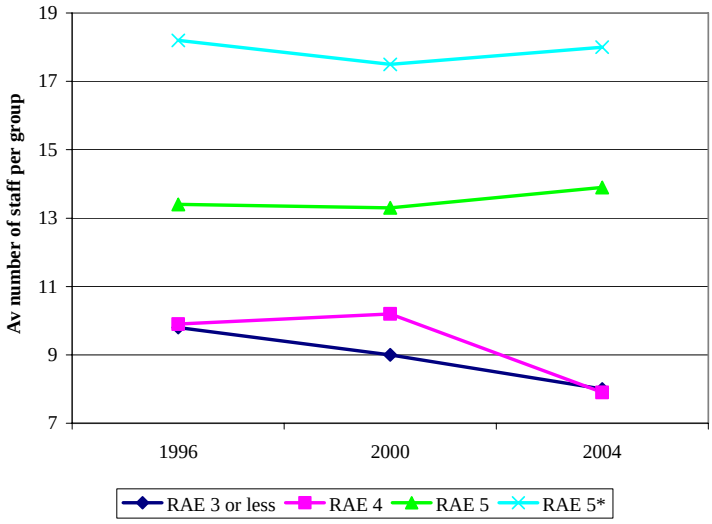



**Figure 3. Association between RAE 2001 score and average numbers of staff for core groups, 1996-2004**




3. Some results from the survey

The survey enabled us to look at staffing by age and gender as well as by RAE score. Within the mathematical sciences only 21% of the staff are female, while in medical statistics, broadly defined, 47% are female. Table 1 shows the distribution of staff by age and RAE score within the mathematical sciences. Table 2.shows the results of attempts to recruit staff.

**Table 1. Math Sci by RAE score: Age structure**

| | <30 | 30-34 | 35-39 | 40-44 | 45-49 | 50-54 | 55-59 | 60+ | Total |
|---|---|---|---|---|---|---|---|---|---|
| 5-5* | 16 | 35 | 21 | 30 | 20 | 29 | 24 | 19 | 194 |
| % | 8 | 18 | 11 | 15 | 10 | 15 | 12 | 10 | 100 |
| 3-4 | 0 | 7 | 10 | 12 | 8 | 16 | 19 | 9 | 81 |
| % | 0 | 9 | 12 | 15 | 10 | 20 | 23 | 11 | 100 |
| no score | 0 | 1 | 2 | 4 | 4 | 7 | 17 | 7 | 42 |
| % | 0 | 2 | 5 | 10 | 10 | 17 | 40 | 17 | 100 |
| Total | 16 | 43 | 33 | 46 | 32 | 52 | 60 | 35 | 317 |
| % | 5 | 14 | 10 | 15 | 10 | 16 | 19 | 11 | 100 |

**Table 2. Recruitment in Math/Stats departments by RAE score in 2001**

| | 5* | 5 | 4 | 3 | no score | Total |
|---|---|---|---|---|---|---|
| total number of groups | 4 | 10 | 7 | 3 | 9 | 33 |
| # of groups that advertised vacancies | 4 | 7 | 3 | 1 | 0 | 15 |
| # posts advertised | 19 | 14 | 5 | 1 | 0 | 39 |
| # posts filled | 14 | 12 | 0 | 1 | 0 | 27 |

Again the results are clear in Tables 1 and 2. Those groups with a high RAE score have a reasonably uniform age distribution and have been able to recruit replacement staff. Those with lower scores have an ageing staff profile and find it very difficult to fill vacancies; their future prospects do not look good.

The pattern of teaching varies with subject area. In the mathematical sciences, and in applied areas such as psychology, economics and sociology (the metrics), teaching takes place in each undergraduate year and also often at the Masters level. In medicine, however, there is very little teaching. Medical statistics is a source of demand for statisticians rather than a source of supply.

Combining the results from the DAS and the survey we classified the statistics groups in the mathematical sciences into strong, marginal and weak. This classification correlates highly with RAE score . Table 3 gives the age distribution of staff in this classification.

**Table 3. Math Sci by Strength of Group: Age structure**

| | <30 | 30-34 | 35-39 | 40-44 | 45-49 | 50-54 | 55-59 | 60+ | Total |
|---|---|---|---|---|---|---|---|---|---|
| strong | 16 | 40 | 28 | 39 | 28 | 40 | 39 | 24 | 254 |
| % | 6 | 16 | 11 | 15 | 11 | 16 | 15 | 9 | 100 |
| marginal | 0 | 2 | 2 | 4 | 2 | 8 | 12 | 3 | 33 |
| % | 0 | 6 | 6 | 12 | 6 | 24 | 36 | 9 | 100 |
| weak | 0 | 1 | 3 | 3 | 2 | 4 | 9 | 8 | 30 |
| % | 0 | 3 | 10 | 10 | 7 | 13 | 30 | 27 | 100 |
| Total | 16 | 43 | 33 | 46 | 32 | 52 | 60 | 35 | 317 |
| % | 5 | 14 | 10 | 15 | 10 | 16 | 19 | 11 | 100 |

From Table 3 we used the marginal distribution of ages to forecast the total number of staff in 2010. On this basis we predict a further decline of about 7%. If now we disaggregate by strength and adopt a scenario approach to making projections, then a bullish scenario leads to a decline of 7% while a pessimistic scenario gives a decline of over 22%. We believe that the 22% decline will be closer to the actual figure if there are no policy changes by the funding bodies with respect to statistics, or more generally the mathematical sciences. Using qualitative data from the survey convinced us that the weak universities were in a parlous state, and that many groups will be closed down by 2010 if present funding rules are maintained.

Defining a statistician is not easy. In our analysis we have concentrated on university statisticians within the mathematical sciences, numbering 577 in the DAS for 2005, most of whom will have a Ph.D. in statistics. Within UK universities there are nearly 400 statisticians in areas related to medicine, and an unknown number in other areas such as economics, management, informatics, etc. With the exception of medicine the other groups provide their own training programmes in statistics. The overall health of statistics depends on all these groups, but the mathematical sciences group is the largest and feeds its products into all the other groups.

We also looked at some COPS data on Ph.Ds in statistics. Our tentative conclusion was that the numbers of UK domiciled Ph.Ds produced would meet only the demand from Academia. Assuming that about 50% of Ph.Ds will find work outside of UK Academia it is clear that within the UK we are not producing enough Ph.Ds to maintain population levels. Our birth rate is too low.

4. Policy implications for the UK

Mathematics, including probability, provides the language for scientific enquiry and statistics provides an important methodology. In a knowledge-based society the mathematical sciences must be a key part of the education system. The UK does not have a planned system of higher education. Rather it has a pseudo market system based on student choice, within which the institutions are autonomous and prices are determined by funding and research councils. The result is that of the 125 university institutions in the UK only 63 offer a degree programme in mathematics (see Royal Society (2006)). The DAS for 2005 identifies 61 groups of statisticians within the mathematical sciences. Under present funding rules this concentration into fewer universities will continue with many of the weak groups being closed. Local access to degrees in the mathematical sciences will be limited and in many areas only those who can afford to leave home will be able to study the mathematical sciences. Does this matter? I think it does, but that is a value judgement, and markets are a value-free zone.

What can be done? The UK is one of 45 countries that have signed up to the Bologna process to create a European Higher Education Area with standardised degree structures and credit transfer. The process is based on a 3:2:3 year system, similar to that in the USA. Most countries have moved, or have plans to move, to this system. In the UK, or at least in England, there are no plans and very little discussion at the institutional level. I am a fan of the US higher education system, and I would like to see the whole of the UK take this opportunity to redesign its system along the lines of a state such as California. This would be a revolution, but arguably no greater than that in 1992 when the number of universities doubled. Within this new UK system I would argue for advanced (professional) statistics training to take place primarily at the masters level, leaving more time for mathematics at the undergraduate level. The same pattern would be appropriate for subjects such as economics. At the undergraduate level the concentration could be on the basics of the discipline, with advanced statistical methods taught at the masters level. A major problem is how to fund this change.

The other revolution that is needed is at the school level, see Smith(2004). In England there is too much choice and too much specialisation too early in a student's career. Employers regularly complain about poor levels of numeracy, and scientists about the lack of fluency in algebra. There is a cultural problem; journalists who would express horror at grammatical errors abuse percentages with impunity. Of the 300,000+ students taking A levels in the final year at school only 60,000 are taking a course in mathematics. These students provide the bulk of the entries to all the degrees in science, engineering and technology. Of these about 6,000(CHECK) read for degrees in the mathematical sciences. To increase numeracy, algebraic fluency and the number of statisticians we must first increase the take-up of mathematics at schools. If this could be achieved then perhaps the downward trends identified above could be halted and possibly turned around. Restricting the options available at A level would be a good starting point.

Are the UK's problems shared by other countries, especially signatories to the Bologna process?

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Smith, T.M.F. and Staetsky, L (2007).The teaching of statistics in UK universities. J. R. Statist. Soc. A, **170**, Part 3, pp. 1-42.

RESUME

La perception que le corps enseignant des sciences mathematique est sur la decline dans les univerites de l'UK recevoit la confirmation. On attend une compression des personnel enseignant entre 7% et 22% avant 2010. On deliberes les implications.