

## **OVERVIEW REPORT : Statistics and Operational Research, UoA24**

DESCRIPTOR : Statistical methodology and applications (such as medical statistics, economic and social statistics, financial modelling), mathematical statistics, operational research, applied probability and probability theory.

In addition, the panel dealt with Actuarial Science submissions. In some cases, material was submitted to the panel which should have been sent to another UoA

BACKGROUND : The panel received 46 submissions. Of these, 7 were from Scotland, and the remainder were from England. The submissions described the research of 469 staff, of whom 396 were category A or A\*.

Submissions were judged on the basis of :

- a) The quality of the listed research outputs, published during 1996-2000,
- b) The extent of the postgraduate research activity as indicated by the numbers of research students, research studentships and research degrees awarded,
- c) Evidence of esteem, from externally funded research support,
- d) Evidence of vitality of the department, prospects for continuing development, and national and international prestige.

Of these, a) was the leading indicator and the other three indicators were not placed in any order of priority. Thus the panel was very much focussed on research quality. The panel recognised that researchers who are new to the profession may require time to establish a publication record. Thus new entrants into the profession, many of whom are producing high quality research, were assessed with special care.

The panel was of size 6. The user sub-panel was of size 9, and the international panel was of size 5. Because of the breadth of the subject, and the variety of the work received, the panel received the advice of 12 specialist advisers on selected material. In total, 30 people were involved in the assessment process. In addition, advice was obtained, in certain cases, from other panels, as a result of cross-referral. Panel members were also active in providing cross-referral advice for many other panels.

The panel met 6 times; 3 of these meetings, which covered 5 days, were in the assessment phase. The panel chair was a member of the physical sciences umbrella group of panel chairs, which met 3 times, and in addition there was a separate meeting of the chairs of the Pure Mathematics, Applied Mathematics and Statistics panel chairs.

The submissions were professionally produced. Panel members all read all of the submissions, and accessed and read research material thoroughly, in order to determine the

standing of each individual submitted. This resulted in panel members examining in detail far more than the minimum 20% of material, mentioned in the panel criteria. Most submissions provided detailed information on individuals, highlighting prime activities and main achievements, as suggested in the panel's criteria. This was exceptionally helpful to the panel. There was a very high degree of agreement between the panel members, regarding the grades for the different submissions. As a result, in all cases the final gradings were readily agreed by consensus.

Panel members kept strictly to the working methods described in the criteria documents, especially with regard to withdrawing from panel meetings during discussions of any institution in which panel members had a material interest.

#### RESULTS :

It should be realised that the information presented here does not relate to the substantial amount of Statistics and Operational Research material that has been submitted to other panels.

The table below gives the percentages of submissions in the different grades for Statistics and Operational Research, and the corresponding percentages for the entire exercise, covering 69 Units of Assessment.

Grade :	5*	5	4	3a	3b	2	1
Stats/OR	13	33	30	17	4	2	0
RAE overall	11	28	26	19	11	5	1

The overall figures are to be found in the RAE document, RAE4/01, together with much more general performance information. In paragraph 1.5 of that document is the observation that, "The results of the 2001 RAE confirm the United Kingdom's position as one of the world's foremost research nations. They are consistent with the findings of the review of research conducted by HEFCE in 2000, which showed that on many measures UK researchers remain among the best in the world." The Statistics and Operational Research research ratings awarded fully support this view. The panel believes that the grades obtained in 2001 reflect the strength and high international standing of Statistics and Operational Research in the UK.

The international panel received all the submissions provisionally graded as 4, 5 or 5\* by the panel, and their comments confirmed the decisions taken by the panel. In many of the grades, there are groups close to the upper boundary for those grades, with staff doing very good work. This is reflected in the panel feedback to institution Vice Chancellors and Principals.

The table below categorises Statistics and Operational Research submissions according to the grades obtained in 2001 and 1996. ND denotes institutions which were not declared in the appropriate exercise.

		2001							
		5*	5	4	3a	3b	2	ND	Total
1996	5*	1							1
	5	3	4						7
	4	2	9	6					17
	3a		2	6	1			2	10
	3b			2	6	1		4	13
	2				2			4	6
	1							1	1
	ND					1	1		2
	Total	6	15	14	8	2	1	11	57

One institution with a Grade 4 was flagged, indicating grade 5\* work taking place in a particular subject area.

The tables below show the letters for the various grades, for the 1996 and 2001 exercises. The letter indicates the percentage of staff returned as research active by a group : A: 95-100, B: 80-94.9, C: 60-79.9, D: 40-59.9, E: 20-39.9, F: < 20.

		1996					
		A	B	C	D	E	F
5*	1						
5	3	4					
4	5	8	3	1			
3a	3	3	4				
3b	3	2	4	1	3		
2	1			2	2	1	
1					1		
<b>Total</b>	16	17	11	4	6	1	

		2001				
		A	B	C	D	E
5*	1	3	1	1		
5	8	5	2			
4	4	6	4			
3a	4		1	1	2	
3b			1	1		
2				1		
1						
<b>Total</b>	17	14	9	4	2	

#### OBSERVATIONS :

There has been much movement of staff over the past 5 years. It is encouraging to see excellent new appointments in many cases. Several of these have come from abroad, and add to the range of talent and expertise of the subjects. A characteristic of some of the new appointments has been a shift in direction to Stochastic Analysis, where much excellent work is being done. However the panel is concerned that statistics groups seek and continue to appoint the very best statisticians.

A gratifying development has been University and Research Council recognition of the widespread importance of the subjects, and in several cases this has given rise to new

chairs in areas such as Bioinformatics and Public Health. Since the last RAE, there has been a welcome increase in the number of Chair appointments in Operational Research and in related areas such as Management Science and Systems Modelling. There have been exciting new groupings, in Statistical Genetics, Statistical Ecology, Medical Statistics, Actuarial Genetics and many others. Some places have developed excellently by building on current strengths, while others have branched out. There have been encouraging successes in groups obtaining substantial infrastructure awards.

Statistics has a distinctive character, and panel members frequently encountered much ingenuity and energy displayed by applied statisticians. This underlines the health, vitality and importance of the subject. The panel read much material that was at the forefront of the developments of modern applied and theoretical statistics. However, there is untapped potential in areas such as Engineering and Biometry. Much of the Operational Research material read was of a commendably high standard, with internationally leading research in Applied Operational Research, entailing the development of modelling methodologies and algorithms within recognised problem contexts, and in the mathematical aspects of programming and scheduling. The research submitted maintains the UK Operational Research tradition of being near to the applications interface.

In many instances, there were indications of a decline in the number of PhD students. The panel regards this as most serious. Research students are the seed-corn of the future. There needs to be adequate Research Council support for doctoral training in Statistics and Operational Research, which recognises the need for realistic stipends, in order to attract the most talented individuals. A decline in this sector, coinciding with an age-distribution which has many staff located in the 50-60 age-group, would be a disaster for the subjects. To take Operational Research as an example, of the 17 professors submitted within this unit of assessment who are doing research in Operational Research, 76% are over 50 years of age, and 41% are over 55. The next 5 years are critically important. The level of international quality talent in the 50-60 year age band is substantial. Because of the high level of demand for researchers in Statistics and Operational Research, Statistics and Operational Research groups are vulnerable to movement and change. It is vital that there is investment in the subjects nationally, in view of their strategic importance in a very wide range of different areas. A number of the issues raised here repeat the findings of the Roberts' Review of the Supply of Scientists and Engineers, of November 2001.

The overall performance in the 2001 research assessment exercise is an overwhelming success. Anyone seeing the breadth and depth in the submissions could not fail to be impressed. Many of the most innovative ideas in Statistics and Operational Research have their origin in the UK, and the submissions show that, despite the difficulties many institutions have, the UK retains its leading position in Statistics and Operational Research.

A.H. Christer

J.B. Copas

P.J. Donnelly

J.N.S. Matthews

B.J.T. Morgan (Chair)

B.W. Silverman